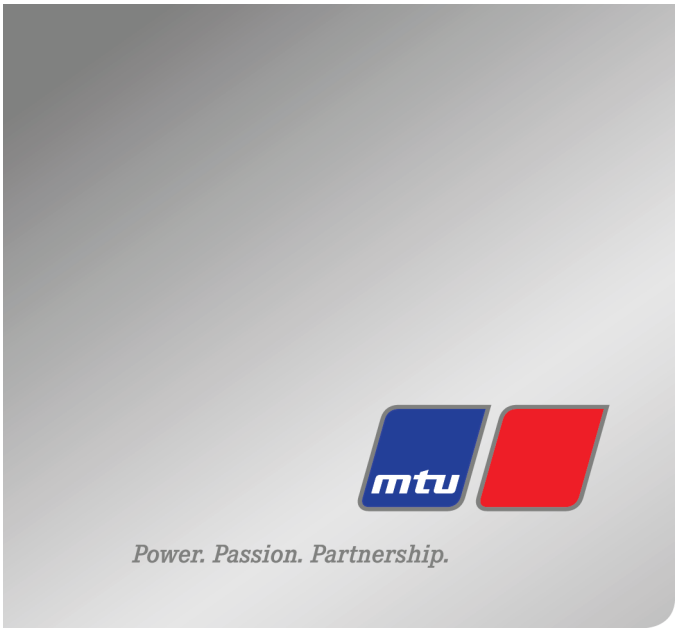
Operating Instructions

Diesel engine
12V4000Cx5
16V4000Cx5

MS15041/03E



Engine model	kW/cyl.	rpm	Application group
12V4000C15	95.8 kW/cyl.	1800	5A, continuous operation, unlimited
12V4000C25	104.1 kW/cyl.	1800	5A, continuous operation, unlimited
12V4000C35	125.0 kW/cyl.	1800	5A, continuous operation, unlimited
12V4000C55	145.8 kW/cyl.	1900	5B, continuous operation, variable
12V4000C65	155.3 kW/cyl.	1800	5B, continuous operation, variable
12V4000C65	155.3 kW/cyl.	1900	5B, continuous operation, variable
16V4000C45	125 kW/cyl.	1800	5B, continuous operation, variable
16V4000C45	125 kW/cyl.	1900	5B, continuous operation, variable
16V4000C55	140 kW/cyl.	1800	5B, continuous operation, variable
16V4000C55	140 kW/cyl.	1900	5B, continuous operation, variable
16V4000C65	150 kW/cyl.	1800	5B, continuous operation, variable
16V4000C65	150 kW/cyl.	1900	5B, continuous operation, variable
All 5A power ratings can also be applied in the 5B applications.			

Table 1: Applicability

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⚠ **WARNING**: Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65warnings.ca.gov/diesel

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1 Safety

1.1 Important provisions for all products

General

This product may pose a risk of injury or damage in the following cases:
- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Changes or modifications which are neither made nor authorized by the manufacturer
- Noncompliance with the safety instructions and warning notices

Nameplates

The product is identified by nameplate, model designation or serial number. This data must match the specifications in these instructions.

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

All EU-certified engines delivered by MTU come with a second nameplate. This second nameplate is delivered "loosely" with the engine. If the nameplate secured to the engine after installation in the vehicle/system is not visible without the removal of components, the system integrator must install the second nameplate in a clearly visible area on the vehicle/system.

Emission specifications and emission label

Responsibility for compliance with emission regulations

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-related components must only be serviced, exchanged or repaired if the components used for this purpose are approved by the manufacturer.

Noncompliance with these specifications will invalidate the design type approval or certification issued by the emissions regulation authorities. The manufacturer does not accept any liability for violations of the emission regulations.

The product must be operated over its entire life cycle according to the conditions defined as "Intended use" (→ Page 7).

Emission certification applicable to engines with EPA Nonroad Tier 4 emission certification in accordance with 40 CFR 1039

Extract from the standard:

Failing to follow these instructions when installing a certified engine in a piece of nonroad equipment violates federal law (40 CFR 1068.105(b)), subject to fines or other penalties as described in the Clean Air Act.

Extract from the standard:

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a duplicate label on the equipment, as described in 40 CFR 1068.105.

When fitting the second label, the requirements of 40 CFR 1068.105(c) must be followed and observed. This paragraph describes the process for requesting and fitting the label, the documentation obligations and storage obligations for the required documents.

TIM-ID: 0000040530 - 013

Replacing components with emission labels

On all MTU engines fitted with emission labels, these labels must remain on the engine throughout its operational life.

Exception: Engines used exclusively in land-based, military applications other than by US government agencies.

Please note the following when replacing components with emission labels:
- The relevant emission labels must be affixed to the spare part.
- Emission labels shall not be transferred from the replaced part to the spare part.
- The emission labels must be removed from the replaced part and destroyed.

TIM-ID: 0000040530 - 013

1.2 Correct use of all products

Correct use

The product is intended for use in accordance with its contractually-defined purpose as described in the relevant technical documents only.

Intended use entails operation:

- 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 preservation approved by the manufacturer in accordance with the (→ Preservation and Represervation 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 (also applies to engine control/parameters)
- In compliance with all safety regulations and in adherence with all warning notices in this manual
- In compliance with the maintenance work and intervals specified in the (→ Maintenance Schedule) throughout the useful life of the product
- 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

The product must not be operated in explosive atmospheres unless the engine fulfills the conditions for such use and approval has been granted.

Any other use, particularly misuse, is considered as being contrary to the intended purpose. Such improper use increases the risk of injury and damage when working with the product. The manufacturer shall not be held liable for any damage resulting from improper, non-intended use.

The specifications of the manufacturer 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 websites:

- For drive systems: http://www.mtu-online.com
- For power generation: http://www.mtuonsiteenergy.com

Modifications or conversions

Unauthorized changes to the product represent a contravention of its intended use and compromise safety.

Changes or modifications shall only be considered to comply with the intended use when expressly authorized by the manufacturer. The manufacturer shall not be held liable for any damage resulting from unauthorized changes or modifications.

TIM-ID: 0000065671 - 005

1.3 Personnel and organizational requirements

Organizational measures of the user/manufacturer

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

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

Personnel must receive instruction on product handling and repair based on this manual. In particular, personnel must have read and understood the safety requirements and warnings before starting work.

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

Personnel requirements

All work on the product must be carried out by trained, instructed and qualified personnel only:

- Training at the Training Center of the manufacturer
- Qualified personnel from the areas mechanical engineering, plant construction, and electrical engineering and also for work with live parts

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

Personnel shall not report for duty under the influence of alcohol, drugs or strong medication.

Clothing and personal protective equipment

Always wear appropriate personal protective equipment, e.g. safety shoes, ear protectors, protective gloves, goggles, breathing mask. Follow the instructions concerning personal protective equipment in the descriptions of the individual activities.

Safe handling of Substances of Very High Concern pursuant to the REACH regulation (Registration, Evaluation, Authorization and restriction of Chemicals): We recommend wearing protective gloves at all times in order to reduce risk when working.

TIM-ID: 0000040531 - 012

1.4 Initial start-up and operation - Safety regulations

Safety regulations for initial start-up

Install the product correctly and carry out acceptance in accordance with the manufacturer's specifications before putting the product into service. All necessary approvals must be granted by the relevant authorities and all requirements for initial startup must be fulfilled.

Whenever the product is subsequently taken into operation ensure that:

- All personnel is clear of the danger zone surrounding moving parts of the machine. Electrically-actuated linkages may be set in motion when the Engine Control Unit (governor) is switched on.
- All maintenance and repair work has been completed.
- All loose parts have been removed from rotating machine components.
- All safeguards are in place.
- All components must be properly grounded. Ground separately by means of a grounding stake as necessary.
- No persons wearing pacemakers or any other technical body aids are present.
- The service room is adequately ventilated.
- In the first few hours of operation, the product emits gases as a result of smoldering e.g. lacquers or oil. These gases may be hazardous to health. Always wear respiratory protection in the operating room during this period.
- The exhaust system is leak-tight and that the gases are vented to atmosphere.
- The product must be free of any damage, this applies in particular to lines and cabling.
- Protect battery terminals, generator terminals or cables against accidental contact.
- Check that all connections have been correctly allocated e.g. +/- polarity, fuel line/reduction agent line, supply/return.

Immediately after putting the product into operation, make sure that all control and display instruments as well as the monitoring, signaling and alarm systems work properly.

Smoking is prohibited in the area of the product.

Safety regulations during operation

The operator must be familiar with the control and display elements.

The operator must be familiar with the consequences of any operations performed.

During operation, the display instruments and monitoring units must be permanently observed with regard to present operating status, violation of limit values and warning or alarm messages.

Malfunctions and emergency stop

Practice emergency procedures, especially emergency stopping, at regular intervals.

Take the following steps if any system malfunctions are detected or signaled by the system:

- Inform supervisor(s) in charge.
- Analyze the message.
- Respond by taking any necessary emergency action, e.g. emergency stop.

After a safety shutdown, the engine must only be started after the cause of the shutdown has been eliminated.

Contact Service if the root cause of the malfunction cannot be clearly identified.

Operation

Do not remain in the operating room when the product is running unless absolutely necessary. Keep your stay as short as possible.

Keep a safe distance away from the product if possible. Do not touch the product unless expressly instructed to do so following a written procedure.

TIM-ID: 0000040533 - 020

Do not inhale the exhaust gases of the product.

The following requirements must be fulfilled before the product is started:
- Wear ear protectors.
- Mop up any leaked or spilled fluids and lubricants immediately or soak up with a suitable binding agent.

Operation of electrical equipment

When electrical equipment is in operation, certain components of these appliances are electrically live.

Follow the applicable operating and safety instructions when operating the devices and heed warnings at all times.

TIM-ID: 0000040533 - 020

1.5 Assembly, maintenance, and repair work – Safety regulations

Safety regulations for work prior to assembly, maintenance, and repair

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

Allow the product to cool down to less than 50 °C (risk of explosion from oil vapors, fluids and lubricants, risk of burning).

Relieve pressure in fluid and lubricant systems and compressed-air lines which are to be opened. Use suitable containers of adequate capacity to catch fluids and lubricants.

Release residual pressure before removing or replacing a component in the supply line. To depressurize pressurized lines, shut off the lines first, then release the residual pressure.

Work must only be carried out on lines when they are free of fluids and lubricants.

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

Never carry out assembly, maintenance, or repair work with the product in operation, unless:
- It is expressly permitted to do so following a written procedure.

Lock-out the product to preclude undesired starting, e.g.
- Start interlock
- Key switch
- Close supply line for hydraulic starting.

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

Disconnect the battery cables or actuate the battery isolating switch, if fitted. Lock circuit breakers.

Before starting work on CaPoS, if used:
- Switch off the charging system (DC/DC converter).
- Discharge the UltraCap modules using the appropriate discharger.
- Short-circuit the UltraCap modules with a suitable wire jumper.

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

Before working on the exhaust gas aftertreatment system, close the shutoff valve on the reducing agent tank. Note that the reducing agent pumps continue to run for a certain period when the engine is stopped.

Disconnect the control equipment from the product.

Use the recommended special tools or suitable equivalents when instructed to do so.

Safety regulations when performing assembly, maintenance, and repair work

Special tools and lifting equipment

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

Setting down, lifting and climbing

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

Use appropriate lifting equipment for all components. Use all specified attachment points and observe the center of gravity.

Never work on engines or components when they are held in place by lifting equipment.

Make sure components or assemblies are placed on stable surfaces. Adopt suitable measures to prevent components/tools from falling down.

Assume a safe standing position when performing assembly work.

Never use the product as a climbing aid.

TIM-ID: 0000040535 - 021

When working high on the equipment, always use suitable ladders and work platforms. Special instructions for outdoor areas: There must be no risk of slipping e.g. due to icing.

Removing, installing and cleanliness

Pay particular attention to cleanliness at all times.

Completely wipe up escaped fluids and lubricants due to the risk of slipping.

Take special care when removing ventilation or plug screws from the product.

Ensure that O-rings are not installed in a slanted/twisted condition.

Carry out appropriate cleaning procedures to clean and inspect components requiring special cleanness (e.g. components carrying oil, fuel, or air).

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

Ensure that all mounts and dampers are installed correctly.

Remove any accumulation of condensate after assembling chilled components. Coat the components with a suitable corrosion inhibitor as necessary.

Lines

Ensure that lines for all fluids and lubricants and their connections are clean.

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

Fit new seals when re-installing lines.

Never bend lines and avoid damaging lines, particularly the fuel lines.

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.

Miscellaneous

Sufficient ventilation must be guaranteed during the work.

Wear a breathing mask offering protection against soot, dust, and mineral fibers (filter class P3) when working on exhaust components. Clean the work area with a dust extraction machine of class H. Wear protective gloves and goggles for protection against acidic condensate.

Do not touch elastomeric seals (e.g. Viton sealing rings) with your bare hands if they have a carbonized or resinous appearance.

Elastomer components (e.g. engine mounts, damping elements, couplings and V-belts) must not be painted. Only install them after painting the engine or mask them prior to painting.

The following applies to starters with copper-beryllium alloy pinions:
- Wear a respirator mask (filter class P3). 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 after performing assembly, maintenance, and repair work

Before barring the engine, make sure no one is in the danger zone of the engine.

Check that all access ports/apertures which have been opened to facilitate working are closed again.

Check that all safeguards have been installed and that all tools and loose parts have been removed (especially the barring tool).

Ensure that no unattached parts have been left in/on the product (e.g. including rags and cable straps).

Ensure that the grounding system is properly connected.

TIM-ID: 0000040535 - 021

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 cables or actuate the battery isolating switch.
- Separate the electrical ground of electronic equipment from the ground of the unit.

No other assembly, maintenance, or repair work must be carried out in the vicinity of the product while welding is in progress. There is a risk of explosion or fire due to oil vapors or 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 can induce interfering voltages in the wiring harnesses which may damage the electrical system.

Remove components (e.g. exhaust pipe) from the product before performing necessary welding work.

Hydraulic installation and removal

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

Observe the max. permissible push-on pressure specified for the equipment.

Do not attempt to bend or apply force to lines which are under pressure.

Before starting work, pay attention to the following:
- Vent the installation/removal jig, the pumps and the pipework at the relevant designated points.
- 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 of components, 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 manufacturer when working on batteries.

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

Do not allow battery acids to come into contact with skin or clothing.

Wear protective clothing, goggles and protective gloves.

Do not place objects on the battery.

Before connecting the cable to the battery, check the battery polarity. The battery may explode and spray acid if the battery terminals are connected incorrectly.

Working on electrical and electronic assemblies

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

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

ESD (Electrostatic Discharge): Work on components which could be damaged by electrostatic discharge must always be carried out with appropriate equipment. Appropriate equipment is e.g. electrically conductive work surfaces or antistatic wristbands.

TIM-ID: 0000040535 - 021

Do not damage wiring during removal work. When reconnecting, ensure that cabling cannot be damaged during operation by:
- Contact with sharp edges
- Chafing on components
- Contact with hot surfaces.

Do not secure cables on lines carrying fluids.

Do not use cable ties to secure lines.

Always use connector pliers to tighten union nuts on connectors.

Subject the device as well as the product to functional testing on completion of all repair work. The emergency stop function must be tested in particular. The functional check of the emergency stop, during which the voltage supply of the ECU is switched off, must only be carried out when the product is cold.

Store spare parts properly prior to replacement, i.e. protect them against moisture in particular. Package faulty electronic components or assemblies properly before dispatching for repair:
- Moisture-proof
- Shock-proof
- Wrapped in antistatic foil (as necessary)

Working with laser equipment

Work with laser devices shall be carried out by trained and qualified personnel only. Follow the safety instructions in the manufacturer's user manual when working with laser equipment.

Wear special laser safety glasses when working with laser equipment (danger of concentrated radiation).

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

Measuring component dimensions

Workpieces, components and measuring equipment lie in the specified tolerance range at a reference temperature of 20 °C.

TIM-ID: 0000040535 - 021

1.6 Fire and environmental protection, fluids and lubricants

Fire prevention and fire

Fire, naked light and smoking are prohibited.

In case of a fire, stop the fuel supply if this is possible without endangering personnel.

The product has hot surfaces that can ignite combustible gases and other substances in the immediate area. The operating company must install and operate the product a safe distance away from danger sources and observe any relevant safety regulations or recommendations. Products that comply with the SOLAS Convention do not constitute such as danger.

After working with combustible fluids and lubricants (e.g. cleaning agents), ensure the area is well ventilated. The resultant steam/air mixture must be sufficiently diluted to prevent a potentially explosive atmosphere.

Eliminate leaks of fluids and lubricants immediately. Fluids and lubricants on hot components can cause fires, so keep the product clean at all times. Do not leave rags saturated with fluids and lubricants on the product. Do not store combustible materials near the product.

Incorrect refueling of the reducing agent system with fuel can result in fire.

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

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 cable from the external power source to the ground cable of the engine or to the ground terminal of the starter.

Ensure that suitable extinguishing agents (fire extinguishers) are always available and that staff are familiar with their correct handling.

A fire can result in the creation of toxic substances. Always wear protective gloves when handling components and wear additional personal protective equipment is necessary.

Noise

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

Noise can lead to an increased risk of accidents if acoustic signals, warning shouts or sounds indicating danger are compromised.

Environmental protection and disposal

Dispose of used fluids, lubricants and components 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/auxiliary materials (process materials)

Process materials can also be or contain hazardous or toxic substances. When using process materials and other chemical substances, observe the associated safety data sheet. The safety data sheet may be obtained from the relevant manufacturer or from MTU.

Only process materials approved by the manufacturer in accordance with the Fluids and Lubricants Specifications must be used. The most recent respective version must be requested from the manufacturer.

Contamination of process materials with reducing agent (e.g. AdBlue®, DEF): Store process materials in separate containers and their own drip trays. Even extremely small amounts of reducing agent contamination can result in malfunctions in sensors and other components.

Used oil contains combustion residues that are harmful to health.

When handling used oil, protective gloves must be used.

Wash relevant areas after contact with used oil.

TIM-ID: 0000040536 - 018

Registration, evaluation, approval and restriction of chemicals (REACH ordinance)

Particularly hazardous substances used with our products are named in a list:

www.mtu-online.com/mtu/technische-info → SVHC as per REACH in MTU products

Compressed air

- Unauthorized use of compressed air, e.g. forcing flammable liquids (hazard class AI, AII and B) out of containers, risks causing an explosion.
- Wear goggles when blowing dirt off workpieces or blowing away chips.
- 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 which are to be connected must be designed to withstand this pressure. Install pressure-reducing or safety valves set to the admissible pressure if this is not the case.
- Hose couplings and connections must be securely attached.
- Provide the snout of the air nozzle with a protective disk (e.g. rubber disk).
- Release residual pressure before removing a compressed air device from the supply line. To depressurize compressed-air lines, shut off the lines first, then release the residual pressure.
- Carry out a leak test in the specified manner.

Painting

- Observe the relevant safety data sheet for all materials.
- When carrying out painting work outside the spray stands provided with fume extraction systems, ensure that the area is well ventilated. Make sure that neighboring work areas are not adversely affected.
- Avoid open flames in the surrounding area.
- 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 specified containers without fixed covers.
- Avoid body contact (eyes, hands).
- Wear protective clothing, protective gloves, closed shoes and safety goggles.
- Make sure that the working area is well ventilated.
- Avoid knocking or jolting the containers, valves and fittings or workpieces in any way.

Acids/alkalines/reducing agents (e.g. 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 reducing agent is swallowed, rinse out mouth and drink plenty of water.
- Remove any wet clothing immediately.
- After skin contact, wash affected body areas with plenty of water.
- Rinse eyes immediately with eyedrops or clean mains water. Consult a doctor as soon as possible.
  Contamination of reducing agent with other process materials: Store reducing agent in separate containers and use separate drip trays. Even extremely slight contamination can lead to malfunctions in the exhaust aftertreatment system.
  Mistakenly filling the tank of the reducing agent system with fuel can cause leakage at the seals and in the hoses.

TIM-ID: 0000040536 - 018

1.7 Standards for warning notices in the text and highlighted information

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.

Warning notices

1. This manual with all safety instructions and warning notices must be issued to all personnel involved in operation, maintenance, repair, assembly, installation, or transportation.
2. The highest level warning notice is used if several hazards apply at the same time. Warnings related to personal injury shall be considered to include a warning of potential damage.

Highlighted information

Important
This field contains product information which is important or useful for the user. This information must not refer to hazards related to personal injury or material damage.

TIM-ID: 0000040578 - 006

2 Transport

2.1 Transportation

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Crossbeam	T80091826	1
Crossbeam	T80092360	1

DANGER



Suspended load
Danger to life
- Never stand under suspended loads!
- Wear appropriate personal protective equipment.

Transportation

1. Install the engine mount locking devices and the engine shipping lock prior to transportation (→ Page 20).
2. Use the lifting eyes provided to transport the engine/generator (→ Page 18).
3. Use suitable transport and lifting gear only.
4. Transport the system, engine/generator in their respective installation positions only: max. admissible diagonal pull 10° (→ Page 18).
5. Do not place unsecured parts on the system, engine/generator.
6. Raise and lower the system, engine/generator slowly. Do not allow hoist slings or chains to contact the system, engine/generator or any of their component parts. Readjust lifting gear as necessary.
7. For special packaging with aluminum foil: Suspend the engine by the lifting eyes on the bearing pedestal or transport by means of handling equipment (forklift truck) capable of bearing the load.
8. Secure the system, engine/generator to prevent tipping during transportation. Secure such as to preclude slipping and tipping when driving up or down inclines and ramps.

Placement after transport

1. Engine may only be set/transported on a horizontal surface and the engine mounts/transport supports provided for this purpose.
2. Make sure that the consistency and load-bearing capacity of the ground or support surface is adequate.
3. Never set the engine down on its oil pan unless expressly authorized to do so by MTU.

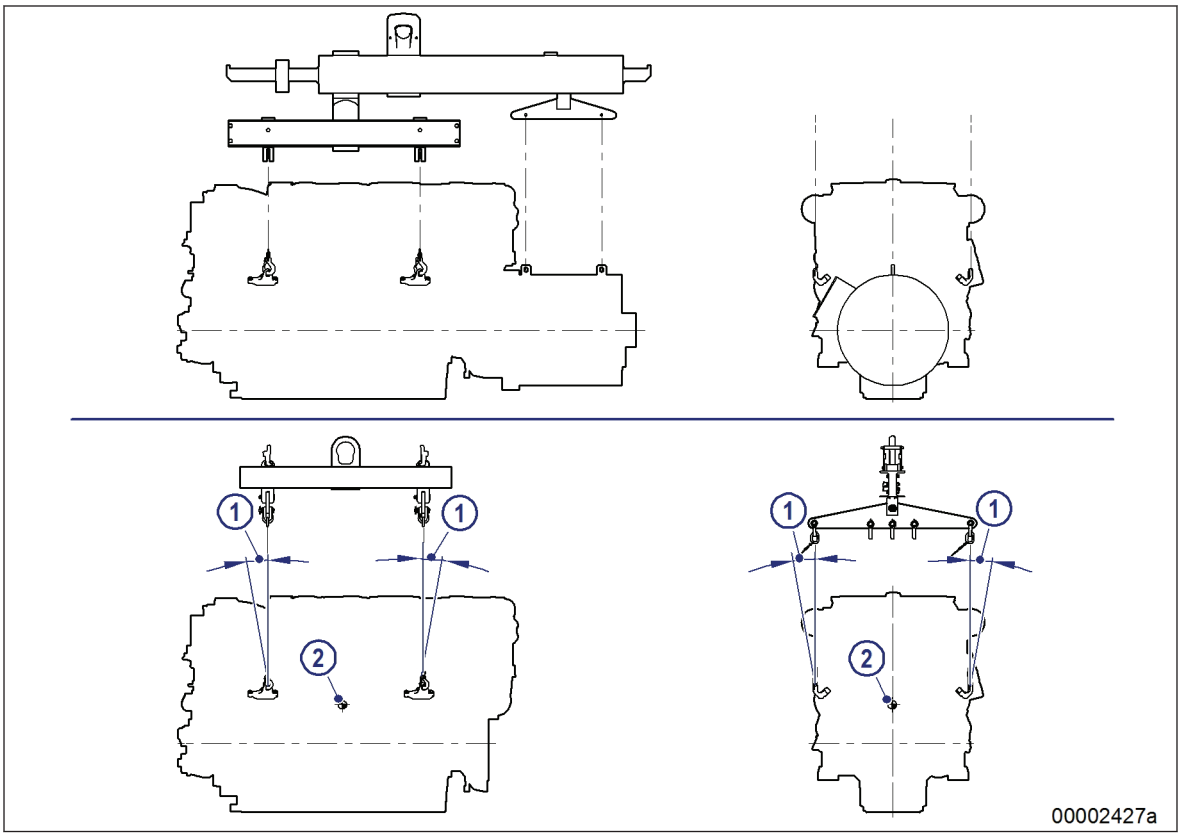
TIM-ID: 0000063325 - 002

2.2 Lifting requirements

Lifting requirements

DANGER

Suspended load.
Danger to life!
- Use suitable equipment and lifting devices.
- Never stand beneath a suspended load and keep a safe distance.
- Wear personal protective equipment (e.g. protective helmet, safety shoes).



1 Max. admissible diagonal pull 10°

2 Centre of gravity

Take note of the engine center of gravity

Refer to the installation/arrangement drawings for details of the center of gravity of the system or the center of gravity of the engine/generator.

TIM-ID: 0000063326 - 002

2.3 Crankshaft - Transport locking device

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10–60 Nm	F30452769	1
Torque wrench, 60–320 Nm	F30452768	1
Ratchet adapter	F30027340	1
Engine oil		

Transport locking device

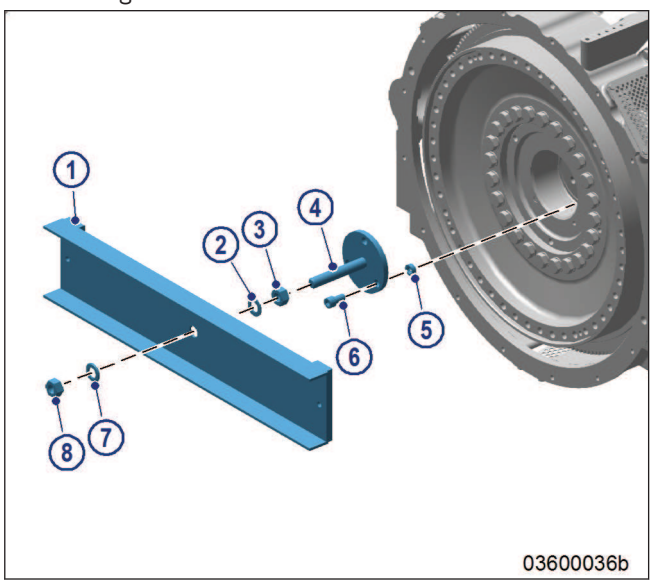
Note: The locking device protects the crankshaft bearings from shocks and vibration damage during engine transport.

For removal and installation of the transport locking device, observe the following:

- The transport locking device must remain installed as long as possible during engine installation in order to avoid damage.
- Starting or barring the engine is allowed only with the transport locking device removed. If the generator/gearbox is installed, ensure that the transport locking device of the generator/gearbox is removed.
- Prior to transport of the engine, always install the transport locking device according to the specifications.
- If the generator/gearbox is installed and also has to be moved, install transport locking device of generator/gearbox.
- Always use the screws supplied with or installed in the transport locking device to secure it on the engine.
- Fit this documentation in an easily visible place on the engine.

Removing transport locking device on driving end (KS), variant A

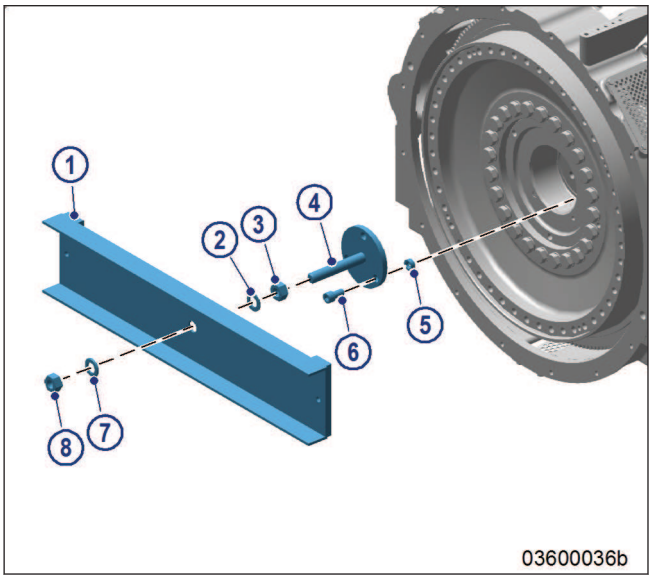
1. Remove parts (1) to (8) from engine. Spacer sleeves (5) are optional.
2. Store the removed parts of the transport locking device for possible reuse.



TIM-ID: 0000060211 - 003

Installing transport locking device on driving end (KS), variant A

1. Screw retainer (4) with spacer sleeves (5) and screws (6) on crankshaft. Spacer sleeves (5) are optional.



2. Tighten screws (6) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M16	Tightening torque	(Engine oil)	180 Nm +18 Nm

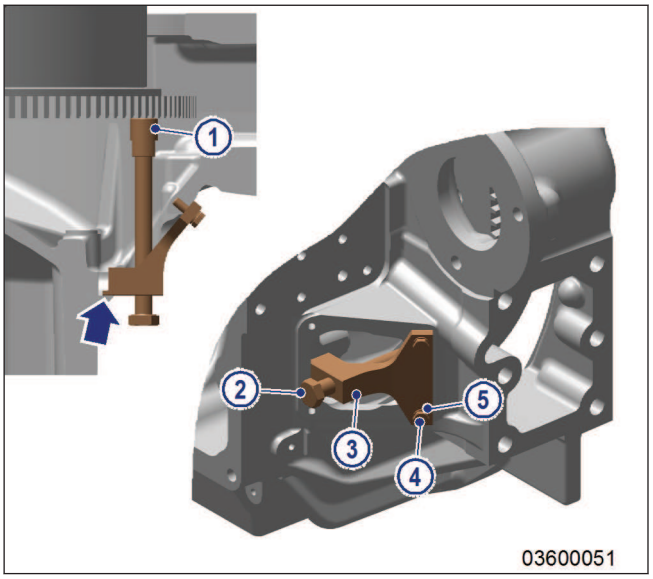
3. Screw nut (3) with washer (2) onto retainer (4). Fit support (1) with washer (7) and nut (8) and tighten nut (8) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut	M24	Tightening torque	(Engine oil)	100 Nm +10 Nm

4. Secure with nut (3).
5. Mark the engine as "Fitted with transportation locking device".

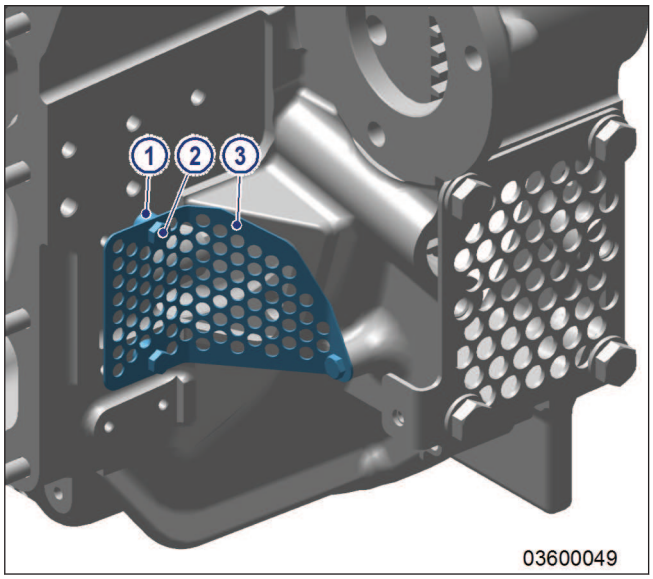
Removing transport locking device on driving end (KS), variant B

1. Unscrew screw (2) on both sides of the flywheel housing.
2. Unscrew screws (4) on both sides of the flywheel housing and take off washers (5).
3. Remove retainer (3) and threaded bushing (1).



TIM-ID: 0000060211 - 003

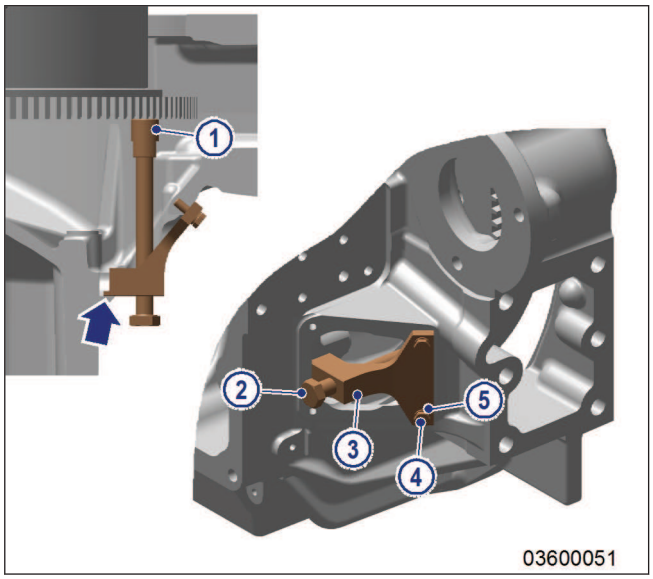
4. Install guard plate (3) with screws (2) and spacer sleeves (1) on flywheel housing.
5. Store the removed parts of the transport locking device carefully for possible reuse.



Installing transport locking device on driving end (KS), variant B

Note: Keep guard plate and screws on the engine. They must be reinstalled when the transport locking device has been removed.

1. Remove guard plate (3) from flywheel housing.
2. Insert screw (2) in retainer (3), mount threaded bushing (1) and hand-tighten.
3. Install retainer (3) in opening on flywheel housing on both sides with screw (4) and washers (5).



Note: Ensure retainer is seated flush (arrow).

4. Tighten screws (4) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M8x25	Tightening torque	(Engine oil)	31 Nm +3 Nm

5. Tighten screw (2) on both sides alternately in three steps with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M16x160	Preload torque	(Engine oil)	15 Nm +2 Nm
Screw	M16x160	Residual torque	(Engine oil)	30 Nm +3 Nm
Screw	M16x160	Tightening torque	(Engine oil)	45 Nm +5 Nm

TIM-ID: 0000060211 - 003

3 General Information

3.1 Tightening specifications for screws, nuts and bolts

Tightening torques for setscrew and connections as per MTN 5008 standard

This standard applies to setscrews not subject to dynamic loads and the associated nuts according to:

- MMN 384
- ISO 4762 (DIN 912)
- ISO 4014 (DIN 931-1)
- ISO 4017 (DIN 933)
- DIN EN ISO 8765 (EN 28765; DIN 960)
- DIN EN ISO 8676 (EN 28676; DIN 961)
- DIN 6912

This standard applies to studs not subject to dynamic loads and the associated nuts according to:

- DIN 833
- DIN 835
- DIN EN ISO 5395 (DIN 836)
- DIN 938
- DIN 939

This standard applies to screws with hexalobular heads according to:

- DIN 34800
- DIN 34801

The standard does not apply to heat-resistant screws in the hot component zone.

Tightening torques M_A are specified for screws of strength class 8.8 (surface condition bare, phosphatized or galvanized) and 10.9 (surface condition bare or phosphatized).

The values in the table are based on a friction coefficient μtot = 0.125.

Threads and mating faces of screws and nuts must be coated with engine oil prior to assembly.

When hand-tightening (defined torque), an assembly tolerance of -5+15% of the figures in the table is permitted.

When machine-tightening, the permissible assembly tolerance is ±15%.

Tightening torques for setscrews

Thread	Hand-tightening		Machine-tightening	
	8.8 M_A (Nm)	10.9 M_A (Nm)	8.8 M_A (Nm)	10.9 M_A (Nm)
M6	9	12	8	11
M8	21	31	20	28
M8 x 1	23	32	21	30
M10	42	60	40	57
M10 x 1.25	45	63	42	60
M12	74	100	70	92
M12 x 1.25	80	110	75	105
M12 x 1.5	76	105	72	100
M14	115	160	110	150
M14 x 1.5	125	180	120	170
M16	180	250	170	235
M16 x 1.5	190	270	180	255

TIM-ID: 0000002333 - 018

Thread	Hand-tightening		Machine-tightening	
	8.8 M_A (Nm)	10.9 M_A (Nm)	8.8 M_A (Nm)	10.9 M_A (Nm)
M18	250	350	240	330
M18 x 1.5	280	400	270	380
M20	350	500	330	475
M20 x 1.5	390	550	350	520
M22	480	680	450	650
M22 x 1.5	520	730	490	700
M24	600	850	570	810
M24 x 1.5	680	950	640	900
M24 x 2	660	900	620	850
M27	900	1250	850	1175
M27 x 2	960	1350	900	1275
M30	1200	1700	1100	1600
M30 x 2	1350	1900	1250	1800
M_A = tightening torques				

Tightening torques for studs

Thread	screwed into		
	Steel M_A (Nm)	Gray cast iron M_A (Nm)	AI alloy M_A (Nm)
M6	9	6	6
M8	11	9	10
M10	17	13	13
M12	27	23	18
M14	37	33	33
M16	55	45	–
M_A = tightening torques			

Tightening torques for setscrews and nuts made of stainless steel

The values in the table are based on a friction coefficient µtot = 0.12, lubricated with Molykote on the thread and under the screw head.

Basic size	Strength class		Material
	70 M_A (Nm)	80 M_A (Nm)	
M5	3.7	4.9	A2 / A4
M6	6.4	8.5	A2 / A4
M8	15.3	20.4	A2 / A4
M10	31	41	A2 / A4
M12	52	70	A2 / A4
M16	126	167	A2 / A4
M20	254	326	A2 / A4
M_A = tightening torques			

TIM-ID: 0000002333 - 018

Tightening torque for self-locking hex nuts

Thread	M_A (Nm)	Lubricants
M6	7.5 +1	–
M8	17 +2	–
M10	35 +4	–
M12	59 +6	–
M14	100 +10	–
M16	140 +14	–
M20	290 +29	–
M_A = tightening torques		

Tightening torque for stress bolt connections as per MTN 5007 standard

This standard applies to stress pin bolts and stress bolts which are subjected to static and dynamic load of strength class 10.9 as well as to the associated nuts.

Shaft and transition dimensions as per MMN 209 standard and material and machining as per MMN 389 standard (bright surface or phosphatized).

The values in the table are based on a friction coefficient µtot = 0.125.

Threads and mating faces of screws and nuts must be coated with engine oil prior to assembly.

An assembly tolerance of +10% of the figures in the table is permitted due to unavoidable deviations during the tightening process.

The values in the tables are for manual tightening using a torque wrench.

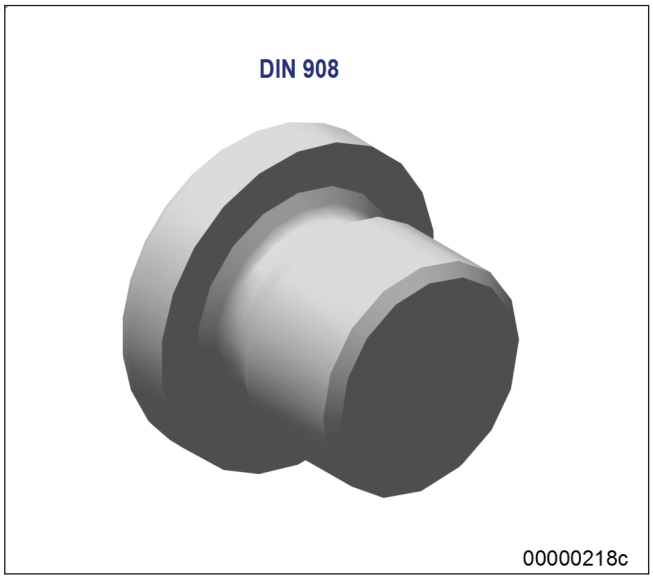
Thread	Not torsion-protected M_A(Nm)	Torsion-protected M_A (Nm)
M6	9	12
M8	21	28
M8 x 1	24	30
M10	42	55
M10 x 1.25	46	60
M12	75	93
M12 x 1.5	78	99
M14	120	150
M14 x 1.5	135	160
M16	180	225
M16 x 1.5	200	245
M18	250	315
M18 x 1.5	300	360
M20	350	450
M20 x 1.5	430	495
M22	500	620
M22 x 1.5	560	675
M24	640	790
M24 x 2	700	850
M27	900	1170
M27 x 2	1000	1230

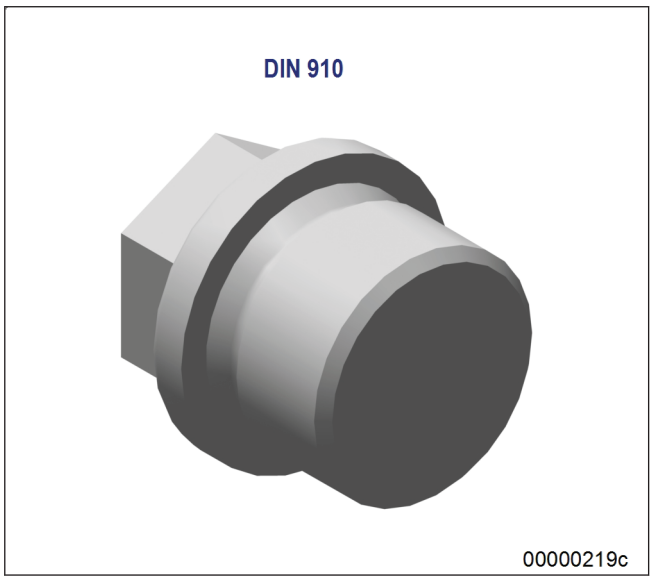
TIM-ID: 0000002333 - 018

Thread	Not torsion-protected M_A(Nm)	Torsion-protected M_A (Nm)
M30	1250	1575
*Protect screw shaft from torsion when tightening.		
M_A= tightening torques.		

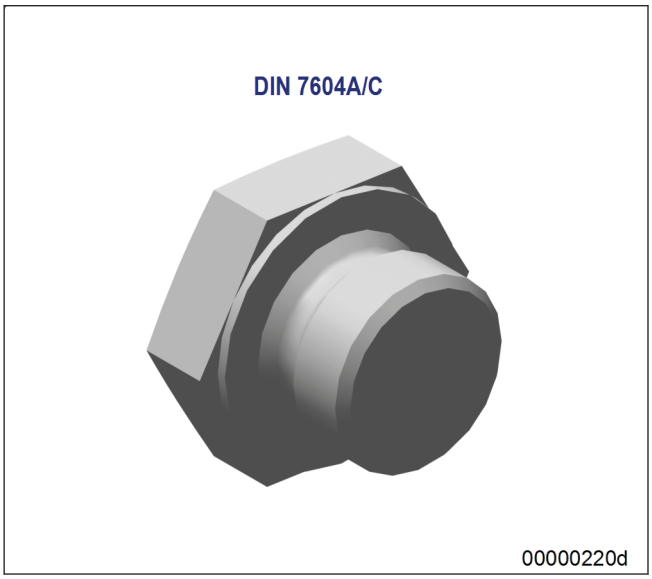
Tightening torques for plug screws as per MTN 5183-1 standard

This standard applies to plug screws to DIN 908, DIN 910 and DIN 7604 with threaded end to DIN 3852 Form A (sealed with sealing ring to DIN 7603-Cu).





TIM-ID: 0000002333 - 018



Tightening torques M_A are given for screw plugs made of steel (St) with surface protected by a phosphate coating and oiled or galvanized.

Threads and mating faces beneath heads must be coated with engine oil prior to assembly.

An assembly tolerance of +10% of the figures in the table is permitted due to unavoidable deviations during the tightening process.

Tightening torques for plug screws to DIN 908, DIN 910 and DIN 7604A (with short threaded end).

Thread	screwed into	
	Steel/gray cast iron M_A (Nm)	AI alloy M_A (Nm)
M10 x 1	15	15
M12 x 1.5	25	25
M14 x 1.5	35	30
M16 x 1.5	40	35
M18 x 1.5	50	40
M20 x 1.5	60	50
M22 x 1.5	70	70
M24 x 1.5	85	80
M26 x 1.5	100	100
M27 x 2	100	100
M30 x 1.5	110	110
M30 x 2	120	120
M33 x 2	160	160
M36 x 1.5	190	180
M38 x 1.5	220	200
M42 x 1.5	260	240
M45 x 1.5	290	270
M48 x 1.5	310	300
M52 x 1.5	325	320
M56 x 2	380	360

TIM-ID: 0000002333 - 018

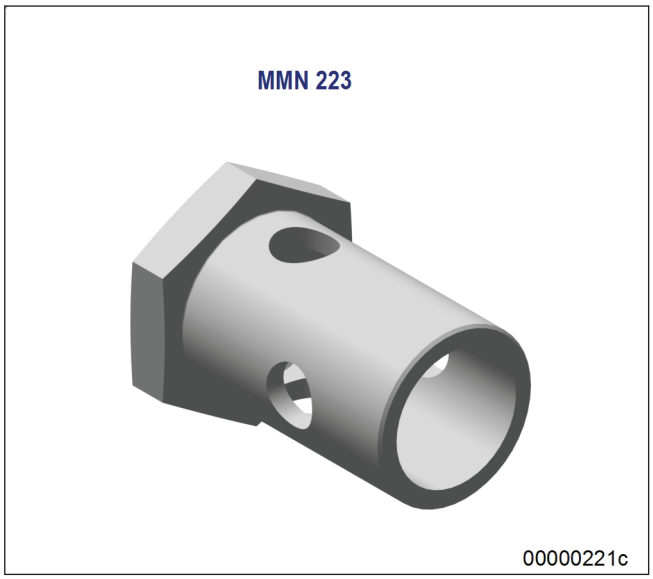
Thread	screwed into	
	Steel/gray cast iron M_A (Nm)	AI alloy M_A (Nm)
M64 x 2	400	400
M_A = tightening torques		

Tightening torque for plug screws DIN 7604C (with long screwed end)

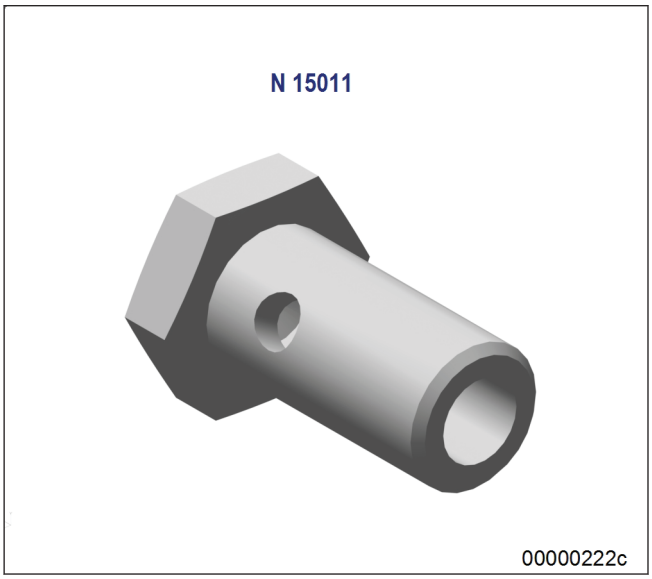
Thread	screwed into	
	Steel/gray cast iron M_A (Nm)	AI alloy M_A (Nm)
M8 x 1	10	10
M22 x 1.5	80	65
M26 x 1.5	105	90
M30 x 1.5	130	130
M38 x 1.5	140	120
M45 x 1.5	160	140
M_A = tightening torques		

Tightening torque for banjo screws as per MTN 5183-2 standard

This standard applies to banjo screws to MMN 223 and N 15011 sealed with sealing ring to DIN 7603-Cu.



TIM-ID: 0000002333 - 018



The stated tightening torques M_A apply to steel (St) banjo screws with a phosphatized surface and oiled or galvanized and for copper-aluminum alloy.

Threads and mating faces beneath heads must be coated with engine oil prior to assembly.

An assembly tolerance of +10% of the figures in the table is permitted due to unavoidable deviations during the tightening process.

Tightening torques for steel banjo screws

Thread	inserted in steel/gray cast iron/aluminum alloy M_A (Nm)
M8 x 1	10
M10 x 1	15
M12 x 1.5	20
M14 x 1.5	25
M16 x 1.5	25
M18 x 1.5	30
M22 x 1.5	60
M26 x 1.5	90
M30 x 1.5	130
M38 x 1.5	140
M45 x 1.5	160
M_A = tightening torques	

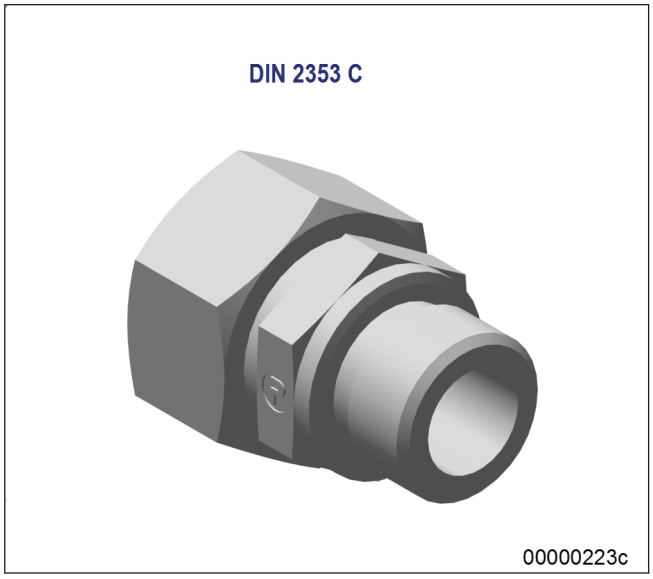
Tightening torques for copper-aluminum alloy banjo screws

Thread	inserted in steel/gray cast iron/aluminum alloy M_A (Nm)
M10 x 1	15
M16 x 1.5	30
M_A = tightening torques	

TIM-ID: 0000002333 - 018

Tightening torques for male connectors as per MTN 5183-3 standard

This standard applies to male unions to DIN 2353 Series L with threaded end to DIN 3852 Form A (sealed by sealing ring to DIN 7603-Cu).



Tightening torques M_A are given for male unions made of steel (St) with phosphatized surface coating and oiled, or galvanized.

Threads and mating faces beneath heads must be coated with engine oil prior to assembly.

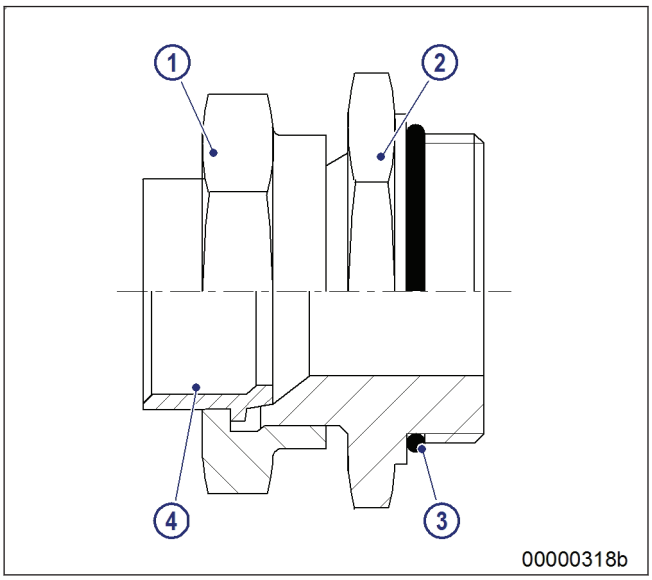
An assembly tolerance of +10% of the figures in the table is permitted due to unavoidable deviations during the tightening process.

Thread	inserted in steel/gray cast iron M_A (Nm)
M10 x 1	15
M12 x 1.5	20
M14 x 1.5	35
M16 x 1.5	50
M18 x 1.5	60
M22 x 1.5	70
M26 x 1.5	100
M32 x 2	160
M42 x 2	260
M48 x 2	320
M_A = tightening torques	

TIM-ID: 0000002333 - 018

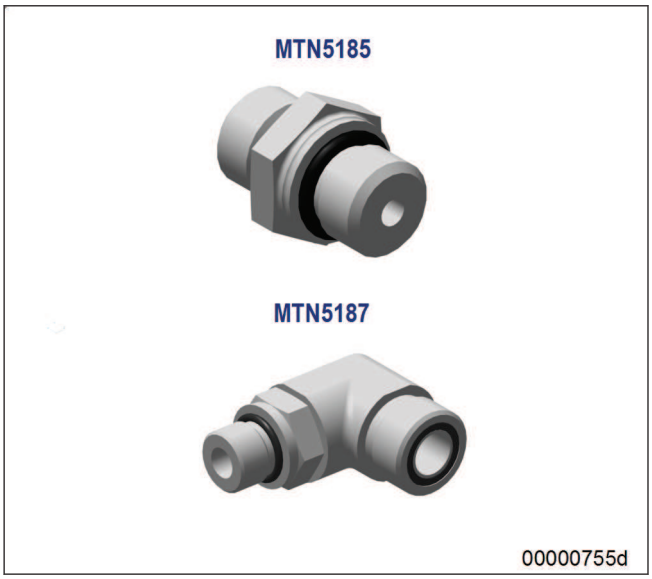
Tightening torques for union nuts as per DIN 3859-2

1 Union nut
2 Screw fixture
3 O-ring
4 Linear ball bearing



Union nut: On installing the ball-type union, after tightening the union nut firmly by hand (noticeable increase in force), it should be tightened another 1/4 turn (90°) past this point.

Tightening torques for spigot unions with O-ring to ISO 6149-2

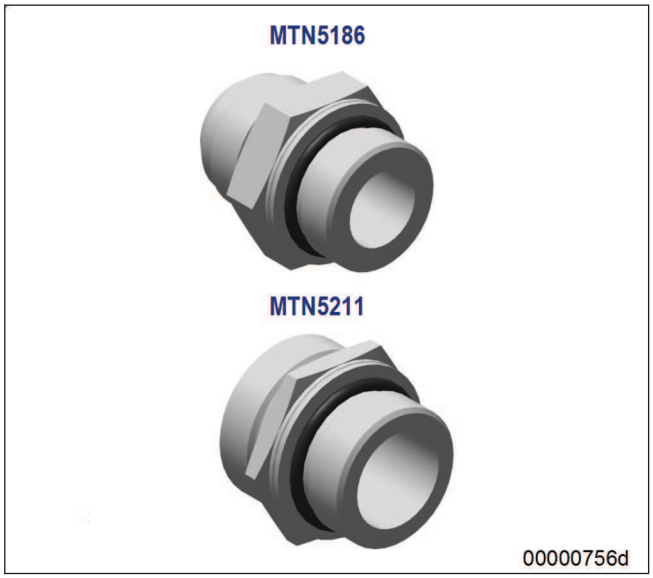


Thread	Torque (Nm) +10%
M8 x 1	10
M10 x 1	20
M12 x 1.5	35
M14 x 1.5	45
M16 x 1.5	55
M18 x 1.5	70
M20 x 1.5[1)]	80
M22 x 1.5	100

TIM-ID: 0000002333 - 018

Thread	Torque (Nm) +10%
M27 x 2	170
M33 x 2	310
M42 x 2	330
M48 x 2	420
M60 x 2	500
[1)]Only for sealing off installation spaces for screw-in valves (see ISO 6149-47 and ISO 7789)	

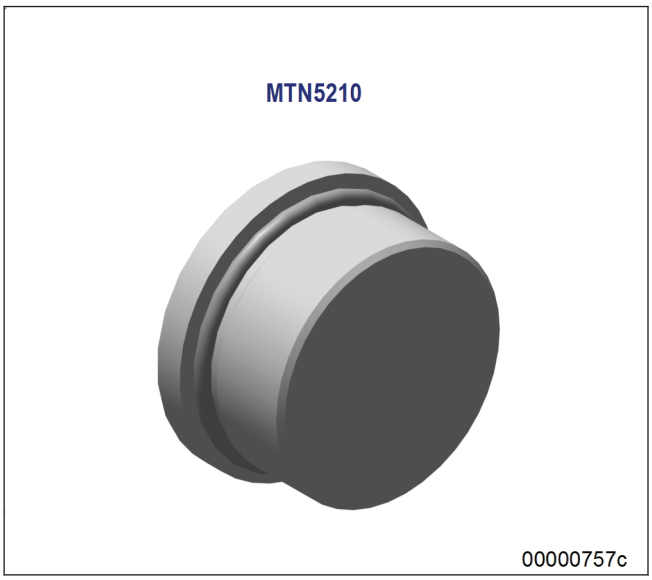
Tightening torques for screwed plugs with O-ring as per ISO 6149-3



Thread	Torque (Nm) +10%
M8 x 1	8
M10 x 1	15
M12 x 1.5	25
M14 x 1.5	35
M16 x 1.5	40
M18 x 1.5	45
M22 x 1.5	60
M27 x 2	100
M33 x 2	160
M42 x 2	210
M48 x 2	260
M60 x 2	315

TIM-ID: 0000002333 - 018

Tightening torques for plug screw joints as per MTN 5183-6



Thread	screwed into	
	Steel/gray cast iron M_A (Nm)	AI alloy M_A (Nm)
M10 x 1	20	10 +2
M12 x 1.5	35	14 +2
M14 x 1.5	45	15 +3
M16 x 1.5	55	18 +3
M18 x 1.5	70	23 +3
M22 x 1.5	100	33 +4
M27 x 2	170	57 +5
M33 x 2	310	103 +10
M42 x 2	330	110 +11
M48 x 2	420	140 +14
M60 x 2	–	200 +20
M_A = tightening torques		

Assembly instructions and tightening torque for hose fittings with union nuts

These instructions do not apply to ORFS fittings. In contrast to the instructions for pipe unions, hose fittings with sealing heads and the matching adapters must be fitted and connected as follows.

Hose fitting, metallic sealing with union nut: tighten union nut by hand then tighten a further max. 1/4 of a turn with a wrench.

Hose fitting with O-ring and union nut: tighten union nut by hand then tighten a further max. 1/2 of a turn with a wrench.

Hoses must be properly aligned before tightening the union nuts.

Sealing head/sealing cone with metric union nut		
Metric thread	Pipe outer dia.	Torque (Nm)
M12 x 1.5	6	20
M14 x 1.5	8	38

TIM-ID: 0000002333 - 018

Sealing head/sealing cone with metric union nut		
Metric thread	Pipe outer dia.	Torque (Nm)
M16 x 1.5	8 10	45
M18 x 1.5	10 12	51
M20 x 1.5	12	58
M22 x 1.5	14 15	74
M24 x 1.5	16	74
M26 x 1.5	18	105
M30 x 2	20 22	135
M36 x 2	25 28	166
M42 x 2	30	240
M45 x 2	35	290
M52 x 2	38 42	330

Sealing head with BSP union nut	
BSPP thread	Torque (Nm)
G1/4	20
G3/8	34
G1/2	60
G5/8	69
G3/4	115
G1	140
G1.1/4	210
G1.1/2	290
G2	400

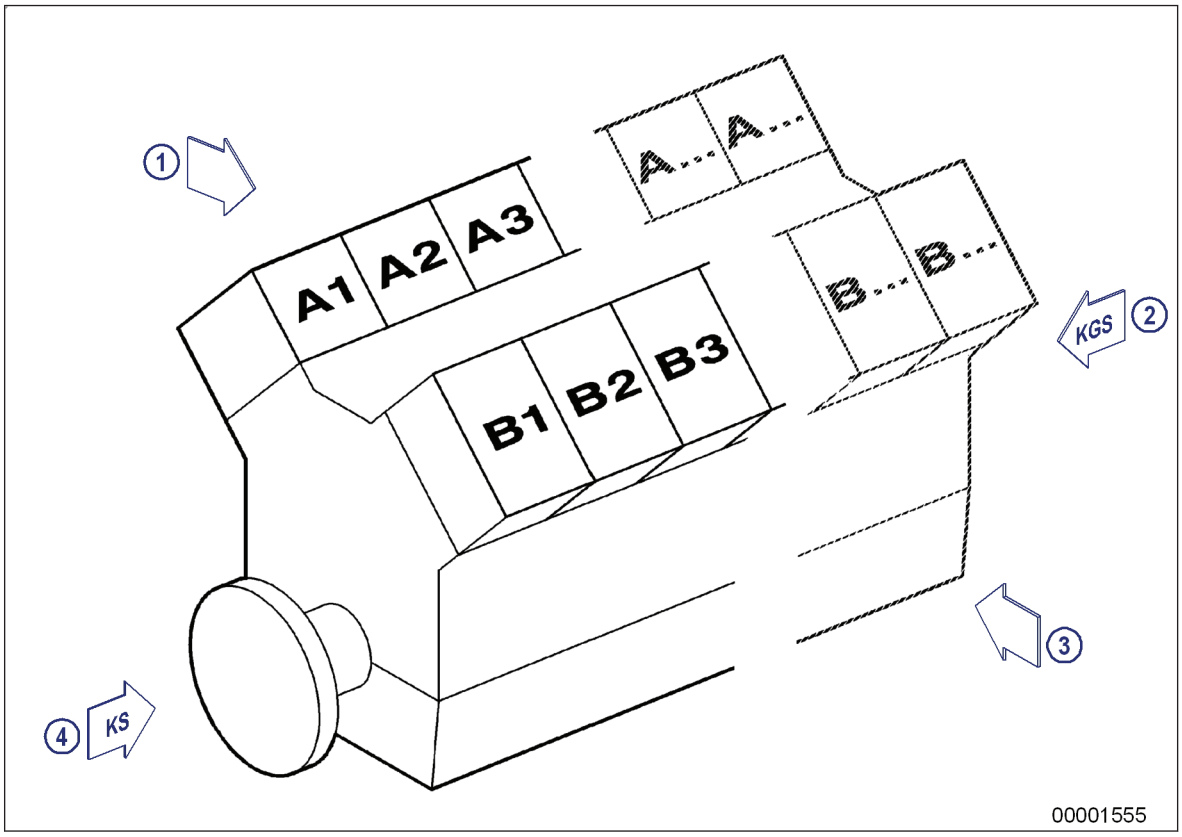
SAE sealing cone with union nut JIC 37°		
UNF thread	Size	Torque (Nm)
7/16-20	-4	15
1/2-20	-5	20
9/16-18	-6	30
3/4-16	-8	50
7/8-14	-10	69
1.1/16-12	-12	98
1.3/16-12	-14	118
1.5/16-12	-16	140
1.5/8-12	-20	210
1.7/8-12	-24	290
2.1/2-12	-32	450

TIM-ID: 0000002333 - 018

ORFS – flat sealing with union nut		
UNF thread	Size	Torque (Nm)
9/16-18	-4	14 +2
11/16-16	-6	24 +3
13/16-16	-8	43 +4
1-14	-10	60 +8
1.3/16-12	-12	90 +5
1.3/16-12	-14	90 +5
1.7/16-12	-16	125 +10
1.11/16-12	-20	170 +20
2-12	-24	200 +25
2-1/2-20	-32	460 +30

TIM-ID: 0000002333 - 018

3.2 Engine side and cylinder designations



1 Left engine side (A-side)
2 Engine free end in accordance with DIN ISO 1204 (KGS = Kupplungsgegenseite)
3 Right engine side (B-side)
4 Engine driving end in accordance with DIN ISO 1204 (KS = Kupplungsseite)

Engine sides are always designated (in accordance with DIN ISO 1204) as viewed from driving end (4).

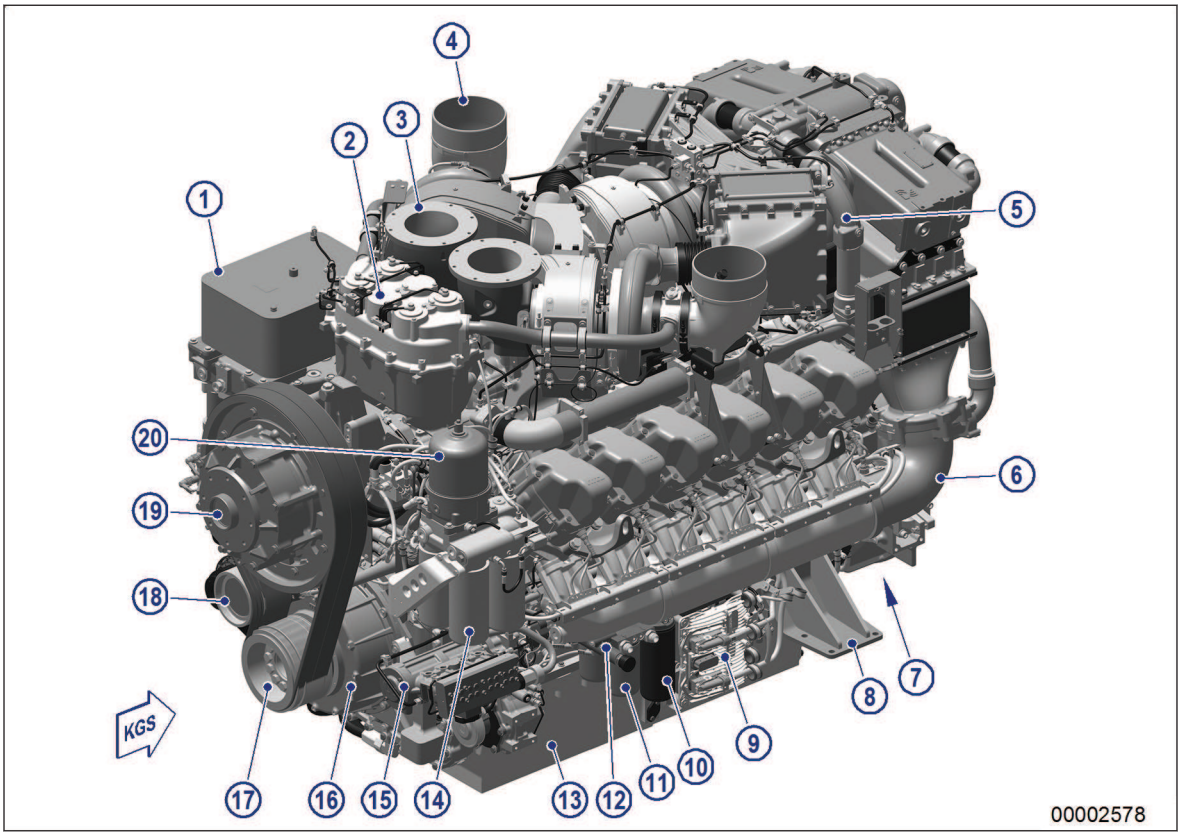
For cylinder designation (in accordance with DIN ISO 1204), the letter "Ax" refers to the cylinders on the left-hand side of the engine (1) and letter "Bx" refers to the cylinders on the right-hand side (3). The cylinders of each bank are numbered consecutively, starting with x=1 at driving end (4).

The numbering of other engine components also starts with 1 at driving end (4).

TIM-ID: 0000002185 - 014

3.3 Engine layout – 12V4000Cx5

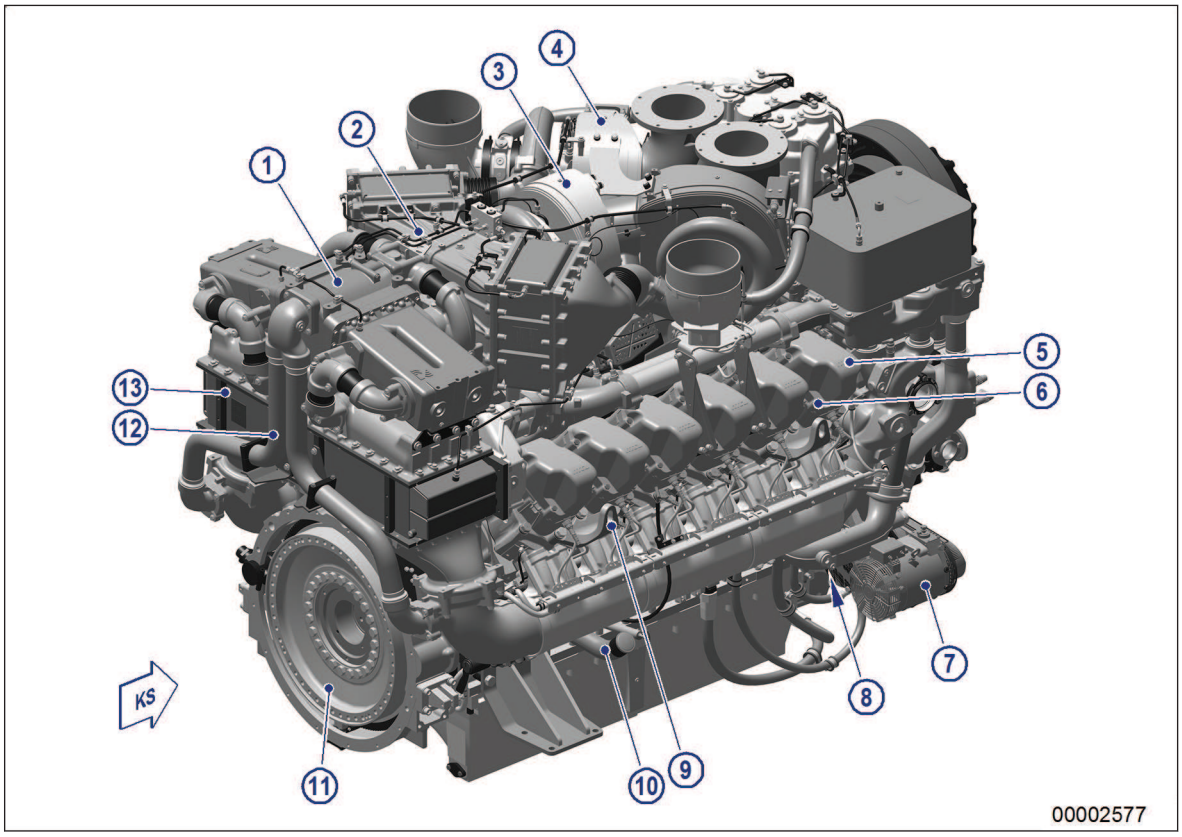
Engine overview – Free end



1 Oil heat exchanger
2 Crankcase breather
3 Exhaust outlet
4 Air intake
5 Engine coolant line
6 Charge-air line
7 Starter
8 Engine mounting bracket
9 Engine governor ECU9
10 Additional fuel filter
11 Fuel filter
12 Fuel priming pump
13 Oil pan
14 Engine oil filter
15 HP fuel pump
16 Vibration damper
17 Fan drive
18 Belt tensioner
19 Fan coupling
20 Centrifugal oil filter

TIM-ID: 0000063490 - 001

Engine overview – Driving end



1 EGR cooler
2 Intercooler (low pressure)
3 Exhaust turbocharger (high pressure)
4 Exhaust turbocharger (low pressure)
5 Cylinder head cover
6 Cylinder head
7 Battery-charging generator
8 Oil priming pump
9 Engine lifting equipment
10 Oil filler neck
11 Flywheel
12 EGR system after EGR cooler
13 Intercooler (high pressure)

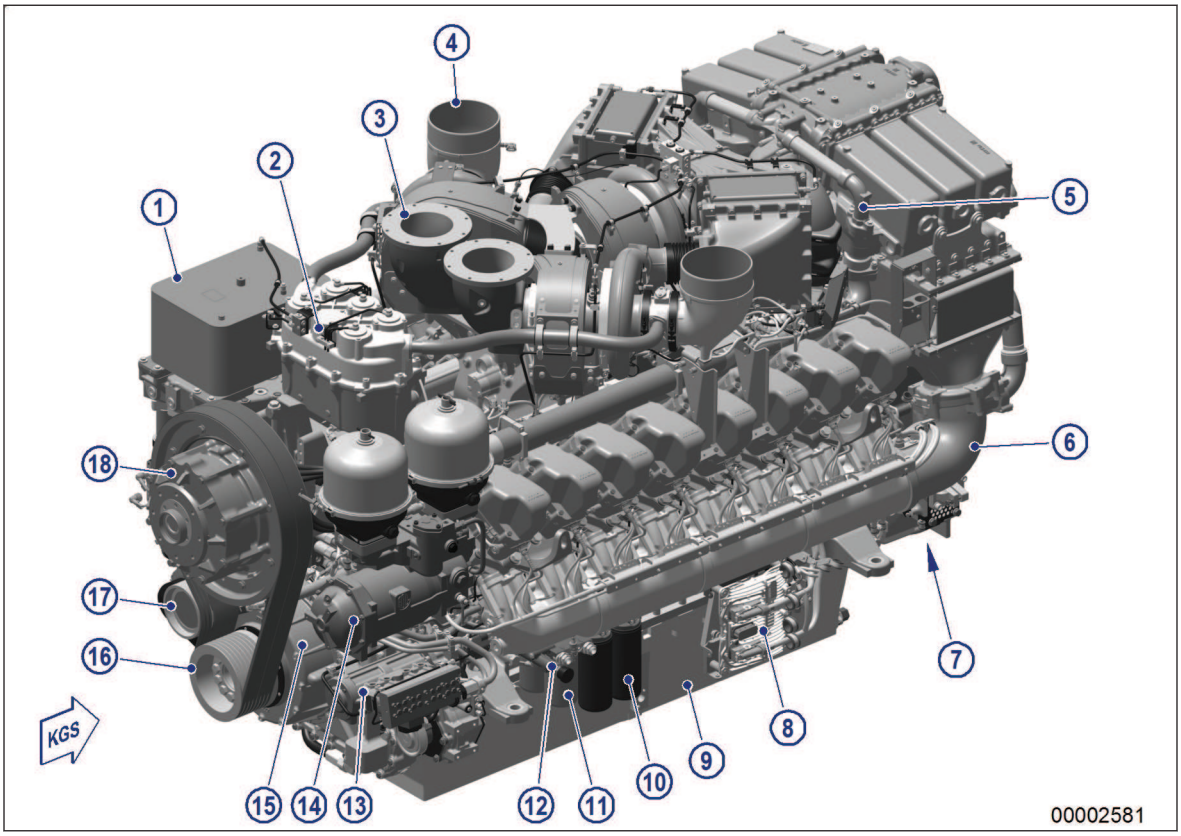
Engine model designation

Key to engine model designation 12V4000Cx5	
12	Number of cylinders
V	Cylinder arrangement: V engine
4000	Series
C	Application: Construction and Industrial (C&I)
x	Application segment: 1,2,3,4,5,6
5	Design index

TIM-ID: 0000063490 - 001

3.4 Engine layout – 16V4000Cx5

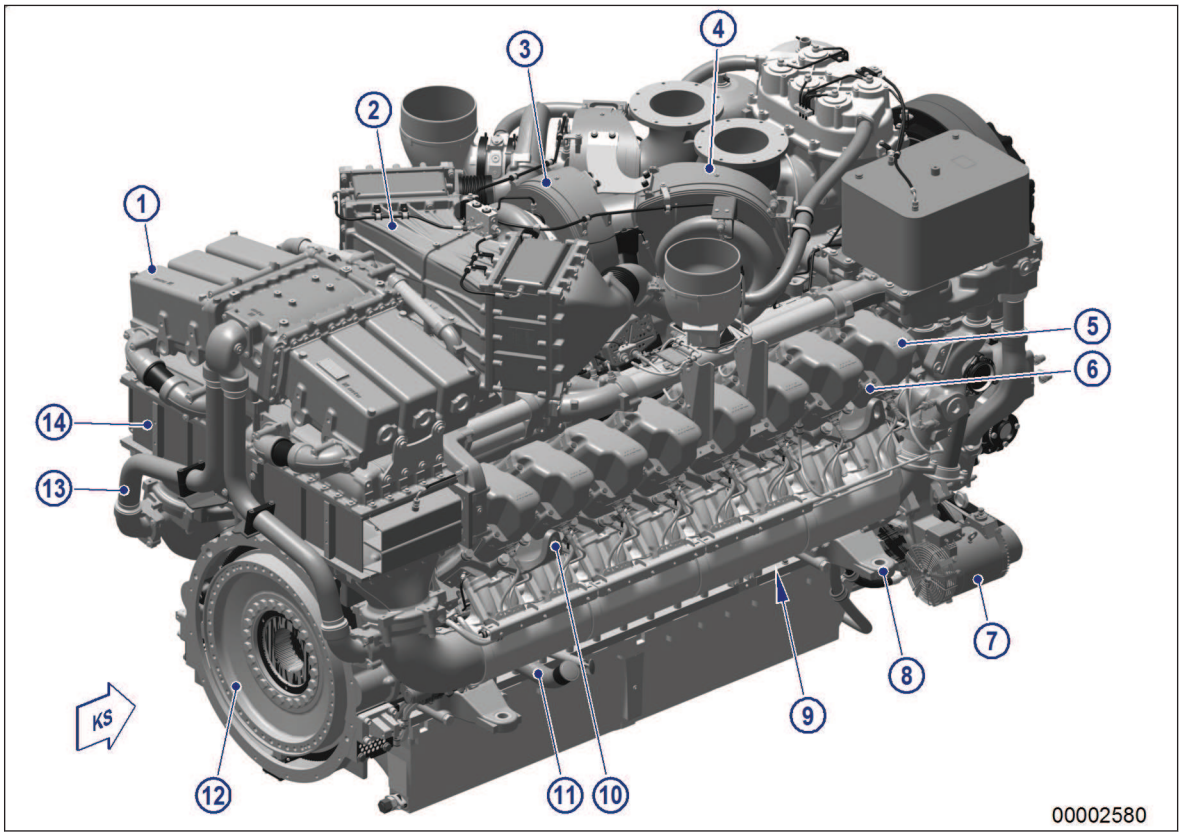
Engine overview – Free end



1 Oil heat exchanger
2 Crankcase breather
3 Exhaust outlet
4 Air intake
5 Engine coolant line
6 Charge-air line
7 Starter
8 Engine governor ECU9
9 Oil pan
10 Additional fuel filter
11 Fuel filter
12 Fuel priming pump
13 HP fuel pump
14 Automatic oil filter
15 Vibration damper
16 Fan drive
17 Belt tensioner
18 Fan coupling

TIM-ID: 0000063500 - 001

Engine overview – Driving end



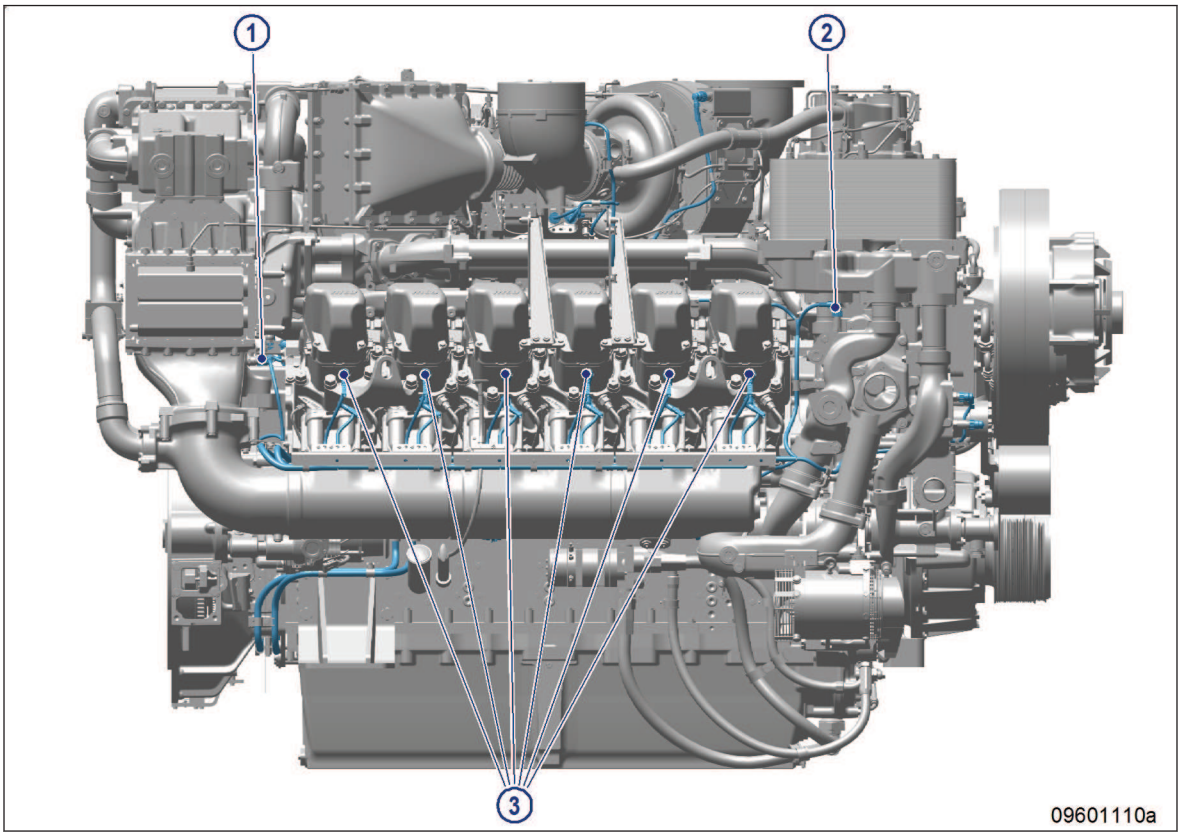
1 EGR cooler
2 Intercooler (low pressure)
3 Exhaust turbocharger (high pressure)
4 Exhaust turbocharger (low pressure)
5 Cylinder head cover
6 Cylinder head
7 Battery-charging generator
8 Engine mounting bracket
9 Oil priming pump
10 Engine lifting equipment
11 Oil filler neck
12 Flywheel
13 EGR system after EGR cooler
14 Intercooler (high pressure)

Engine model designation

Key to engine model designation 16V4000Cx5	
16	Number of cylinders
V	Cylinder arrangement: V engine
4000	Series
C	Application: Construction and Industrial (C&I)
x	Application segment: 1,2,3,4,5,6
5	Design index

TIM-ID: 0000063500 - 001

3.5 Overview of sensors, actuators and injectors – 12V4000Cx5

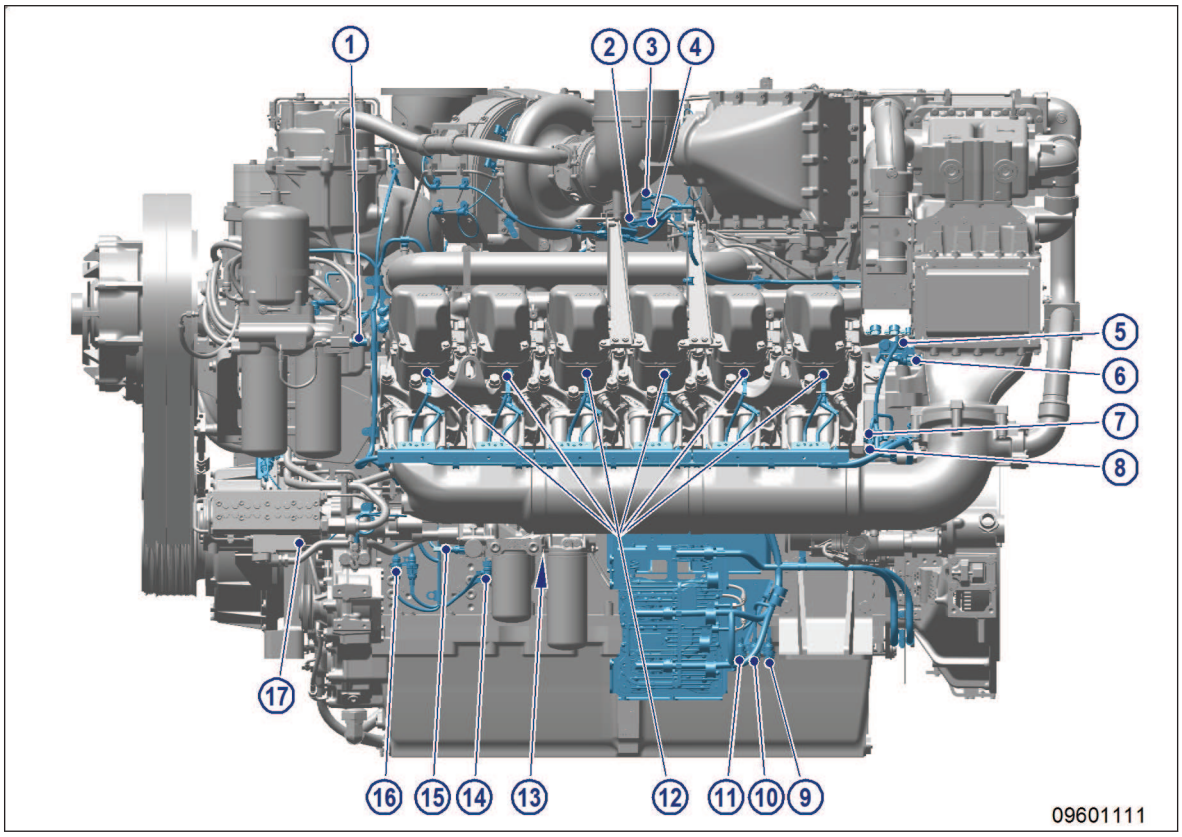


1 B10.2 - Charge-air pressure, B side

2 B16 - Coolant pressure

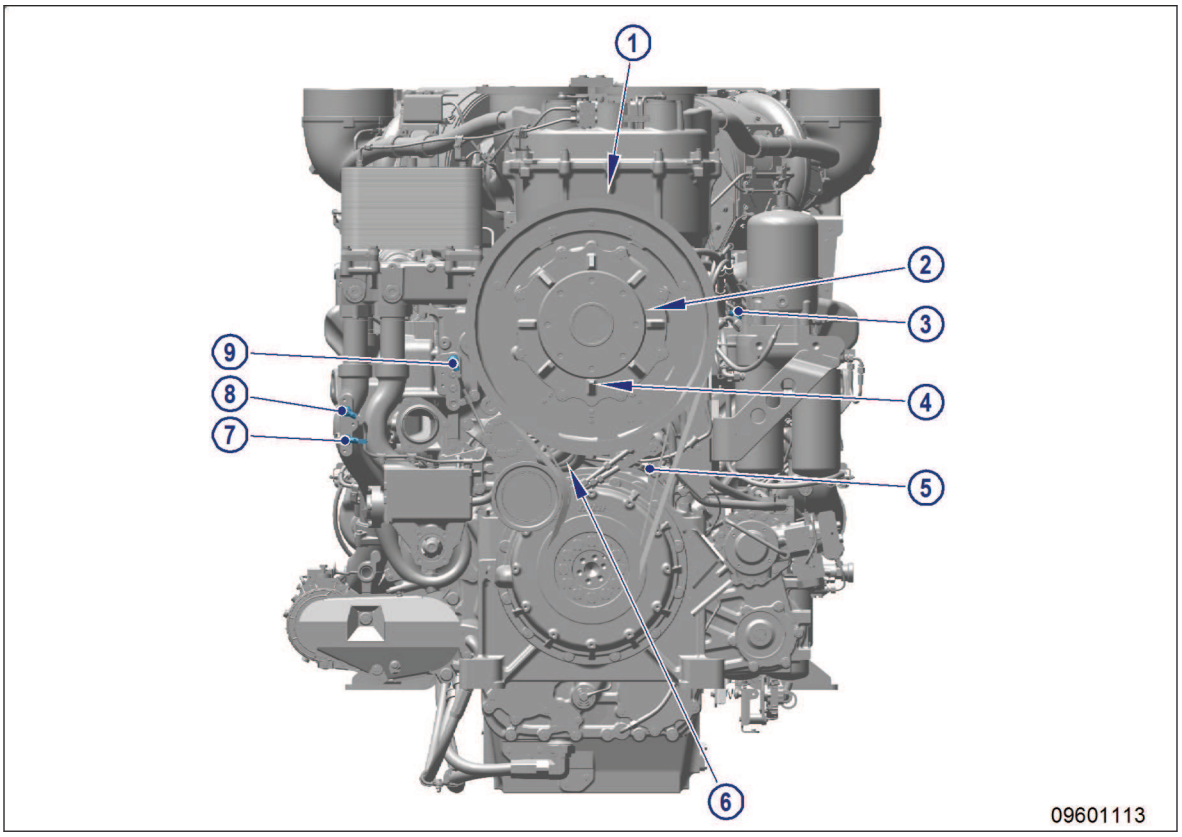
12 Y39 - Injector (B1-B6)

TIM-ID: 0000063565 - 001



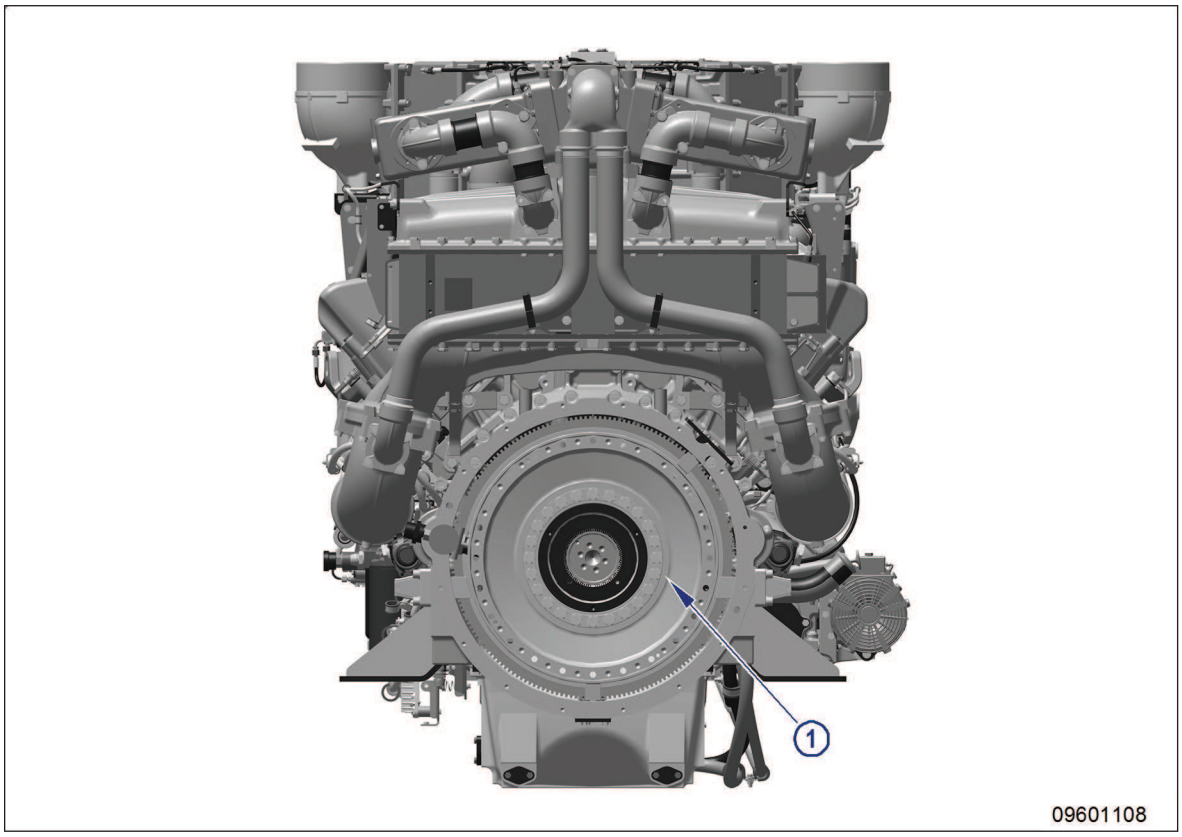
1 B5.3 - Lube oil pressure before filter
2 M52 - HP turbine bypass flap
3 B4 - Exhaust temperature
4 M55 - EGR dispenser cylinder flap
5 M53 - EGR shutoff flap
6 B10.1 - Charge-air pressure, A side
7 A19 - Electronic engine identification label (EIL)
8 B9 - Charge air temperature
9 F57 - Charge-air coolant
10 F70 - Water level in fuel prefilter
11 F33 - Coolant
12 Y39 - Injector (A1-A6)
13 B34.3 - Fuel pressure before optional filter
14 F34.2 - Fuel pressure before filter
15 F34.1 - Fuel pressure after filter
16 M8 - Suction restrictor (HP pump)
17 F46 - Leak fuel level

TIM-ID: 0000063565 - 001



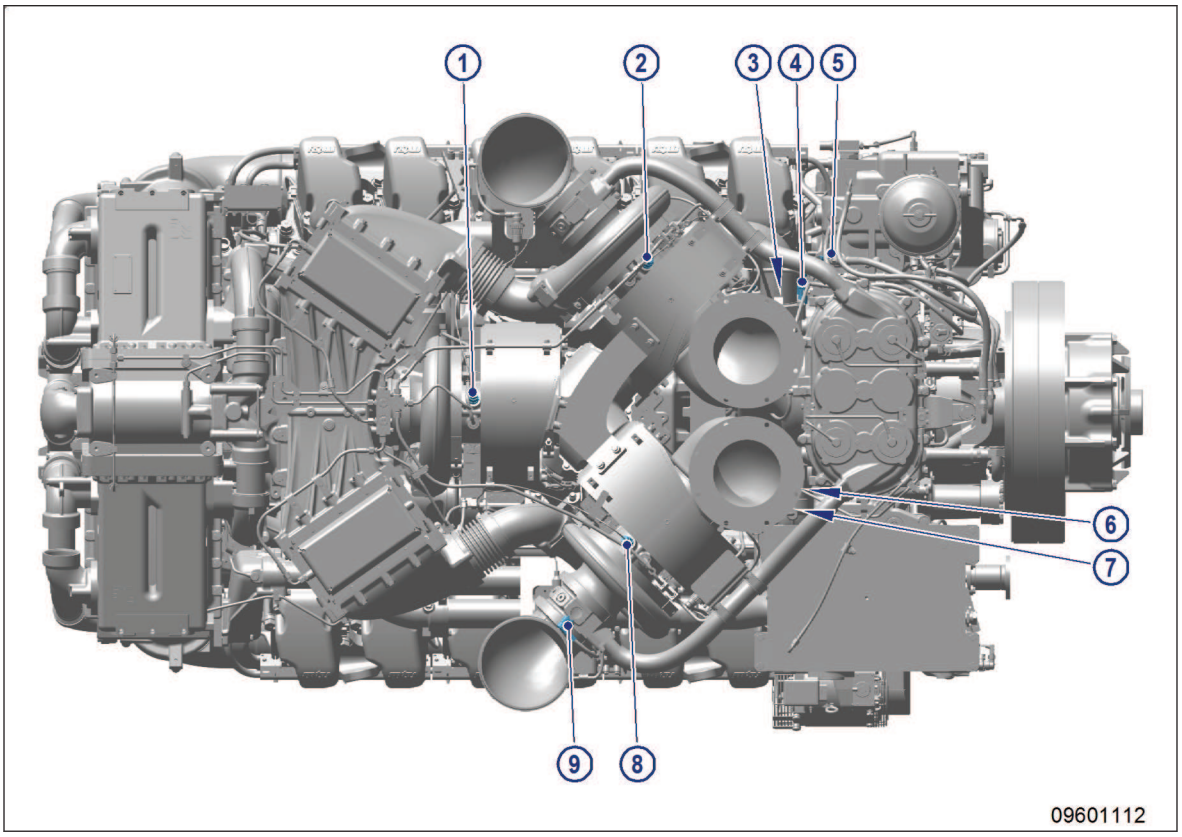
1 B50 - Crankcase pressure
2 Y44 - Fan control valve
3 B5.1 - Lube oil pressure after filter
4 B33 - Fuel temperature (Rail)
5 B48 - Fuel pressure (Rail)
6 B1 - Camshaft speed
7 B43 - Charge-air coolant pressure
8 B26 - Charge-air coolant temperature
9 B6 - Engine coolant temperature

TIM-ID: 0000063565 - 001



1 B13 - Crankskaft speed

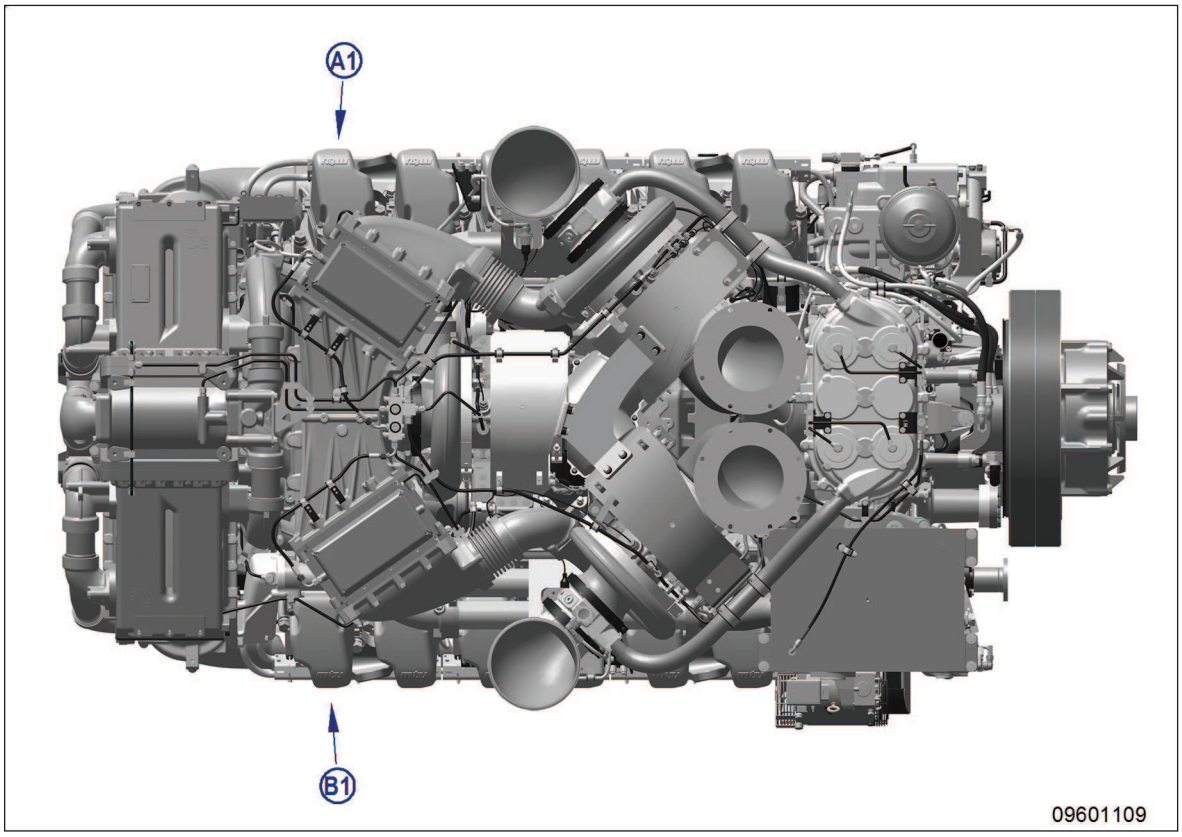
TIM-ID: 0000063565 - 001



1 B44.3 - Turbocharger speed (high pressure)
2 B44.1 - Turbocharger speed (low pressure) A side
3 B88.1 - LAMBDA NOx (Conti) A side
4 B89 - LAMBDA (Bosch)
5 B7 - Lube oil temperature
6 B91.3 - Exhaust pressure LAMDA
7 B88.2 - LAMBDA NOx (Conti) B side
8 B44.2 - Turbocharger speed (low pressure) B side
9 B90 - Intake-air humidity (pressure, temperature)

TIM-ID: 0000063565 - 001

Injectors

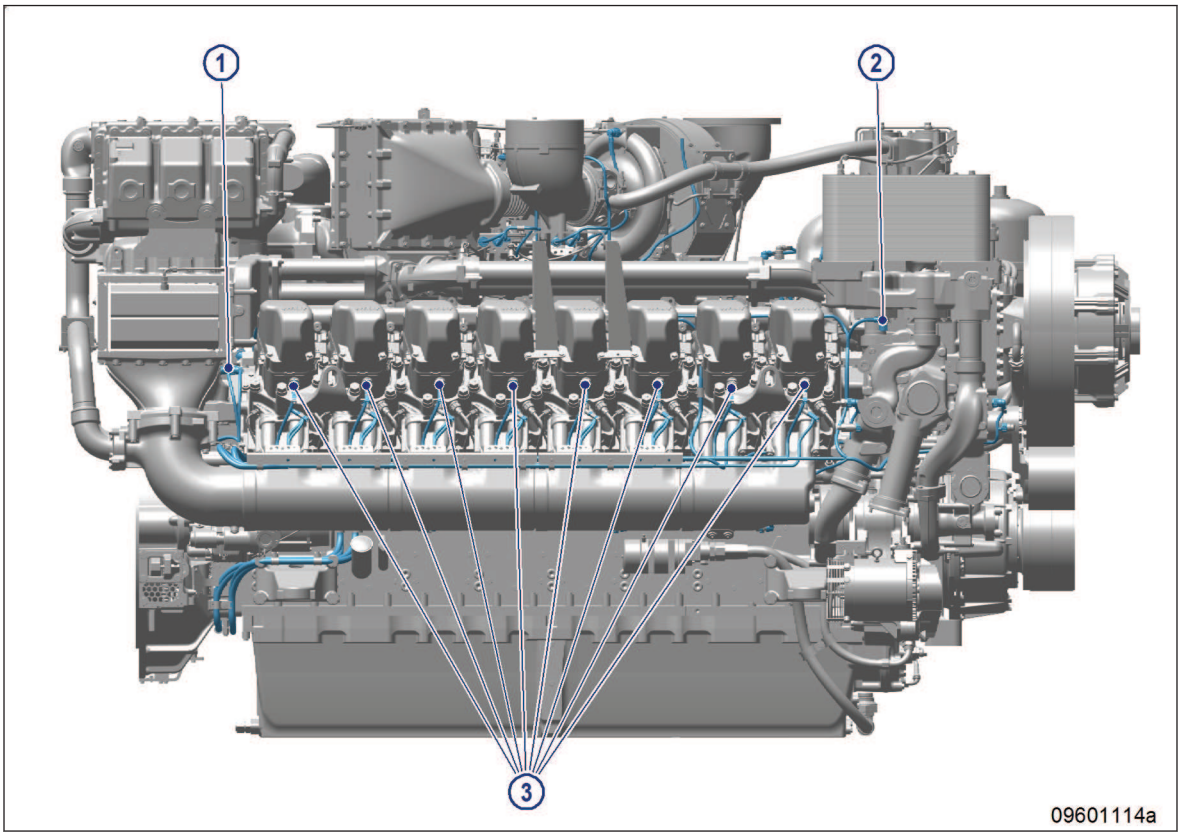


A1 Injector Y39A1	A5 Injector Y39A5	B3 Injector Y39B3
A2 Injector Y39A2	A6 Injector Y39A6	B4 Injector Y39B4
A3 Injector Y39A3	B1 Injector Y39B1	B5 Injector Y39B5
A4 Injector Y39A4	B2 Injector Y39B2	B6 Injector Y39B6

The injectors are numbered in ascending order and located below the cylinder head covers. Injector replacement and necessary activities (→ Page 176).

TIM-ID: 0000063565 - 001

3.6 Overview of sensors, actuators and injectors - 16V4000Cx5

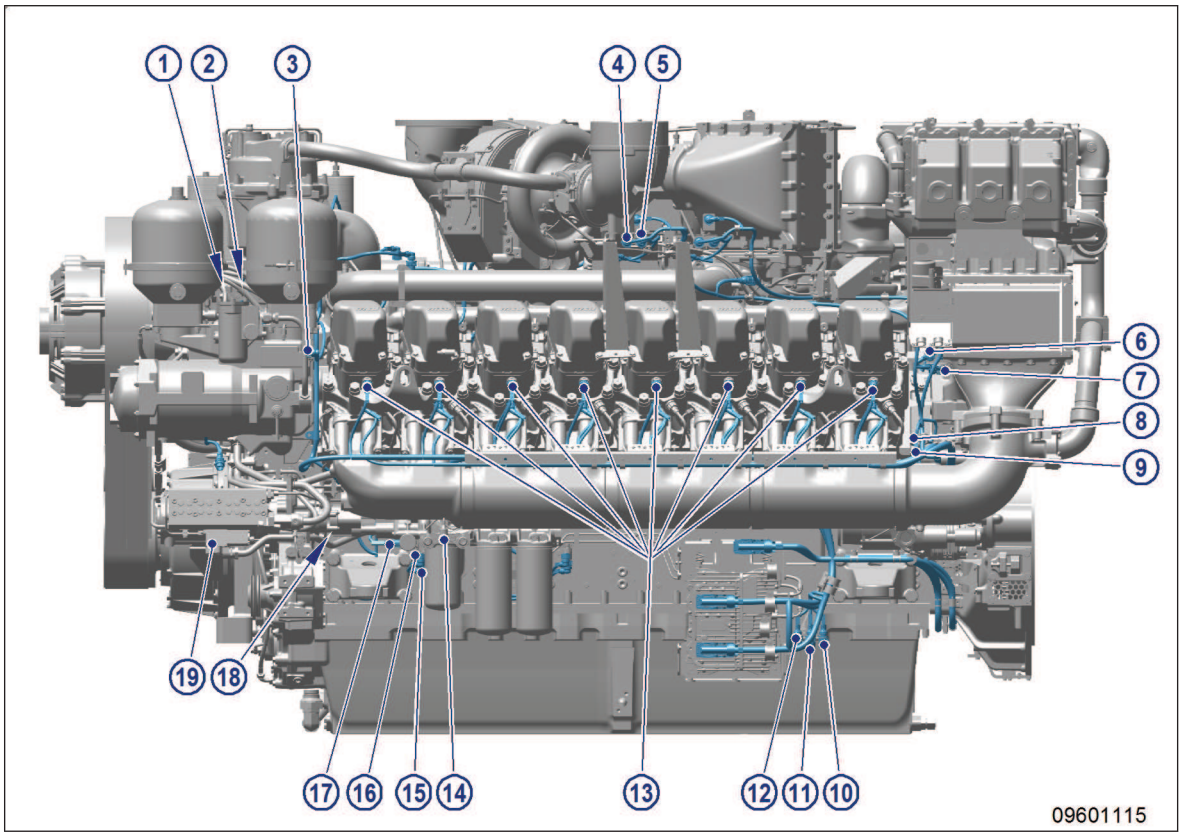


1 B10.2 - Charge-air pressure, B side

2 B16 - Coolant pressure

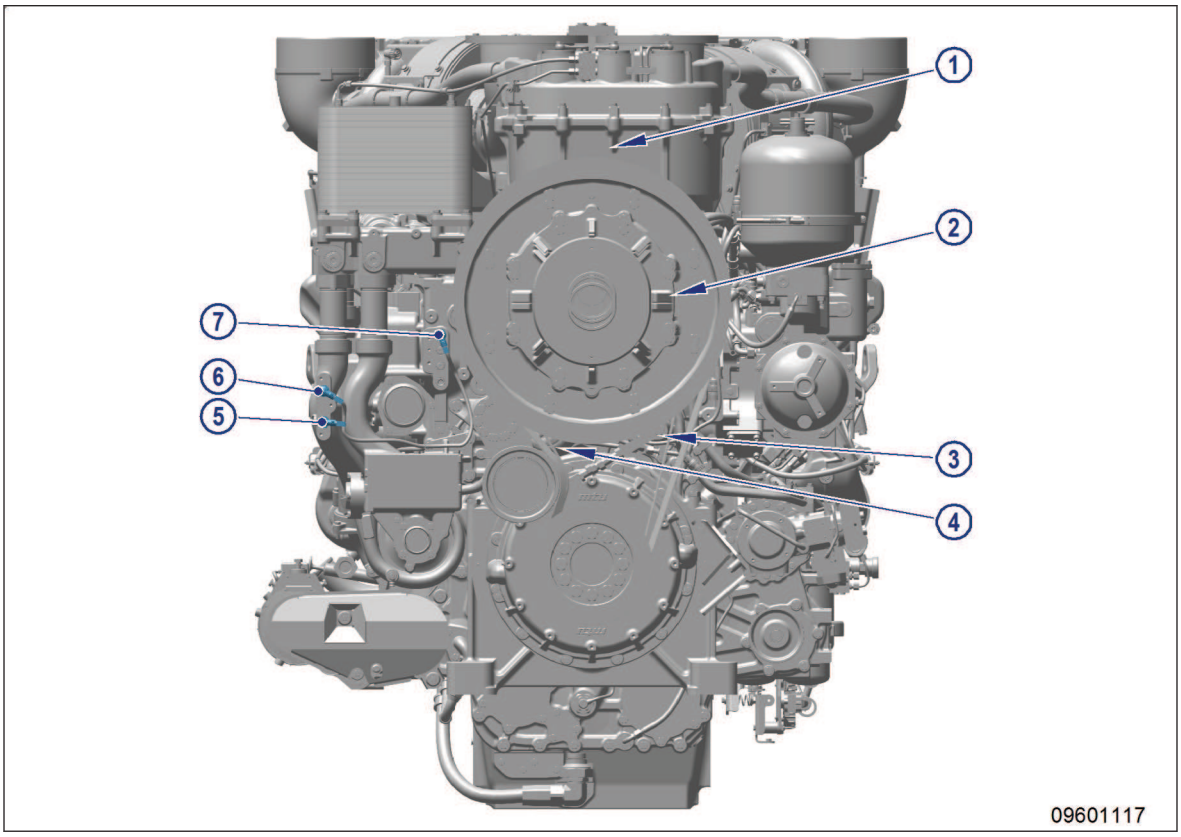
12 Y39 - Injector (B1-B8)

TIM-ID: 0000063596 - 001

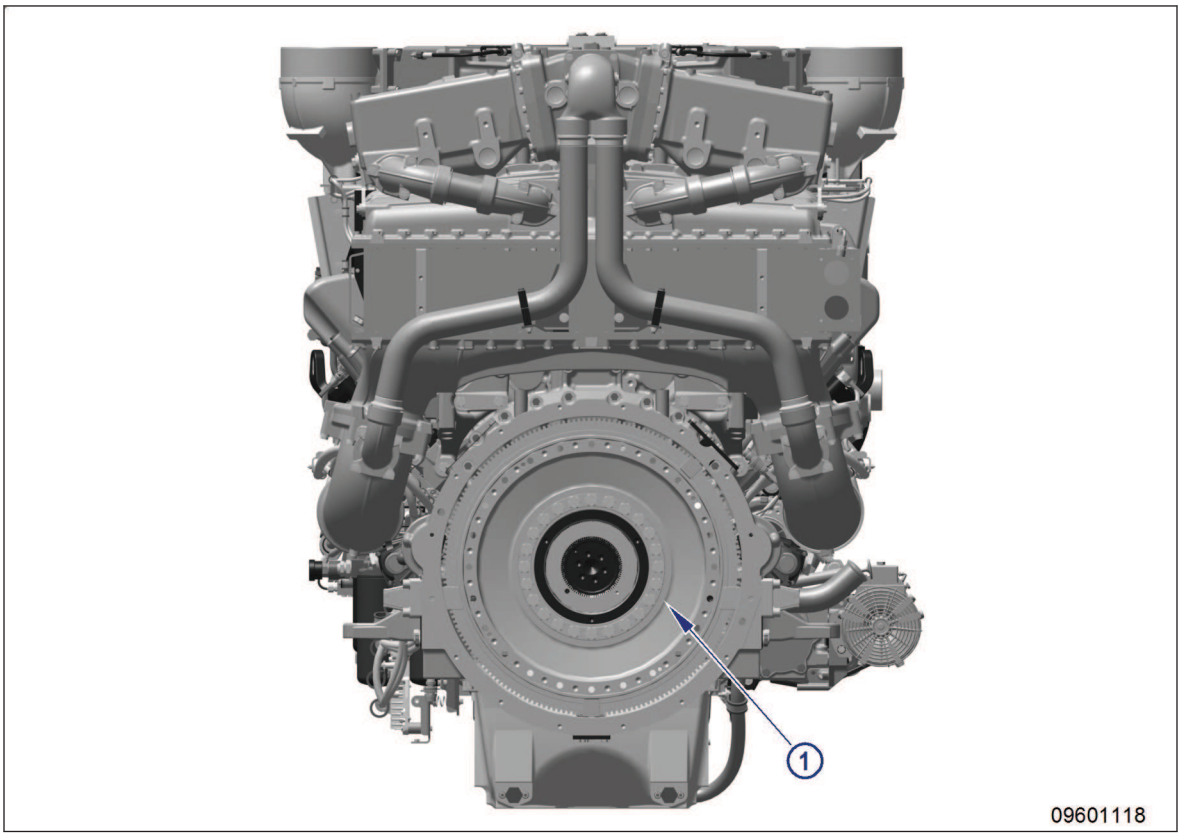


1 B5.3 - Lube oil pressure before filter
2 B5.1 - Lube oil pressure after filter
3 B7 - Lube oil temperature
4 M52 - HP turbine bypass flap
5 M55 - EGR dispenser cylinder flap
6 M53 - EGR shutoff flap
7 B10.1 - Charge-air pressure, A side
8 A19 - Electronic engine identification label (EIL)
9 B9 - Charge air temperature
10 F57 - Charge-air coolant
11 F70 - Water level in fuel prefilter
12 F33 - Coolant
13 Y39 - Injector (A1-A8)
14 B34.3 - Fuel pressure before optional filter
15 F34.2 - Fuel pressure before filter
16 B33 - Fuel temperature (Rail)
17 B34.1 - Fuel pressure after filter
18 M8 - Suction restrictor (HP pump)
19 F46 - Leak fuel level

TIM-ID: 0000063596 - 001

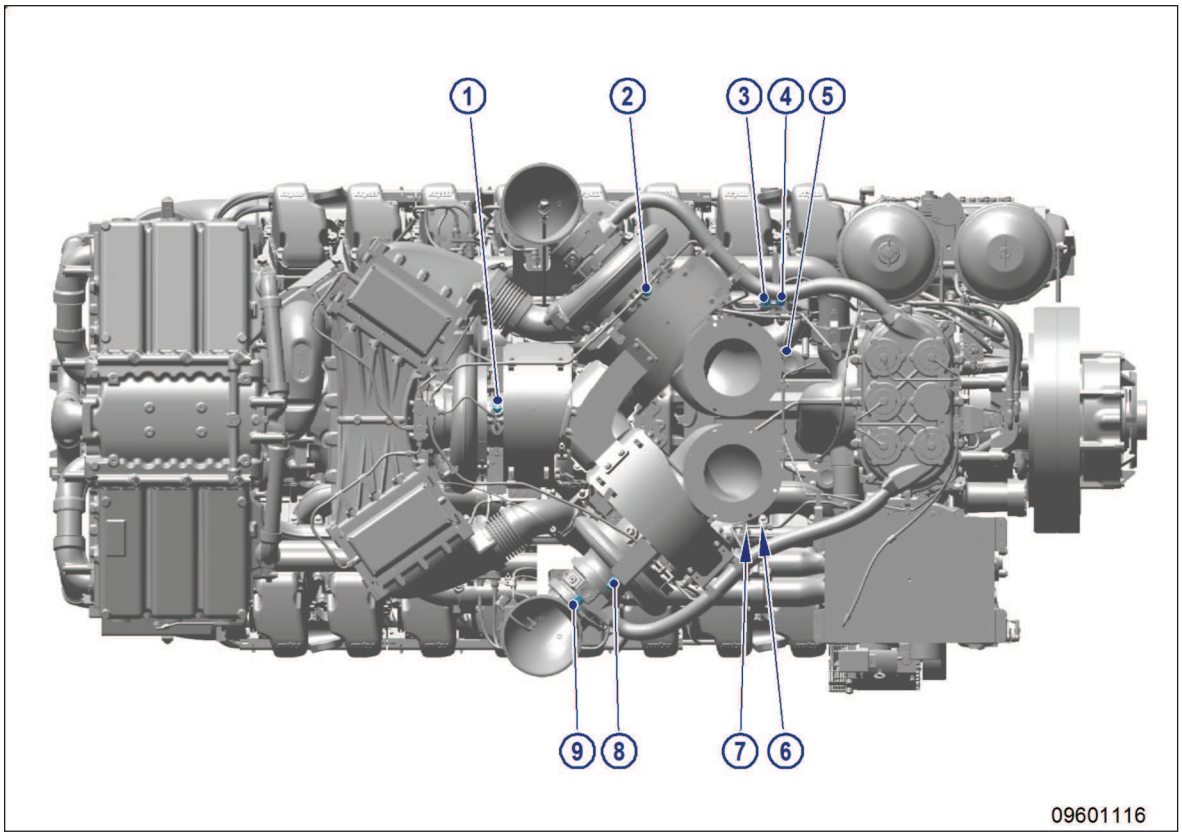


1 B50 - Crankcase pressure
2 Y44 - Fan control valve
3 B48 - Fuel pressure (Rail)
4 B1 - Camshaft speed
5 B43 - Charge-air coolant pressure
6 B26 - Charge-air coolant temperature
7 B6 - Coolant temperature



1 B13 - Crankskaft speed

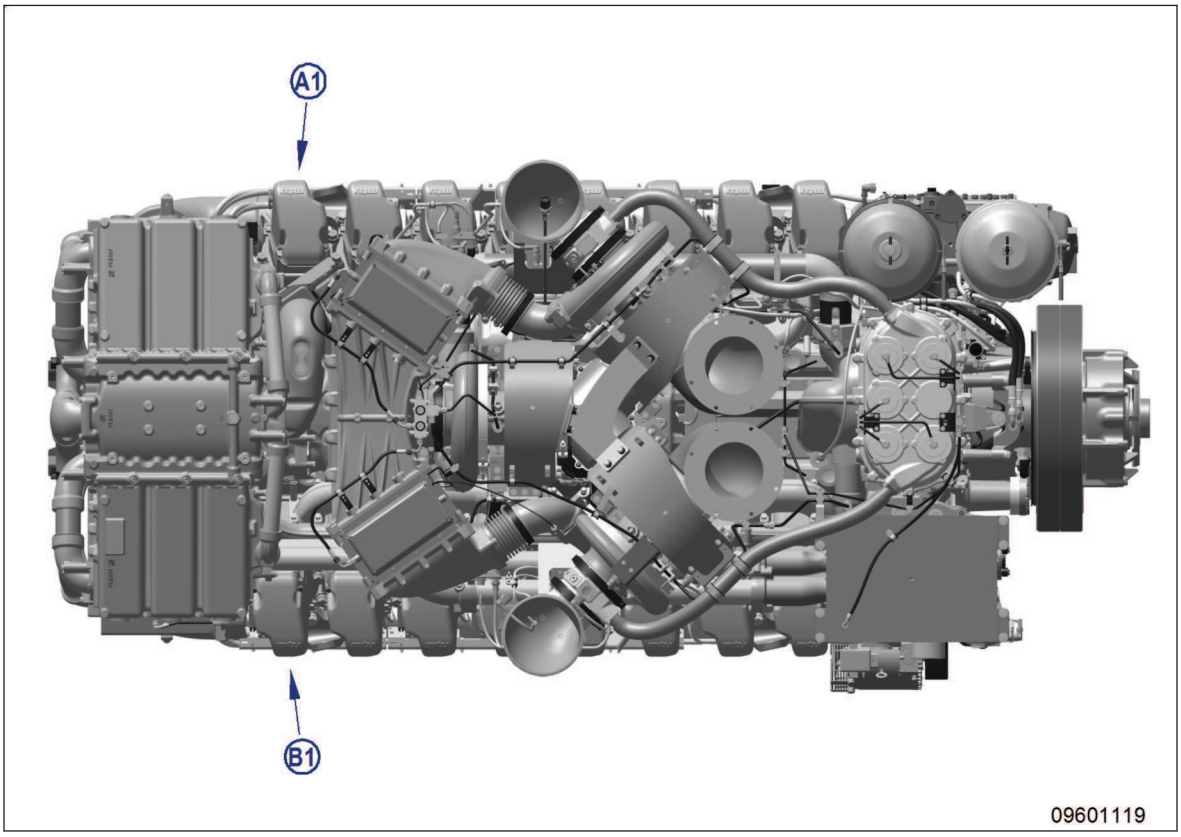
TIM-ID: 0000063596 - 001



1 B44.3 - Turbocharger speed (high pressure)
2 B44.1 - Turbocharger speed (low pressure) A side
3 B88.1 - LAMBDA NOx (Conti) A side
4 B89 - LAMBDA (Bosch)
5 B4 - Exhaust temperature
6 B91.3 - Exhaust pressure LAMDA
7 B88.2 - LAMBDA NOx (Conti) B side
8 B44.2 - Turbocharger speed (low pressure) B side
9 B90 - Intake-air humidity (pressure, temperature)

TIM-ID: 0000063596 - 001

Injectors



A1 Injector Y39A1
A2 Injector Y39A2
A3 Injector Y39A3
A4 Injector Y39A4
A5 Injector Y39A5
A6 Injector Y39A6
A7 Injector Y39A7
A8 Injector Y39A8
B1 Injector Y39B1
B2 Injector Y39B2
B3 Injector Y39B3
B4 Injector Y39B4
B5 Injector Y39B5
B6 Injector Y39B6
B7 Injector Y39B7
B8 Injector Y39B8

The injectors are numbered in ascending order and located below the cylinder head covers. Injector replacement and necessary activities (→ Page 176).

TIM-ID: 0000063596 - 001

4 Technical Data

4.1 Product data 12V4000C15 12V4000C25 12V4000C35

Legend

DL Reference value: Continuous power. Continuously attainable power at standard conditions
BL Reference value: Fuel stop power. Maximum engine power. Not continuously attainable in some applications (margin for load fluctuations).
A Design value. Value required to design an external system (plant).
R Guideline value. Typical average value for information, only partially suitable for design purposes.
L Limit value. Value which must not be fallen short of (lower limit, min. value) or exceeded (upper limit, max. value), not suitable for design purposes.
N Not yet defined value. Value has not yet been defined or will not be defined.
- Not applicable. Module is not applicable to the given product type.
X Applicable. Module is applicable to the given product type.
> Actual value must be greater than the specified value.
< Actual value must be less than the specified value.
* Not sufficiently validated value (+/- 10% tolerance).
** Not sufficiently validated value (+/- 5% tolerance).

Identifier	Product type	Application	Speed	Nominal power	
1	12V4000C15	Industrial / main drive of vehicle 5A continuous operation, unrestricted	1800 rpm	1150 kW 1542 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
2	12V4000C25	Industrial / main drive of vehicle 5A continuous operation, unrestricted	1800 rpm	1250 kW 1676 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
3	12V4000C35	Industrial / main drive of vehicle 5A continuous operation, unrestricted	1800 rpm	1500 kW 2012 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)

Reference condition

Identifier			1	2	3
Intake air temperature		°C	25	25	25
Charge-air coolant temperature		°C	45	45	45
Barometric pressure		mbar	1000	1000	1000
Site altitude above sea level		m	100	100	100

1. Power-related data

Identifier			1	2	3
Rated engine speed	A	rpm	1800	1800	1800
Effective power (w/o fan) (Fuel stop power ISO 3046)	A	kW	1150	1250	1500

TIM-ID: 0000065241 - 004

2. General conditions (for maximum power)

Identifier			1	2	3
Intake depression (new filter)	A	mbar	15	15	15
Intake depression, max. (total pressure referenced to atmosphere)	L	mbar	50	50	50
Exhaust gas overpressure (total pressure referenced to atmosphere)	A	mbar	30	30	30
Exhaust gas overpressure, max.	L	mbar	85	85	85
Maximum admissible deviation between intake air temperature measured at the engine and ambient air temperature (measured in the shade at a distance of approx. 8 meters or 25 feet)	L	°C	3	3	3
Fuel temperature at engine inlet connection	R	°C	25	25	25
Fuel temperature at engine inlet connection, max (w/o power reduction)	L	°C	65	65	65

4. Model-related data (basic design)

Identifier			1	2	3
Number of cylinders		-	12	12	12
Cylinder arrangement: V angle		Degrees (°)	90	90	90
Bore		mm	170	170	170
Stroke		mm	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2
Number of inlet valves per cylinder		-	2	2	2
Number of exhaust valves per cylinder		-	2	2	2

5. Air / exhaust gas

Identifier			1	2	3
Charge-air pressure before cylinder	R	bar abs	3.4	3.7	3.8

7. Coolant system (high-temperature circuit)

Identifier			1	2	3
Coolant temperature at ambient temperature up to 40 °C (at engine connection: outlet to cooling system)	A	°C	105	105	105
Coolant temperature after engine, limit 1	L	°C	107	107	107
Coolant temperature after engine, limit 2	L	°C	109	109	109
Coolant antifreeze content, max.	L	%	50	50	50
Coolant pump: differential pressure	R	bar	4,8*	4,8*	4,8*
Thermostat: Starts to open	R	°C	79	79	79
Thermostat: Fully open	R	°C	92	92	92

TIM-ID: 0000065241 - 004

8. Coolant system (low-temperature circuit)

Identifier			1	2	3
Coolant temperature before intercooler (at engine connection: inlet from cooling equipment)	A	°C	45	45	45
Coolant antifreeze content, max.	L	%	50	50	50
Thermostat: Starts to open	R	°C	38	38	38
Thermostat: Fully open	R	°C	51	51	51

10. Lube oil system

Identifier			1	2	3
Lube-oil operating temperature before engine, to	R	°C	95	95	95
Lube-oil temperature before engine, limit 1	L	°C	106	106	106
Lube-oil temperature before engine, limit 2	L	°C	108	108	108
Lube-oil operating pressure before engine, to	R	bar	6.7 *	6.7 *	6.7 *

11. Fuel system

Identifier			1	2	3
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.5	-0.5	-0.5
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5

16. Inclinations – standard oil system (reference: waterline)

Identifier			1	2	3
Longitudinal inclination, continuous max. driving end down (option: max. operating inclinations)	L	Degrees (°)	30	30	30
Longitudinal inclination, continuous max. driving end up (option: max. operating inclinations)	L	Degrees (°)	30	30	30
Transverse inclination, continuous max. (option: max. operating inclinations)	L	Degrees (°)	30	30	30

18. Capacities

Identifier			1	2	3
Engine coolant capacity, engine side (without cooling system)	R	Liters	220	220	220
Charge-air coolant, engine side	R	Liters	69	69	69
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	250	250	250
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	290	290	290

19. Masses / main dimensions

Identifier			1	2	3
Engine mass, dry (standard scope of supply)	R	kg	8320 **	8320 **	8320 **

TIM-ID: 0000065241 - 004

22. Acoustics

Identifier			1	2	3
Exhaust noise, unsilenced – BL (free-field sound pressure level Lp, 1 m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	108	109	109
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	dB(A)	121	121	121

TIM-ID: 0000065241 - 004

4.2 Product data 12V4000C55 12V4000C65 12V4000C65

Legend

DL Reference value: Continuous power. Continuously attainable power at standard conditions
BL Reference value: Fuel stop power. Maximum engine power. Not continuously attainable in some applications (margin for load fluctuations).
A Design value. Value required to design an external system (plant).
R Guideline value. Typical average value for information, only partially suitable for design purposes.
L Limit value. Value which must not be fallen short of (lower limit, min. value) or exceeded (upper limit, max. value), not suitable for design purposes.
N Not yet defined value. Value has not yet been defined or will not be defined.
- Not applicable. Module is not applicable to the given product type.
X Applicable. Module is applicable to the given product type.
> Actual value must be greater than the specified value.
< Actual value must be less than the specified value.
* Not sufficiently validated value (+/- 10% tolerance).
** Not sufficiently validated value (+/- 5% tolerance).

Identifier	Product type	Application	Speed	Nominal power	
1	12V4000C55	Industrial / main drive of vehicle 5B continuous operation, variable	1900 rpm	1750 kW 2347 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
2	12V4000C65	Industrial / main drive of vehicle 5B continuous operation, variable	1800 rpm	1864 kW 2500 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
3	12V4000C65	Industrial / main drive of vehicle 5B continuous operation, variable	1900 rpm	1864 kW 2500 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)

Reference condition

Identifier			1	2	3
Intake air temperature		°C	25	25	25
Charge-air coolant temperature		°C	45	45	45
Barometric pressure		mbar	1000	1000	1000
Site altitude above sea level		m	100	100	100

1. Power-related data

Identifier			1	2	3
Rated engine speed	A	rpm	1900	1800	1900
Effective power (w/o fan) (Fuel stop power ISO 3046)	A	kW	1750	1864	1865

TIM-ID: 0000065240 - 004

2. General conditions (for maximum power)

Identifier			1	2	3
Intake depression (new filter) (total pressure referenced to atmosphere)	A	mbar	15	15	15
Intake depression, max. (total pressure referenced to atmosphere)	L	mbar	50	50	50
Exhaust gas overpressure (total pressure referenced to atmosphere)	A	mbar	30	30	30
Exhaust gas overpressure, max. (total pressure referenced to atmosphere)	L	mbar	85	85	85
Maximum admissible deviation between intake air temperature measured at engine inlet and ambient air temperature (measured in the shade at a distance of approx. 8 meter or 25 feet)	L	°C	3	3	3
Fuel temperature at engine inlet connection	R	°C	25	25	25
Fuel temperature at engine inlet connection, max (w/o power reduction)	L	°C	65	65	65

4. Model-related data (basic design)

Identifier			1	2	3
Number of cylinders		-	12	12	12
Cylinder arrangement: V angle		Degrees (°)	90	90	90
Bore		mm	170	170	170
Stroke		mm	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2
Number of inlet valves per cylinder		-	2	2	2
Number of exhaust valves per cylinder		-	2	2	2

5. Air / exhaust gas

Identifier			1	2	3
Charge-air pressure before cylinder	R	bar abs	4.1	4.4	4.6

7. Coolant system (high-temperature circuit)

Identifier			1	2	3
Coolant temperature at ambient temperature up to 40 °C (at engine connection: outlet to cooling system)	A	°C	105	105	105
Coolant temperature after engine, limit 1	L	°C	107	107	107
Coolant temperature after engine, limit 2	L	°C	109	109	109
Coolant antifreeze content, max.	L	%	50	50	50
Coolant pump: differential pressure	R	bar	5.4	-	5.4
Thermostat: Starts to open	R	°C	79	79	79
Thermostat: Fully open	R	°C	92	92	92

TIM-ID: 0000065240 - 004

8. Coolant system (low-temperature circuit)

Identifier			1	2	3
Coolant temperature before intercooler (at engine connection: inlet from cooling equipment)	A	°C	45	45	45
Coolant antifreeze content, max.	L	%	50	50	50
Thermostat: Starts to open	R	°C	38	38	38
Thermostat: Fully open	R	°C	51	51	51

10. Lube oil system

Identifier			1	2	3
Lube-oil operating temperature before engine, to	R	°C	95	95	95
Lube-oil temperature before engine, limit 1	L	°C	106	106	106
Lube-oil temperature before engine, limit 2	L	°C	108	108	108
Lube-oil operating pressure before engine, to	R	bar	6.7 *	6.7 *	6.7 *

11. Fuel system

Identifier			1	2	3
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.5	-0.5	-0.5
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5

16. Inclinations – standard oil system (reference: waterline)

Identifier			1	2	3
Longitudinal inclination, continuous max. driving end down (option: max. operating inclinations)	L	Degrees (°)	15	15	15
Longitudinal inclination, continuous max. driving end up (option: max. operating inclinations)	L	Degrees (°)	15	15	15
Transverse inclination, continuous max. (option: max. operating inclinations)	L	Degrees (°)	15	15	15

18. Capacities

Identifier			1	2	3
Engine coolant capacity, engine side (without cooling system)	R	Liters	220	220	220
Charge-air coolant, engine side	R	Liters	69	69	69
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	195	195	195
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	155	155	155
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	195	195	195

TIM-ID: 0000065240 - 004

19. Masses / main dimensions

Identifier			1	2	3
Engine mass, dry (standard scope of supply)	R	kg	8320 **	8320 **	8320 **

22. Acoustics

Identifier			1	2	3
Exhaust noise, unsilenced – BL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	111	110	111
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	dB(A)	123	122	123

TIM-ID: 0000065240 - 004

4.3 Product data 16V4000C45 16V4000C45 16V4000C55 16V4000C55 16V4000C65

Legend

DL Reference value: Continuous power. Continuously attainable power at standard conditions
BL Reference value: Fuel stop power. Maximum engine power. Not continuously attainable in some applications (margin for load fluctuations).
A Design value. Value required to design an external system (plant).
R Guideline value. Typical average value for information, only partially suitable for design purposes.
L Limit value. Value which must not be fallen short of (lower limit, min. value) or exceeded (upper limit, max. value), not suitable for design purposes.
N Not yet defined value. Value has not yet been defined or will not be defined.
- Not applicable. Module is not applicable to the given product type.
X Applicable. Module is applicable to the given product type.
> Actual value must be greater than the specified value.
< Actual value must be less than the specified value.
* Not sufficiently validated value (+/- 10% tolerance).
** Not sufficiently validated value (+/- 5% tolerance).

Identifier	Product type	Application	Speed	Nominal power	
1	16V4000C45	Industrial / main drive of vehicle 5B continuous operation, variable	1800 rpm	2000 kW 2682 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
2	16V4000C45	Industrial / main drive of vehicle 5B continuous operation, variable	1900 rpm	2000 kW 2682 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
3	16V4000C55	Industrial / main drive of vehicle 5B continuous operation, variable	1800 rpm	2240 kW 3004 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
4	16V4000C55	Industrial / main drive of vehicle 5B continuous operation, variable	1900 rpm	2240 kW 3004 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)
5	16V4000C65	Industrial / main drive of vehicle 5B continuous operation, variable	1800 rpm	2400 kW 3218 bhp	Ref. 25°C/45°C EPA Nonroad T4 (40CFR1039)

Reference condition

Identifier			1	2	3	4	5
Intake air temperature		°C	25	25	25	25	25
Charge-air coolant temperature		°C	45	45	45	45	45
Barometric pressure		mbar	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100

TIM-ID: 0000065267 - 004

1. Power-related data

Identifier			1	2	3	4	5
Rated engine speed	A	rpm	1800	1900	1800	1900	1800
Effective power (w/o fan) (Fuel stop power ISO 3046)	A	kW	2000	2000	2240	2240	2400

2. General conditions (for maximum power)

Identifier			1	2	3	4	5
Intake depression (new filter)	A	mbar	15	15	15	15	15
Intake depression, max. (total pressure referenced to atmosphere)	L	mbar	50	50	50	50	50
Exhaust gas overpressure (total pressure referenced to atmosphere)	A	mbar	30	30	30	30	30
Exhaust gas overpressure, max. (total pressure referenced to atmosphere)	L	mbar	85	85	85	85	85
Maximum admissible deviation between intake air temperature measured at engine inlet and ambient air temperature (measured in the shade at a distance of approx. 8 meter or 25 feet)	L	°C	3	3	3	3	3
Fuel temperature at engine inlet connection	R	°C	25	25	25	25	25
Fuel temperature at engine inlet connection, max (w/o power reduction)	L	°C	65	65	65	65	65

4. Model-related data (basic design)

Identifier			1	2	3	4	5
Number of cylinders		-	16	16	16	16	16
Cylinder arrangement: V angle		Degrees (°)	90	90	90	90	90
Bore		mm	170	170	170	170	170
Stroke		mm	210	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3	76.3	76.3
Number of inlet valves per cylinder		-	2	2	2	2	2
Number of exhaust valves per cylinder		-	2	2	2	2	2

TIM-ID: 0000065267 - 004

5. Air / exhaust gas

Identifier			1	2	3	4	5
Charge-air pressure before cylinder	R	bar abs					4.4

7. Coolant system (high-temperature circuit)

Identifier			1	2	3	4	5
Coolant temperature at ambient temperature up to 40 °C (at engine connection: outlet to cooling system)	A	°C	105	105	105	105	105
Coolant temperature after engine, limit 1	L	°C	107	107	107	107	107
Coolant temperature after engine, limit 2	L	°C	109	109	109	109	109
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Thermostat: Starts to open	R	°C	79	79	79	79	79
Thermostat: Fully open	R	°C	92	92	92	92	92

8. Coolant system (low-temperature circuit)

Identifier			1	2	3	4	5
Coolant temperature before intercooler (at engine connection: inlet from cooling equipment)	A	°C	45	45	45	45	45
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Thermostat: Starts to open	R	°C	38	38	38	38	38
Thermostat: Fully open	R	°C	51	51	51	51	51

10. Lube oil system

Identifier			1	2	3	4	5
Lube-oil operating temperature before engine, to	R	°C	95	95	95	95	95
Lube-oil temperature before engine, limit 1	L	°C	106	106	106	106	106
Lube-oil temperature before engine, limit 2	L	°C	108	108	108	108	108

TIM-ID: 0000065267 - 004

11. Fuel system

Identifier			1	2	3	4	5
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3	-0.3	-0.3
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.5	-0.5	-0.5	-0.5	-0.5
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5	1.5

16. Inclinations – standard oil system (reference: waterline)

Identifier			1	2	3	4	5
Longitudinal inclination, continuous max. driving end down (option: max. operating inclinations)	L	Degrees (°)	15	15	15	15	15
Longitudinal inclination, continuous max. driving end up (option: max. operating inclinations)	L	Degrees (°)	15	15	15	15	15
Transverse inclination, continuous max. (option: max. operating inclinations)	L	Degrees (°)	15	15	15	15	15

19. Masses / main dimensions

Identifier			1	2	3	4	5
Engine mass, dry (standard scope of supply)	R	kg	9975	9975	9975	9975	10199

22. Acoustics

Identifier			1	2	3	4	5
Exhaust noise, unsilenced – BL (free-field sound pressure level Lp, 1m distance, ISO 6798, +3dB(A) tolerance)	R	dB(A)	110	110	111	111	111
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3dB(A) tolerance)	R	dB(A)	123	123	124	124	124

TIM-ID: 0000065267 - 004

4.4 Firing order

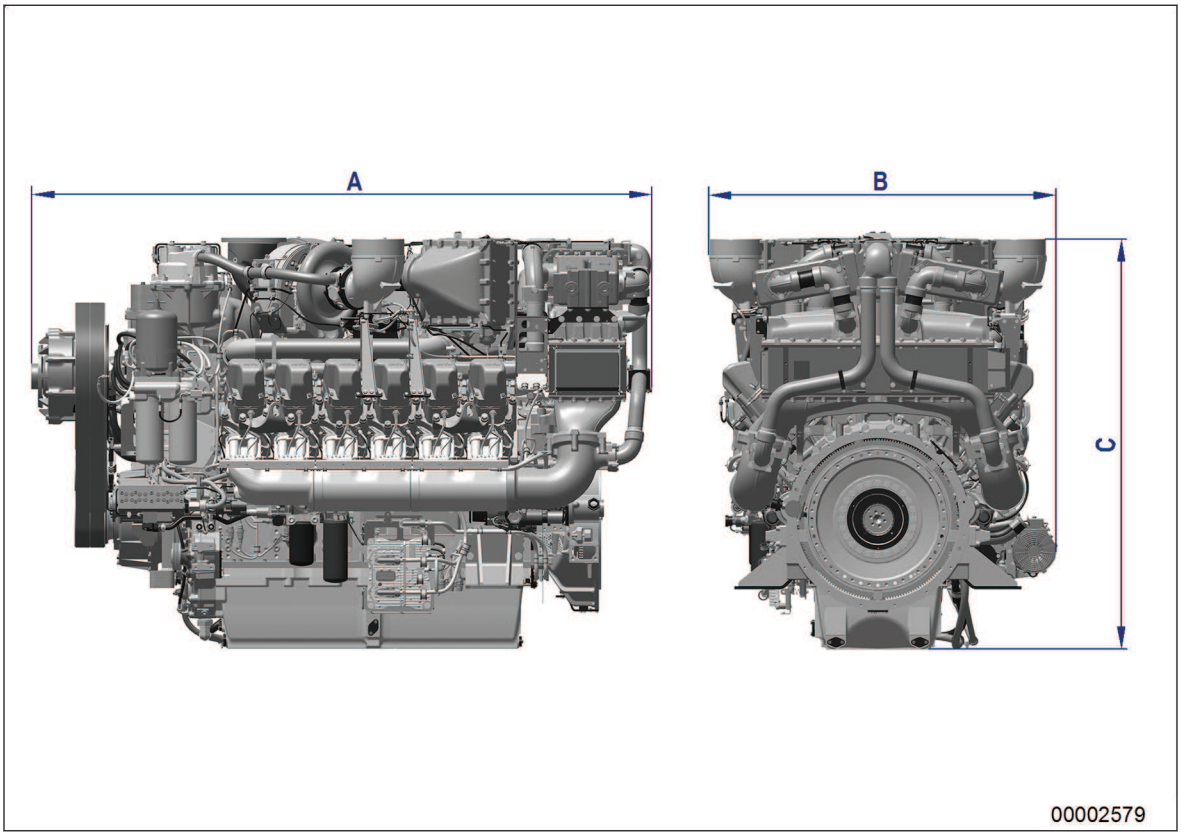
Firing order

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

TIM-ID: 0000062692 - 001

4.5 Main engine dimensions - 12V4000Cx5

Main engine dimensions

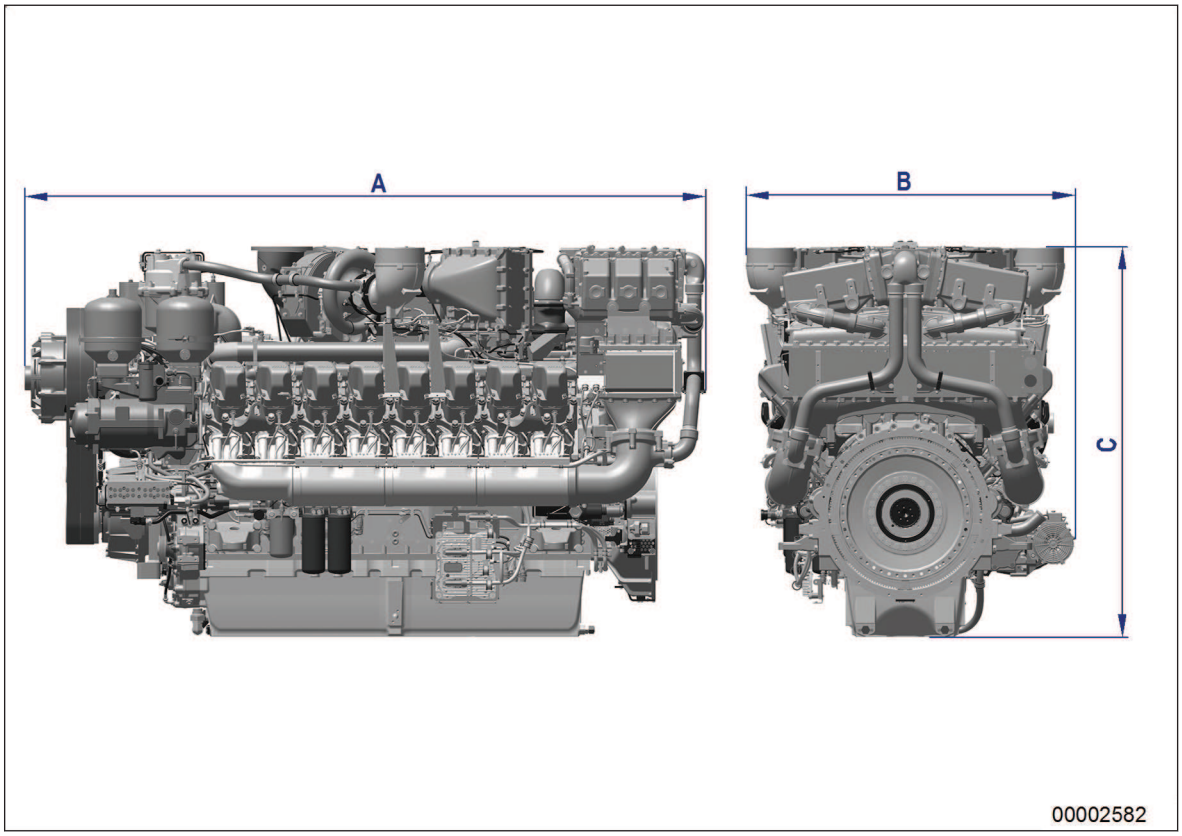


Item	Dimensions
Length (A)	approx. 2878 mm
Width (B)	approx. 1685.5 mm
Height (C)	approx. 1992 mm

TIM-ID: 0000063505 - 001

4.6 Main engine dimensions - 16V4000Cx5

Main engine dimensions



Item	Dimensions
Length (A)	approx. 3348 mm
Width (B)	approx. 1685.5 mm
Height (C)	approx. 1992 mm

TIM-ID: 0000063506 - 001

5 Operation

5.1 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	Action
Engine	Depreserve (→ Preservation and Represervation Specifications A001070/..).
Cylinder liner	Perform endoscopic examination of cylinder liner (→ Page 159).
Valve drive	Lubricate valve gear every ≥ 6 months (→ Page 165).
Lube oil system	Check engine oil level (→ Page 202). Bar engine using starting system (→ Page 155).
Fuel prefilter	Fill with fuel (if fitted).
Coolant circuit	If engine has been out of service for more than 1 year, change engine coolant (→ Page 218). Change charge-air coolant (→ Page 229).
Coolant circuit	Check engine coolant level (→ Page 216); Check charge-air coolant level (→ Page 227).
Coolant circuit	Preheat coolant with coolant preheating unit (if available).
Engine governor	Check electrical connections (→ Page 256).
Engine management	Read out fault memory using DiaSys, see (→ manufacturer's documentation). Check all active fault messages, eliminate faults as necessary (→ Page 81).

TIM-ID: 0000045459 - 002

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

Preconditions

☑ Engine is stopped and starting disabled.

WARNING



In case of out-of-service periods of more than one week: Possible corrosion of components carrying air or exhaust gas due to weather conditions, e.g. rain or snow.
Risk of injury by flying debris when putting the engine into operation!
- Check the components carrying air and exhaust for corrosion.
- Do not put the engine in operation if corrosion was detected.

Putting into operation

Item	Measure
Engine oil system	Check engine oil level (→ Page 202).
Coolant circuit	Check engine coolant level (→ Page 216); Check charge-air coolant level (→ Page 227).
Coolant circuit	Heat coolant with coolant preheater (if available; see manufacturer's documentation).
Engine control system	Put into operation (see manufacturer's documentation).

TIM-ID: 0000002683 - 007

5.3 Re-starting the engine following an automatic safety shutdown

NOTICE

Re-starting the engine following an automatic safety shutdown.
Risk of severe engine damage!
- Before starting the engine, make sure the root cause of the safety shutdown was eliminated.
- If the root cause cannot be identified or eliminated, contact Service.

Note:
- If an engine has been shutdown by a fault (red alarm), the engine may only be re-started when the fault has been identified and eliminated.

Procedure following an automatic safety shutdown

1. Eliminate fault.
2. If the root cause cannot be identified or eliminated, contact Service.

Important

The function "Overdrive safety system" (if fitted), which is only used in emergency situations, is not affected.

TIM-ID: 0000081383 - 001

5.4 Operational checks

DANGER



Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Operational checks

Item	Action
Control and display panels	Check readings of operational data (speed, temperature, pressures).
Engine oil	Check engine oil level (→ Page 202).
Engine operation	Visually inspect engine for leaks and general condition. Check engine for abnormal running noises, exhaust color and vibrations.
Air filter	Check signal ring position of maintenance indicator on air filter (if applicable).
Battery-charging generator	Check battery-charging generator for contamination, clean as necessary (→ Page 238).
Exhaust gas system	Check exhaust color (→ Page 78).
Fuel prefilter	Drain water and contaminants at the drain cock of the fuel prefilter, if fitted. Check vacuum gage setting on fuel prefilter, if installed.
Engine coolant pump	Check relief bore (→ Page 224).
Charge-air coolant pump	Check relief bore (→ Page 236).

TIM-ID: 0000030232 - 008

5.5 Emission label – Check

Emission label – Check

Note: If there are any irregularities, notify your MTU contact person/service partner without delay.

1. Check that emission labels are present (there can be more than one).
2. Check emission label for intactness.
3. Check that emission label is fully legible.
4. Check content of emission label:
   - Does the label on the engine match the label document in the Business Portal/Equipment?
   - Does the engine number on the emission label match the engine identification plate?
   - Does the Manufacturing Date match the year of manufacture on the identification plate?

TIM-ID: 0000063752 - 002

5.6 Engine - Starting in manual mode

Preconditions

☑ Engine is not under load.

☑ External start interlock is not activated.

DANGER



Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE



Re-starting the engine following an automatic safety shutdown.
Risk of severe engine damage!
- Before starting the engine, make sure the root cause of the safety shutdown was eliminated.
- If the root cause cannot be identified or eliminated, contact Service.

Preparation

Item	Action
Operating mode switch (if applicable).	Change to manual mode.
Coolant preheating unit (if applicable).	Switch on

Starting the engine

Item	Action
Control cabinet, control panel etc. (depending on manufacturer).	1. If a coolant preheater unit is available, ensure that the coolant temperature is > 40 °C. 2. Press start button. • Automatic starting sequence is executed. • Engine speed instrument indicates increasing speed. • After the starting sequence is completed, engine runs at idle speed.

TIM-ID: 0000002233 - 007

5.7 Engine - Stopping in manual mode

Preconditions

☑ Engine is not under load.

☑ Engine is running in manual mode.

NOTICE

Stopping the engine when it is running at full load subjects it to extreme thermal and mechanical stresses.

Overheating of and, therefore, damage to components is possible!

- Before shutting down the engine, allow it to idle until the engine temperatures decrease and constant levels are indicated.

Preparation

Item	Measure
Engine	Operate engine at idling speed for approx. 5 minutes.

Stop engine

Item	Measure
Switch cabinet, operator station etc. (depending on manufacturer)	Press stop button. • Automatic stopping sequence is executed.

TIM-ID: 0000002291 - 005

5.8 After stopping the engine – Putting the engine out of operation

Preconditions

☑ MTU Preservation and Represervation Specifications (A001070/..) are available.

NOTICE

Engine coolant with inadequate freeze protection. Water remaining in the pressure sensors freezes at temperatures below 0 °C.
Risk of sensor damage!
- Remove pressure sensors and shake off residual water.

After stopping the engine

Item	Measure
Coolant circuit	Drain engine coolant (→ Page 219) and Drain charge-air coolant (→ Page 230) if • freezing temperatures are expected, 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. • the antifreeze concentration is 50% and the engine room temperature is below -40 °C.
Engine control system	Switch off (see manufacturer's documentation).
Air intake and exhaust system	If the equipment is to remain out of service for more than one week, seal the engine's air and exhaust sides. Otherwise, components carrying air or exhaust gas are at risk of corrosion. If the equipment is to remain out of service for more than one month, preserve the engine (→ MTU Preservation and Represervation Specifications A001070/..).

TIM-ID: 0000002709 - 010

5.9 Plant – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

☑ No operating voltage applied.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
High-pressure cleaner	(→ Tools Catalog)	1
Cleaner (Hakupur 50/136)	X00056700	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

Water jet from high-pressure cleaning unit.
Risk of eye injury, risk of scalding!
- Do not direct water jet at persons.
- Wear protective clothing, protective gloves, and goggles/safety 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.

Cleaning the plant

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 high-pressure cleaning units carefully and observe the safety precautions.
3. The following requirements apply for cleaning the plant outside with a high-pressure cleaning unit:
   - 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 fan jet nozzle only.

Note: Never direct 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 high-pressure jet to remove loosened dirt.
   e) Dry engine with compressed air.

TIM-ID: 0000010171 - 034

6 Maintenance

6.1 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 202)
W0501		Visually inspect engine for leaks and general condition.	(→ Page 70)
W0505		Check relief bores of coolant pump(s).	(→ Page 224) (→ Page 236)
W0506		Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 78)
W0507		Drain water and contamination from fuel prefilter.	(→ Page 70)
W0508		Check reading on differential pressure gauge of fuel prefilter.	(→ Page 70) (→ Page 263) (→ Page 275)
W0800		Check emissions label for presence, readability and content.	(→ Page 71)
W1001		Replace fuel filter or fuel filter element.	(→ Page 185)
W1003		Check belt condition and tension, replace if necessary.	(→ Page 237)
W1006		Replace fuel injection valves/injectors.	(→ Page 176)
W1008	X	Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest.	(→ Page 208)
W1009		Measure thickness of oil residue layer, clean out and replace filter sleeve, together with every engine oil change, at the latest.	(→ Page 213)
W1011		Perform endoscopic examination.	(→ Page 159)
W1055		Replace oil separator.	(→ Page 163)
W1207		Check valve clearance, adjust as necessary. ATTENTION! First adjustment after 1,000 operating hours on a new engine and after 1,000 operating hours following each overhaul of the cylinder heads.	(→ Page 168)
W1296	X	Replace valve.	(→ Page 226)
W1463		Check general condition of engine mounting (visual inspection).	(→ Page 249)
W1481		Replace intermediate fuel filter or its filter element.	(→ Page 190)
W1525		Replace sensor.	(→ Page 257)
W1526		Replace sensor.	(→ Page 259)
W1551		Check function of exhaust flap actuators.	(→ Page 195) (→ Page 253)
W1575		Check general condition of trunnion mounts (visual inspection).	(→ Page 247)
W1610		Check securing screws of trunnion mounts for secure seating.	(→ Page 247)
W1636		Reset drift compensation parameter (CDC) and enter injector codes (IIG).	(→ Page 252)

TIM-ID: 0000063603 - 003

Task	Option	Maintenance tasks	
W1675		Replace fuel prefilter or its filter element.	(→ Page 70) (→ Page 263) (→ Page 275)
W1689		Measure valve protrusion.	(→ Page 166)
W1716		Clean battery-charging generator.	(→ Page 238)
W1817		Check coupling rods of EGR flaps for clearance.	(→ Page 195)
W1864	X	Check and clean oil indicator filter.	(→ Page 210)
W1940		Replace auxiliary PTO of battery-charging generator.	(→ Page 157)

Table 2: Maintenance task reference table [QL1]

TIM-ID: 0000063603 - 003

7 Troubleshooting

7.1 Troubleshooting

Engine does not turn when starter is actuated

Cause	Corrective action
Battery/UltraCaps low or defective	▶ Charge or replace (→ manufacturer's documentation)
Cable connections faulty	▶ Check cable connections for secure seating (→ manufacturer's documentation)
Starter: plant starter controller or starter faulty	1. Visual inspection procedure 2. Check whether cable connections are properly secured 3. Contact Service
Engine wiring defective	▶ Check (→ Page 251)
Engine / generator control: Assemblies or plug-in connections loose	▶ Perform visual inspection (→ manufacturer's documentation).
Engine governor: Plug-in connections loose	▶ Check plug-in connections (→ Page 256)
Barring tool installed	▶ Remove barring tool (→ Page 154)
Running gear blocked (engine cannot be barred manually)	▶ Contact Service
Engine transport locking device installed	▶ Remove transport locking device (→ Page 20)
External transport locking device installed	▶ Remove external transport locking device
External cranking lock activated	▶ Deactivate external cranking lock

Engine turns but does not fire

Cause	Corrective action
Engine too cold	▶ Preheat (25 °C)
High load, e.g. gearbox engaged	▶ Reduce load
Poor rotation by starter: Battery/ UltraCaps low or defective	▶ Charge or replace battery/UltraCaps (→ manufacturer's documentation)
Engine wiring defective	▶ Check (→ Page 251)
Air in fuel system	▶ Vent fuel system (→ Page 182)
Engine governor defective	▶ Contact Service

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Engine fires unevenly

Cause	Corrective action
Engine, fluids and lubricants too cold	▶ Preheat engine with plant auxiliaries
Injector defective	▶ Check, replace as necessary (→ Page 177)
Engine wiring defective	▶ Check (→ Page 251)
Air in fuel system	▶ Vent fuel system (→ Page 182)
Engine governor defective	▶ Contact Service

Engine does not reach rated speed

Cause	Corrective action
Fuel prefilter clogged	▶ Replace (→ manufacturer's documentation)
Fuel filter clogged	▶ Replace (→ Page 185) (→ manufacturer's documentation)
Additional fuel filter clogged	▶ Replace (→ Page 190)
Air filter clogged	▶ Check, replace as necessary (→ manufacturer's documentation)
Injector defective	▶ Check, replace as necessary (→ Page 177)
Engine wiring defective	▶ Check (→ Page 251)
Engine overloaded	▶ Contact Service.
Speed demand setting does not match rated speed	▶ Correct speed demand setting
Engine alarm involving power reduction signaled	▶ Rectify cause of engine alarm
Rated speed limited by the plant	▶ Check plant parameter settings and correct as necessary

Engine speed not steady

Cause	Corrective action
Injector defective	▶ Check, replace as necessary (→ Page 177)
Speed transmitter defective	▶ Contact Service
Air in fuel system	▶ Vent fuel system (→ Page 182)
Engine governor defective	▶ Contact Service
High load fluctuations, e.g. by consumers attached to auxiliary PTOs	1. Switch off consumers 2. Contact Service

Charge air temperature too high

Cause	Corrective action
Incorrect coolant concentration	▶ Check (→ MTU test kit)
Intercooler clogged	▶ Contact Service
EGR cooler clogged	▶ Contact Service
Engine room: Air-intake temperature too high	▶ Check fans and air supply/exhaust ducts

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Charge-air pressure too low

Cause	Corrective action
Air filter clogged	▶ Check, clean as necessary (→ manufacturer's documentation)
Intercooler clogged	▶ Contact Service
Exhaust turbocharger defective	▶ Contact Service

Coolant discharge at intercooler

Cause	Corrective action
Intercooler: Leaking, major coolant discharge	▶ Contact Service

Blue exhaust gas

Cause	Corrective action
Too much engine oil in the engine	▶ Drain engine oil (→ Page 204)
Oil separator of crankcase breather contaminated	▶ Replace filter (→ Page 163)
Exhaust turbocharger, cylinder head, piston rings or cylinder liner defective	▶ Contact Service

White exhaust gas

Cause	Corrective action
Engine is not at operating temperature	▶ Preheat/run up to operating temperature
Water in fuel	▶ Check fuel system at fuel prefilter (→ manufacturer's documentation) Drain water from fuel prefilter (→ manufacturer's documentation)
Intercooler leaky	▶ Contact Service

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7.2 Fault messages

Possible engine reactions to yellow alarm:

Warning, power limitation / reduction, speed limitation, engine stop

Possible engine reactions to red alarm:

Engine stop, power limitation / reduction, speed limitation, warning

3 – HI T-Fuel

Cause	Corrective action
The fuel temperature at sensor B33 has violated limit value 1. Fuel temperature is too high.	1. Reduce power. 2. Check fuel cooling system (if applicable). 3. Contact Service.

4 – SS T-Fuel

Cause	Corrective action
The fuel temperature at sensor B33 has violated limit value 2. Fuel temperature is too high.	1. Reduce power. 2. Check fuel cooling system (if applicable). 3. Contact Service.

5 – HI T-Charge Air

Cause	Corrective action
The charge-air temperature at sensor B9 has violated limit value 1. Charge-air temperature is too high.	1. Reduce power. 2. Check whether alarms 9 and 10 are pending. 3. Contact Service.

6 – SS T-Charge Air

Cause	Corrective action
The charge-air temperature at sensor B9 has violated limit value 2. Charge-air temperature is too high.	1. Reduce power. 2. Check whether alarms 9 and 10 are pending. 3. Contact Service.

9 – HI T-Coolant Intercooler

Cause	Corrective action
The coolant temperature in the intercooler at sensor B26 has violated limit value 1. Coolant temperature in intercooler is too high.	1. Reduce power. 2. Check whether alarm 23 is pending. 3. Check cooler (plant side) for contamination. 4. Check operation of fan (plant side). 5. Contact Service.

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10 – SS T-Coolant Intercooler

Cause	Corrective action
The intercooler coolant temperature measured at sensor B26 has violated limit value 2. Coolant temperature in intercooler is too high.	1. Reduce power. 2. Check whether alarm 23 is pending. 3. Check cooler (plant side) for contamination. 4. Check operation of fan (plant side). 5. Contact Service.

15 – LO P-Lube Oil

Cause	Corrective action
The lube oil pressure at sensor B5.1 has violated lower limit value 1. The lube oil pressure is too low.	1. Check engine oil level (→ Page 202). 2. Contact Service.

16 – SS P-Lube Oil

Cause	Corrective action
The lube oil pressure at sensor B5.1 has violated lower limit value 2. The lube oil pressure is too low.	1. Check engine oil level (→ Page 202). 2. Contact Service.

19 – HI T-Exhaust A

Cause	Corrective action
The exhaust temperature at sensor B4.40 has violated limit value 1. Exhaust gas temperature is too high.	▶ Run injector test according to DiaSys description. Contact Service if no DiaSys is available.

20 – SS T-Exhaust A

Cause	Corrective action
The exhaust temperature at sensor B4.40 has violated limit value 2. Exhaust gas temperature is too high.	▶ Run injector test according to DiaSys description. Contact Service if no DiaSys is available.

23 – LO Coolant Level

Cause	Corrective action
Coolant level at level switch F33 in HT circuit is too low.	1. Check engine coolant level (→ Page 216). 2. Check relief bore of engine coolant pump (→ Page 224). 3. Visually check coolant circuit for leaks. 4. Contact Service.

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25 – HI P-Diff-Lube Oil

Cause	Corrective action
The differential oil pressure at sensors B5.1 and B5.3 has violated limit value 1. The differential oil pressure is too high.	1. Replace engine oil filter. 2. Contact Service.

26 – SS P-Diff-Lube Oil

Cause	Corrective action
The differential oil pressure at sensors B5.1 and B5.3 has violated limit value 2. The differential oil pressure is too high.	1. Replace engine oil filter. 2. Contact Service.

27 – HI Level Leakage Fuel

Cause	Corrective action
Switch F46 in the collection tank has tripped. The HP fuel system is leaking.	▶ Contact Service.

30 – SS Engine Overspeed

Cause	Corrective action
Engine speed has violated the limit value or the engine overspeed test has been tripped. Engine emergency stop has been tripped.	1. If an emergency stop has been tripped by the engine overspeed test, restart the engine. 2. Contact Service if the emergency stop was tripped by the engine.

31 – HI ETC1 Overspeed

Cause	Corrective action
The speed of the LP turbocharger, A side, at sensor B44.1 has violated limit value 1. The exhaust turbocharger speed is too high. Cause: Fault or malfunction of another exhaust turbocharger.	1. Reduce power. 2. Contact Service.

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32 – SS ETC1 Overspeed

Cause	Corrective action
The speed of the A side LP turbocharger at sensor B44.1 has violated limit value 2. The exhaust turbocharger speed is too high. Cause: Fault or malfunction of another exhaust turbocharger.	1. Reduce power. 2. Contact Service.

33 – HI P-Diff-Fuel

Cause	Corrective action
The differential pressure at sensors B34.1 and B34.2 has violated limit value 1. The differential pressure is too high.	1. Replace fuel filter (→ Page 185). 2. Contact Service.

34 – SS P-Diff-Fuel

Cause	Corrective action
The differential pressure at sensors B34.1 and B34.2 has violated limit value 2. The differential pressure is too high.	1. Replace fuel filter (→ Page 185). 2. Contact Service.

36 – HI ETC2 Overspeed

Cause	Corrective action
The speed of the LP turbocharger, B side, at sensor B44.2 has violated limit value 1. The exhaust turbocharger speed is too high. Cause: Fault or malfunction of another exhaust turbocharger.	1. Reduce power. 2. Contact Service.

37 – SS ETC2 Overspeed

Cause	Corrective action
The speed of the LP turbocharger, B side, at sensor B44.2 has violated limit value 2. The exhaust turbocharger speed is too high. Cause: Fault or malfunction of another exhaust turbocharger.	1. Reduce power. 2. Contact Service.

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44 – LO Coolant Level Intercooler

Cause	Corrective action
Coolant level in LT circuit at switch F57 is too low.	1. Check charge-air coolant level (→ Page 227). 2. Check relief bore of charge-air coolant pump (→ Page 236). 3. Visually check coolant circuit for leaks. 4. Contact Service.

51 – HI T-Lube Oil

Cause	Corrective action
The lube oil temperature at sensor B7 has violated limit value 1. Lube oil temperature is too high.	1. Reduce power. 2. Check operation of cooler and fan (plant side). 3. Check engine coolant level (→ Page 216). 4. Contact Service.

52 – SS T-Lube Oil

Cause	Corrective action
The lube oil temperature at sensor B7 has violated limit value 2. Lube oil temperature is too high.	1. Check operation of cooler and fan (plant side). 2. Check engine coolant level (→ Page 216). 3. Contact Service.

57 – LO P-Coolant

Cause	Corrective action
The coolant pressure at sensor B16.has violated limit value 1. Coolant pressure is too low.	1. Check relief bore of engine coolant pump (→ Page 224). 2. Check engine coolant level (→ Page 216). 3. Contact Service.

58 – SS P-Coolant

Cause	Corrective action
The coolant pressure at sensor B16.has violated limit value 2. Coolant pressure is too low.	1. Check relief bore of engine coolant pump (→ Page 224). 2. Check engine coolant level (→ Page 216). 3. Contact Service.

63 – HI P-Crank Case

Cause	Corrective action
The crankcase pressure at sensor B50 has violated upper limit value 1. The crankcase pressure is too high.	1. Stop engine. 2. Contact Service.

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64 – SS P-Crank Case

Cause	Corrective action
The crankcase pressure at sensor B50 has violated upper limit value 2. The crankcase pressure is too high.	1. Stop engine. 2. Contact Service.

65 – LO P-Fuel

Cause	Corrective action
The fuel pressure at sensor B34.1 has violated limit value 1. Fuel pressure is too low.	1. Replace fuel prefilter (→ Page 263) (→ Page 275). 2. Replace additional fuel filter (→ Page 263) (→ Page 275). 3. Replace fuel filter (→ Page 263) (→ Page 275). 4. Contact Service.

66 – SS P-Fuel

Cause	Corrective action
The fuel pressure at sensor B34.1 has violated limit value 2. Fuel pressure is too low.	1. Replace fuel prefilter (→ Page 263) (→ Page 275). 2. Replace additional fuel filter (→ Page 263) (→ Page 275). 3. Replace fuel filter (→ Page 263) (→ Page 275). 4. Contact Service.

67 – HI T-Coolant

Cause	Corrective action
The coolant temperature at sensor B6 has violated limit value 1. Coolant temperature is too high.	1. Reduce power. 2. Check operation of cooler and fan (plant side). 3. Check engine coolant level (→ Page 216). 4. Contact Service.

68 – SS T-Coolant

Cause	Corrective action
The coolant temperature at sensor B6 has violated limit value 2. Coolant temperature is too high.	1. Check operation of cooler and fan (plant side). 2. Check engine coolant level (→ Page 216). 3. Contact Service.

82 – HI P-Fuel (Common Rail)

Cause	Corrective action
The HP fuel pressure at sensor B48 has violated the limit value. Fuel pressure is too high.	▶ Contact Service.

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83 – LO P-Fuel (Common Rail)

Cause	Corrective action
The HP fuel pressure at sensor B48 has violated the limit value. Fuel pressure is too low.	▶ Contact Service.

89 – SS Engine Speed too Low

Cause	Corrective action
The engine speed has violated the limit value. Engine emergency stop has been tripped.	1. Acknowledge alarm. 2. Check for additional messages. 3. Contact Service.

90 – SS Idle Speed Not Reached

Cause	Corrective action
Engine speed has not reached idling speed within the specified time after starter disengagement speed was reached.	1. Check pressure supply (plant) of starter. 2. Check additional fuel filter, replace as necessary (→ Page 263) (→ Page 275). 3. Check fuel filter, replace as necessary (→ Page 263) (→ Page 275). 4. Check fuel prefilter, replace as necessary (→ Page 263) (→ Page 275). 5. Check for additional messages. 6. Contact Service.

91 – SS Release Speed Not Reached

Cause	Corrective action
Engine speed has not reached starter disengagement speed within the specified time after starter speed was reached.	1. Check pressure supply (plant) of starter. 2. Check for additional messages. 3. Contact Service.

92 – SS Starter Speed Not Reached

Cause	Corrective action
Engine speed has not reached the specified speed threshold within the specified time.	1. Check pressure supply (plant) of starter. 2. Check for additional messages. 3. Contact Service.

93 – SS T-Preheat

Cause	Corrective action
Engine coolant temperature has not reached the specified limit value 2. Preheating is not functioning. Start interlock.	▶ Contact Service.

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94 – LO T-Preheat

Cause	Corrective action
Engine coolant temperature has not reached the specified limit value 1. Preheating is not functioning.	▶ Contact Service.

95 – AL Prelubrication Fault

Cause	Corrective action
The oil pressure at sensor B5.1 has violated the specified value. The specified oil pressure was not reached. The start procedure was terminated.	1. Check engine wiring (→ Page 251). 2. Contact Service.

102 – AL Fuel Cons. Counter Defect

Cause	Corrective action
The fuel consumption calculated by the ECU and stored on stopping the engine cannot be read out properly on restarting the engine.	▶ Contact Service.

104 – AL Eng Hours Counter Defect

Cause	Corrective action
The operating hours calculated by the ECU and stored on stopping the engine cannot be read out properly on restarting the engine.	▶ Contact Service.

118 – LO ECU Power Supply Voltage

Cause	Corrective action
The supply voltage of the ECU has violated the specified limit value 1.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

119 – LOLO ECU Power Supply Voltage

Cause	Corrective action
The supply voltage of the ECU has violated the specified limit value 2.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

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120 – HI ECU Power Supply Voltage

Cause	Corrective action
The supply voltage of the ECU has violated the specified limit value 1.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

121 – HIHI ECU Power Supply Voltage

Cause	Corrective action
The supply voltage of the ECU has violated the specified limit value 2.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

122 – HI T-ECU

Cause	Corrective action
The temperature at the sensor inside the ECU has violated the upper limit value. The temperature inside the housing is too high.	▶ Contact Service.

180 – AL CAN1 Node Lost

Cause	Corrective action
Connection or communication with a node on CAN bus 1 has failed.	1. Check engine wiring (→ Page 251). 2. Disconnect power supply, then reconnect. 3. Contact Service.

181 – AL CAN2 Node Lost

Cause	Corrective action
Connection or communication with a node on CAN bus 2 has failed.	1. Check engine wiring (→ Page 251). 2. Disconnect power supply, then reconnect. 3. Contact Service.

186 – AL CAN1 Bus Off

Cause	Corrective action
CAN bus 1 for MTU Automation (e.g. ECU/MAU/SAM) disrupted or faulty.	1. Check plug connectors for engine governor (→ Page 256). 2. Contact Service.

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187 – AL CAN1 Error Passive

Cause	Corrective action
CAN bus 1 for MTU Automation (e.g. ECU/MAU/SAM) disrupted or faulty.	1. Check plug connectors for engine governor (→ Page 256). 2. Contact Service.

188 – AL CAN2 Bus Off

Cause	Corrective action
CAN bus 2 to plant-side automation (e.g. Murphy Display) disrupted or faulty.	1. Check connection between plant automation system and MTU automation system. 2. Contact Service.

201 – SD T-Coolant

Cause	Corrective action
The signal from the coolant temperature sensor (B6) at the coolant distribution housing is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

202 – SD T-Fuel

Cause	Corrective action
The signal from the fuel temperature sensor (B33) on the HP distributor is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

203 – SD T-Charge Air

Cause	Corrective action
The signal from the charge-air temperature sensor (B9), A side, is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

205 – SD T-Coolant Intercooler

Cause	Corrective action
The signal from the charge-air coolant temperature sensor (B26) after engine inlet is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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206 – SD T-Exhaust A

Cause	Corrective action
The signal from the exhaust gas temperature sensor (B4) in the A side exhaust pipe is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

208 – SD P-Charge Air

Cause	Corrective action
The signal from the charge-air pressure sensor (B10.1) after intercooler, A side, is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

211 – SD P-Lube Oil

Cause	Corrective action
The signal from the lube oil pressure sensor after filter (B5.1) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

212 – SD P-Coolant

Cause	Corrective action
The signal from the coolant pressure sensor after coolant pump (B16) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

213 – SD P-Coolant Intercooler

Cause	Corrective action
The signal from the coolant pressure sensor (B43) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

214 – SD P-Crankcase

Cause	Corrective action
The signal form the crankcase pressure sensor (B50) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

215 – SD P-HD

Cause	Corrective action
The signal from the rail pressure sensor (B48) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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216 – SD T-Lube Oil

Cause	Corrective action
The signal from he lube oil temperature sensor (B7) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

220 – SD Level Coolant Water

Cause	Corrective action
The signal from the coolant level sensor (F33) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

221 – SD P-Diff Lube Oil

Cause	Corrective action
Lube oil pressure sensors B5.3 and/or B5.1 supply incorrect signal or no signal.	1. Check engine wiring (→ Page 251). 2. Contact Service.

222 – SD Level Leakage Fuel

Cause	Corrective action
The signal from the fuel leak sensor (F46) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

223 – SD Level Coolant Intercooler

Cause	Corrective action
The signal from the charge-air coolant level sensor (F57) on the coolant expansion tank is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

227 – SD P-Lube Oil before Filter

Cause	Corrective action
The signal from the oil pressure sensor before filter (B5.3) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

228 – SD P-Fuel before Filter

Cause	Corrective action
The signal from the fuel pressure sensor before main fuel filter (B34.2) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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229 – AL Stop Camshaft Sensor Defect

Cause	Corrective action
Emergency engine stop following failure of the crankshaft sensor (B13) and camshaft sensor (B1).	▶ Contact Service.

230 – SD Crankshaft Speed

Cause	Corrective action
The signal from the crankshaft speed sensor (B13) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

231 – SD Camshaft Speed

Cause	Corrective action
The signal from the camshaft speed sensor (B1) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

232 – SD Charger 1 Speed

Cause	Corrective action
The signal from the speed sensor (B44.1), ETC A side, is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

233 – SD Charger 2 Speed

Cause	Corrective action
The signal from the speed sensor (B44.2), ETC B side, is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

239 – SD P-Diff Fuel

Cause	Corrective action
The pressure sensors B34.1 and/or B34.2 supply incorrect signal or no signal.	1. Check engine wiring (→ Page 251). 2. Contact Service.

240 – SD P-Fuel

Cause	Corrective action
The signal from the fuel pressure sensor after main fuel filter (B34.1) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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245 – SD ECU Power Supply Voltage

Cause	Corrective action
The signal from the internal voltage sensor in the ECU is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

266 – SD Speed Demand

Cause	Corrective action
Signal of analog speed setting missing.	1. Switch on plant-side automation. 2. Contact Service.

270 – SD Frequency Input

Cause	Corrective action
The signal at the analog frequency input is missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

321 – AL Wiring Cylinder A1

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A1 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

322 – AL Wiring Cylinder A2

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A2 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

323 – AL Wiring Cylinder A3

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A3 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

324 – AL Wiring Cylinder A4

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A4 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

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325 – AL Wiring Cylinder A5

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A5 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

326 – AL Wiring Cylinder A6

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A6 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

327 – AL Wiring Cylinder A7

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A7 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

328 – AL Wiring Cylinder A8

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder A8 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

329 – AL Wiring Cylinder A9

Cause	Corrective action
Short circuit fault in injector wiring cylinder A9 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

330 – AL Wiring Cylinder A10

Cause	Corrective action
Short circuit fault in injector wiring cylinder A10 or injector defective.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

331 – AL Wiring Cylinder B1

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B1 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

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332 – AL Wiring Cylinder B2

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B2 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

333 – AL Wiring Cylinder B3

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B3 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

334 – AL Wiring Cylinder B4

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B4 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

335 – AL Wiring Cylinder B5

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B5 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

336 – AL Wiring Cylinder B6

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B6 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

337 – AL Wiring Cylinder B7

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B7 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

338 – AL Wiring Cylinder B8

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B8 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

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339 – AL Wiring Cylinder B9

Cause	Corrective action
Short circuit fault in injector wiring cylinder B9 or injector faulty.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

340 – AL Wiring Cylinder B10

Cause	Corrective action
Short circuit fault in the injector wiring for cylinder B10 or injector defective.	1. Check wiring of relevant injector (→ Page 251). 2. Replace injector (→ Page 176). 3. Contact Service.

341 – AL Open Load Cylinder A1

Cause	Corrective action
Disruption fault in injector wiring to cylinder A1.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

342 – AL Open Load Cylinder A2

Cause	Corrective action
Disruption fault in injector wiring for cylinder A2.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

343 – AL Open Load Cylinder A3

Cause	Corrective action
Disruption fault in injector wiring for cylinder A3.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

344 – AL Open Load Cylinder A4

Cause	Corrective action
Disruption fault in injector wiring for cylinder A4.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

345 – AL Open Load Cylinder A5

Cause	Corrective action
Disruption fault in injector wiring for cylinder A5.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

346 – AL Open Load Cylinder A6

Cause	Corrective action
Disruption fault in injector wiring for cylinder A6.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

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347 – AL Open Load Cylinder A7

Cause	Corrective action
Disruption fault in injector wiring for cylinder A7.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

348 – AL Open Load Cylinder A8

Cause	Corrective action
Disruption fault in injector wiring for cylinder A8.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

349 – AL Open Load Cylinder A9

Cause	Corrective action
Disruption fault in injector wiring to cylinder A9.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

350 – AL Open Load Cylinder A10

Cause	Corrective action
Disruption fault in injector wiring to cylinder A10.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

351 – AL Open Load Cylinder B1

Cause	Corrective action
Disruption fault in injector wiring to cylinder B1.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

352 – AL Open Load Cylinder B2

Cause	Corrective action
Disruption fault in injector wiring to cylinder B2.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

353 – AL Open Load Cylinder B3

Cause	Corrective action
Disruption fault in injector wiring to cylinder B3.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

354 – AL Open Load Cylinder B4

Cause	Corrective action
Disruption fault in injector wiring to cylinder B4.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

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355 – AL Open Load Cylinder B5

Cause	Corrective action
Disruption fault in injector wiring to cylinder B5.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

356 – AL Open Load Cylinder B6

Cause	Corrective action
Disruption fault in injector wiring to cylinder B6.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

357 – AL Open Load Cylinder B7

Cause	Corrective action
Disruption fault in injector wiring to cylinder B7.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

358 – AL Open Load Cylinder B8

Cause	Corrective action
Disruption fault in injector wiring to cylinder B8.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

359 – AL Open Load Cylinder B9

Cause	Corrective action
Disruption fault in injector wiring to cylinder B9.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

360 – AL Open Load Cylinder B10

Cause	Corrective action
Disruption fault in injector wiring to cylinder B10.	1. Check wiring of relevant injector (→ Page 251). 2. Contact Service.

361 – AL Power Stage Low

Cause	Corrective action
The output stage voltage to control the injectors is too low.	1. Check power supply (plant). 2. Contact Service.

362 – AL Power Stage High

Cause	Corrective action
The output stage voltage to control the injectors is too high	1. Check power supply (plant). 2. Contact Service.

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363 – AL Stop Power Stage

Cause	Corrective action
The output stage voltage to control the injectors is too low. Engine stop	1. Check power supply (plant). 2. Contact Service.

365 – AL Stop MV-Wiring Ground

Cause	Corrective action
Short circuit of injector positive connection to ground of one or more injectors. Short circuit of negative connection of one or more injectors to ground.	1. Check cabling (→ Page 251). 2. Restart engine. 3. Contact Service.

381 – AL Wiring TOP 1

Cause	Corrective action
Short circuit or wire break at transistor output 1 plant side (TOP 1).	1. Check cabling (→ Page 251). 2. Contact Service.

382 – AL Wiring TOP 2

Cause	Corrective action
Short circuit or wire break at transistor output 2 plant side (TOP 2).	1. Check cabling (→ Page 251). 2. Contact Service.

383 – AL Wiring TOP 3

Cause	Corrective action
Short circuit or wire break at transistor output 3 plant side (TOP 3).	1. Check cabling (→ Page 251). 2. Contact Service.

384 – AL Wiring TOP 4

Cause	Corrective action
Short circuit or wire break at transistor output 4 plant side (TOP 4).	1. Check cabling (→ Page 251). 2. Contact Service.

400 – AL Open Load Digital Input 1

Cause	Corrective action
Open load detected at digital input 1 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

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401 – AL Open Load Digital Input 2

Cause	Corrective action
Open load detected at digital input 2 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

402 – AL Open Load Digital Input 3

Cause	Corrective action
Open load detected at digital input 3 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

403 – AL Open Load Digital Input 4

Cause	Corrective action
Open load detected at digital input 4 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

404 – AL Open Load Digital Input 5

Cause	Corrective action
Open load detected at digital input 5 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

405 – AL Open Load Digital Input 6

Cause	Corrective action
Open load detected at digital input 6 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

406 – AL Open Load Digital Input 7

Cause	Corrective action
Open load detected at digital input 7 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

407 – AL Open Load Digital Input 8

Cause	Corrective action
Open load detected at digital input 8 of the ECU.	1. Check cabling (→ Page 251). 2. Contact Service.

408 – AL Open Load Emerg. Stop Input ESI

Cause	Corrective action
Open load detected at the emergency stop input.	1. Check cabling (→ Page 251). 2. Contact Service.

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410 – LO U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated lower limit value 1.	1. Check power supply (plant). 2. Check cabling (→ Page 251). 3. Contact Service.

411 – LOLO U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated lower limit value 2.	1. Check power supply (plant). 2. Check cabling (→ Page 251). 3. Contact Service.

412 – HI U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated upper limit value 1.	1. Check power supply (plant). 2. Check cabling (→ Page 251). 3. Contact Service.

413 – HIHI U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated upper limit value 2.	1. Check power supply (plant). 2. Check cabling (→ Page 251). 3. Contact Service.

414 – HI Level Water Fuel Prefilter

Cause	Corrective action
Switch F70 in the fuel prefilter has been tripped by an excessively high water content in the fuel.	1. Drain water and contaminants from fuel prefilter (→ Page 263) (→ Page 275). 2. Replace fuel prefilter (→ Page 263) (→ Page 275). 3. Contact Service.

415 – LO P-Coolant Intercooler

Cause	Corrective action
The charge-air coolant pressure in the intercooler at sensor B43 has violated limit value 1. Charge-air coolant pressure is too low.	1. Check relief bore of charge-air coolant pump (→ Page 236). 2. Check intercooler for coolant discharge (→ Page 191). 3. Contact Service.

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416 – SS P-Coolant Intercooler

Cause	Corrective action
The charge-air coolant pressure in the intercooler at sensor B43 has violated limit value 2. Charge-air coolant pressure is too low.	1. Check relief bore of charge-air coolant pump (→ Page 236). 2. Check intercooler for coolant discharge (→ Page 191). 3. Contact Service.

417 – SD Level Water Fuel Prefilter

Cause	Corrective action
The signal from the level sensor for water in the fuel prefilter (F70) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

440 – AL L1 P-Aux 1

Cause	Corrective action
The pressure measurement sensor in the pressure measurement channel has violated limit value 1. The pressure value in the pressure measurement channel is too low.	▶ Contact Service.

442 – AL L2 P-Aux1

Cause	Corrective action
The pressure measurement sensor in the pressure measurement channel has violated limit value 2. The pressure value in the pressure measurement channel is too low.	▶ Contact Service.

444 – SD U-PDU

Cause	Corrective action
Fault in the internal supply voltage for the injector output stage.	▶ Contact Service.

445 – SD P-Ambient Air

Cause	Corrective action
The signal from the ambient pressure sensor in the ECU is faulty or missing.	▶ Contact Service.

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454 – SS Power Reduction Active

Cause	Corrective action
Power reduction activated. A main alarm activating power reduction has been tripped.	1. Check for additional messages. 2. Contact Service.

470 – SD T-ECU

Cause	Corrective action
The signal from the temperature sensor in the ECU is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

480 – AL Ext. Engine Protection

Cause	Corrective action
External engine protection function is active.	1. Check plant signal. 2. Contact Service.

488 – HI ETC3 Overspeed

Cause	Corrective action
The speed of the HP turbocharger at sensor B44.3 has violated limit value 1. The exhaust turbocharger speed is too high. Cause: Fault or malfunction of another exhaust turbocharger.	1. Reduce power. 2. Contact Service.

489 – SS ETC3 Overspeed

Cause	Corrective action
The speed of the HP turbocharger at sensor B44.3 has violated limit value 2. The exhaust turbocharger speed is too high. Cause: Fault or malfunction of another exhaust turbocharger.	1. Reduce power. 2. Contact Service.

536 – AL Wiring PWM_CM1

Cause	Corrective action
The M8 HP fuel control block of the HP fuel pump can not be activated.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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549 – AL Power Cut-Off detected

Cause	Corrective action
ECU operating voltage was switched off while the engine was running. Only disconnect the voltage supply when the engine is stationary.	1. If the voltage supply was not disconnected manually, check engine wiring (→ Page 251). 2. Contact Service.

551 – SS Engine Overspeed Camshaft

Cause	Corrective action
The engine speed measured at camshaft sensor B1 has violated upper limit value 2 or the engine overspeed test was tripped. Engine emergency stop has been tripped.	▶ Contact Service.

558 – AL Wiring PWM_CM2

Cause	Corrective action
Wire break or short circuit in the power supply for the NOx sensor on A side (B88.1).	1. Check engine wiring (→ Page 251). 2. Contact Service.

582 – AL Emergency Stop Failed

Cause	Corrective action
The emergency stop failure alarm is raised if the engine fails to come to a standstill during a programmable time after the emergency stop signal is received.	▶ Contact Service.

587 – AL Wiring PWM_CM4

Cause	Corrective action
Open circuit or short circuit in wiring to fan control Y44.2	1. Check engine wiring (→ Page 251). 2. Contact Service.

597 – AL Wiring PWM_CM5

Cause	Corrective action
Open circuit or short circuit in wiring to fan control Y44.1	1. Check engine wiring (→ Page 251). 2. Contact Service.

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608 – AL Wiring PWM_CM6

Cause	Corrective action
Open circuit or short circuit in wiring to fan oil priming pump M2.	1. Check engine wiring (→ Page 251). 2. Contact Service.

609 – AL Wiring PWM_CM7

Cause	Corrective action
Wire break or short circuit in the power supply for the TriCAN sensor (B90) or the NOx sensor on B side (B88.2).	1. Check engine wiring (→ Page 251). 2. Contact Service.

614 – AL L1 P-Fuel Add.sec.fuelfilt. Diff

Cause	Corrective action
The differential pressure above the intermediate fuel filter at sensors B34.2 and B34.3 has violated limit value 1. The differential pressure is too high.	1. Replace additional fuel filter (→ Page 263) (→ Page 275). 2. Replace fuel filter (→ Page 263) (→ Page 275). 3. Replace fuel prefilter (→ Page 263) (→ Page 275). 4. Contact Service.

615 – AL EIL Protection

Cause	Corrective action
Engine number in EIL does not match the engine number saved in the ECU	1. Check engine wiring (→ Page 251). 2. Contact Service.

616 – AL EIL Error

Cause	Corrective action
ECU can not detect EIL.	▶ Contact Service.

625 – SD P-Fuel bef. Add.sec.fuelfilter

Cause	Corrective action
The signal from the fuel pressure sensor (B34.3) before the additional filter is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

626 – AL Wiring PWM_CM8

Cause	Corrective action
Disruption or short circuit in the wiring of the servomotor for bypass flap M52.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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627 – AL Wiring PWM_CM9

Cause	Corrective action
Disruption or short circuit in wiring to servomotor of dispenser flap M55.	1. Check engine wiring (→ Page 251). 2. Contact Service.

628 – AL Wiring PWM_CM10

Cause	Corrective action
Disruption or short circuit in wiring to servomotor of EGR shutoff flap M53.	1. Check engine wiring (→ Page 251). 2. Contact Service.

629 – AL Flap Egr A Defect

Cause	Corrective action
The EGR shutoff flap (M53) is faulty.	1. Check operation of the EGR shutoff flap (→ Page 195). 2. Contact Service.

631 – AL Flap Bypass A Defect

Cause	Corrective action
The bypass flap (M52) is faulty.	1. Check operation of the bypass flap (→ Page 195). 2. Contact Service.

632 – AL Flap Dispenser Defect

Cause	Corrective action
The dispenser flap (M55) is faulty.	1. Check operation of the dispenser flap (→ Page 195). 2. Contact Service.

633 – SD P-Ambient Air (HDT2800)

Cause	Corrective action
The signal from the air pressure sensor (B90) is missing.	▶ Contact Service.

634 – SD T0-Ambient Air (HDT2800)

Cause	Corrective action
The signal from the temperature sensor (B90) is missing.	▶ Contact Service.

635 – SD Air Humidity (HDT2800)

Cause	Corrective action
The signal from the humidity sensor (B90) is missing.	▶ Contact Service.

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647 – SD P-Exhaust Lambda

Cause	Corrective action
The signal from the exhaust gas sensor (B91.3) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

648 – SD P-Charge Air B

Cause	Corrective action
The signal from the charge-air pressure sensor (B10.2) after intercooler on B side is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

727 – AL L1 Delta T-NT Intercooler

Cause	Corrective action
The differential temperature at sensors B26 and B90 has violated limit value 1. The LT coolant inlet temperature is too high in relation to the ambient air temperature.	1. Check cooler (plant side) for contamination. 2. Check operation of fan (plant side). 3. Contact Service.

728 – AL L2 Delta T-NT Intercooler

Cause	Corrective action
The differential temperature at sensors B26 and B90 has violated limit value 2. The LT coolant inlet temperature is too high in relation to the ambient air temperature.	1. Check cooler (plant side) for contamination. 2. Check operation of fan (plant side). 3. Contact Service.

754 – SD Bosch LSU Lambda Sensor

Cause	Corrective action
The signal from the lambda sensor (B89) is faulty or missing.	1. Check lambda sensor and replace as necessary (→ Page 259). 2. Contact Service.

806 – SD Charger 3 Speed

Cause	Corrective action
The signal from the speed sensor (B44.3) C-ETC (high pressure) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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833 – AL Emission Warning

Cause	Corrective action
Emission fault summary alarm	1. Check for additional messages. 2. Contact Service.

834 – AL Gas Path Warning

Cause	Corrective action
Emission fault summary alarm	1. Check for additional messages. 2. Contact Service.

835 – AL Gas Path Fault

Cause	Corrective action
Emission fault summary alarm	1. Check for additional messages. 2. Contact Service.

836 – AL Speed Demand Failure

Cause	Corrective action
The ECU is unable to receive a speed demand signal via the CAN bus. Alarm 266 is signaled simultaneously.	1. Switch on plant-side automation. 2. Contact Service.

857 – AL NOx ATO1 Sensor Defect

Cause	Corrective action
The signal from the NOx sensor (B88.1) in the exhaust pipe after the LP turbocharger A side is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Check NOx sensor and replace as necessary (→ Page 257). 3. Contact Service.

871 – AL NOx ATO1 Communication Lost

Cause	Corrective action
The ECU cannot detect the NOx sensor (B88.1) after LP turbocharger A side on the bus.	1. Check engine wiring (→ Page 251). 2. Check NOx sensor and replace as necessary (→ Page 257). 3. Contact Service.

872 – AL EGR FlpA Wear Limit3

Cause	Corrective action
Fast reference run of EGR shutoff flap (M53) faulty (executed after every ECU restart).	1. Check state of charge of batteries (plant side). 2. Check operation of the EGR shutoff flap (→ Page 195). 3. Contact Service.

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877 – AL Bypass FlpA Wear Limit3

Cause	Corrective action
Fast reference run of bypass flap (M52) faulty (executed after every ECU restart).	1. Check state of charge of batteries (plant side). 2. Check operation of the bypass flap (→ Page 195). 3. Contact Service.

879 – AL Dispenser Flp Wear Limit3

Cause	Corrective action
Fast reference run of dispenser flap (M55) faulty (executed after every ECU restart).	1. Check state of charge of batteries (plant side). 2. Check operation of the dispenser flap (→ Page 195). 3. Contact Service.

898 – AL Trican Communication Lost

Cause	Corrective action
The ECU is no longer able to detect the TriCAN sensor (B90) on the bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

947 – AL Invalid LSI Channel Config

Cause	Corrective action
Incorrect LSI channel configuration.	▶ Contact Service.

953 – AL Lambda value invalid

Cause	Corrective action
Status information of lambda sensor (B89); is generated in case of short-term implausible measured values or with faulty lambda sensor.	1. Acknowledge alarm. 2. Replace lambda sensor (→ Page 259). 3. Contact Service.

954 – AL NOx value invalid

Cause	Corrective action
Status information of NOx sensor (B88); is generated in case of short-term implausible measured values or with faulty NOx sensor.	1. Acknowledge alarm. 2. Replace NOx sensor (→ Page 257). 3. Contact Service.

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956 – AL p5 ctrlvar limit min active

Cause	Corrective action
The charge-air pressure regulator attempts to adjust its set value but has reached its lower limit. The bypass flap (M52) is fully open.	1. Check operation of the bypass flap (→ Page 195). 2. Contact Service.

957 – AL p5 ctrlvar max BOI min active

Cause	Corrective action
Emission-related alarm. The charge-air pressure regulator attempts to adjust its set value but has reached its upper limit. The bypass flap (M52) is fully closed. The retardation of the start of injection (BOI) has reached its maximum value.	1. Check air filter (plant side) for contamination. 2. Check operation of the bypass flap (→ Page 195). 3. Check exhaust turbocharger (LP) – turbine housing (→ Contact Service). 4. Check exhaust turbocharger (HP) – turbine housing (→ Contact Service). 5. Contact Service.

958 – AL Lambda ctrlvar limit min active

Cause	Corrective action
The lambda regulator attempts to adjust its set value but has reached its lower limit. The EGR shutoff flap (M53) is fully closed. The dispenser flap (M55) is fully open.	1. Check operation of the dispenser flap (→ Page 195). 2. Contact Service.

959 – AL Lambda ctrlvar max BOI min act

Cause	Corrective action
Emission-related alarm. This fault is a strong indication of serious soot contamination in the EGR cooler (sooting). However, it can also be caused by a mechanical defect in the exhaust flap before the cooler and/or the dispenser flap (broken linkage, but servomotor electrically OK). A signal error of the lambda sensor can also result in this alarm.	1. Check operation of the EGR shutoff flap and the dispenser flap (→ Page 195). 2. Contact Service.

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960 – AL NOx p5 min BOI max active

Cause	Corrective action
Emission-related alarm. The charge-air pressure has reached the minimum value defined in the performance map. The advanced start of injection has reached its maximum value.	1. Check operation of the bypass flap (→ Page 195). 2. Contact Service.

961 – AL NOx p5 max BOI min active

Cause	Corrective action
Emission-related alarm. This fault is a strong indication of serious soot contamination in the EGR cooler (sooting). The charge-air pressure has reached the maximum value defined in the performance map. The retardation of the start of injection (BOI) has reached its maximum value.	▶ Contact Service.

962 – AL GPS Lambda ctrlvar max active

Cause	Corrective action
This fault message indicates a heavily sooted EGR cooler. The lambda regulator attempts to adjust its set value but has reached its upper limit. The EGR shutoff flap (M53) is fully opened. The dispenser flap (M55) is fully closed.	1. Check operation of the EGR shutoff flap, dispenser flap and bypass flap (→ Page 195). 2. Contact Service.

963 – AL GPS p5 ctrlvar max active

Cause	Corrective action
The required charge-air pressure could not be reached.	1. Clean air filter (→ Contact Service). 2. Check operation of the bypass flap (→ Page 195). 3. Check exhaust turbocharger (LP) – turbine housing (→ Contact Service). 4. Check exhaust turbocharger (HP) – turbine housing (→ Contact Service). 5. Contact Service.

964 – AL GPS p5 ctrlvar min active

Cause	Corrective action
The required charge-air pressure could not be reached.	1. Check operation of the bypass flap (→ Page 195). 2. Contact Service.

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973 – AL Check Sum IIG

Cause	Corrective action
The IIG value entered does not match the defined input format.	1. Check the IIG input in DiaSys, repeat as necessary. 2. Contact Service.

974 – AL CAN3 Bus Off

Cause	Corrective action
The first engine CAN (CAN 3) for engine-side sensor / actuator system is disrupted or faulty.	1. Check engine wiring (→ Page 251). 2. Contact Service.

975 – AL CAN3 Error Passive

Cause	Corrective action
The first engine CAN (CAN 3) for engine-side sensor / actuator system is faulty.	1. Check engine wiring (→ Page 251). 2. Contact Service.

976 – AL CAN4 Bus Off

Cause	Corrective action
The second engine CAN (CAN 4) for engine-side sensor / actuator system is disrupted or faulty.	1. Check engine wiring (→ Page 251). 2. Contact Service.

977 – AL CAN4 Error Passive

Cause	Corrective action
The second engine CAN (CAN 4) for engine-side sensor / actuator system is faulty.	1. Check engine wiring (→ Page 251). 2. Contact Service.

983 – AL Stop on Trigger Crashrecorder

Cause	Corrective action
The alarm indicates that the crash recorder has been triggered and, as a result, a start interlock has been activated.	▶ Contact Service.

984 – AL NOx ATO2 Sensor Defect

Cause	Corrective action
The signal from the NOx sensor (B88.2) in the exhaust pipe after the turbocharger B side is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Check NOx sensor and replace as necessary (→ Page 257). 3. Contact Service.

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985 – AL NOx ATO2 Communication Lost

Cause	Corrective action
The ECU cannot detect the NOx sensor (B88.2) after LP turbocharger B side on the bus.	1. Check engine wiring (→ Page 251). 2. Check NOx sensor and replace as necessary (→ Page 257). 3. Contact Service.

1015 – AL Total breakdown NOx sensors

Cause	Corrective action
Both NOx sensors (B88.1 and B88.2) indicate sensor defect or an invalid value.	1. Replace NOx sensors (→ Page 257). 2. Contact Service.

1026 – AL IAP Communication Lost

Cause	Corrective action
The maximum number of unsuccessful connection attempts with the EXU has been exceeded.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1027 – AL Engine Cold Active

Cause	Corrective action
This fault is signaled and the “Engine Cold” function initiated if one of the temperature values has violated the defined limit.	1. Switch on preheater. 2. Check preheater, overhaul as necessary (see manufacturer's documentation). 3. Contact Service.

1032 – AL Inj. Drift Limit 1 Cyl. A1

Cause	Corrective action
The drift correction for energization (start and duration) of injector A1 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1033 – AL Inj. Drift Limit 1 Cyl. A2

Cause	Corrective action
The drift correction for energization (start and duration) of injector A2 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

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1034 – AL Inj. Drift Limit 1 Cyl. A3

Cause	Corrective action
The drift correction for energization (start and duration) of injector A3 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1035 – AL Inj. Drift Limit 1 Cyl. A4

Cause	Corrective action
The drift correction for energization (start and duration) of injector A4 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1036 – AL Inj. Drift Limit 1 Cyl. A5

Cause	Corrective action
The drift correction for energization (start and duration) of injector A5 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1037 – AL Inj. Drift Limit 1 Cyl. A6

Cause	Corrective action
The drift correction for energization (start and duration) of injector A6 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1038 – AL Inj. Drift Limit 1 Cyl. A7

Cause	Corrective action
The drift correction for energization (start and duration) of injector A7 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

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1039 – AL Inj. Drift Limit 1 Cyl. A8

Cause	Corrective action
The drift correction for energization (start and duration) of injector A8 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1040 – AL Inj. Drift Limit 1 Cyl. A9

Cause	Corrective action
The drift correction for energization (start and duration) of injector A9 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1041 – AL Inj. Drift Limit 1 Cyl. A10

Cause	Corrective action
The drift correction for energization (start and duration) of injector A10 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1042 – AL Inj. Drift Limit 1 Cyl. B1

Cause	Corrective action
The drift correction for energization (start and duration) of injector B1 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1043 – AL Inj. Drift Limit 1 Cyl. B2

Cause	Corrective action
The drift correction for energization (start and duration) of injector B2 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

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1044 – AL Inj. Drift Limit 1 Cyl. B3

Cause	Corrective action
The drift correction for energization (start and duration) of injector B3 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1045 – AL Inj. Drift Limit 1 Cyl. B4

Cause	Corrective action
The drift correction for energization (start and duration) of injector B4 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1046 – AL Inj. Drift Limit 1 Cyl. B5

Cause	Corrective action
The drift correction for energization (start and duration) of injector B5 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1047 – AL Inj. Drift Limit 1 Cyl. B6

Cause	Corrective action
The drift correction for energization (start and duration) of injector B6 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1048 – AL Inj. Drift Limit 1 Cyl. B7

Cause	Corrective action
The drift correction for energization (start and duration) of injector B7 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

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1049 – AL Inj. Drift Limit 1 Cyl. B8

Cause	Corrective action
The drift correction for energization (start and duration) of injector B8 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1050 – AL Inj. Drift Limit 1 Cyl. B9

Cause	Corrective action
The drift correction for energization (start and duration) of injector B9 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1051 – AL Inj. Drift Limit 1 Cyl. B10

Cause	Corrective action
The drift correction for energization (start and duration) of injector B10 has violated limit 1. The injector has soon reached its maximum drift limit.	▶ Schedule an injector replacement.

1052 – AL Inj. Drift Limit 2 Cyl. A1

Cause	Corrective action
The drift correction for energization (start and duration) of injector A1 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1053 – AL Inj. Drift Limit 2 Cyl. A2

Cause	Corrective action
The drift correction for energization (start and duration) of injector A2 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

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1054 – AL Inj. Drift Limit 2 Cyl. A3

Cause	Corrective action
The drift correction for energization (start and duration) of injector A3 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1055 – AL Inj. Drift Limit 2 Cyl. A4

Cause	Corrective action
The drift correction for energization (start and duration) of injector A4 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1056 – AL Inj. Drift Limit 2 Cyl. A5

Cause	Corrective action
The drift correction for energization (start and duration) of injector A5 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1057 – AL Inj. Drift Limit 2 Cyl. A6

Cause	Corrective action
The drift correction for energization (start and duration) of injector A6 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1058 – AL Inj. Drift Limit 2 Cyl. A7

Cause	Corrective action
The drift correction for energization (start and duration) of injector A7 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

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1059 – AL Inj. Drift Limit 2 Cyl. A8

Cause	Corrective action
The drift correction for energization (start and duration) of injector A8 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1060 – AL Inj. Drift Limit 2 Cyl. A9

Cause	Corrective action
The drift correction for energization (start and duration) of injector A9 has violated limit 2. The injector has soon reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1061 – AL Inj. Drift Limit 2 Cyl. A10

Cause	Corrective action
The drift correction for energization (start and duration) of injector A10 has violated limit 2. The injector has soon reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1062 – AL Inj. Drift Limit 2 Cyl. B1

Cause	Corrective action
The drift correction for energization (start and duration) of injector B1 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1063 – AL Inj. Drift Limit 2 Cyl. B2

Cause	Corrective action
The drift correction for energization (start and duration) of injector B2 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

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1064 – AL Inj. Drift Limit 2 Cyl. B3

Cause	Corrective action
The drift correction for energization (start and duration) of injector B3 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1065 – AL Inj. Drift Limit 2 Cyl. B4

Cause	Corrective action
The drift correction for energization (start and duration) of injector B4 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1066 – AL Inj. Drift Limit 2 Cyl. B5

Cause	Corrective action
The drift correction for energization (start and duration) of injector B5 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1067 – AL Inj. Drift Limit 2 Cyl. B6

Cause	Corrective action
The drift correction for energization (start and duration) of injector B6 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1068 – AL Inj. Drift Limit 2 Cyl. B7

Cause	Corrective action
The drift correction for energization (start and duration) of injector B7 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

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1069 – AL Inj. Drift Limit 2 Cyl. B8

Cause	Corrective action
The drift correction for energization (start and duration) of injector B8 has violated limit 2. The injector has reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1070 – AL Inj. Drift Limit 2 Cyl. B9

Cause	Corrective action
The drift correction for energization (start and duration) of injector B9 has violated limit 2. The injector has soon reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1071 – AL Inj. Drift Limit 2 Cyl. B10

Cause	Corrective action
The drift correction for energization (start and duration) of injector B10 has violated limit 2. The injector has soon reached its maximum drift limit.	▶ Replace injector (→ Page 176).

1097 – AL Act Egr A Communication Lost

Cause	Corrective action
The ECU can no longer detect the EGR shutoff flap (M53) on the bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1098 – AL Act Egr A Temperature Warning

Cause	Corrective action
The internal servomotor electronics of the EGR shutoff flap (M53) signal increased temperature.	▶ Contact Service.

1099 – AL Act Egr A Targetposition

Cause	Corrective action
The servomotor of the EGR shutoff flap (M53) has not reached the target position within the specified time.	▶ Contact Service.

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1103 – AL Flap BypassA Communication Lost

Cause	Corrective action
The ECU can no longer detect the bypass flap (M52) on the bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1104 – AL Act BypasA Temperature Warning

Cause	Corrective action
The internal servomotor electronics of the bypass flap (M52) signal increased temperature.	▶ Contact Service.

1105 – AL Act Bypass A Targetposition

Cause	Corrective action
The servomotor of the bypass flap (M52) has not reached the target position within the specified time.	▶ Contact Service.

1109 – AL Act Dispens Communication Lost

Cause	Corrective action
The ECU can no longer detect the dispenser flap (M55) on the bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1110 – AL Act Dispens Temperature Warning

Cause	Corrective action
The internal servomotor electronics of the dispenser flap (M55) signal increased temperature.	▶ Contact Service.

1111 – AL Act Dispenser Targetposition

Cause	Corrective action
The servomotor of the dispenser flap (M55) has not reached the target position within the specified time.	▶ Contact Service.

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1115 – AL Difference P0 P1 Intake Air L1

Cause	Corrective action
The differential pressure at sensor B90 and the ambient air pressure sensor integrated in the ECU have violated limit value 1. The intake air differential pressure is too high.	1. Check air filter (plant side) for contamination. 2. Contact Service.

1116 – AL Difference P0 P1 Intake Air L2

Cause	Corrective action
The differential pressure at sensor B90 and the ambient air pressure sensor integrated in the ECU have violated limit value 2. The intake air differential pressure is too high.	1. Check air filter (plant side) for contamination. 2. Contact Service.

1120 – AL Flap Egr A Calibration Drive Err

Cause	Corrective action
The ECU has detected a calibration run error in the EGR shutoff flap (M53). Cause: The learned rotation range (angle) during the calibration run was not plausible. The learned angle is not between a minimum and maximum permissible limit.	▶ Contact Service.

1122 – AL Flap BypassA Calibr. Drive Err

Cause	Corrective action
The ECU has detected a calibration run error in the bypass flap (M52). Cause: The learned rotation range (angle) during the calibration run was not plausible. The learned angle is not between a minimum and maximum permissible limit.	▶ Contact Service.

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1124 – AL Flap Dispenser Calibr Drive Err

Cause	Corrective action
The ECU has detected a calibration run error in the dispenser flap (M55). Cause: The learned rotation range (angle) during the calibration run was not plausible. The learned angle is not between a minimum and maximum permissible limit.	▶ Contact Service.

1130 – AL Short Circuit Analog Out 1

Cause	Corrective action
Incorrect plant value at analog output 1 (e.g. moving-coil instrument, output signal for HT circuit fan control).	▶ Contact Service.

1131 – AL Short Circuit Analog Out 2

Cause	Corrective action
Incorrect plant value at analog output 2 (e.g. moving-coil instrument, output signal for LT circuit fan control).	▶ Contact Service.

1139 – AL Communication Error ECU - EXU

Cause	Corrective action
Communication error between ECU and EXU.	1. Check engine wiring (→ Page 251). 2. Restart ECU. 3. Contact Service.

1167 – AL Implausible NOx High Limit1

Cause	Corrective action
NOx emissions too high. The NOx emissions from the engine have violated limit value 1 cumulatively.	▶ Contact Service.

1168 – AL Implausible NOx Low Limit1

Cause	Corrective action
NOx emissions too low. Cumulative NOx emissions from the engine have violated limit value 1.	▶ Contact Service.

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1172 – AL Implausible NOx High Limit2

Cause	Corrective action
NOx emissions too high. The NOx emissions from the engine have violated limit value 2 cumulatively.	▶ Contact Service.

1173 – AL Implausible NOx Low Limit2

Cause	Corrective action
NOx emissions too low. Cumulative NOx emissions from the engine have violated limit value 2.	▶ Contact Service.

1174 – HI T-Fuel f(T0)

Cause	Corrective action
The charge-air pressure at sensor B33 has violated upper limit value 1. Fuel temperature is too high.	1. Reduce power. 2. Check fuel cooling system (if applicable). 3. Contact Service.

1175 – SS T-Fuel f(T0)

Cause	Corrective action
The charge-air pressure at sensor B33 has violated upper limit value 1. The fuel temperature has violated the critical upper limit value.	1. Reduce power. 2. Check fuel cooling system (if applicable). 3. Contact Service.

1178 – AL J1939 Heartbeat1 Lost

Cause	Corrective action
No message via J1939 plant bus (CAN2).	▶ Contact Service.

1179 – AL J1939 Heartbeat2 Lost

Cause	Corrective action
No message via J1939 plant bus (CAN2).	▶ Contact Service.

1180 – AL NOx 2 Sensor invalid

Cause	Corrective action
Status information of NOx sensor (B88.2), generated in case of short-term implausible measured values or sensor defect.	1. Acknowledge alarm. 2. Replace NOx sensor (→ Page 257). 3. Contact Service.

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1183 – AL Invalid Measurement Config

Cause	Corrective action
Selected measuring point not activated or configured incorrectly.	▶ Contact Service.

1186 – AL EGR FlpA Wear Limit2

Cause	Corrective action
Fast reference run of EGR shutoff flap (M53) faulty (executed after every ECU restart). Limit value 2.	1. Check state of charge of batteries (plant side). 2. Check operation of the EGR shutoff flap (→ Page 195). 3. Contact Service.

1188 – AL Bypass FlpA Wear Limit2

Cause	Corrective action
Fast reference run of bypass flap (M52) faulty (executed after every ECU restart). Limit value 2.	1. Check state of charge of batteries (plant side). 2. Check operation of the bypass flap (→ Page 195). 3. Contact Service.

1190 – AL Dispenser Flp Wear Limit2

Cause	Corrective action
Fast reference run of EGR dispenser flap (M55) faulty (executed after every ECU restart). Limit value 2.	1. Check state of charge of batteries (plant side). 2. Check operation of the dispenser flap (→ Page 195). 3. Contact Service.

1201 – AL Stop Start Low Power Supply

Cause	Corrective action
Engine start is blocked because the supply voltage is too low.	1. Check state of charge of batteries (plant side). 2. Contact Service.

1368 – SD P-Exhaust AGR A (P6)

Cause	Corrective action
The signal from the exhaust gas pressure sensor (B98) after cylinder before dispenser flap is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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1372 – AL Exhaust gas inclusion

Cause	Corrective action
The pressure differential between exhaust gas pressure after cylinder (P6) measured at sensor B98, and charge-air pressure (P5) measured at sensor B10.1, has violated the limit. A fault has occurred in the exhaust gas path.	▶ Contact Service.

1373 – AL P6 Sensor A Sooting

Cause	Corrective action
The ECU has not detected any variation in pressure at exhaust gas pressure sensor B98. The exhaust line to the sensor is contaminated with soot.	▶ Contact Service.

1376 – AL Refdrive Impossibl Ubat Low

Cause	Corrective action
The ECU supply voltage is too low for successful homing of all flaps even when the engine is running.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

1377 – AL Refdrive Impossibl Eng Op Point

Cause	Corrective action
Homing of one or more flaps before engine start was not completed successfully. Homing the affected flaps is no longer possible.	1. Run engine up to idling speed. Result: Homing is executed. 2. Contact Service.

1378 – AL Act Egr A Ref-Drv EngStop

Cause	Corrective action
This alarm is set in the fault memory if homing the EGR shutoff flap (M53) was not successful when initiated with the engine at standstill.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

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1380 – AL Act Byp A Ref-Drv EngStop

Cause	Corrective action
This alarm is set in the fault memory if homing the bypass flap (M52) was not successful when initiated with the engine at standstill.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

1382 – AL Act Dispenser Ref-Drv EngStop

Cause	Corrective action
This alarm is set in the fault memory if homing the dispenser flap (M55) was not successful when initiated with the engine at standstill.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

1384 – AL Act Egr A Ref-Drv Eng Running

Cause	Corrective action
Homing the EGR shutoff flap (M53) could not be carried out.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check engine wiring (→ Page 251). 4. Contact Service.

1386 – AL Act Byp A Ref-Drv Eng Running

Cause	Corrective action
Homing the bypass flap (M52) could not be carried out.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check engine wiring (→ Page 251). 4. Contact Service.

1388 – AL Act Disp Ref-Drv Eng Running

Cause	Corrective action
Homing the dispenser flap (M55) could not be carried out.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Check engine wiring (→ Page 251). 4. Contact Service.

1390 – AL Flap Egr A Wear Limit 1

Cause	Corrective action
The range of rotation on homing the EGR shutoff flap (M53) has violated limit 1. The flap mechanism is beginning to wear.	▶ Replace linkage rod at next scheduled maintenance interval (→ Page 197).

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1392 – AL Flap Byp A Wear Limit 1

Cause	Corrective action
The range of rotation on homing the bypass flap (M52) has violated limit 1. The flap mechanism is beginning to wear.	▶ Replace linkage rod at next scheduled maintenance interval (→ Page 197).

1394 – AL Flap Disp Wear Limit 1

Cause	Corrective action
The range of rotation on homing the dispenser flap (M55) has violated limit 1. The flap mechanism is beginning to wear.	▶ Replace linkage rod at next scheduled maintenance interval (→ Page 197).

1396 – AL Flap Egr A Wear Limit 2

Cause	Corrective action
The range of rotation on homing the EGR shutoff flap (M53) has violated limit 2. The flap mechanism is significantly worn.	▶ Replace linkage rod (→ Page 197).

1398 – AL Flap Byp A Wear Limit 2

Cause	Corrective action
The range of rotation on homing the bypass flap (M52) has violated limit 2. The flap mechanism is significantly worn.	▶ Replace linkage rod (→ Page 197).

1400 – AL Flap Disp Wear Limit 2

Cause	Corrective action
The range of rotation on homing the dispenser flap (M55) has violated limit 2. The flap mechanism is significantly worn.	▶ Replace linkage rod (→ Page 197).

1402 – AL Flap Egr A linkage failure

Cause	Corrective action
The range of rotation on homing the EGR shutoff flap (M53) has violated the limit. The flap mechanism is faulty.	1. Check exhaust flap for damage (→ Page 192). 2. Replace the linkage rod if it is damaged (→ Page 192). 3. Contact Service on detecting any other damage at the exhaust flap.

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1404 – AL Flap Byp A linkage failure

Cause	Corrective action
The range of rotation on homing the bypass flap (M52) has violated the limit. The flap mechanism is faulty.	1. Check exhaust flap for damage (→ Page 192). 2. Replace the linkage rod if it is damaged (→ Page 192). 3. Contact Service on detecting any other damage at the exhaust flap.

1406 – AL Flap Dispenser linkage failure

Cause	Corrective action
The range of rotation on homing the dispenser flap (M55) has violated the limit. The flap mechanism is faulty.	1. Check exhaust flap for damage (→ Page 192). 2. Replace the linkage rod if it is damaged (→ Page 192). 3. Contact Service on detecting any other damage at the exhaust flap.

1408 – AL Flap Egr A restricted Limit 1

Cause	Corrective action
The range of rotation on homing the EGR shutoff flap (M53) has violated limit 1. Flap travel is marginally restricted.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1410 – AL Flap Byp A restricted Limit 1

Cause	Corrective action
The range of rotation on homing the bypass flap (M52) has violated limit 1. Flap travel is marginally restricted.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1412 – AL Flap Disp restricted Limit 1

Cause	Corrective action
The range of rotation on homing the dispenser flap (M55) has violated limit 1. Flap travel is marginally restricted.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1414 – AL Flap Egr A restricted Limit 2

Cause	Corrective action
The range of rotation on homing the EGR shutoff flap (M53) has violated limit 2. Flap travel is restricted.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

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1416 – AL Flap Byp A restricted Limit 2

Cause	Corrective action
The range of rotation on homing the bypass flap (M52) has violated limit 2. Flap travel is restricted.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1418 – AL Flap Disp restricted Limit 2

Cause	Corrective action
The range of rotation on homing the dispenser flap (M55) has violated limit 2. Flap travel is restricted.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1420 – AL Flap Egr A blocked drive

Cause	Corrective action
The mechanism of the EGR shutoff flap (M53) is blocked.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1422 – AL Flap Bypass A blocked drive

Cause	Corrective action
The mechanism of the bypass flap (M52) is blocked.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1424 – AL Flap Dispenser blocked drive

Cause	Corrective action
The mechanism of the dispenser flap (M55) is blocked.	1. Check smooth operation of the exhaust flap mechanism. 2. Contact Service.

1430 – AL Act Agr A Temperature Alert

Cause	Corrective action
The internal electronics of the servomotor of the EGR shutoff flap (M53) signals that temperature is too high.	1. Check for high temperatures in the vicinity of the servomotor, e.g. resulting from faulty insulation, defective seals, signs of sooting (→ Page 192). 2. Check coolant connections of servomotor for leaks and blockages (→ Page 253). 3. Contact Service.

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1432 – AL Act Byp A Temperature Alert

Cause	Corrective action
The internal electronics of the servomotor of the bypass flap (M52) signals that temperature is too high.	1. Check for high temperatures in the vicinity of the servomotor, e.g. resulting from faulty insulation, defective seals, signs of sooting (→ Page 192). 2. Check coolant connections of servomotor for leaks and blockages (→ Page 253). 3. Contact Service.

1434 – AL Act Dispenser Temperature Alert

Cause	Corrective action
The internal electronics of the servomotor of the dispenser flap (M55) signals that temperature is too high.	1. Check for high temperatures in the vicinity of the servomotor, e.g. resulting from faulty insulation, defective seals, signs of sooting (→ Page 192). 2. Check coolant connections of servomotor for leaks and blockages (→ Page 253). 3. Contact Service.

1436 – AL Act Agr A Voltage Supply

Cause	Corrective action
The servomotor supply voltage for the EGR shutoff flap (M53) is below 9V or above 32V. The servomotor assumes a safe position.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

1438 – AL Act Byp A Voltage Supply

Cause	Corrective action
The servomotor supply voltage for the bypass flap (M52) is below 9V or above 32V. The servomotor assumes a safe position.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

1440 – AL Act Dispenser Voltage Supply

Cause	Corrective action
The servomotor supply voltage for the dispenser flap (M55) is below 9V or above 32V. The servomotor assumes a safe position.	1. Check state of charge of batteries (plant side). 2. Check plug connectors for engine governor (→ Page 256). 3. Contact Service.

1448 – AL ECU Comm Lost to Act EGR A

Cause	Corrective action
The ECU is no longer able to detect the EGR shutoff flap (M53) on the CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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1450 – AL ECU Comm Lost to Act Byp A

Cause	Corrective action
The ECU is no longer able to detect the bypass flap (M52) on the CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1452 – AL ECU Comm Lost to Act Dispenser

Cause	Corrective action
The ECU is no longer able to detect the dispenser flap (M55) on the CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1454 – AL Act EGR A Comm Lost to ECU

Cause	Corrective action
The servomotor of the EGR shutoff flap (M53) receives no data from the ECU via the CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1456 – AL Act Byp A Comm Lost to ECU

Cause	Corrective action
The servomotor bypass flap (M52) receives no data from the ECU via the CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1458 – AL Act Dispenser Comm Lost to ECU

Cause	Corrective action
The servomotor of the dispenser flap (M55) receives no data from the ECU via the CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

1550 – AL LSU Stop Cal Airmass

Cause	Corrective action
Calibration of lambda sensor failed. Engine coasting too short	1. Execute manual lambda calibration via DiaSys® (→ Dialog system DiaSys® E531920/..). 2. Start engine (→ Page 72). 3. Shut down engine in accordance with specifications (→ Page 73). 4. Contact Service.

1551 – AL LSU Stop Cal Min Max

Cause	Corrective action
Calibration of lambda sensor failed. Sensor defective.	1. Replace lambda sensor (→ Page 259). 2. Contact Service.

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1552 – AL LSU Stop Cal Delta Factor

Cause	Corrective action
Calibration of lambda sensor failed. Sensor defective.	1. Replace lambda sensor (→ Page 259). 2. Contact Service.

1553 – AL Act Agr A Targetpos Blocked

Cause	Corrective action
The servomotor of the EGR shutoff flap (M53) has not reached the target position within the specified time.	▶ Contact Service.

1555 – AL Act Byp A Targetpos Blocked

Cause	Corrective action
The servomotor of the bypass flap (M52) has not reached the target position within the specified time.	▶ Contact Service.

1557 – AL Act Disp Targetpos Blocked

Cause	Corrective action
The servomotor of the dispenser flap (M55) has not reached the target position within the specified time.	▶ Contact Service.

1738 – AL Implausible P5 or P6

Cause	Corrective action
The deviation between charge-air pressure (B10.1 or the mean value of B10.1 and B10.2) and exhaust pressure after cylinder (B98 or the mean value of B98.1 and B98.2) has violated the limit. The deviation is too great.	▶ Contact Service.

5000 – AL Sensordefect T-EXU Device

Cause	Corrective action
The signal from the EXU internal temperature sensor is faulty or missing.	▶ Contact Service.

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5001 – AL HI T-EXU Device

Cause	Corrective action
The temperature limit measured at the device-internal temperature sensor of the EXU has been violated. The temperature of the EXU device is too high.	▶ Contact Service.

5002 – AL Sensordefect EXU Power Supply

Cause	Corrective action
The signal from the EXU internal voltage sensor is faulty or missing.	▶ Contact Service.

5003 – AL LO EXU Supply Voltage

Cause	Corrective action
The supply voltage of the EXU has violated limit value 1.	1. Check state of charge of batteries (plant side). 2. Check plug connection cables to the EXU (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

5004 – AL LOLO EXU Supply Voltage

Cause	Corrective action
The supply voltage of the EXU has violated limit value 2.	1. Check state of charge of batteries (plant side). 2. Check plug connection cables to the EXU (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

5005 – AL HI EXU Supply Voltage

Cause	Corrective action
The supply voltage of the EXU has violated limit value 1.	1. Check state of charge of batteries (plant side). 2. Check plug connection cables to the EXU (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

5006 – AL HIHI EXU Supply Voltage

Cause	Corrective action
The supply voltage of the EXU has violated limit value 2.	1. Check state of charge of batteries (plant side). 2. Check plug connection cables to the EXU (→ Page 256). 3. Check battery-charging generator (→ Page 238). 4. Contact Service.

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5009 – AL EXU Device Defect

Cause	Corrective action
Fault in EXU	▶ Contact Service.

5011 – AL experimental parameter set

Cause	Corrective action
Test operation activated via DiaSys.	▶ No actions required.

5012 – AL CAN PU Data Flash Error

Cause	Corrective action
EXU device-internal memory module faulty.	▶ Contact Service.

5014 – AL incorrect parameter setting

Cause	Corrective action
The ECU data record and the EXU data record are at variance leading to deactivation of the single accumulator pressure monitoring.	1. Check plug connection cables between ECU and EXU (→ Page 256). 2. Restart ECU and EXU. 3. Contact Service.

5018 – AL CAN1 error passive

Cause	Corrective action
CAN bus 1 for plant-side MTU automation (e.g. MAU/SAM) faulty. Alarm 5019 follows if fault persists.	▶ Contact Service.

5019 – AL CAN1 bus off

Cause	Corrective action
CAN bus 1 for plant-side MTU automation (e.g. MAU/SAM) disrupted/failed.	▶ Contact Service.

5020 – AL CAN2 error passive

Cause	Corrective action
CAN bus 2 to customer automation (e.g. Murphy display) faulty. Alarm 5021 follows if fault persists.	▶ Contact Service.

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5021 – AL CAN2 bus off

Cause	Corrective action
CAN bus 2 to customer automation (e.g. Murphy display) disrupted/failed.	▶ Contact Service.

5022 – AL CAN1 Node Lost

Cause	Corrective action
Connection to a node on CAN bus 1 lost.	▶ Contact Service.

5023 – AL CAN2 Node Lost

Cause	Corrective action
Connection to a node on CAN bus 2 failed.	▶ Contact Service.

5024 – AL duplicate node failure CAN1 CAN2

Cause	Corrective action
Connection to a node on CAN bus 1 and CAN bus 2 failed.	▶ Contact Service.

5025 – AL CAN3 error passive

Cause	Corrective action
Communication with ECU (CAN bus 3) is out of order.	1. Check plug connection cables between ECU and EXU (→ Page 256). 2. Contact Service.

5026 – AL CAN3 bus off

Cause	Corrective action
Communication with ECU (CAN bus 3) disrupted/failed.	1. Check plug connection cables between ECU and EXU (→ Page 256). 2. Contact Service.

5027 – AL SD Camshaft Speed

Cause	Corrective action
The signal from the camshaft speed sensor (B1) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

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5028 – AL SD Crankshaft Speed

Cause	Corrective action
The signal from the crankshaft speed sensor (B13) is faulty or missing.	1. Check engine wiring (→ Page 251). 2. Contact Service.

5029 – AL Synchronization Lost

Cause	Corrective action
Unable to synchronize crankshaft and camshaft.	1. Check engine wiring (→ Page 251). 2. Contact Service.

5030 – AL CAN3 communication lost

Cause	Corrective action
The EXU receives no data from the ECU in spite of intact CAN bus.	1. Check engine wiring (→ Page 251). 2. Contact Service.

5199 – AL IAP NotAvailable

Cause	Corrective action
Faults have occurred that result in deactivation of the individual accumulator pressure monitoring. Occurs in conjunction with the following other alarms: 5014, 5025, 5026, 5027, 5028, 5029, 5030.	▶ Contact Service.

5200 – AL Dev P_Rail ECU EXU

Cause	Corrective action
Excessive difference in pressure measured at sensor B48 in the fuel distributor block and the averaged pressure value of sensors B97A1-Bx of the specified limit. One of the pressure sensors delivers an incorrect measured value.	▶ Contact Service.

5201 – AL IAP Sensor Cyl A1 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A1) in injector A1 is faulty or missing.	▶ Contact Service.

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5202 – AL IAP Sensor Cyl A2 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A2) in injector A2 is faulty or missing.	▶ Contact Service.

5203 – AL IAP Sensor Cyl A3 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A3) in injector A3 is faulty or missing.	▶ Contact Service.

5204 – AL IAP Sensor Cyl A4 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A4) in injector A4 is faulty or missing.	▶ Contact Service.

5205 – AL IAP Sensor Cyl A5 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A5) in injector A5 is faulty or missing.	▶ Contact Service.

5206 – AL IAP Sensor Cyl A6 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A6) in injector A6 is faulty or missing.	▶ Contact Service.

5207 – AL IAP Sensor Cyl A7 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A7) in injector A7 is faulty or missing.	▶ Contact Service.

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5208 – AL IAP Sensor Cyl A8 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A8) in injector A8 is faulty or missing.	▶ Contact Service.

5209 – AL IAP Sensor Cyl A9 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A9) in injector A9 is faulty or missing.	▶ Contact Service.

5210 – AL IAP Sensor Cyl A10 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.A10) in injector A10 is faulty or missing.	▶ Contact Service.

5211 – AL IAP Sensor Cyl B1 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B1) in injector B1 is faulty or missing.	▶ Contact Service.

5212 – AL IAP Sensor Cyl B2 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B2) in injector B2 is faulty or missing.	▶ Contact Service.

5213 – AL IAP Sensor Cyl B3 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B3) in injector B3 is faulty or missing.	▶ Contact Service.

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5214 – AL IAP Sensor Cyl B4 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B4) in injector B4 is faulty or missing.	▶ Contact Service.

5215 – AL IAP Sensor Cyl B5 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B5) in injector B5 is faulty or missing.	▶ Contact Service.

5216 – AL IAP Sensor Cyl B6 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B6) in injector B6 is faulty or missing.	▶ Contact Service.

5217 – AL IAP Sensor Cyl B7 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B7) in injector B7 is faulty or missing.	▶ Contact Service.

5218 – AL IAP Sensor Cyl B8 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B8) in injector B8 is faulty or missing.	▶ Contact Service.

5219 – AL IAP Sensor Cyl B9 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B9) in injector B9 is faulty or missing.	▶ Contact Service.

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5220 – AL IAP Sensor Cyl B10 Defect

Cause	Corrective action
The signal from the single accumulator pressure sensor (B97.B10) in injector B10 is faulty or missing.	▶ Contact Service.

5221 – AL No Injection Detected CylA1

Cause	Corrective action
The pressure variation measured at sensor B97A1 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A1.	1. Check whether alarm 5201 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5222 – AL No Injection Detected CylA2

Cause	Corrective action
The pressure variation measured at sensor B97A2 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A2.	1. Check whether alarm 5202 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5223 – AL No Injection Detected CylA3

Cause	Corrective action
The pressure variation measured at sensor B97A3 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A3.	1. Check whether alarm 5203 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5224 – AL No Injection Detected CylA4

Cause	Corrective action
The pressure variation measured at sensor B97A4 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A4.	1. Check whether alarm 5204 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

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5225 – AL No Injection Detected CylA5

Cause	Corrective action
The pressure variation measured at sensor B97A5 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A5.	1. Check whether alarm 5205 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5226 – AL No Injection Detected CylA6

Cause	Corrective action
The pressure variation measured at sensor B97A6 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A6.	1. Check whether alarm 5206 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5227 – AL No Injection Detected CylA7

Cause	Corrective action
The pressure variation measured at sensor B97A7 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A7.	1. Check whether alarm 5207 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5228 – AL No Injection Detected CylA8

Cause	Corrective action
The pressure variation measured at sensor B97A8 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A8.	1. Check whether alarm 5208 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5229 – AL No Injection Detected CylA9

Cause	Corrective action
The pressure variation measured at sensor B97A9 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A9.	1. Check whether alarm 5209 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

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5230 – AL No Injection Detected CylA10

Cause	Corrective action
The pressure variation measured at sensor B97A10 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder A10.	1. Check whether alarm 5210 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5231 – AL No Injection Detected CylB1

Cause	Corrective action
The pressure variation measured at sensor B97B1 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B1.	1. Check whether alarm 5211 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5232 – AL No Injection Detected CylB2

Cause	Corrective action
The pressure variation measured at sensor B97B2 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B2.	1. Check whether alarm 5212 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5233 – AL No Injection Detected CylB3

Cause	Corrective action
The pressure variation measured at sensor B97B3 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B3.	1. Check whether alarm 5213 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5234 – AL No Injection Detected CylB4

Cause	Corrective action
The pressure variation measured at sensor B97B4 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B4.	1. Check whether alarm 5214 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

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5235 – AL No Injection Detected CylB5

Cause	Corrective action
The pressure variation measured at sensor B97B5 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B5.	1. Check whether alarm 5215 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5236 – AL No Injection Detected CylB6

Cause	Corrective action
The pressure variation measured at sensor B97B6 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B6.	1. Check whether alarm 5216 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5237 – AL No Injection Detected CylB7

Cause	Corrective action
The pressure variation measured at sensor B97B7 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B7.	1. Check whether alarm 5217 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5238 – AL No Injection Detected CylB8

Cause	Corrective action
The pressure variation measured at sensor B97B8 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B8.	1. Check whether alarm 5218 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5239 – AL No Injection Detected CylB9

Cause	Corrective action
The pressure variation measured at sensor B97B9 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B9.	1. Check whether alarm 5219 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

TIM-ID: 0000065298 - 004

5240 – AL No Injection Detected CylB10

Cause	Corrective action
The pressure variation measured at sensor B97B10 and evaluated by the EXU indicates that despite correct energization no fuel is being injected at cylinder B10.	1. Check whether alarm 5220 is signaled. If so, contact Service. 2. Replace injector (→ Page 176). 3. Contact Service.

5241 – AL Implausible BOI CylA1

Cause	Corrective action
The beginning of injection measured by sensor B97A1 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5242 – AL Implausible BOI CylA2

Cause	Corrective action
The beginning of injection measured by sensor B97A2 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5243 – AL Implausible BOI CylA3

Cause	Corrective action
The beginning of injection measured by sensor B97A3 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5244 – AL Implausible BOI CylA4

Cause	Corrective action
The beginning of injection measured by sensor B97A4 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5245 – AL Implausible BOI CylA5

Cause	Corrective action
The beginning of injection measured by sensor B97A5 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

TIM-ID: 0000065298 - 004

5246 – AL Implausible BOI CylA6

Cause	Corrective action
The beginning of injection measured by sensor B97A6 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5247 – AL Implausible BOI CylA7

Cause	Corrective action
The beginning of injection measured by sensor B97A7 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5248 – AL Implausible BOI CylA8

Cause	Corrective action
The beginning of injection measured by sensor B97A8 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5249 – AL Implausible BOI CylA9

Cause	Corrective action
The beginning of injection measured by sensor B97A9 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5250 – AL Implausible BOI CylA10

Cause	Corrective action
The beginning of injection measured by sensor B97A10 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5251 – AL Implausible BOI CylB1

Cause	Corrective action
The beginning of injection measured by sensor B97B1 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

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5252 – AL Implausible BOI CylB2

Cause	Corrective action
The beginning of injection measured by sensor B97B2 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5253 – AL Implausible BOI CylB3

Cause	Corrective action
The beginning of injection measured by sensor B97B3 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5254 – AL Implausible BOI CylB4

Cause	Corrective action
The beginning of injection measured by sensor B97B4 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5255 – AL Implausible BOI CylB5

Cause	Corrective action
The beginning of injection measured by sensor B97B5 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5256 – AL Implausible BOI CylB6

Cause	Corrective action
The beginning of injection measured by sensor B97B6 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5257 – AL Implausible BOI CylB7

Cause	Corrective action
The beginning of injection measured by sensor B97B7 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

TIM-ID: 0000065298 - 004

5258 – AL Implausible BOI CylB8

Cause	Corrective action
The beginning of injection measured by sensor B97B8 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5259 – AL Implausible BOI CylB9

Cause	Corrective action
The beginning of injection measured by sensor B97B9 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5260 – AL Implausible BOI CylB10

Cause	Corrective action
The beginning of injection measured by sensor B97B10 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5261 – AL Implausible EOI CylA1

Cause	Corrective action
The end of injection measured by sensor B97A1 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5262 – AL Implausible EOI CylA2

Cause	Corrective action
The end of injection measured by sensor B97A2 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5263 – AL Implausible EOI CylA3

Cause	Corrective action
The end of injection measured by sensor B97A3 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

TIM-ID: 0000065298 - 004

5264 – AL Implausible EOI CylA4

Cause	Corrective action
The end of injection measured by sensor B97A4 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5265 – AL Implausible EOI CylA5

Cause	Corrective action
The end of injection measured by sensor B97A5 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5266 – AL Implausible EOI CylA6

Cause	Corrective action
The end of injection measured by sensor B97A6 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5267 – AL Implausible EOI CylA7

Cause	Corrective action
The end of injection measured by sensor B97A7 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5268 – AL Implausible EOI CylA8

Cause	Corrective action
The end of injection measured by sensor B97A8 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5269 – AL Implausible EOI CylA9

Cause	Corrective action
The end of injection measured by sensor B97A9 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

TIM-ID: 0000065298 - 004

5270 – AL Implausible EOI CylA10

Cause	Corrective action
The end of injection measured by sensor B97A10 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5271 – AL Implausible EOI CylB1

Cause	Corrective action
The end of injection measured by sensor B97B1 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5272 – AL Implausible EOI CylB2

Cause	Corrective action
The end of injection measured by sensor B97B2 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5273 – AL Implausible EOI CylB3

Cause	Corrective action
The end of injection measured by sensor B97B3 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5274 – AL Implausible EOI CylB4

Cause	Corrective action
The end of injection measured by sensor B97B4 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5275 – AL Implausible EOI CylB5

Cause	Corrective action
The end of injection measured by sensor B97B5 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

TIM-ID: 0000065298 - 004

5276 – AL Implausible EOI CylB6

Cause	Corrective action
The end of injection measured by sensor B97B6 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5277 – AL Implausible EOI CylB7

Cause	Corrective action
The end of injection measured by sensor B97B7 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5278 – AL Implausible EOI CylB8

Cause	Corrective action
The end of injection measured by sensor B97B8 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5279 – AL Implausible EOI CylB9

Cause	Corrective action
The end of injection measured by sensor B97B9 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

5280 – AL Implausible EOI CylB10

Cause	Corrective action
The end of injection measured by sensor B97B10 and evaluated by the EXU is outside the controllable tolerance.	▶ Contact Service.

TIM-ID: 0000065298 - 004

8 Task Description

8.1 Engine

8.1.1 Engine - Barring manually

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Barring tool	F6787910	1
Ratchet with extension	F30006212	1

DANGER

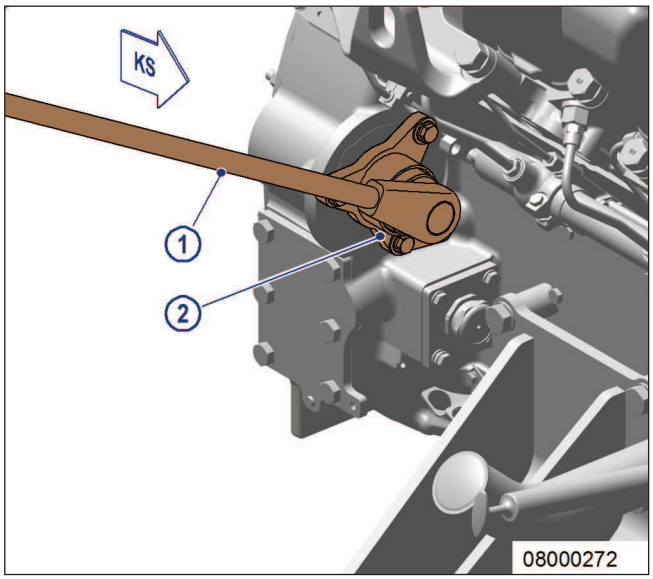
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

Barring engine manually (lateral installation)

1. Remove cover from flywheel housing.
2. Engage barring tool (2) in ring gear and install on flywheel housing.
   - Use barring tool F6787910.
3. Set ratchet (1) onto barring tool (2).
4. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no resistance.

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

5. Remove barring tool in reverse order.



TIM-ID: 0000030234 - 004

8.1.2 Engine - Barring with starting system

DANGER

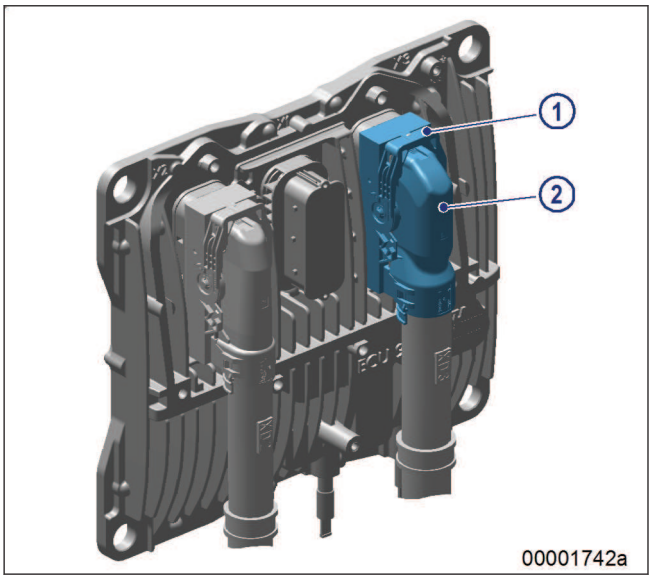
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before barring the engine, make sure that there are no persons in the engine's danger zone.
- After finishing work on the engine, make sure that all safety devices are put back in place and all tools are removed from the engine.

Engine – Barring with starting system

1. Release latch (1) of connector X3 (2).

Note: Seal unused connectors with the supplied protective cap.

2. Remove connector from engine governor.
3. Turn engine in unloaded condition: Press START button.
4. Let the crankshaft rotate until oil pressure is indicated.
5. Engine start is interrupted automatically after the maximum permissible time.
6. Repeat this procedure after approximately 20 seconds if required.
7. Fit connector X3 (2) on engine governor and close latch (1).



TIM-ID: 0000029454 - 004

8.1.3 Engine - Test run

DANGER



Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

WARNING



Exhaust gases are harmful to health and may cause cancer.
Risk of poisoning and suffocation!
- Keep the engine room well-ventilated at all times.
- Repair leaking exhaust pipework immediately.

WARNING



High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Engine – Test run

1. Start engine (→ Page 72).
2. Perform test run not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks (→ Page 70).
4. Stop engine (→ Page 73).

TIM-ID: 0000000870 - 009

8.2 Auxiliary PTO

8.2.1 Auxiliary PTO - Replacement

Special tools, Material, Spare parts

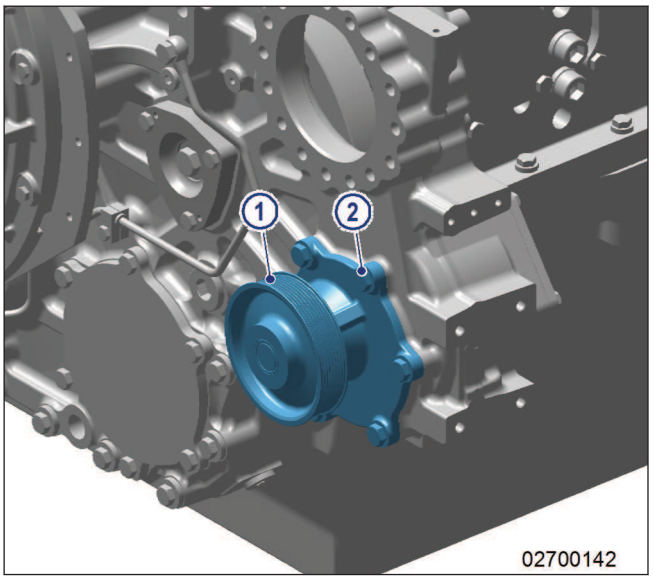
Designation / Use	Part No.	Qty.
Assembly compound (Kluthe Hakuform 30-15)	X00067260	1
Engine oil		
O-ring	(→ Spare Parts Catalog)	
Screw	(→ Spare Parts Catalog)	

NOTICE

Contamination of components.
Damage to component!
- Observe manufacturer's instructions.
- Check components for special cleanliness.

Replacing auxiliary PTO for general purposes

1. Remove auxiliary PTO (1) by loosening screws (2) on the gearcase.
2. Thoroughly clean mating faces and coat with assembly compound before installing the new PTO.
3. Insert auxiliary PTO (1) with new O-ring in bore in gearcase.
4. Screw in screws (2) and tighten crosswise.

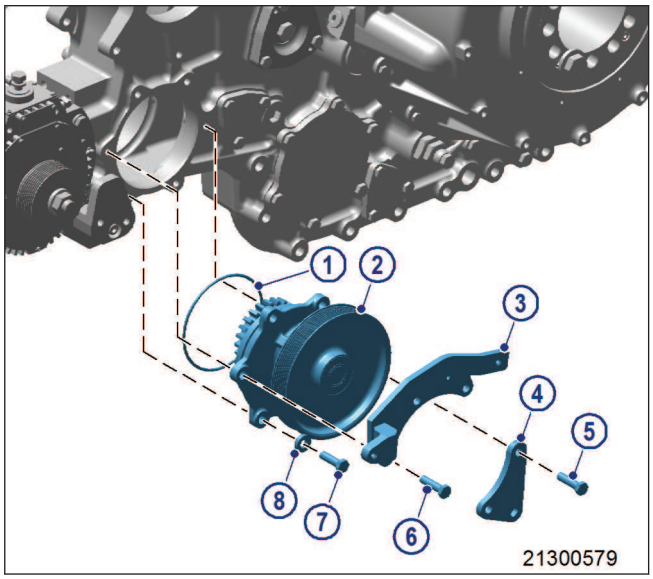


Replacing auxiliary PTO for battery-charging generator

1. Remove protective cover.
2. Remove drive belt (→ Page 239).

TIM-ID: 0000055503 - 002

3. Remove screws (5, 6) and take off retainers (3, 4).
4. Remove screws (7) and washers (8).
5. Remove auxiliary PTO (2) with O-ring (1).
6. Install new auxiliary PTO (2) with new O-ring (1).
7. Install screws (8) with washers (7).
8. Install retainers (3, 4) with screws (5, 6).
9. Tighten screws (5, 6, 8) crosswise.
10. Install drive belt (→ Page 239).
11. Install protective cover.



TIM-ID: 0000055503 - 002

8.3 Cylinder Liner

8.3.1 Cylinder liner - Endoscopic examination

Preconditions

☑ Engine is stopped and starting disabled

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Barring tool	F6555766	1
Ratchet with extension	F30006212	1
Endoscope	Y20097353	1

Preparatory steps

1. Remove cylinder head cover (→ Page 172).
2. Remove injector (→ Page 177).

Positioning crankshaft at BDC

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

Endoscopic examination of cylinder liner

Findings	Measure
• Thin carbon coating around carbon scraper ring • Slight localized additive deposits at top edge • Localized smooth areas at bottom edge • Carbon deposits on entire circumference between top piston ring and bottom edge of carbon scraper ring • First signs of marks left by top piston ring • Bright mark on entire circumference • Faultless, even honing pattern • First signs of marks left by lower cooling bores • Running pattern seems darker	No actions required.
• Dark areas with even or varying degrees of discoloration • 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 are faultless • Piston rings are faultless	Further endoscopic examination required as part of maintenance work.
• On the entire circumference, apart from light areas of discoloration (do not impair operation) clearly darker stripes that start 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.

TIM-ID: 0000003304 - 006

1. Compile endoscopic report using the table.
2. Use technical terms to describe the liner surface (→ Page 161).
3. Depending on findings:
   - Do not take any action or
   - carry out a further endoscopic examination as part of maintenance work or
   - contact Service; cylinder liner must be replaced.

Final steps

1. Install injector (→ Page 177).
2. Install cylinder head cover (→ Page 172).

TIM-ID: 0000003304 - 006

8.3.2 Cylinder liner - Instructions and comments on endoscopic and visual examination

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 honing 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
Polished area	Polished areas are on the running surface but almost the whole honing pattern is still visible. Polished areas appear brighter and more shiny 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 the 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 moisture (condensate) 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 preliminary stage of burn marks. 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	These are caused by a disturbance in the liner / ring tribo system. 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 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.

Table 3: Endoscopic examination – Terms used

TIM-ID: 0000000014 - 017

Evaluation of findings and further measures

The findings in the start phase of oxidation discoloration and burn marks 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.

TIM-ID: 0000000014 - 017

8.4 Crankcase Breather

8.4.1 Oil mist fine separator - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

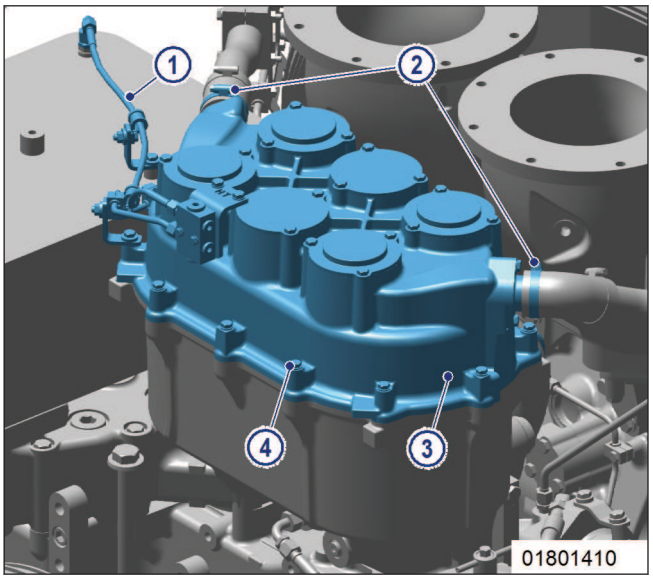
Designation / Use	Part No.	Qty.
Torque wrench, 4–20 Nm	F30044239	1
Engine oil		
Oil mist fine separator	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Locknut	(→ Spare Parts Catalog)	
Washer	(→ Spare Parts Catalog)	

WARNING

Oil is hot.
Oil can contain residue/substances which are harmful to health.
Risk of injury and poisoning!
- Allow the product to cool to below 50 °C before beginning work.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

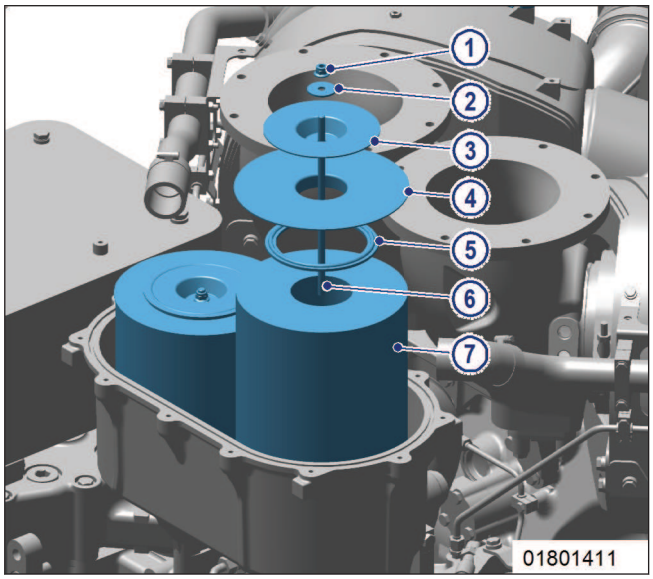
Oil mist fine separator – Replacement

1. Remove line (1) from oil heat exchanger.
2. Remove pipe clamps (2).
3. Remove screws with washers (4).
4. Remove diaphragm housing (3).



TIM-ID: 0000062822 - 002

5. Unscrew locknut (1) and remove together with washer (2).
6. Remove filter cover (3), cover (4) and sealing ring (5).
7. Remove threaded rod (6).
8. Replace oil mist fine separator (7).
9. Replace sealing ring (5) if necessary.
10. Install sealing ring (5), cover (4) and filter cover (3).



11. Fit new locknut (1) and new washer (2) and tighten locknut (1) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Locknut	M10	Tightening torque		10 Nm ±2 Nm

12. Replace further oil mist fine separators in the same way.

TIM-ID: 0000062822 - 002

8.5 Valve Drive

8.5.1 Valve gear - Lubrication

Preconditions

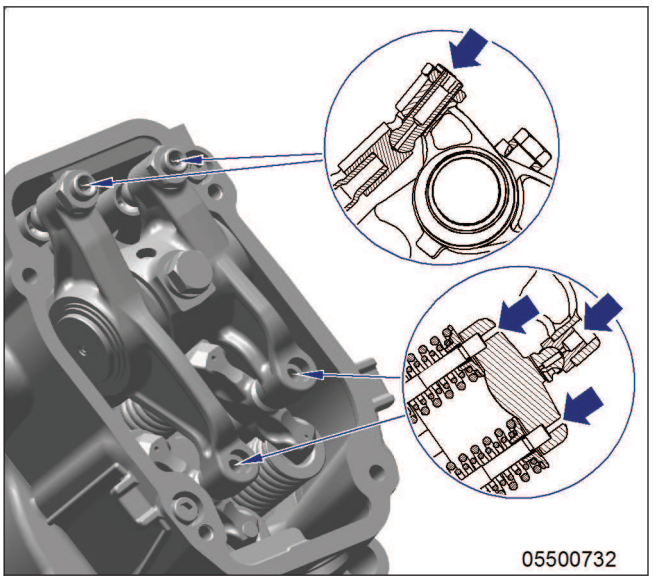
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

Valve gear – Lubrication

1. Remove cylinder head upper section (→ Page 172).
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 upper section (→ Page 172).



TIM-ID: 0000055644 - 001

8.5.2 Valve protrusion - Measurement

Preconditions

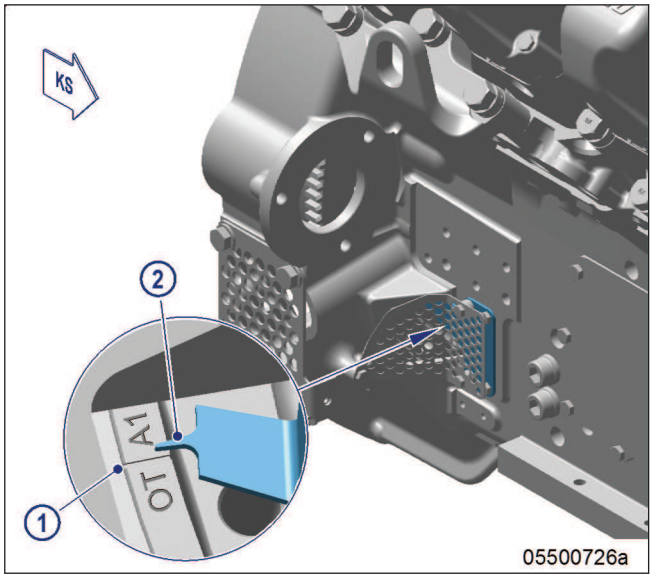
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Depth gauge, 200 mm	Y20000918	1

Preparatory steps

1. Remove cylinder head cover upper section (→ Page 172).
2. Remove injector (→ Page 177).
3. Install barring tool (→ Page 154).
4. Turn crankshaft in direction of rotation using barring gear until TDC mark (1) and pointer (2) are aligned.

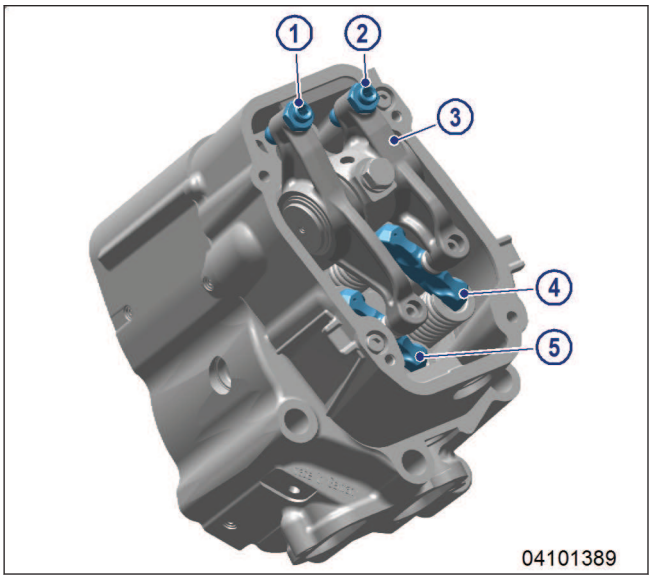


Measuring valve protrusion

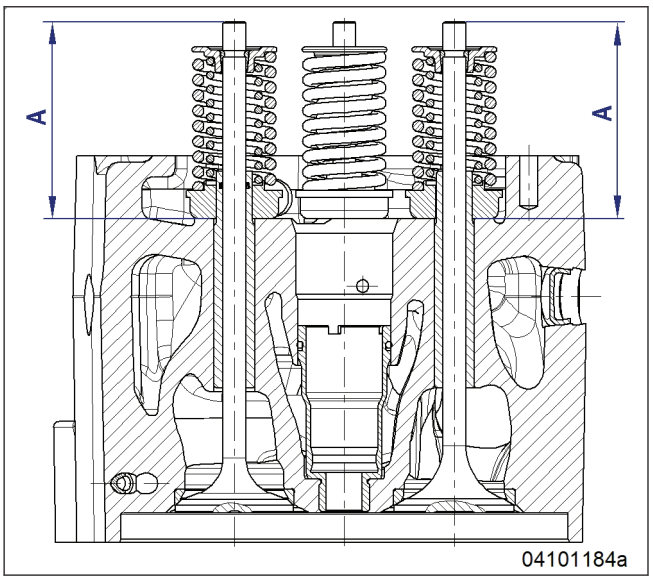
1. Check TDC position of piston in cylinder A1:
   - If rocker arms on cylinder A1 are unloaded, the piston is in firing TDC.
   - If rocker arms on cylinder A1 are loaded, the piston is in overlap TDC.
2. Measure valve protrusion for each valve in two crankshaft positions (firing TDC and overlap TDC for cylinder A1) according to the diagram. Diagram (→ Page 168).

TIM-ID: 0000055030 - 003

3. Loosen adjusting screw (1, 2) and take off valve bridges (4, 5). Do not remove rocker arm (3).



4. Measure distance between valve stem end and cylinder head top at the injector bore with depth gauge (see figure).
   - Specified value for a new cylinder head: 93.8 mm.
   - Admissible wear: 2 mm.
   - Have the affected cylinder head replaced by expert personnel ahead of schedule if the measured value is > 95.8 mm.
5. Install valve bridge.
6. Adjusting valve clearance (→ Page 168)



Final steps

1. Remove barring tool (→ Page 154).
2. Install injector (→ Page 177).
3. Install cylinder head cover upper section (→ Page 172).

TIM-ID: 0000055030 - 003

8.5.3 Valve clearance - Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Coolant temperature is max. 40 °C.

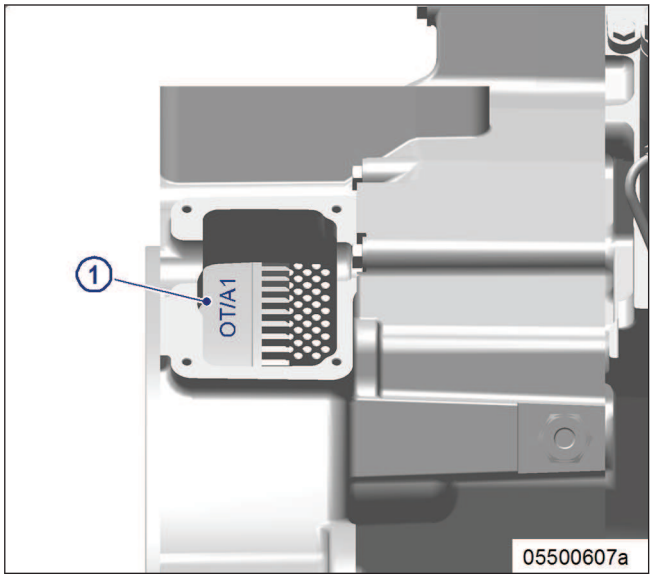
☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y20098771	1
Valve adjusting gauge	Y4349603	1
Allen key	F30002815	1
Torque wrench, 60–320 Nm	F30452768	1
Socket wrench, 24 mm	F30039526	1
Engine oil		

Preparatory steps

1. Remove cylinder head cover upper section (→ Page 172).
2. Install barring device (→ Page 154).
3. The "OT" marking (1) (if fitted) on the flywheel outer circumference must not be used for reference.



TIM-ID: 0000062651 - 002

Note: Pointer (1) in lower opening of flywheel housing (arrow).

4. Use barring device to turn crankshaft in engine direction of rotation until marking OT-A1 on the rear side of the flywheel and pointer (1) are aligned.

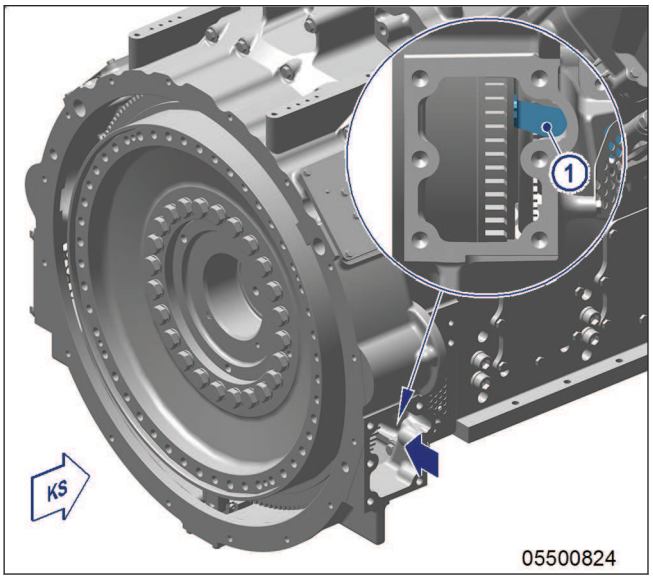


Diagram for 12V engines – Two crankshaft positions

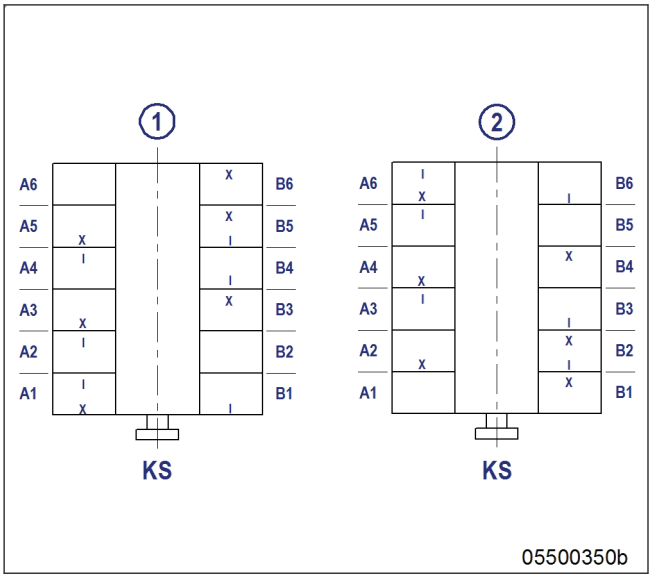
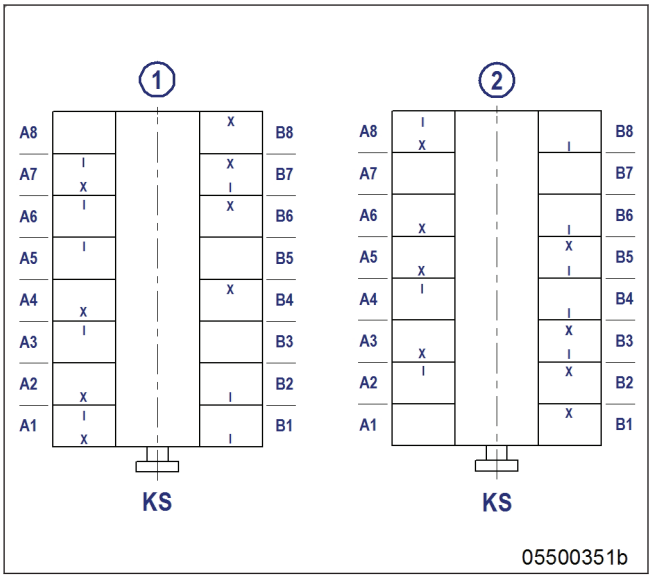
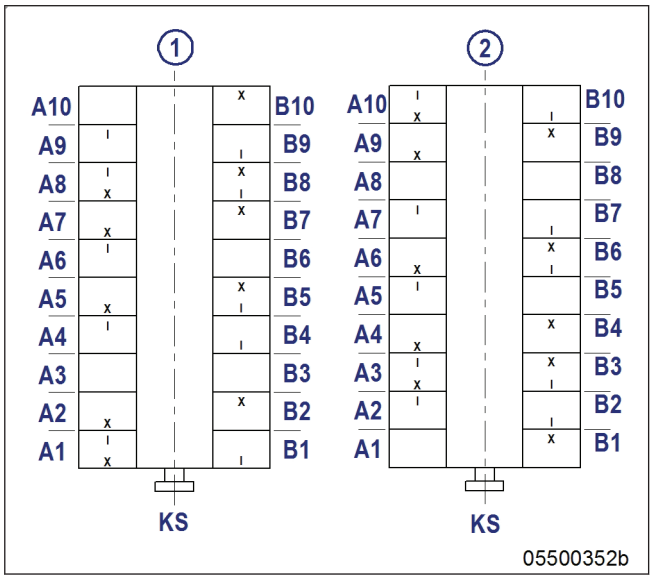


Diagram for 16V engines – Two crankshaft positions



TIM-ID: 0000062651 - 002

Diagram for 20V engines – Two crankshaft positions



Valve clearance at two crankshaft positions – Check

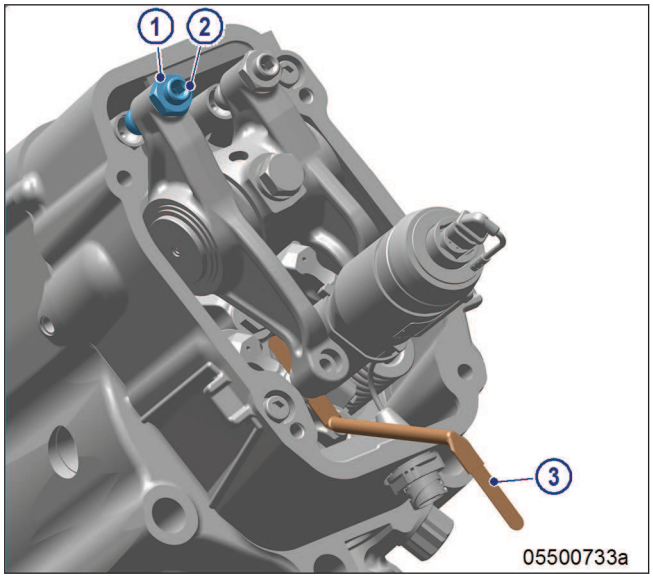
1. Check TDC position of piston in cylinder A1:
   - If rocker arms on cylinder A1 are unloaded, the piston is in firing TDC.
   - If rocker arms on cylinder A1 are loaded, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
   - Inlet (long rocker arm) = 0.2 mm ±0.05 mm
   - Exhaust (short rocker arm) = 0.5 mm ±0.05 mm
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
   - 1 Cylinder A1 is in firing TDC
   - 2 Cylinder A1 is in overlap TDC
   - I Inlet valve
   - X Exhaust valve
4. Use feeler gauge to determine distance between valve bridge and rocker arm.
5. If the deviation from the specified value exceeds 0.1 mm, adjust valve clearance.

Valve clearance – Adjustment

1. Release locknut (1).
2. Insert valve adjusting gauge (3) between valve bridge and rocker arm.
3. Use Allen key to set adjusting screw (2) so that the specified valve clearance is provided.

Note: Valve adjusting gauge must just pass through the gap.

4. Insert valve adjusting gauge (3) between valve bridge and rocker arm.



TIM-ID: 0000062651 - 002

5. Tighten locknut (1) with torque wrench to the specified tightening torque, holding the adjusting screw (2) to prevent it from turning.

Name	Size	Type	Lubricant	Value/Standard
Locknut	M16x1.5	Tightening torque	(Engine oil)	90 Nm +9 Nm **hand tightening**
Locknut	M16x1.5	Tightening torque	(Engine oil)	95 Nm ±9 Nm **machine tightening**

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

Final steps

1. Remove barring device (→ Page 154).
2. Install cylinder head cover upper section (→ Page 172).
3. Enable engine start.

TIM-ID: 0000062651 - 002

8.5.4 Cylinder head cover – Removal and installation

Preconditions

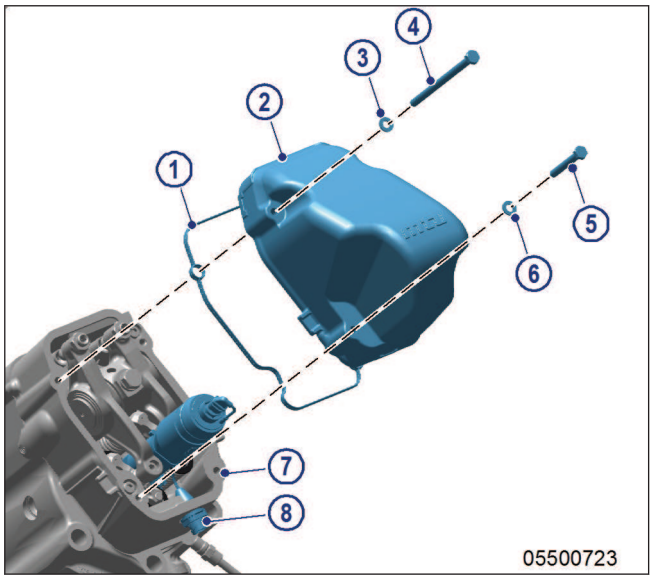
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

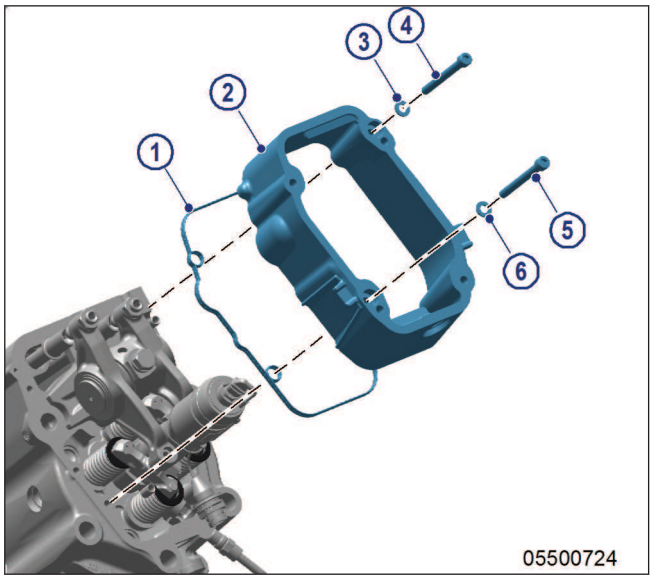
Designation / Use	Part No.	Qty.
Torque wrench, 4–20 Nm	F30044239	1
Assembly compound (Kluthe Hakuform 30-15)	X00067260	1
Gasket	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

Removing cylinder head cover

1. Clean very dirty cylinder head cover upper section (2) prior to removal.
2. Remove screws (4, 5) with washers (3, 6).
3. Remove cylinder head cover upper section (2) with gasket (1) from cylinder head cover lower section (7).
4. Screw out ESD connector (8) from cylinder head cover lower section (7).



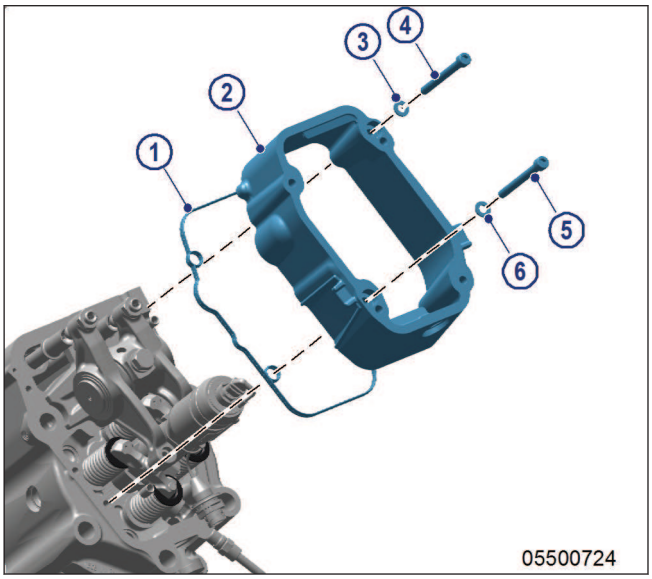
5. Remove screws (4, 5) with washers (3, 6).
6. Remove cylinder head cover lower section (2) with gasket (1) from cylinder head.

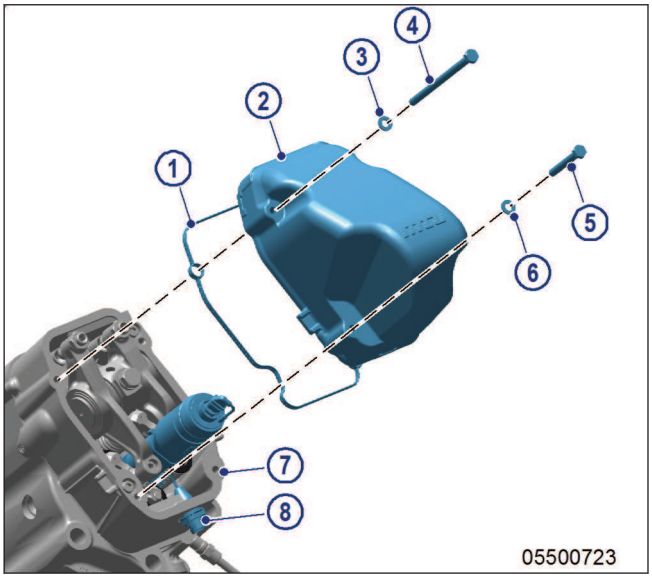


TIM-ID: 0000054366 - 003

Installing cylinder head cover

1. Clean installation surface.
2. Check gasket (1) for damage, replace as necessary.
3. Coat gasket (1) with assembly compound.
4. Place gasket (1) and cylinder head cover lower section (2) on cylinder head.
5. Install cylinder head cover lower section (2) with screws (4, 5) and washers (3, 6).





Note: Ensure that O-ring is positioned correctly.

6. Screw in ESD connector (8) in cylinder head cover lower section (7) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque		6 Nm + 1 Nm

7. Install pressure sensor on ESD connector (8) and tighten bayonet lock to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Connector		Tightening torque		1.2 Nm

8. Check gasket (1) for damage, replace as necessary.
9. Coat gasket (1) with assembly compound.
10. Place gasket (1) and cylinder head cover upper section (2) on cylinder head cover lower section (7).
11. Install cylinder head cover upper section (2) with screws (4, 5) and washers (3, 6).

TIM-ID: 0000054366 - 003

8.6 Injection Pump / HP Pump

8.6.1 HP fuel pump - Filling with engine oil

Preconditions

☑ Engine is stopped and starting disabled.

☑ HP pump is installed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10–60 Nm	F30452769	1
Fuel suction device	F30378207	1
Engine oil		

WARNING



Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

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.

NOTICE

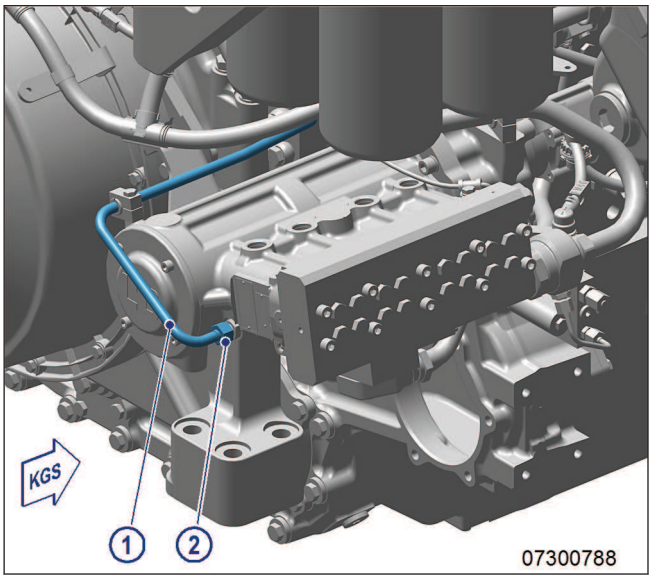


Contaminated components.
Risk of damage to component!
- Check components for special cleanliness and clean if necessary.

TIM-ID: 0000042838 - 005

Preparatory steps

▶ Loosen nut (2) and remove oil line (1) from HP pump.

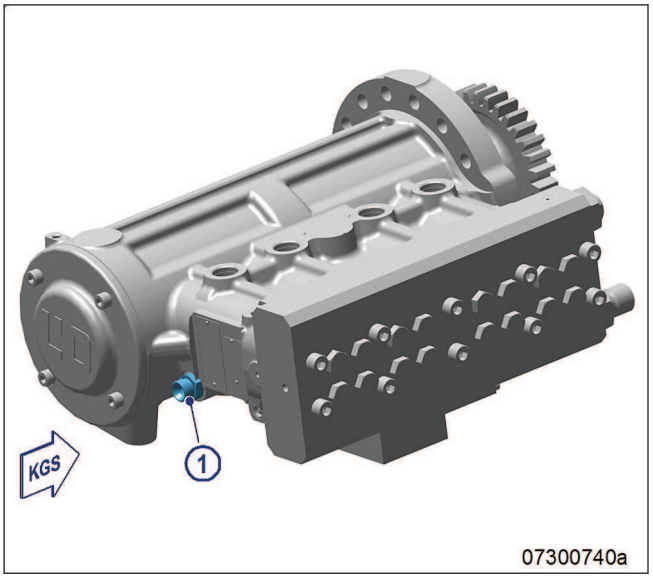


HP pump – Filling

1. Remove union (1).

Note: Excess engine oil runs into gear box.

2. Use fuel suction device to fill HP pump with 2 liters of clean engine oil.



3. Screw in union (1) and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union	M16x1.5	Tightening torque		40 Nm

Final steps

▶ Install oil line.

TIM-ID: 0000042838 - 005

8.7 Injector

8.7.1 Injector - Replacement

Special tools, Material, Spare parts

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

Injector – Replacement

▶ Remove injector and install new one (→ Page 177).

TIM-ID: 0000042329 - 002

8.7.2 Injector - Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Installation/removal jig	F6796646	1
Milling cutter	F30452739	1
Torque wrench, 4–20 Nm	F30044239	1
Torque wrench, 10–60 Nm	F30452769	1
Torque wrench, 60–320 Nm	F30452768	1
Assembly paste (Optimoly Paste White T)	40477	1
Assembly compound (Kluthe Hakuform 30-15)	X00067260	1
Engine oil		
O-ring	(→ Spare Parts Catalog)	

WARNING

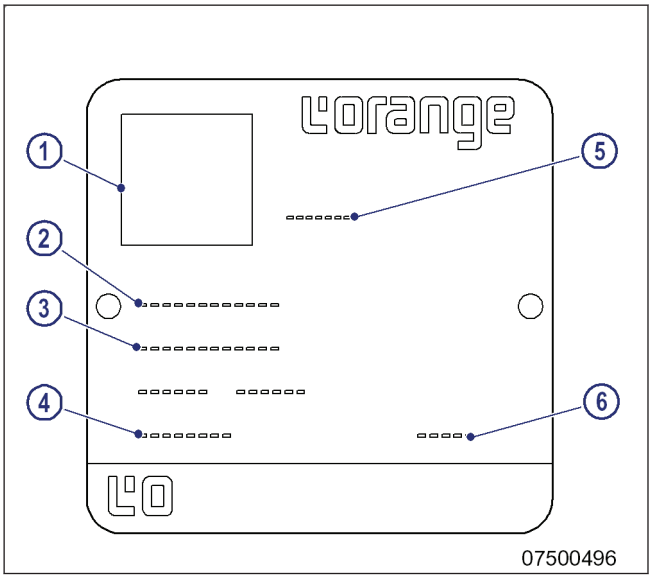
Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

NOTICE

Contamination of components.
Risk of damage to component!
- Seal off components with suitable covers.
- Check components for special cleanliness prior to installation/assembly and clean if necessary.

Label

1 DMC - Data Matrix Code
2 L'Orange part number
3 MTU part number
4 EMI-ID
5 Serial number
6 Date of manufacture



Preparatory steps

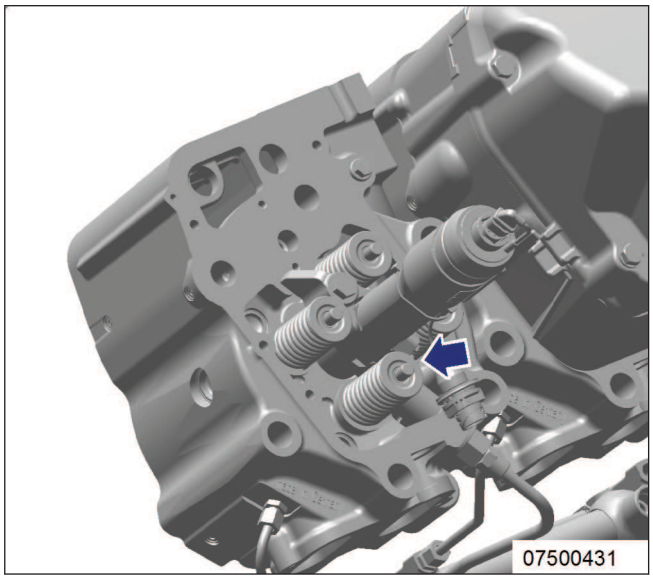
1. Close off fuel supply to engine.
2. Remove cylinder head cover (→ Page 172).

TIM-ID: 0000053873 - 004

Removing injector

Note: The cable connectors feature a latch, which is released by pulling the black connector housing backwards.

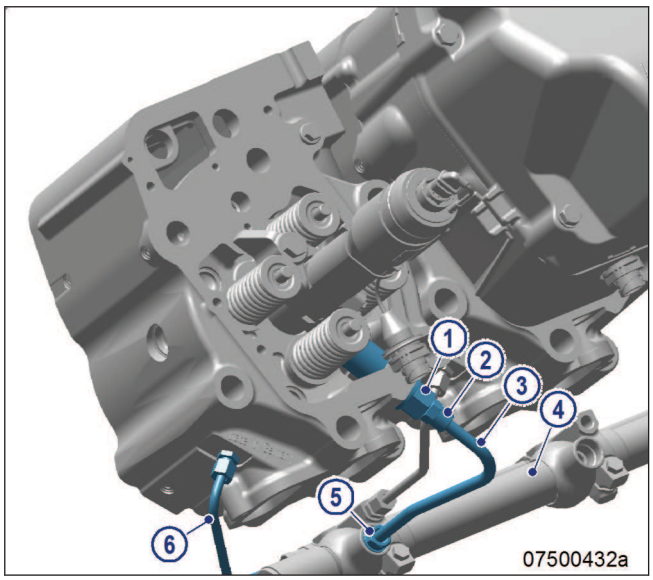
1. Disconnect connectors on injector (arrowed).



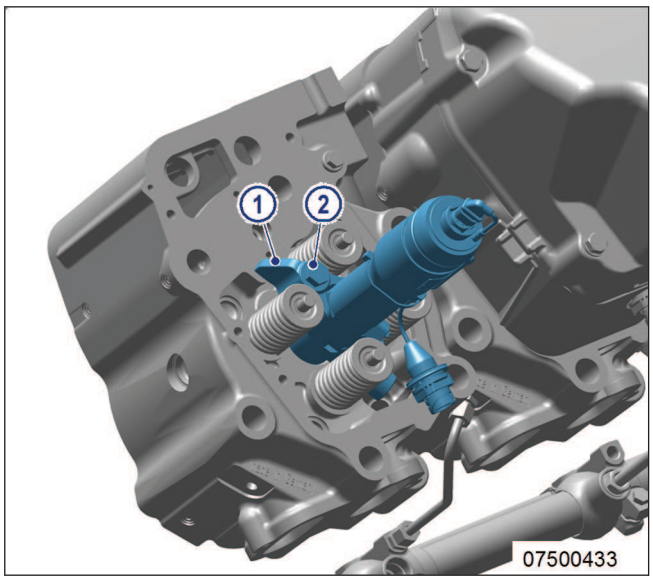
2. Unscrew union nuts (2, 5) and remove HP line (3) from rail (4) and cylinder head.

Note: When the adapter is unscrewed, the stored volume of the injector is emptied.

3. Provide suitable container to collect escaping fuel.
4. Remove adapter (1).
5. Loosen union nuts and remove return line (6).

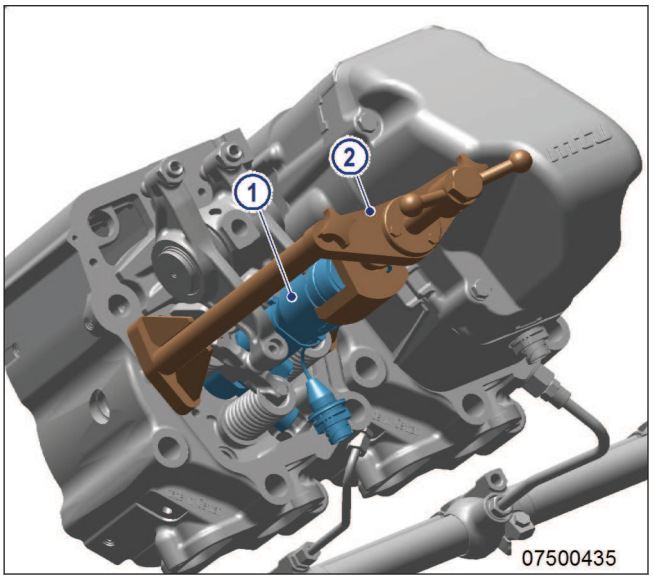


6. Remove screw (2) from hold-down clamp (1).



TIM-ID: 0000053873 - 004

7. Install installation/removal jig (2) on cylinder head.
8. Remove injector (1) and hold-down clamp with installation/removal jig (2).
9. Remove installation/removal jig (2).
10. Clean all mating and sealing surfaces.
11. If carbon residue is present, clean sealing face on cylinder head and protective sleeve with milling cutter.
12. Seal old injector with plug and cap of new injector.
13. Cover all connections and bores, or seal with suitable plugs.



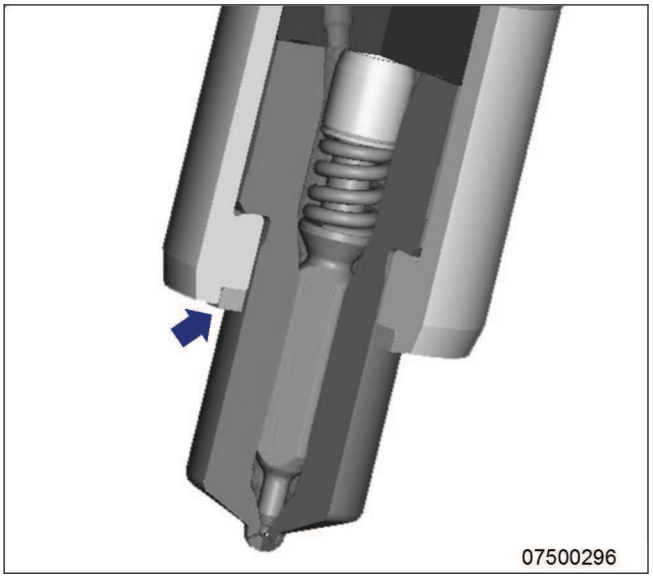
Installing injector

Note: Do not remove plug for HP line until directly before assembly of the adapter.

1. Prior to installation, remove plug.
2. Coat injector with assembly paste at the seat of the nozzle retaining nut.

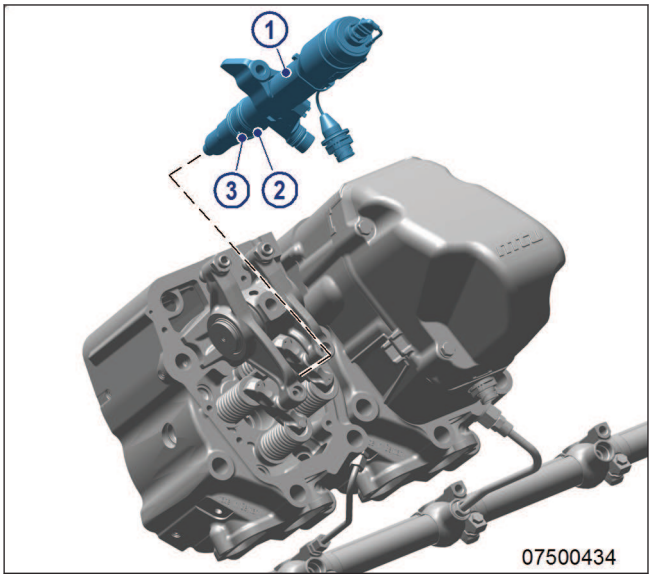
Note: A new sealing ring is included in the scope of delivery of the injector.

3. Insert new sealing ring (arrowed).



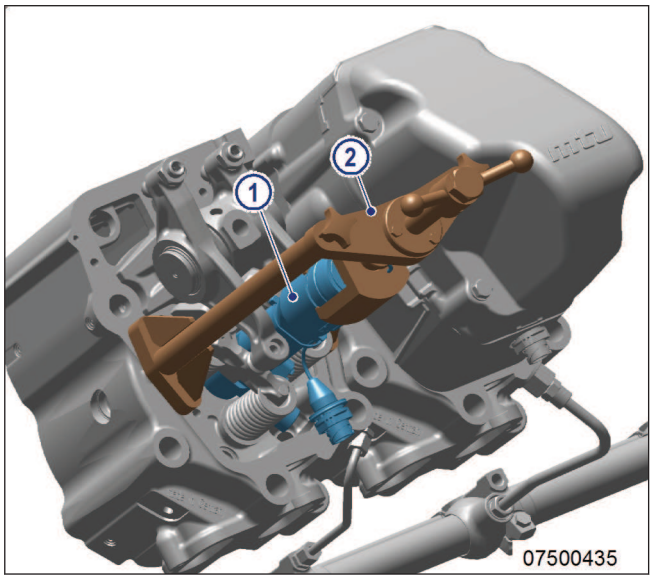
Note: New O-rings and damping ring are included in the scope of delivery of the injector and are pre-assembled.

4. Coat O-rings (2, 3) and damping ring on new injector (1) with assembly compound.
5. Insert injector (1) together with hold-down clamp into cylinder head, ensuring that the high-pressure fuel line connection is aligned correctly.

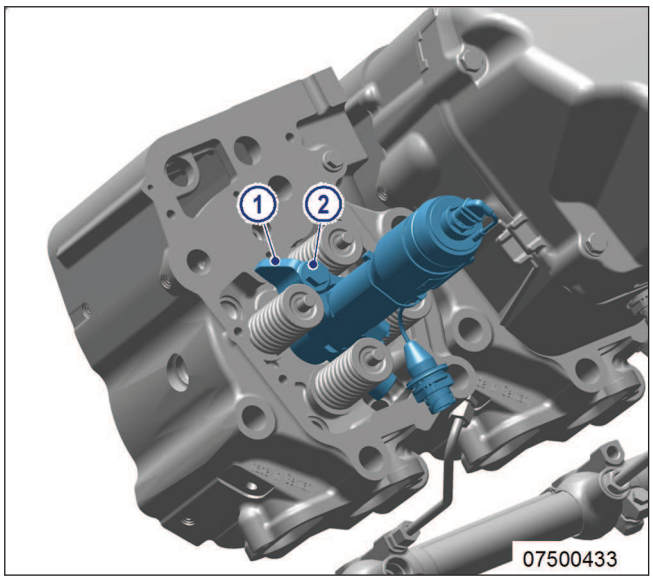


TIM-ID: 0000053873 - 004

6. Press in injector (1) and hold-down clamp with installation/removal jig (2).
7. Remove the installation/removal jig.

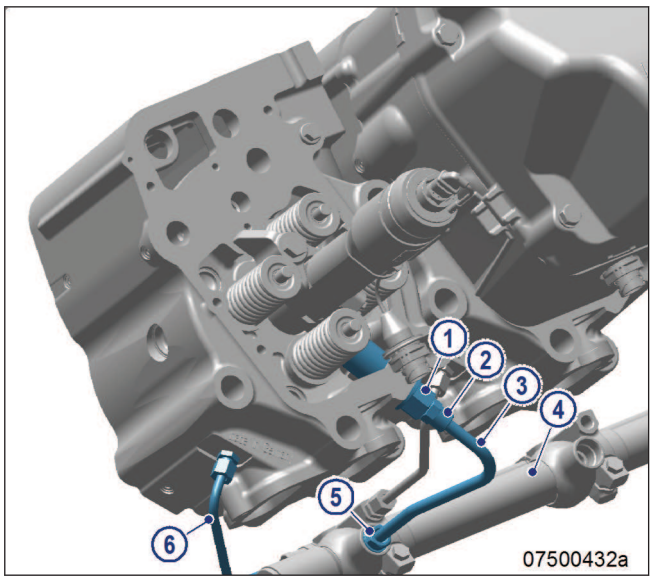


8. Coat screw head mating face on hold-down clamp (1) and screw head mating face and thread of screw (2) with engine oil.
9. Insert screw (2) and tighten hand-tight.



Note: Ensure immaculate cleanliness.

10. Coat thread and sealing cone of adapter (1) with engine oil.
11. Coat O-ring on injector and adapter (1) with assembly compound.
12. Install adapter (1) and tighten hand-tight.



TIM-ID: 0000053873 - 004

13. Tighten screw on hold-down clamp (→ Step 9) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12	Tightening torque	(Engine oil)	100 Nm +10 Nm

14. Tighten adapter (1) tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Adapter	M18	Tightening torque	(Engine oil)	100 Nm +10 Nm

Note: Ensure immaculate cleanliness.

15. Coat thread and sealing cone of HP line (3) with engine oil.

16. Tighten union nuts (2, 5) on HP line (3) to specified torque using a torque wrench. Tightening sequence:
    1 Nut on adapter (2), counterhold on adapter (1)
    2 Nut on rail (5)

Name	Size	Type	Lubricant	Value/Standard
Union nut / thrust screw	M12	Tightening torque	(Engine oil)	40 Nm +5 Nm

17. Release union nuts (2, 5) on HP line (3) approx. 45° angle of rotation while counterholding adapter (1) in relation to injector.

18. Tighten union nuts (2, 5) on HP line (3) without interruption once again to specified final tightening torque using a torque wrench. Tightening sequence:
    1 Nut on adapter (2), counterhold on adapter (1)
    2 Nut on rail (5)

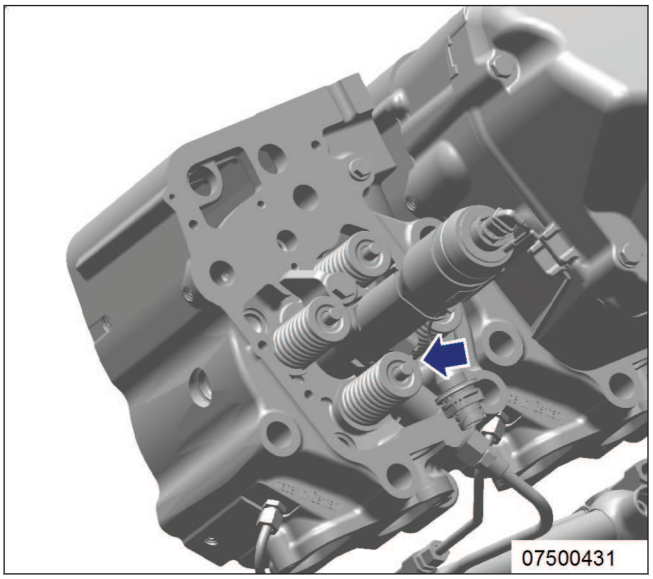
Name	Size	Type	Lubricant	Value/Standard
Union nut / thrust screw	M12	Tightening torque	(Engine oil)	40 Nm +5 Nm

19. Install return line (6) and tighten union nuts.

20. Fit connectors on injector (arrowed).

Note: If the drift correction (CDC) is not reset, the emission certification becomes invalid.

21. Reset drift correction (CDC) with DiaSys® (→ Dialog system DiaSys® E531920/..). If DiaSys® is not available, contact Service.



Final steps

1. Install cylinder head cover (→ Page 172).
2. Open fuel supply to engine.

TIM-ID: 0000053873 - 004

8.8 Fuel System

8.8.1 Fuel system – Venting

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		

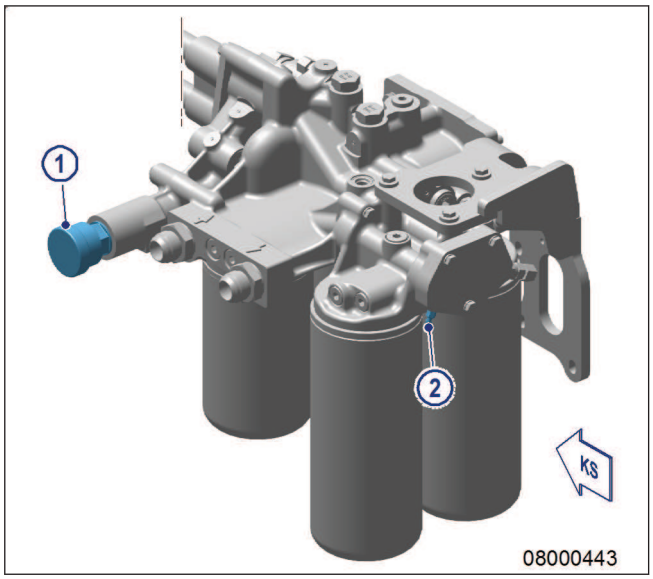
WARNING



Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

Venting LP fuel system – 12V

1. Open threaded vent plug (2) and connect a suitable hose.
2. Provide suitable container to collect escaping fuel.



TIM-ID: 0000063487 - 002

Note: See figure (a).

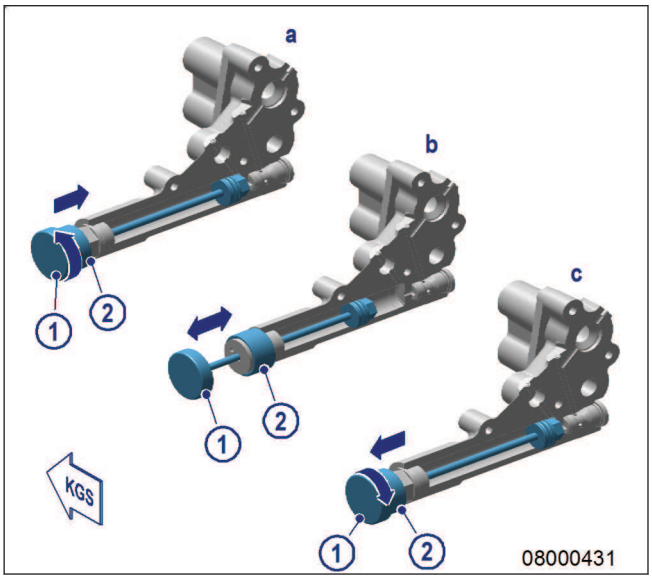
3. Unlock hand pump: Hold sleeve (2) firmly. Turn handle (1) counterclockwise until the sleeve can be pushed backwards (arrow).

Note: See figure (b).

4. Operate the pump with the handle (1) until bubble-free fuel escapes from the vent plug.
5. Close vent plug.
6. Continue to operate the pump until resistance is noticeable (at least 50 times), to achieve full filling height.

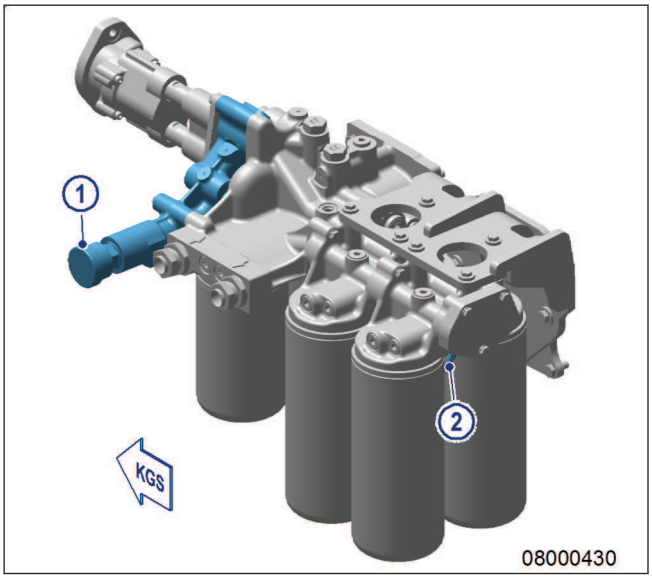
Note: See figure (c).

7. Lock hand pump: Push sleeve (2) forward and hold it. Turn handle (1) clockwise until both parts are screwed together hand-tight.
8. Remove hose from vent plug.
9. Verify that the fuel hand pump is securely locked: Handle (1) must be tightened hand-tight.



Venting LP fuel system – 16V and 20V

1. Open threaded vent plug (2) and connect a suitable hose.
2. Provide suitable container to collect escaping fuel.



TIM-ID: 0000063487 - 002

Note: See (a).

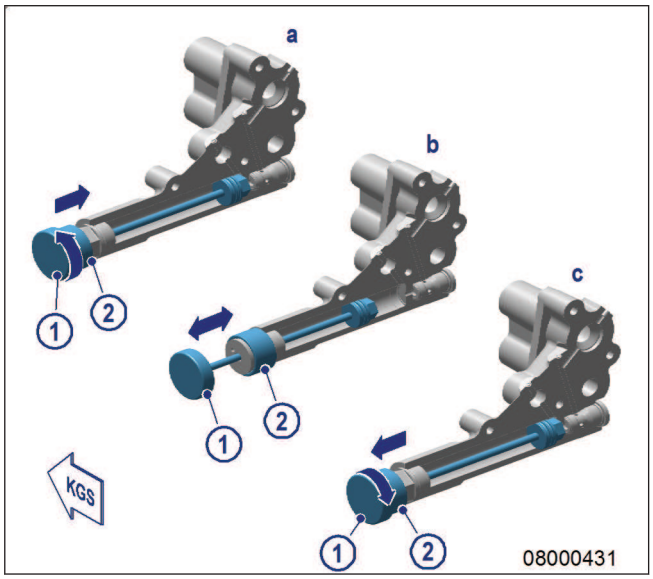
3. Unlock hand pump: Hold sleeve (2) firmly. Turn handle (1) counterclockwise until the sleeve can be pushed backwards (arrow).

Note: See (b).

4. Operate the pump with the handle (1) until bubble-free fuel escapes from the vent plug.
5. Close vent plug.
6. Continue to operate the pump until noticeable resistance occurs (at least 50 times) to achieve full filling height.

Note: See (c).

7. Lock hand pump: Push sleeve (2) forward and hold it. Turn handle (1) clockwise until both parts are screwed together hand-tight.
8. Remove hose from vent plug.
9. Verify that the fuel hand pump is securely locked: Handle (1) must be tightened hand-tight.



TIM-ID: 0000063487 - 002

8.9 Fuel Filter

8.9.1 Fuel 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		
Easy-change filter	(→ Spare Parts Catalog)	2

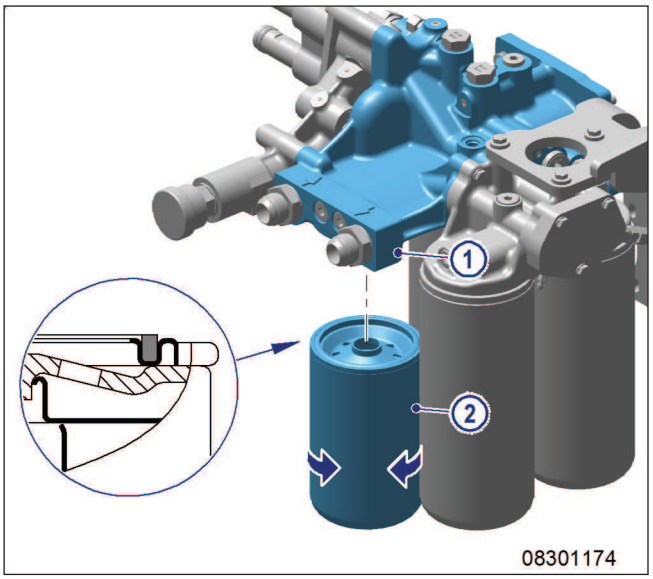
WARNING



Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

Fuel filter – Replacement

1. Provide suitable container to collect escaping fuel.
2. Remove easy-change filter (2) with filter wrench.
3. Clean sealing face on filter head (1).
4. Apply a thin film of engine oil to the seal (arrow) on easy-change filter (2).
5. Screw on easy-change filter (2) by hand until the seal makes contact with the filter head and tighten by hand.
6. Replace other easy-change filters in the same way.
7. Vent fuel system (→ Page 182).



TIM-ID: 0000063489 - 001

8.9.2 Fuel prefilter with internal electrical priming pump - Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		

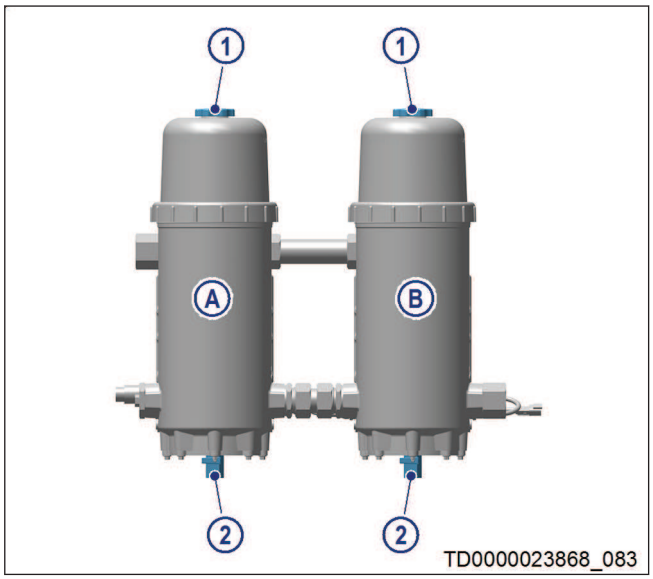
WARNING



Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

Fuel prefilter – Draining

1. Close shut-off valve in fuel supply line for filter A and B.
2. Open threaded vent plug (1) of the filter that should be drained.
3. Open drain valve (2) and drain water and contaminates until clear fuel emerges.
4. Close drain valve (2).
5. Fill filter housing with clean fuel through the vent plug opening.
6. Tighten vent plug (1) by hand until it clicks.
7. Open shut-off valve in fuel supply line for filter A and B.



TIM-ID: 0000082688 - 001

8.9.3 Fuel prefilter with internal electrical priming pump - Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	
Collar wrench	(→ Scope of Supply)	

WARNING



Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

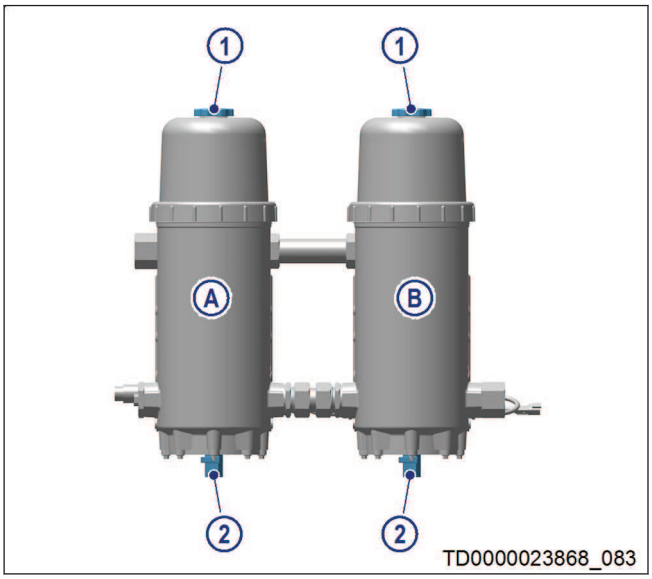
WARNING



Liquid or gaseous media, e.g. fuel, are poisonous.
Escaping vapors of highly volatile media, e.g. fuel or ether.
Risk of fatal injury through swallowing; risk of poisoning through inhalation; irritation to eyes and skin!
- Seek medical attention immediately; do not induce vomiting.
- Do not inhale vapors or mist.
- Wear protective clothing, protective gloves, and safety glasses.
- If contact is made with skin, wash off with water and soap.

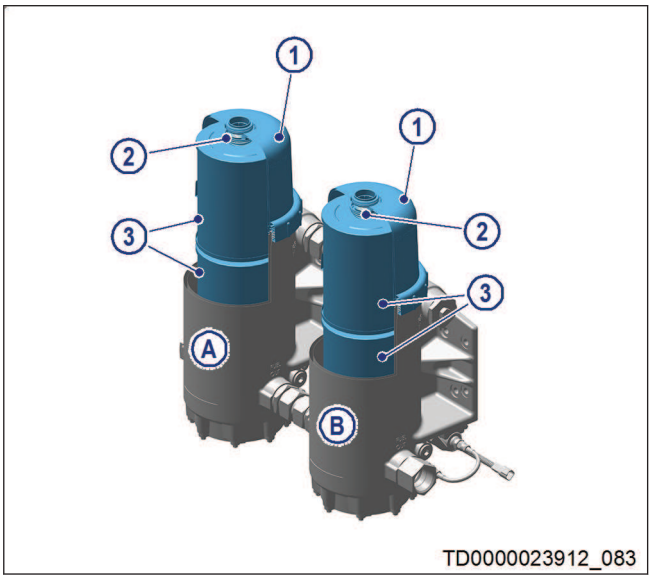
Replacing filter element

1. Close shut-off valve in fuel supply line for filter A and B.
2. Open threaded vent plug (1) of the filter to be replaced.
3. Open drain valve (2) and drain filter completely.
4. Close drain valve (2).

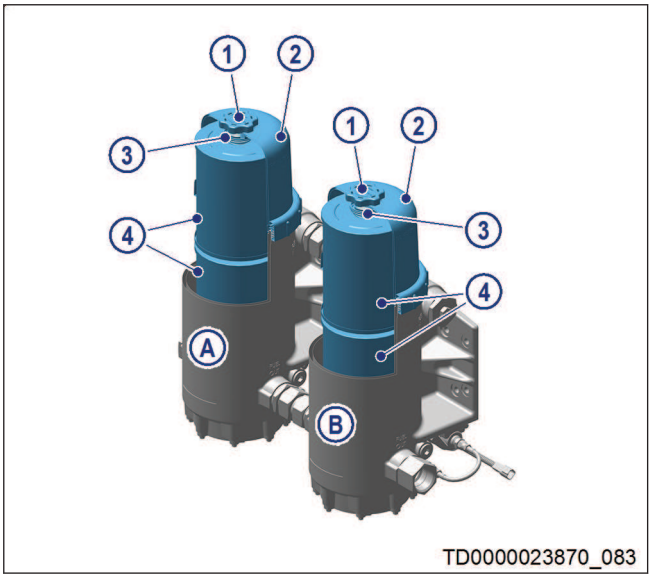


TIM-ID: 0000082689 - 001

5. Use collar wrench to remove clear cover (1) with spring (2) and discard the O-ring from the cover.
6. Remove filter elements (3) by pulling them upwards.
7. Install new O-ring (supplied with new filter elements.) in cover.

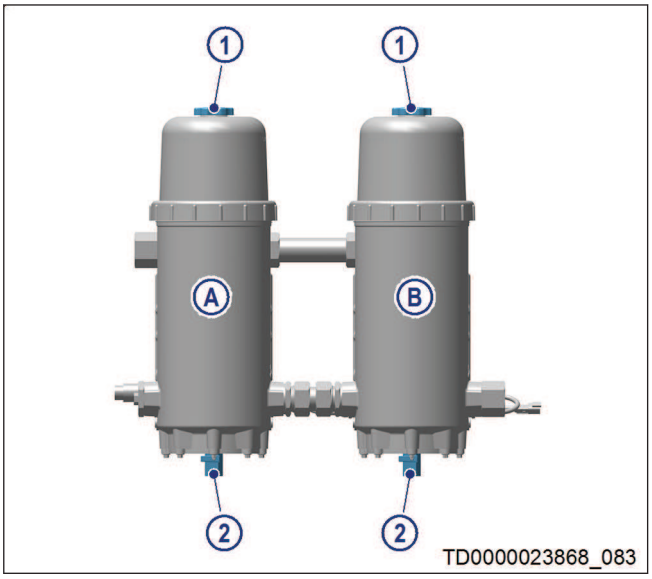


8. Insert new filter elements (4) in filter housing.
9. Use collar wrench to tighten clear cover (2) with spring (3).



Venting when only the prefilter elements are replaced

1. Fill filter housing with clean fuel through the opening of the threaded vent plug (1).
2. Tighten the threaded vent plug (1) by hand until it clicks.
3. Open shut off valve in fuel supply line for filter A and B.

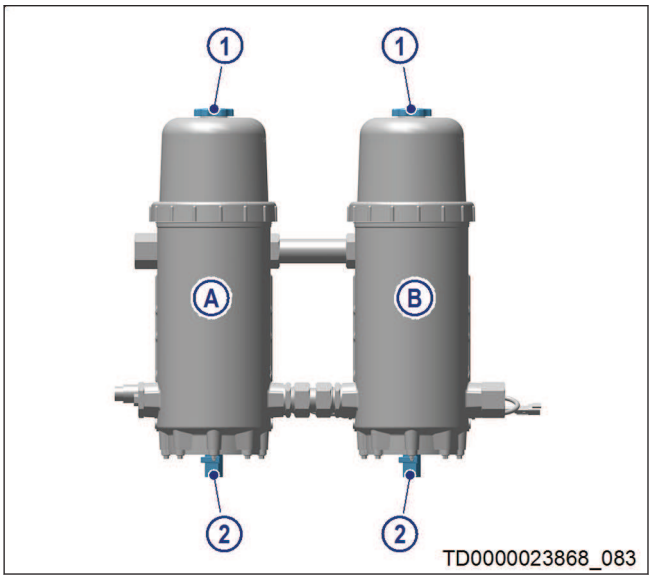


TIM-ID: 0000082689 - 001

Venting when the whole filter chain is replaced (prefilter, primary filter, secondary filter)

Note: If only the primary and secondary filters are replaced, the pump of the prefilter can be used instead of the hand pump to vent the primary and secondary filters.

1. Tighten threaded vent plug (1) of prefilter by hand until it clicks.
2. Open shut off valve in fuel supply line for filter A and B.
3. Open threaded vent plug primary filter (→ Page 182) and connect a suitable hose to collect escaping fuel.
4. Run electrical priming pump of prefilter until bubble-free fuel escapes at the vent plug on the primary filter.
5. Close threaded vent plug on primary filter.



TIM-ID: 0000082689 - 001

8.9.4 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
Engine oil		
Easy-change filter	(→ Spare Parts Catalog)	2

WARNING



Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

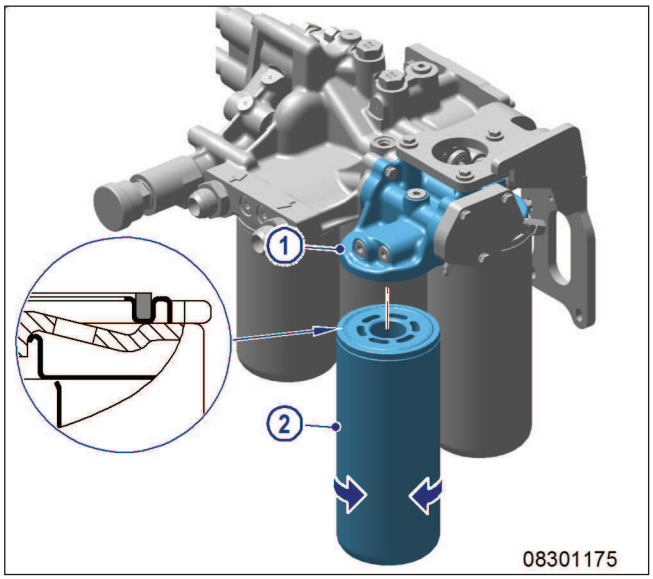
WARNING



Liquid or gaseous media, e.g. fuel, are poisonous.
Escaping vapors of highly volatile media, e.g. fuel or ether.
Risk of fatal injury through swallowing; risk of poisoning through inhalation; irritation to eyes and skin!
- Seek medical attention immediately; do not induce vomiting.
- Do not inhale vapors or mist.
- Wear protective clothing, protective gloves, and safety glasses.
- If contact is made with skin, wash off with water and soap.

Replacing additional fuel filter

1. Provide suitable container to collect escaping fuel.
2. Use filter wrench to remove easy-change filter (2).
3. Clean sealing face on filter head (1).
4. Coat gasket on easy-change filter (2) with thin layer of engine oil (arrow).
5. Screw on easy-change filter (2) by hand until the seal makes contact with the filter head and tighten manually.
6. Replace other easy-change filters in the same way.
7. Vent fuel system (→ Page 182).



TIM-ID: 0000063488 - 002

8.10 Charge-Air Cooling

8.10.1 Charge-air cooler – Leak check

DANGER

Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

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.

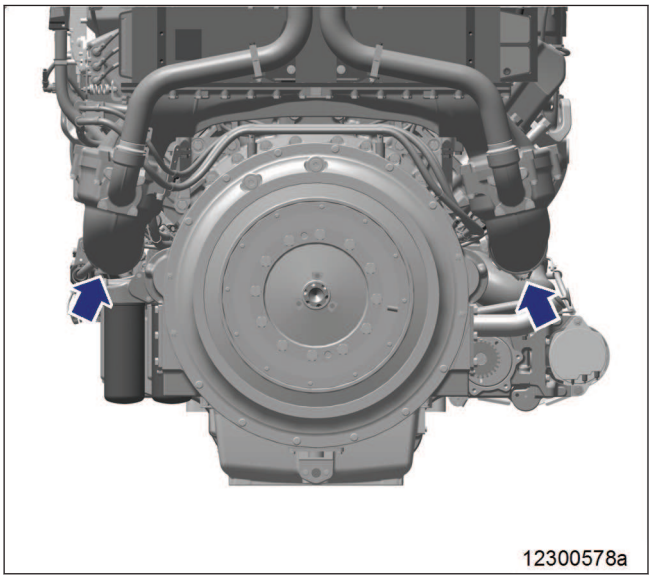
WARNING

Condensation contains acid.
Risk of chemical burns!
- Wear protective goggles.
- Wear protective gloves.

Charge-air cooler leak check

1. With the engine at standstill, open the plug screws in the charge-air elbows on the left and right engine sides on driving end (arrows).
2. If necessary, use a suitable tool to remove obstructions and check the openings for coolant discharge.

Result: If a large amount of coolant is discharged, contact Service.



Emergency measures prior to engine start with a leaking charge-air cooler

1. Remove injector (→ Page 177).
2. Bar engine manually (→ Page 154).
3. Bar engine with starting system to blow out combustion chambers (→ Page 155).

Note: Install injectors in their original fitting position.

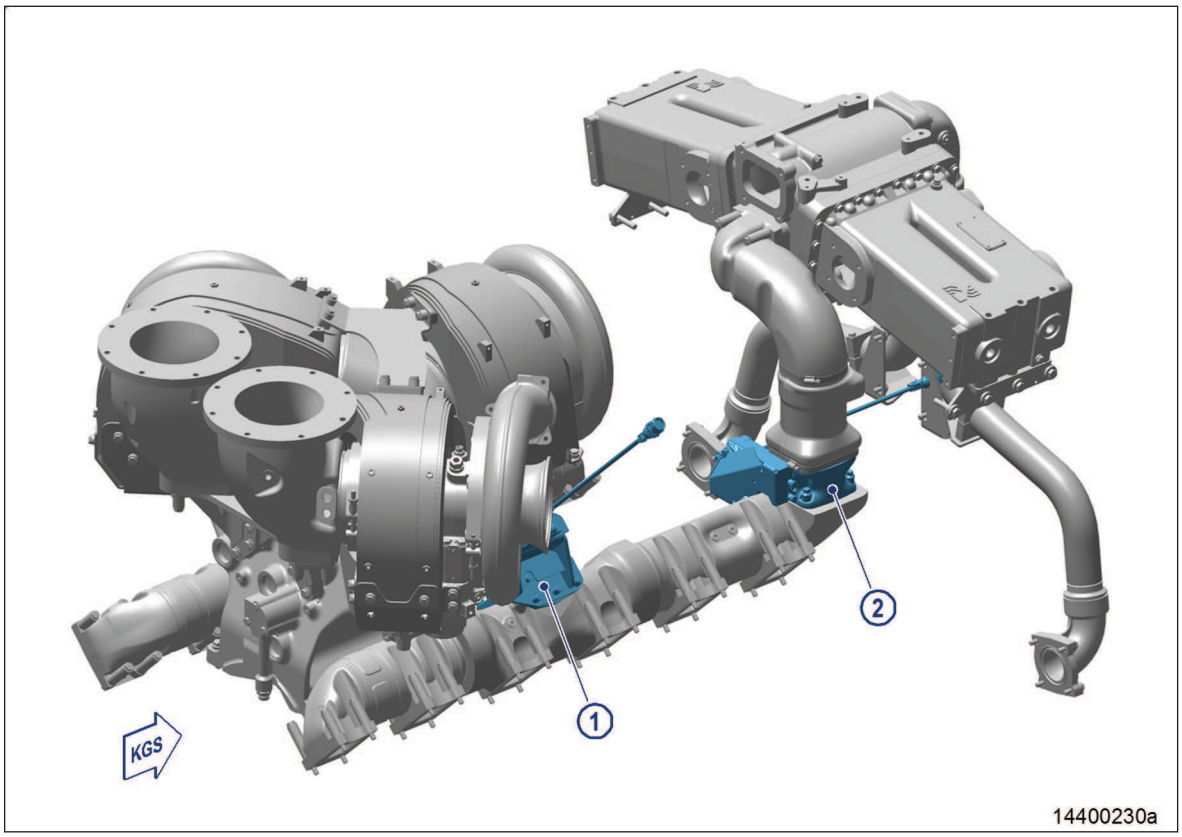
4. Install injector (→ Page 177).

TIM-ID: 0000018644 - 007

8.11 Exhaust Gas Recirculation

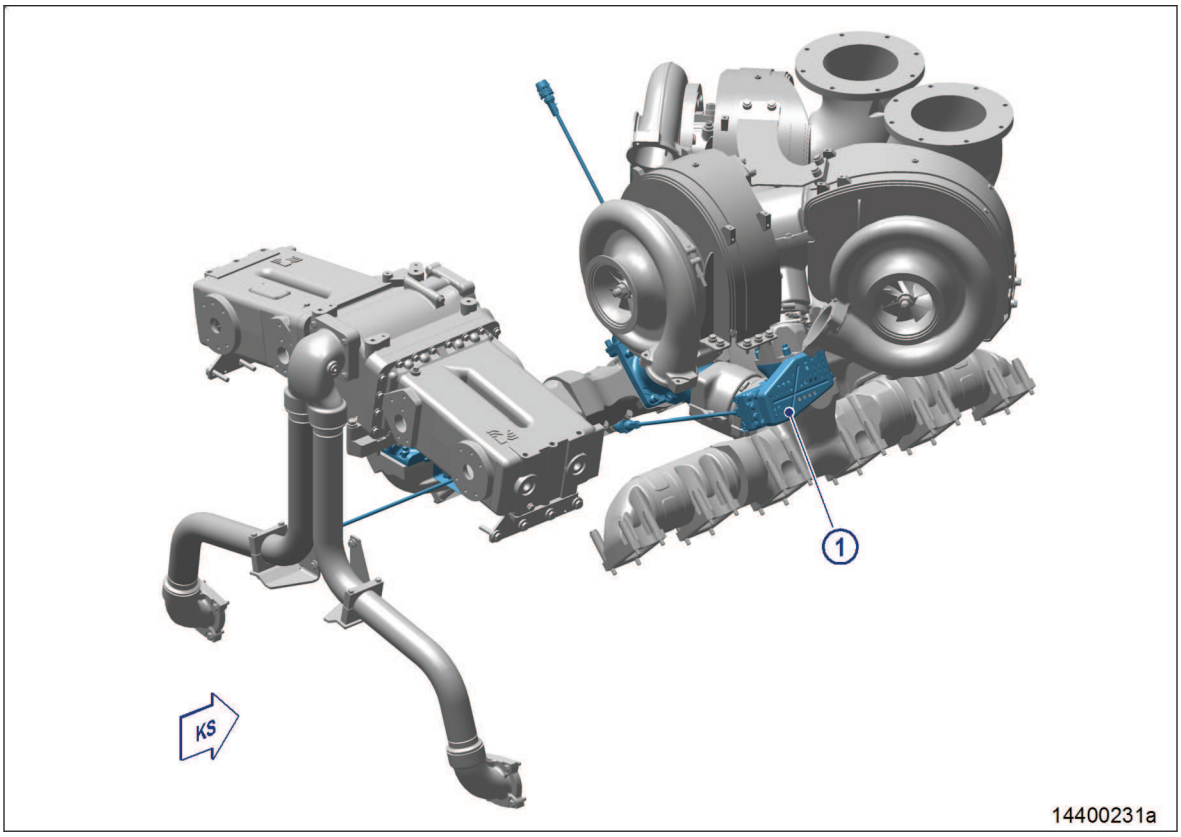
8.11.1 Exhaust flaps overview - 12V and 16V

Exhaust flaps overview – 12V



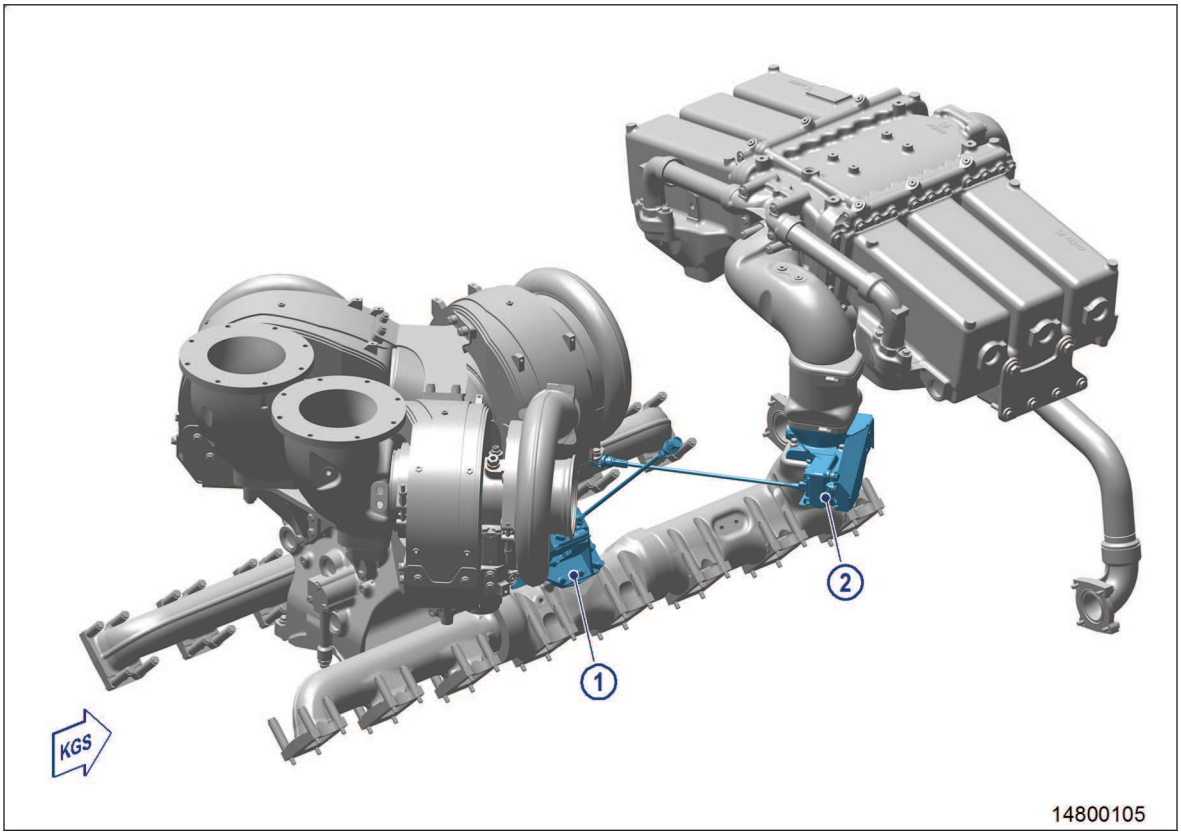
1 Dispenser cylinder flap 2 EGR shutoff flap

TIM-ID: 0000063475 - 002



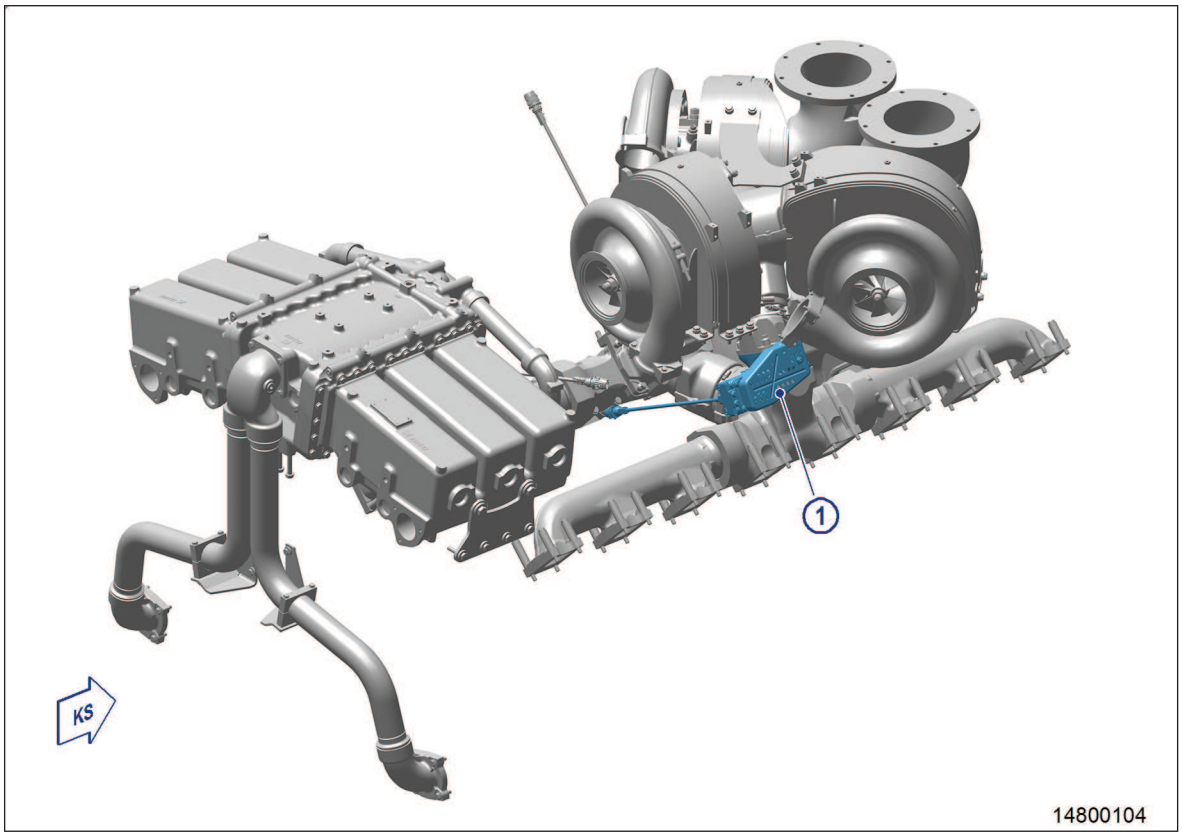
1 Bypass flap

Exhaust flaps overview – 16V



1 Dispenser cylinder flap 2 EGR shutoff flap

TIM-ID: 0000063475 - 002



1 Bypass flap

TIM-ID: 0000063475 - 002

8.11.2 Exhaust flaps – Checking coupling rod clearance and function

Preconditions

☑ Engine is stopped and starting disabled.

☑ No operating voltage applied.

WARNING

Actuation mechanism in the exhaust and intake area closes automatically.
Risk of crushing hands!
- To carry out the teach-in routine, keep clear of the safety zone of the actuation mechanism in the intake and exhaust area.
- Switch off the operating voltage of the engine governor before starting the mechanical test.
- Wear protective goggles.

WARNING

Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

Checking coupling rods (bypass and EGR flap) – mechanical

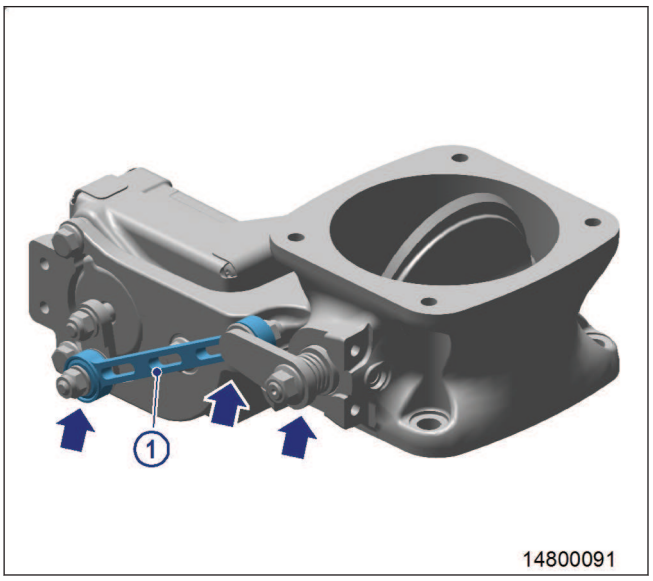
Note: For installation position of exhaust flaps, refer to overview (→ Page 192).

1. Remove guard plates of exhaust flaps (→ Page 197).
2. Check operability and ease of movement of coupling rod (1) by moving it at the specified points (arrows) and make sure that there is no excessive play.

Result: Replace coupling rod (1) if it is jamming, sluggish or features excessive play (→ Page 197).

3. Check whether the internal spring pulls the flap into the F-position:
   - Fail-safe position for bypass flap and EGR shutoff flap: opened.
   - Fail-safe position for donor cylinder flap: closed.

Result: If the bypass flap/EGR shutoff flap is closed or the donor cylinder flap is opened, contact Service.



Checking coupling rod (donor cylinder flap) – mechanical

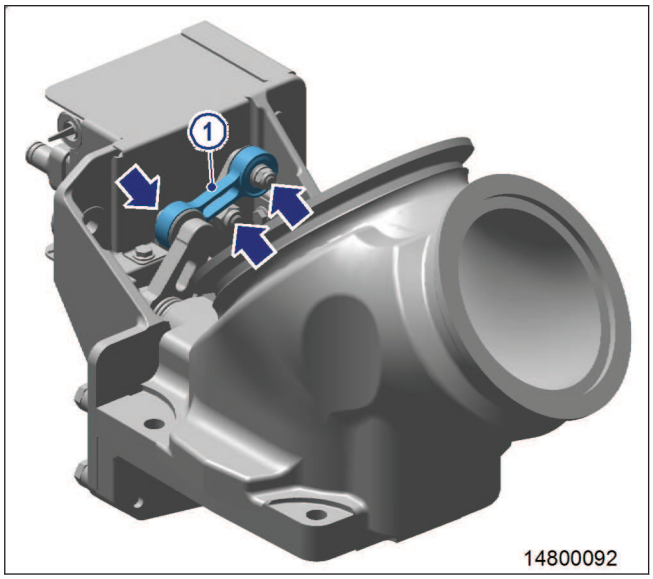
Note: For installation position of exhaust flaps, refer to overview (→ Page 192).

1. Remove guard plates of exhaust flaps.

TIM-ID: 0000060224 - 001

2. Check operability and ease of movement of coupling rod (1) by moving it at the specified points (arrows) and make sure that there is no excessive play.

Result: Replace coupling rod (1) if it is jamming, sluggish or features excessive play (→ Page 197).



TIM-ID: 0000060224 - 001

8.11.3 Exhaust flaps – Coupling rod replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ No operating voltage applied.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6–50 Nm	F30027336	1
Ratchet adapter	F30027340	1
Assembly paste (Ultra-Therm MTU)	50547	
Coupling rod	(→ Spare Parts Catalog)	1
Coupling rod	(→ Spare Parts Catalog)	2
Locknut	(→ Spare Parts Catalog)	
Locking screw	(→ Spare Parts Catalog)	
Washer	(→ Spare Parts Catalog)	

WARNING

Actuation mechanism in the exhaust and intake area closes automatically.
Risk of crushing hands!
- To carry out the teach-in routine, keep clear of the safety zone of the actuation mechanism in the intake and exhaust area.
- Switch off the operating voltage of the engine governor before starting the mechanical test.
- Wear protective goggles.

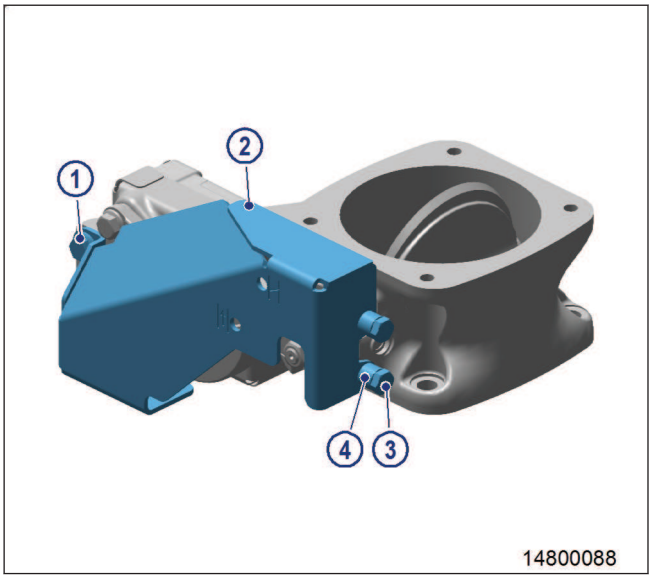
WARNING

Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

Removing coupling rods (bypass and EGR shutoff flaps)

Note: For installation position of exhaust flaps, refer to overview (→ Page 192).

1. Unscrew screws (1, 3) and remove guard plate (2) for exhaust flaps.
2. Remove spacer sleeves (4).

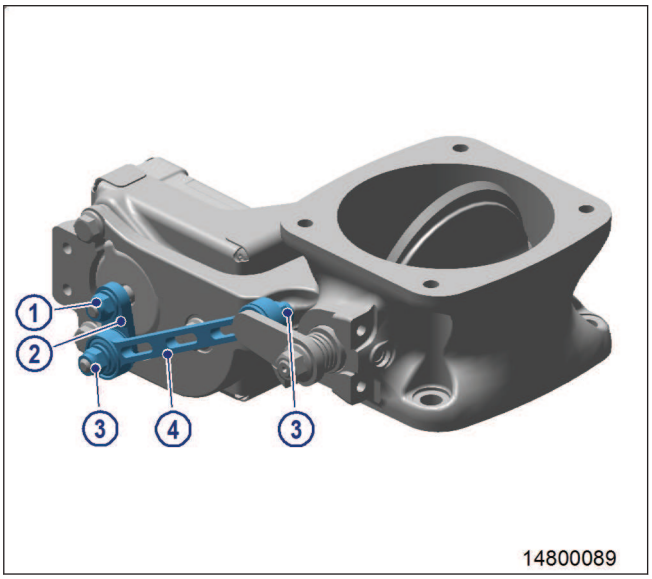


TIM-ID: 0000060174 - 001

3. Unscrew locknuts (3) with washers.
4. Unscrew locknut (1) with washer.

Result: Lever detached from actuator output shaft.

5. Remove coupling rod (4) and lever (2).
6. Remove washers.



Installing coupling rods (bypass and EGR shutoff flaps)

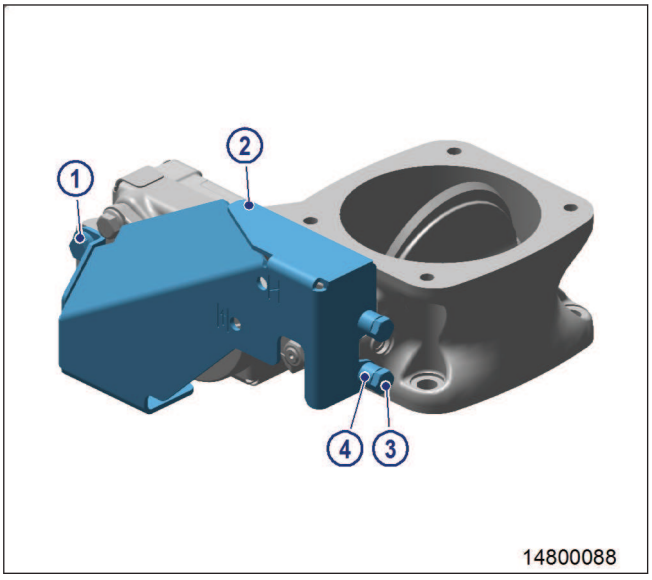
1. Insert coupling rod (4) and washers.
2. Tighten lever (2) with locknut (1) on output shaft to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque	(Assembly paste (Ultra-Therm MTU))	16 Nm ±2 Nm

3. Tighten washers and locknuts (3) to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque	(Assembly paste (Ultra-Therm MTU))	16 Nm ±2 Nm

4. Mount guard plate (2).



5. Tighten securing screws (1) to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Assembly paste (Ultra-Therm MTU))	35 Nm ±2 Nm

TIM-ID: 0000060174 - 001

6. Tighten screws (3) with spacer sleeves (4) to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Assembly paste (Ultra-Therm MTU))	10 Nm ±1 Nm

Note: After every change to the exhaust gas recirculation mechanical system, the DiaSys® must be used to carry out an actuator test (learning run) (→ Dialog system E531920/..).

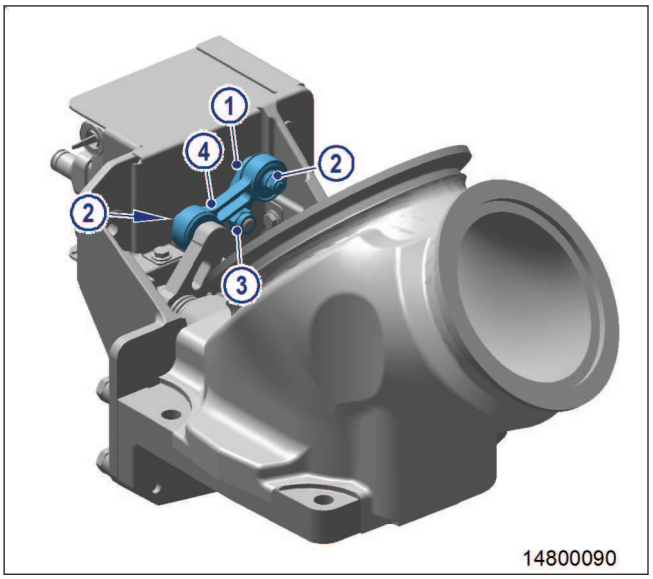
Removing coupling rod (donor cylinder flap)

Note: For installation position of exhaust flaps, refer to overview drawing (→ Page 192).

1. Unscrew locknuts (2) with washers.
2. Unscrew locknut (3).

Result: Lever detached from actuator output shaft.

3. Remove coupling rod (4) and lever (1).
4. Remove washers.



Installing coupling rod (donor cylinder flap)

1. Insert coupling rod (4) and washers.
2. Tighten lever (1) with locknut (3) on output shaft to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque	(Assembly paste (Ultra-Therm MTU))	16 Nm ±2 Nm

3. Tighten locknuts (2) with washers to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque	(Assembly paste (Ultra-Therm MTU))	10 Nm ±1 Nm

Note: After every change to the exhaust gas recirculation mechanical system, the DiaSys® must be used to carry out an actuator test (learning run) (→ Dialog system E531920/..).

TIM-ID: 0000060174 - 001

8.12 Starting Equipment

8.12.1 Starter - Condition check

Preconditions

☑ Engine is stopped and starting disabled.

Starter – Condition check

1. Check securing screws of starter and nut on cable connection for secure seating and tighten if required.
2. Check cabling (→ Page 251).

TIM-ID: 0000000905 - 019

8.13 Lube Oil System, Lube Oil Circuit

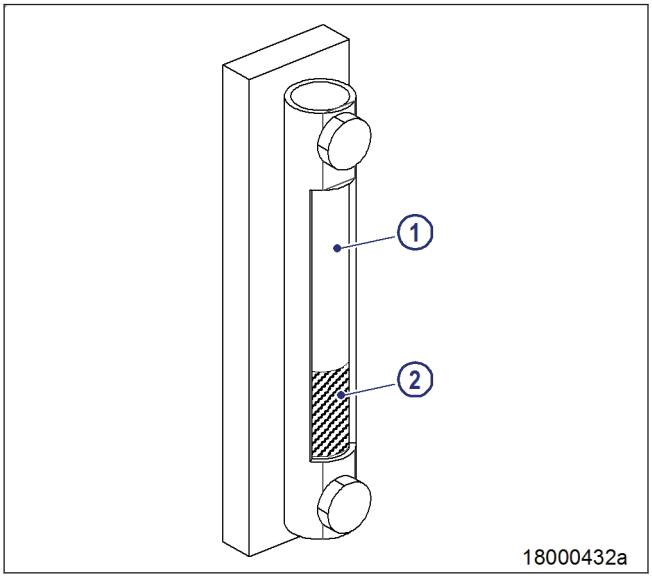
8.13.1 Engine oil level – Check at sight glass

Preconditions

☑ Engine is stopped and starting disabled.

Engine oil level check at sight glass

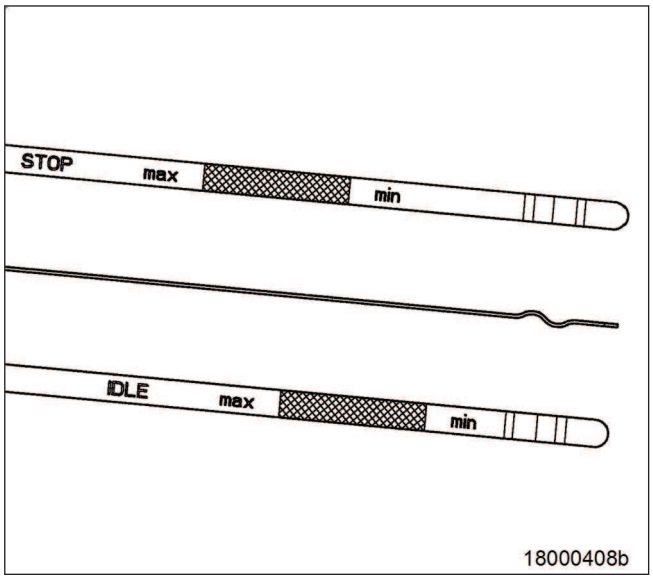
1. Make a preliminary visual check of oil level (2) at the sight glass (1).
2. A proper engine oil level check must always be carried out using the oil dipstick (→ Page 202).



TIM-ID: 0000038098 - 002

8.13.2 Engine oil - Level check with oil dipstick

Checking oil level prior to engine start – Variant A

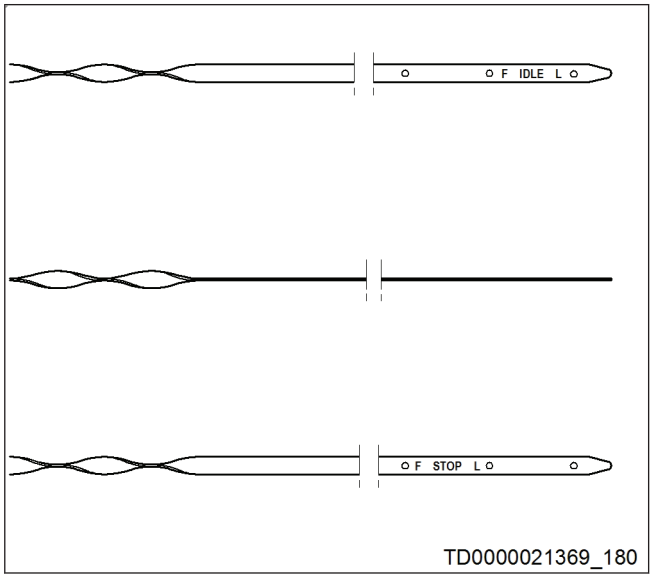


1. Remove oil dipstick from guide tube and wipe it clean.
2. Insert dipstick into guide tube up to the stop, pull out after approx. 10 seconds. Check oil level on oil dipstick side marked “5 Min. after Stop“.

Note: After extended out-of-service periods, the oil level may be up to 2 cm above the “max. “ mark. This might be caused by engine oil flowing from oil filter and heat exchanger back into the oil pan.

3. The oil level must reach the “max.“ mark or exceed it by up to 2 cm.
4. If necessary, top up to “max.“ mark (→ Page 204).
5. Insert oil dipstick into guide tube up to stop.

Checking oil level prior to engine start – Variant B



1. Remove oil dipstick from guide tube and wipe it clean.
2. Insert dipstick into guide tube up to the stop, pull out after approx. 10 seconds. Check oil level on the dipstick side marked “Stop“.

Note: After extended out-of-service periods, the oil level may be up to 2 cm above the “F“ mark. This might be caused by engine oil flowing from oil filter and heat exchanger back into the oil pan.

3. The oil level must reach the “max.“ mark or exceed it by up to 2 cm.
4. If necessary, top up until level reaches “max.” mark (→ Page 204).
5. Insert oil dipstick into guide tube up to stop.

Checking engine oil level with the engine running

1. After the engine has run for approx. 10 minutes at a constant speed of 600 to 900 rpm, pull out oil dipstick from guide tube and wipe it.
2. Insert dipstick into guide tube up to the stop, pull out after approx. 10 seconds. Check oil level on the dipstick side marked “IDLE“.
3. Oil level must not be lower than the “min“ mark.
4. If necessary, top up to “max.“ mark (→ Page 204).

TIM-ID: 0000081058 - 001

Checking engine oil level after engine has stopped

1. 5 minutes after stopping the engine, remove oil dipstick from the guide tube and wipe it.
2. Insert dipstick into guide tube up to the stop, pull out after approx. 10 seconds. Check oil level on oil dipstick side marked “5 Min. after Stop“ or “Stop”.
3. Oil level must be between “min.” and “max.“ marks.
4. If necessary, top up to “max.“ mark (→ Page 204).
5. Insert oil dipstick into guide tube up to stop.

TIM-ID: 0000081058 - 001

8.13.3 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, 10–60 Nm	F30452769	1
Torque wrench, 60–320 Nm	F30452768	1
Torque wrench, 300–800 Nm	F30047798	1
Ratchet bit	F30027341	1
Ratchet bit	F30450902	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

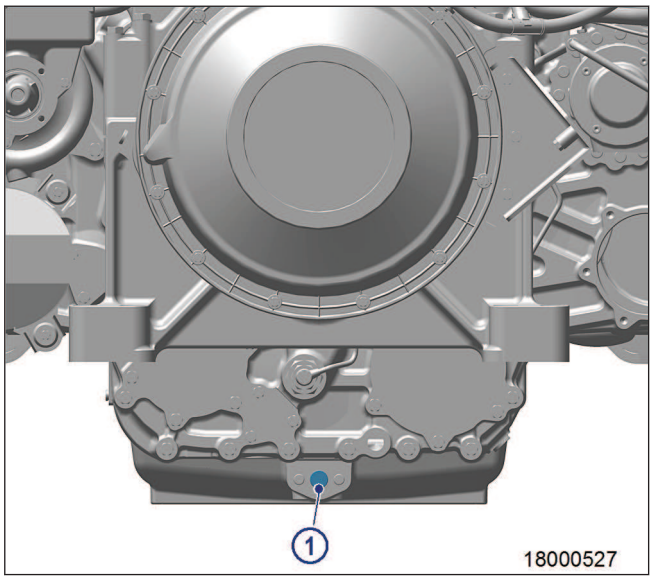
WARNING



Oil is hot.
Oil can contain residue/substances which are harmful to health.
Risk of injury and poisoning!
- Allow the product to cool to below 50 °C before beginning work.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Oil change without semirotary hand pump: Draining engine oil at drain plug(s) on oil pan

1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plugs (1) on driving and free end and drain engine oil.
3. Fit drain plugs (1) on driving and free end and with new sealing ring.



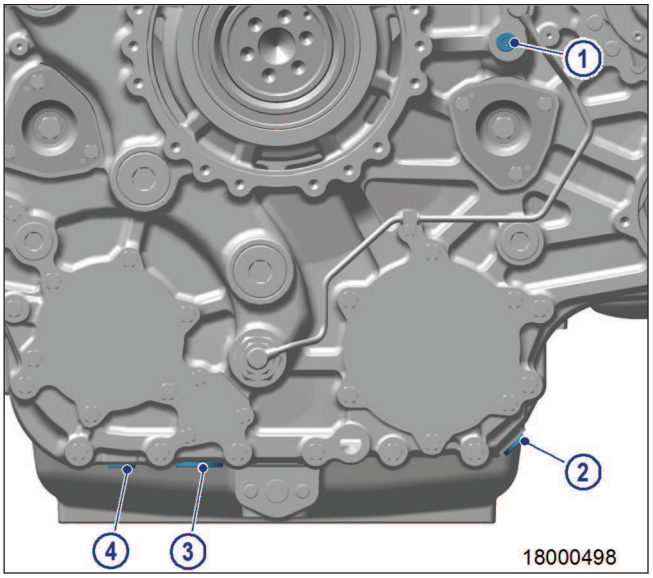
TIM-ID: 0000037912 - 006

Oil change using semirotary hand pump: Extracting engine oil

1. Provide a suitable container in which to collect the engine oil.
2. Extract all engine oil from oil pan using the semirotary hand pump.

Draining residual oil from equipment carrier (only with unscheduled engine oil change)

1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug (1) and drain engine oil from engine oil heat exchanger and from engine oil filter.
3. Remove drain plugs (2, 3, 4) and drain engine oil.
4. Replace engine oil filter (→ Page 208).



Note: Screw in drain plugs with new sealing ring.

5. Screw in drain plug (1) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M18x1.5	Tightening torque	(Engine oil)	50 Nm +10 Nm

6. Screw in drain plugs (2, 4) and tighten to specified torque using a torque wrench.

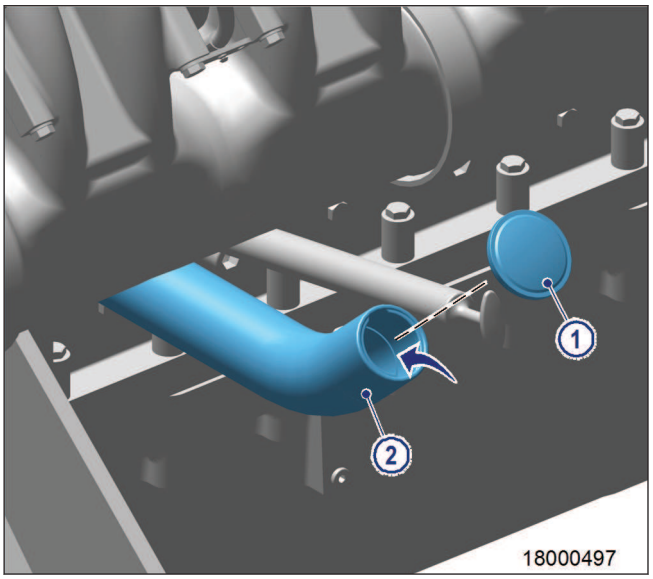
Name	Size	Type	Lubricant	Value/Standard
Screw	M26x1.5	Tightening torque	(Engine oil)	100 Nm +10 Nm

7. Screw in drain plug (3) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M48x1.5	Tightening torque	(Engine oil)	420 Nm +42 Nm

Filling with new engine oil

1. Open cover (1) on filler neck (2).
2. Pour engine oil in at filler neck (2) up to “max.” mark at oil dipstick.
3. Close cover (1) on filler neck (2).
4. Check engine oil level (→ Page 202).



TIM-ID: 0000037912 - 006

8.13.4 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

Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

WARNING

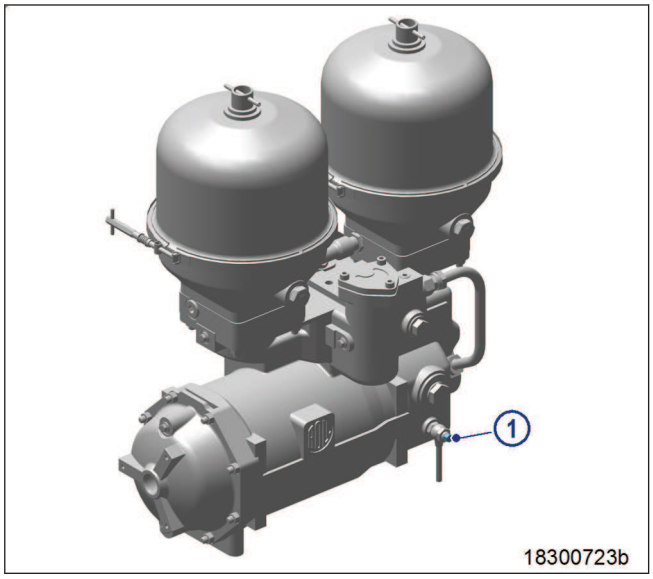
Oil is hot.
Oil can contain residue/substances which are harmful to health.
Risk of injury and poisoning!
- Allow the product to cool to below 50 °C before beginning work.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Engine oil sample extraction (variant A: automatic oil filter) and analysis

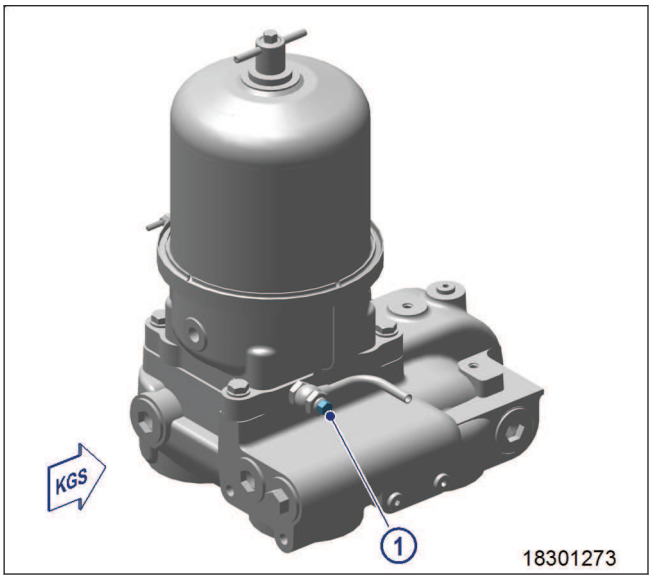
1. With the engine running at operating temperature, open screw (1) on automatic oil filter by 1 to 2 rotations.
2. Drain approx. 2 liters engine oil to flush out the oil sludge.
3. Drain approx. 1 liter engine oil into a clean container.
4. Close screw (1).
5. Using the equipment and chemicals in the MTU test kit, analyze the engine oil for:
   - Dispersing capacity (spot test);
   - Water content;
   - Dilution by fuel.



TIM-ID: 0000062898 - 002

Engine oil sample extraction (variant B: centrifugal oil filter) and analysis

1. With the engine running at operating temperature, open screw (1) 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 (1).
5. Using the equipment and chemicals of the MTU test kit, examine oil for:
   - Dispersing capacity (spot test);
   - Water content;
   - Dilution by fuel.



TIM-ID: 0000062898 - 002

8.14 Oil Filtration / Cooling

8.14.1 Engine oil filter - Replacement

Preconditions

☑ Run engine to reach operating temperature.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	
Engine oil		
Oil filter	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING



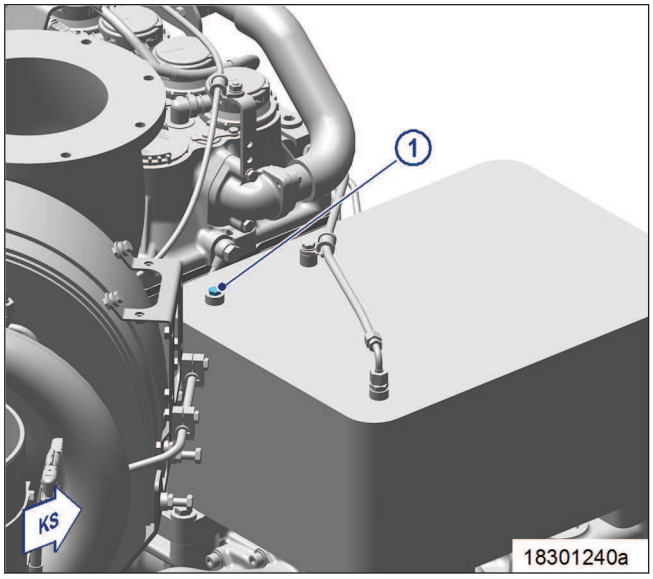
Oil is hot.
Oil can contain residue/substances which are harmful to health.
Risk of injury and poisoning!
- Allow the product to cool to below 50 °C before beginning work.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Replacing engine oil filter

1. Stop engine and disable engine start.
2. After warning up and directly stopping the engine, open the vent plug (1) on the oil heat exchanger.
3. Wait 5 minutes until the oil system is vented and the oil has drained off.

Note: Always use a new sealing ring for the vent plug.

4. Screw the vent plug (1) back in.

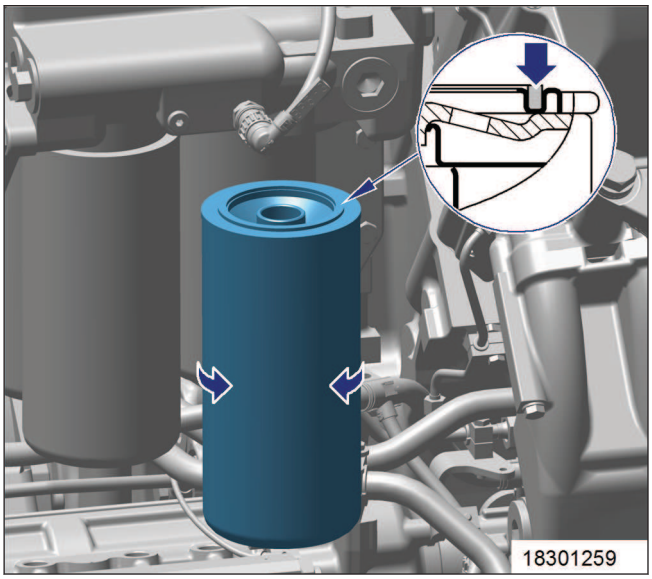


TIM-ID: 0000028834 - 007

5. Remove engine oil filter using the filter wrench.
6. Clean sealing surface on connecting piece.

Note: Only install engine oil filter with an integrated safety valve.

7. Check condition of the new oil filter sealing ring and coat it with engine oil.
8. Screw the engine oil filter on and tighten by hand.
9. Replace other engine oil filters in the same way.
10. Bar the engine using the starting system (→ Page 155).
11. Check engine oil level (→ Page 202).



TIM-ID: 0000028834 - 007

8.14.2 Oil indicator filter – Cleaning and check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Cleaner (Snow-White 11-0)	X00054118	1
Cleaner (Hakupur 50/136)	X00056700	1
Engine oil		
Strainer	(→ Spare Parts Catalog)	
Square-section ring	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING

Oil is hot.
Oil can contain residue/substances which are harmful to health.
Risk of injury and poisoning!
- Allow the product to cool to below 50 °C before beginning work.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

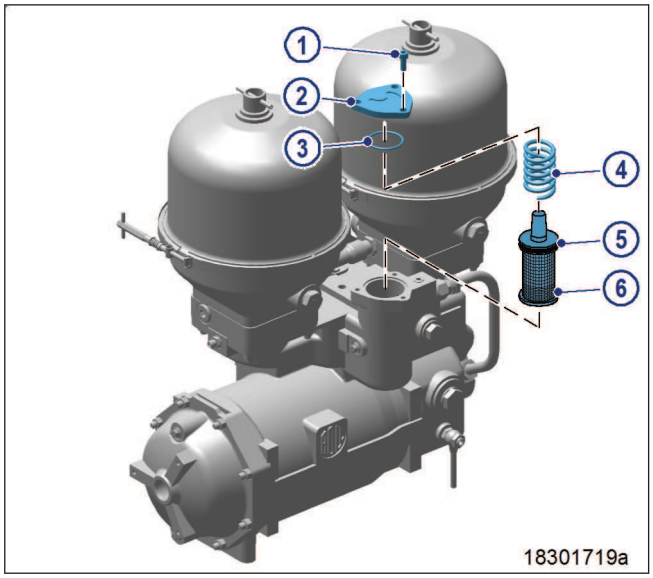
Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

NOTICE

Inappropriate cleaning tool.
Risk of damage to component!
- Observe manufacturer's instructions.
- Use appropriate cleaning tool.

Removing basket strainer – variant A

1. Clean oil indicator filter before disassembling it.
2. Remove screws (1).
3. Take off cover (2) and O-ring (3).
4. Remove spring (4) and strainer (6) from filter housing and allow oil to drip into container.



TIM-ID: 0000036227 - 010

Cleaning strainer

1. Shake coarse contamination out of strainer (6).
2. Clean all metallic parts with cleaner (Snow-White 11-0), then rinse with cleaner (Hakupur 50/136).

Note: Do not damage the fabric of the strainer.

3. Use a soft brush to remove stubborn deposits from strainer as necessary.
4. Blow out strainer (6) with compressed air from outside to inside.

Checking strainer

Item	Findings	Task
Strainer	Metallic residues	• Clean • Monitor engine operation • Check strainer daily • Contact Service.
Strainer	Damaged	Replace
Square-section ring	Damaged	Replace
O-ring	Damaged	Replace

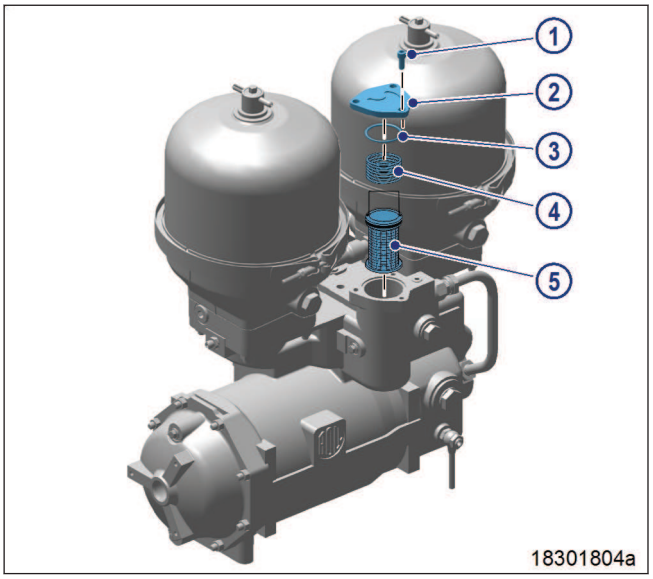
Installing strainer

1. Coat square-section ring (5) on strainer (6) with engine oil and install strainer (6).
2. Coat O-ring (3) with engine oil and install in filter housing.
3. Install spring (4).
4. Fill housing with new engine oil.
5. Install cover (2) and secure with screws (1) and washers.

Removing basket strainer – variant B

Note: Cover (2) is under tension due to spring (4).

1. Remove screws (1).
2. Take off cover (2) and O-ring (3).
3. Remove spring (4).
4. Take strainer (5) out of filter housing.



Cleaning strainer

1. Shake coarse contamination out of strainer (5).
2. Clean all metallic parts with cleaner (Snow-White 11-0), then rinse with cleaner (Hakupur 50/136).

Note: Do not damage the fabric of the strainer.

3. Use a soft brush to remove stubborn deposits from strainer as necessary.
4. Blow out strainer (5) with compressed air from outside to inside.

TIM-ID: 0000036227 - 010

Checking strainer

Item	Findings	Task
Strainer	Metallic residues	• Clean • Monitor engine operation • Check strainer daily • Contact Service.
Strainer	Damaged	Replace
Square section ring	Damaged	Replace
Spring	Damaged	Replace
O-ring	Damaged	Replace

Installing strainer

1. Coat square section ring on basket strainer (5) with engine oil and install basket strainer (5).
2. Coat O-ring (3) with engine and install in filter housing.
3. Move spring (4) into fitting position.
4. Install cover (2) and secure with screws (1).

TIM-ID: 0000036227 - 010

8.14.3 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, 4–20 Nm	F30044239	1
Torque wrench, 10–60 Nm	F30452769	1
Torque wrench, 60–320 Nm	F30452768	1
Cold cleaner (Hakutex 60)	X00070585	1
Assembly compound (Kluthe Hakuform 30-15)	X00067260	1
Filter sleeve	(→ Spare Parts Catalog)	
Filter sleeve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING



Oil is hot.
Oil can contain residue/substances which are harmful to health.
Risk of injury and poisoning!
- Allow the product to cool to below 50 °C before beginning work.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

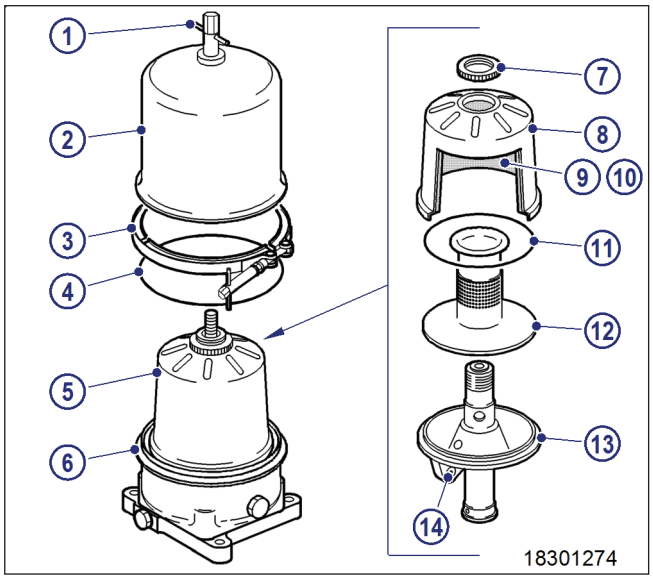
WARNING



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.

TIM-ID: 0000071290 - 002

Centrifugal oil filter, cleaning and filter-sleeve replacement on 12V engines



1. Release screw (1) and remove.
2. Remove clamp (3) and take off hood (2).
3. Carefully remove rotor assembly (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. Take off filter sleeve (9), stiffener plate (10) and sealing ring (11).
7. Measure thickness of oil residue on filter sleeve.
8. Shorten maintenance interval if maximum layer thickness of oil residues exceeds 30 mm.
9. Remove standpipe (12) from lower rotor section (13).
10. Wash out cover (2), rotor cap (8), stiffener plate (10), stand pipe (12), base (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. Press standpipe (12) onto rotor lower section (13).
13. Insert new filter sleeve (9) with stiffener plate (10) into rotor cap (8), ensuring that smooth surface of filter sleeve (9) faces 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 assembly (5), insert into 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:

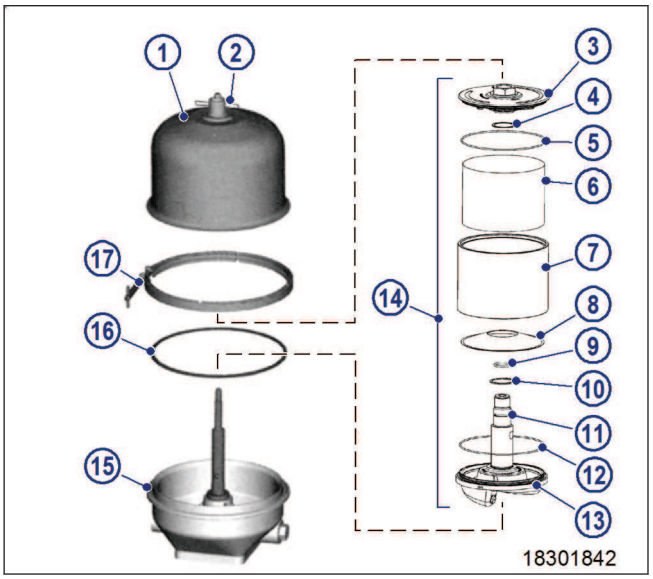
Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		8 to 9 Nm

22. Tighten screw (1) to specified torque using a torque wrench:

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		5 Nm to 7 Nm

TIM-ID: 0000071290 - 002

Centrifugal oil filter, cleaning and filter-sleeve replacement on 16V engines



1. Remove clamp (17).
2. Release cover screw (2) and remove cover (1).
3. Carefully lift rotor (14), allow oil to drain and remove from housing.
4. Holding the rotor (14) firmly, release rotor cover nut (3).
5. Take off rotor cover (3).
6. Remove filter sleeve (6).
7. Measure layer thickness of oil residues on filter sleeve (6).

Result: If the oil residue exceeds the maximum layer thickness of 45 mm, shorten the maintenance interval.

8. Disassemble rotor tube (7), conical disk (8) and rotor base (13).

1. Wash rotor cover (3), rotor tube (7), conical disk (8) and rotor base (13) with cold cleaner.
2. Blow out with compressed air.
3. Check sealing rings (9, 10, 12) and replace if necessary.
4. Coat sealing rings (9, 10) with assembly compound and insert in grooves on bearing shaft (11).
5. Assemble rotor tube (7), conical disk (8) and rotor base (13) with sealing ring (12).

Note: Observe markings and information on paper element!

6. Insert new filter sleeve (6) in rotor tube (7) with the smooth paper surface facing the outer wall.
7. Check sealing rings (4, 5) and replace if necessary.
8. Insert sealing ring (5) in rotor tube (7) and sealing ring (4) in rotor cover (3).
9. Install rotor cap (3) tighten nut for rotor cover (3) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Nut	M12	Tightening torque		80 Nm ±12 Nm

10. Place rotor (14) in housing (15) and check for ease of movement.
11. Check sealing ring (16), replace as necessary.
12. Fit sealing ring (16) on housing (15).
13. Fit hood (1).
14. Tighten cover screw (2) by hand.
15. Install clamp (17) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		20 Nm ±3 Nm

16. Tighten cover nut (2) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		7 Nm ±1 Nm

TIM-ID: 0000071290 - 002

8.15 Coolant Circuit, General, High-Temperature Circuit

8.15.1 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.

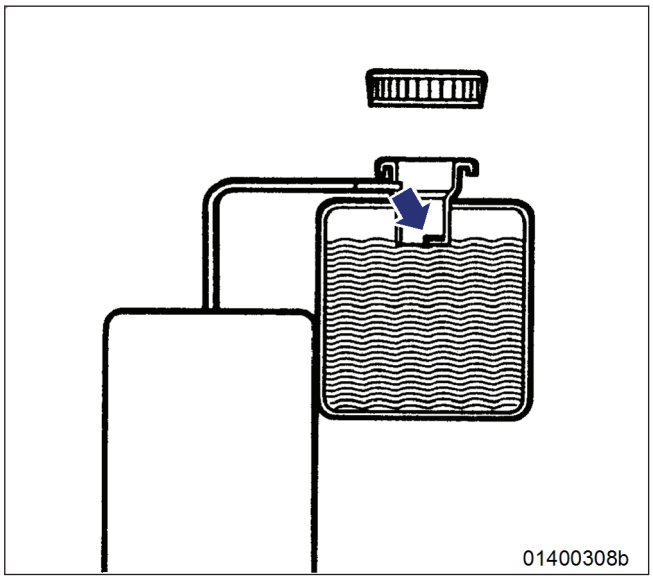
Checking coolant level at filler neck:

1. Turn cap on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn cap counterclockwise and remove.
3. Check engine coolant level (engine coolant must be visible at bottom edge of cast-in eye of filler neck).

Checking coolant level at external cooler:

Note: Engine coolant must be visible at marker plate.

1. Check engine coolant level.
2. Top up engine coolant as necessary (→ Page 221).
3. Check and clean cap.
4. Place cap on filler neck and close.



Checking coolant level with level sensor:

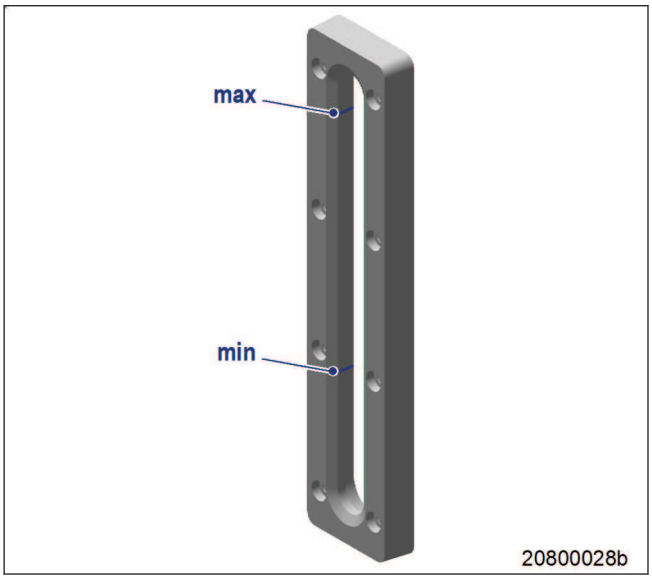
Note: Engine coolant level is automatically monitored by the engine control system.

1. Switch on engine control system and check readings on the display.
2. Top up engine coolant as necessary (→ Page 221).

TIM-ID: 0000000937 - 015

Checking engine coolant level at sight glass

1. Check coolant level (coolant level must be between “min.” and “max.” mark).
2. Top up coolant if necessary (→ Page 221).



TIM-ID: 0000000937 - 015

8.15.2 Engine coolant - Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant change

1. Drain engine coolant (→ Page 219).
2. Fill with engine coolant (→ Page 221).

TIM-ID: 0000000036 - 031

8.15.3 Engine coolant - Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench 10–60 Nm	F30452769	1

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.

Preparatory steps

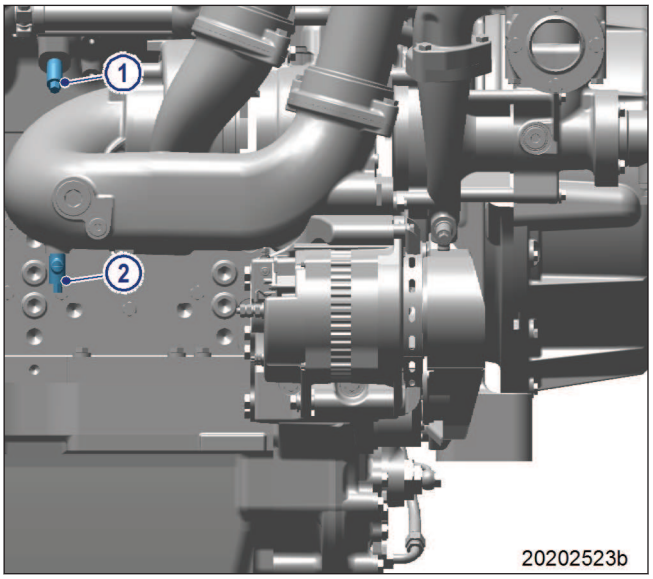
1. Provide a suitable container to collect the coolant.
2. Switch off preheating unit (external).

Engine coolant – Draining

1. Provide a suitable container to collect the coolant.
2. Turn cover on coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
3. Continue to turn cover counterclockwise and remove.
4. Extract remaining engine coolant in the coolant expansion tank via the filler neck.
5. Drain engine coolant at preheating unit (external).
6. Open drain valve (2) and drain engine coolant at elbow on engine coolant pump.
7. Open drain valves (1) on A and B side of crankcase and drain engine coolant.

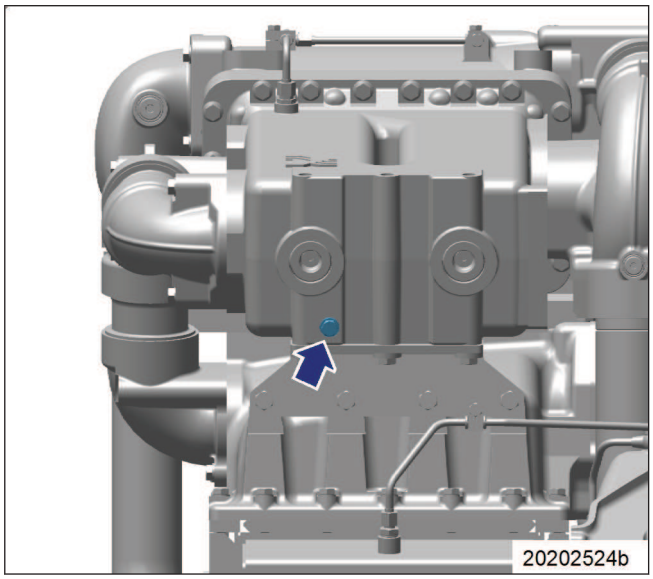
Note: With the air compressor (optional) installed at the drain point (A side), the drain valve is inaccessible.

8. Open supply hose at air compressor.



TIM-ID: 0000030760 - 006

9. Drain remaining engine coolant at EGR cooler, A and B side (arrow).



Final steps

1. Tighten all open drain valves to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Spindle	11A/F	Tightening torque		12 Nm

2. Fit cover on filler neck and close it.

TIM-ID: 0000030760 - 006

8.15.4 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.
Torque wrench 10-60 Nm	F30452769	1
Engine coolant		

WARNING

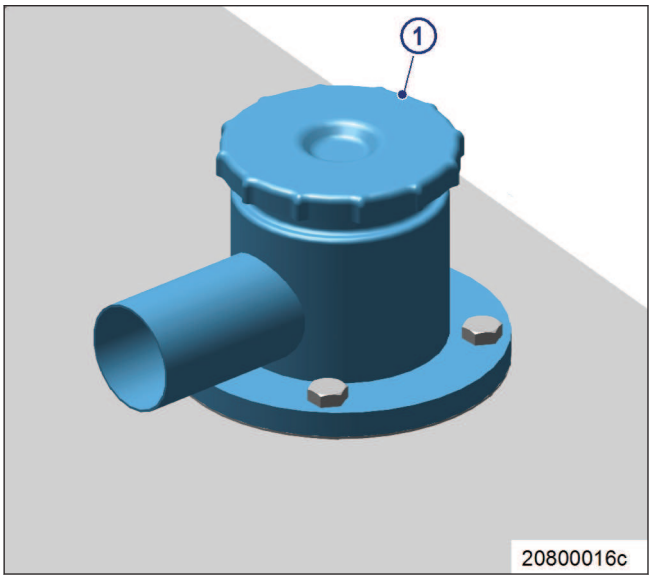
Coolant is hot and highly pressurized.
Risk of injury! Risk of scalding!
- Allow engine to cool down.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

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

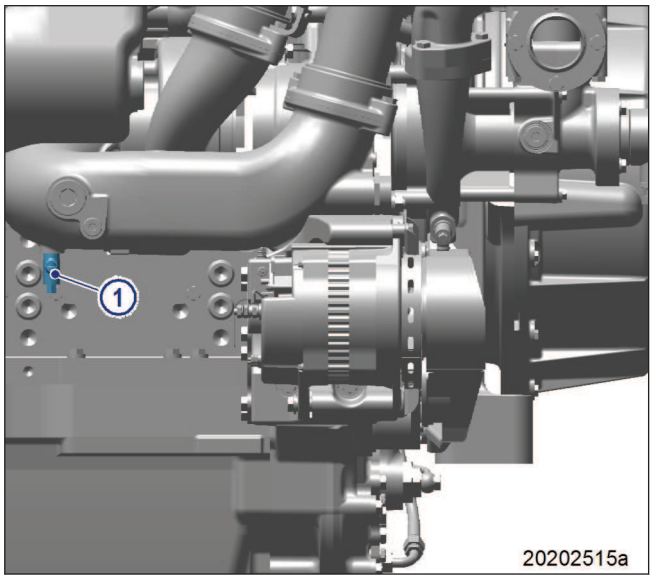
1. Turn cover (1) of coolant expansion tank (external) counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn cover (1) counterclockwise and remove.



TIM-ID: 0000054694 - 003

Filling with engine coolant using pump

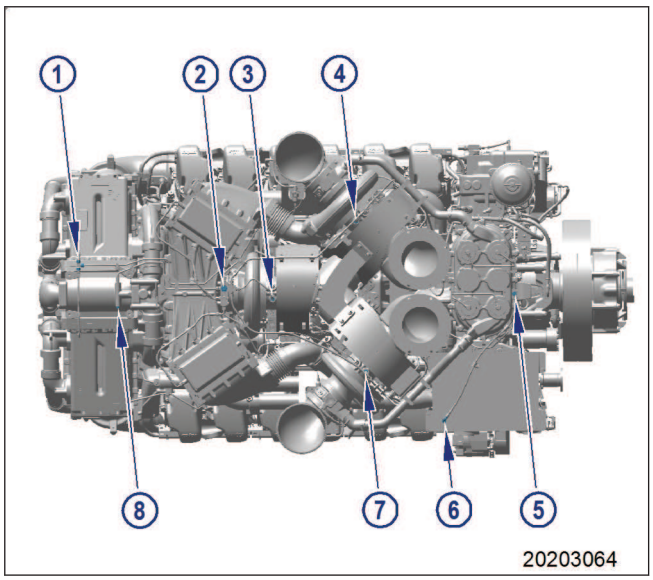
1. Connect appropriate pump with hose to drain valve (1).



2. Open vent points on EGR cooler (1, 8), distributors (2, 5), exhaust turbochargers (3, 4, 7) and oil heat exchanger (6).
3. Open drain valve and pump coolant into engine at 0.5 bar minimum.

Result: When coolant emerges from the vent points, close vent points one by one, proceeding from the lowest point upwards.

4. Fill expansion tank until overflow edge is reached.



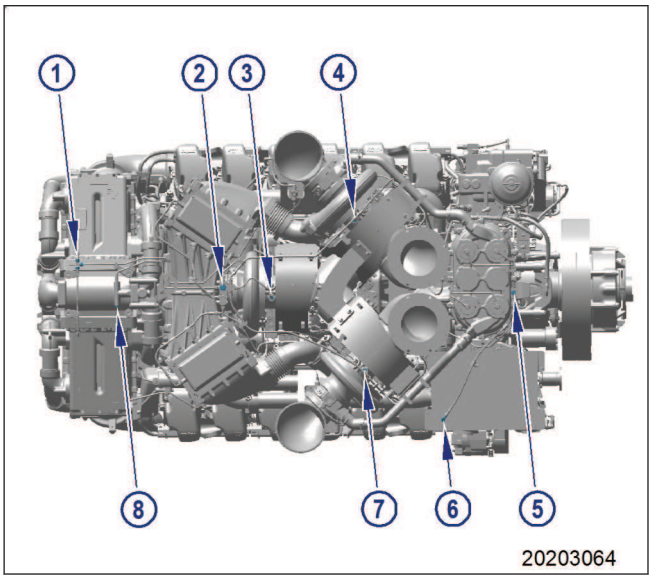
5. Tighten drain valve to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Spindle	11A/F	Tightening torque		12 Nm

6. Check satisfactory condition of cover and clean sealing faces if required.
7. Fit cover on filler neck and close it.
8. Start engine (→ Page 72) and shut down after 10 second of operation without load (→ Page 72).
9. Continue to turn cover counterclockwise and remove.
10. Check engine coolant level (→ Page 216) and top up coolant as necessary:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Fit cover on filler neck and close it.
    c) Repeat the steps from “Start engine” (→ Step 8) until no more engine coolant needs to be topped up.
    d) Disconnect pump and hose.

TIM-ID: 0000054694 - 003

Alternatively: Filling with coolant through filler neck



1. Open vent points on EGR cooler (1, 8), distributors (2, 5), exhaust turbochargers (3, 4, 7) and oil heat exchanger (6).
2. Fill engine coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.

Result: When coolant emerges from the vent points, close vent points one by one, proceeding from the lowest point upwards.

3. Check satisfactory condition of cover and clean sealing faces if required.
4. Place cover onto filler neck and close until first stop is reached.
5. Start engine (→ Page 72) and shut down after 10 second of operation without load (→ Page 73).
6. Turn cover counterclockwise and remove.
7. Check engine coolant level (→ Page 216) and top up coolant as necessary:
   a) Repeat the steps from “Start engine” (→ Step 5) until no more engine coolant needs to be topped up.
   b) Check satisfactory condition of cover and clean sealing faces if required.
   c) Fit cover on filler neck and close it.

Final steps

1. Start the engine and run it without load for some minutes.
2. Check engine coolant level (→ Page 216) and top up coolant as necessary.

TIM-ID: 0000054694 - 003

8.15.5 Engine coolant pump – Relief bore check

DANGER

Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

WARNING

High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

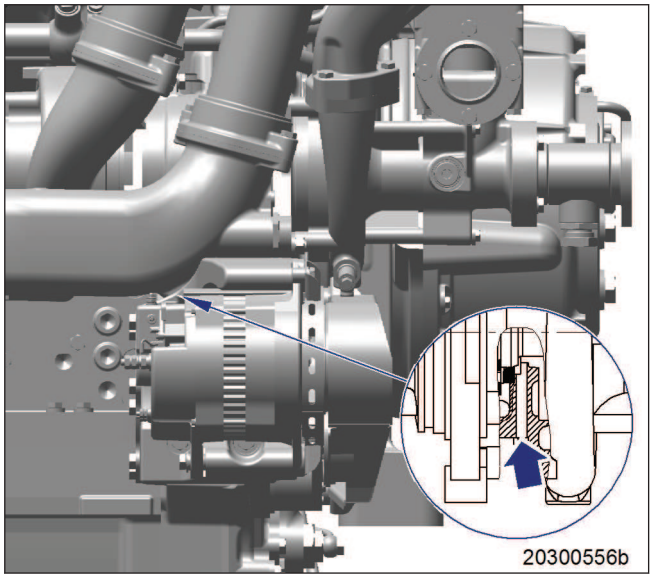
Engine coolant pump, relief bore check

1. Check relief bore (arrow) for oil and coolant discharge.

Note: Observe safety regulations when carrying out maintenance and repair work (→ Page 11).

2. Shut down engine (→ Page 73) and disable engine start.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour
   - Permissible oil discharge: up to 5 drops per hour

Result: If discharge is greater, contact Service.



TIM-ID: 0000037916 - 006

8.15.6 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.
Test kit	F6798833	1
Torque wrench 10–60 Nm	F30452769	1

DANGER

Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

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.

WARNING

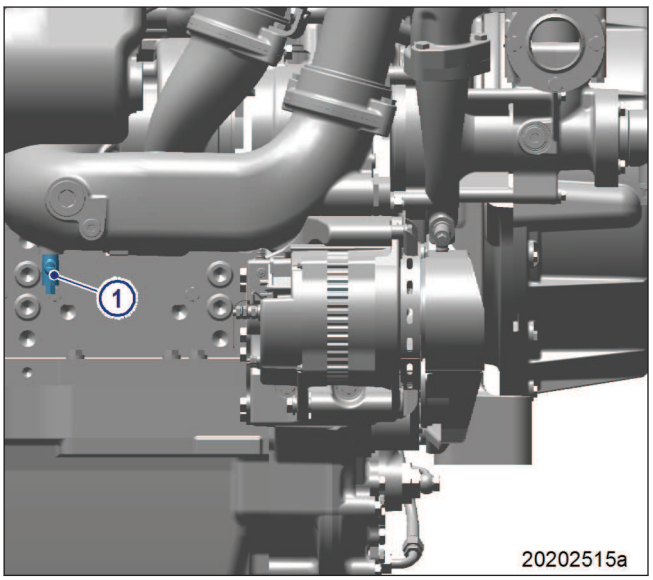
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant – Sample extraction and analysis

1. With the engine running, open drain valve (1).
2. Drain off approx. 1 liter of engine coolant.

Result: Drain point is rinsed.

3. Drain approx. 1 liter coolant into a clean container.



4. Tighten drain valve (1) to specified tightening using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Spindle	11 A/F	Tightening torque		12 Nm

5. Using the equipment and chemicals of the MTU test kit, examine engine coolant for:
   - Concentration of engine coolant additives
   - pH value
6. Engine coolant change intervals (→ MTU Fluids and Lubricants Specifications (A001061/..)).

TIM-ID: 0000037917 - 005

8.15.7 Coolant expansion tank valve cover – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Valve cover	(→ Spare Parts Catalog)	1

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.

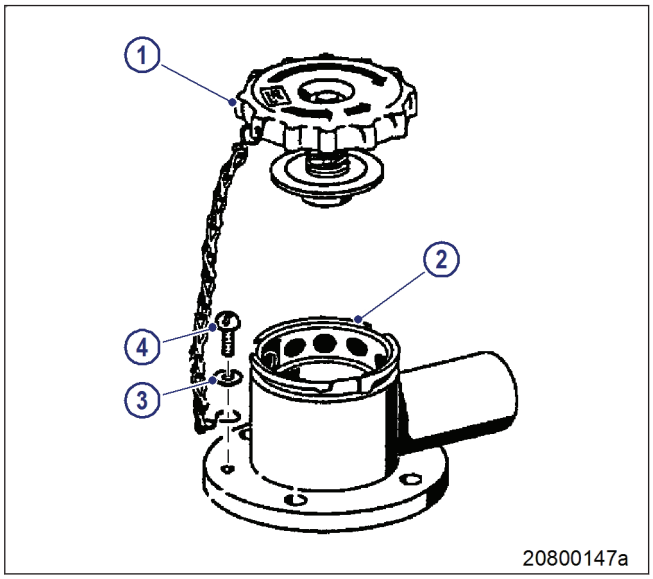
Preparatory steps

▶ Switch off preheater.

Replacing valve cover

Note: Schematic diagram. Design may deviate.

1. Turn valve cover (1) on coolant expansion tank counterclockwise until the first stop and release pressure.
2. Continue to turn valve cover counterclockwise and remove.
3. Remove chain with screw (4) and washer (3).
4. Draw off separated corrosion inhibitor oil in expansion tank via filler neck (2).
5. Fit new valve cover and close it.
6. Install chain.



TIM-ID: 0000065495 - 005

8.16 Low-Temperature Circuit

8.16.1 Charge-air coolant level – Check

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

DANGER

Falling from great heights.
Risk of serious injury – danger to life!
- When working high on the equipment, always use suitable ladders or work platforms.
- Use personal protective equipment.

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

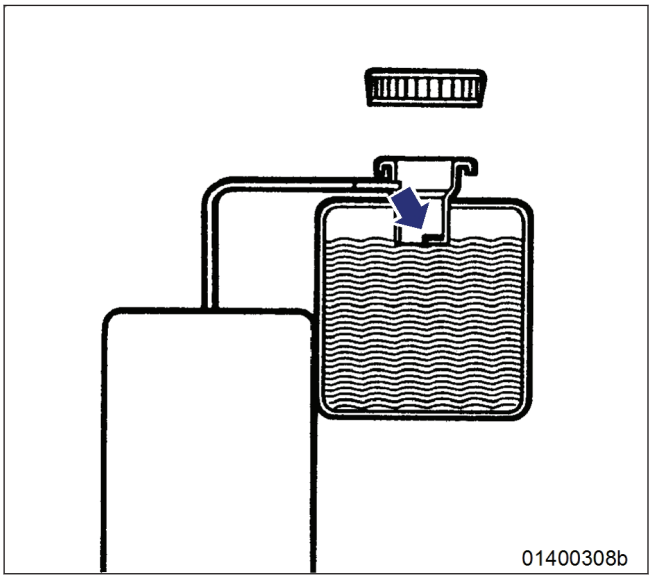
Coolant contains antifreeze and is toxic.
Risk of poisoning and slipping!
- Avoid contact with eyes and skin.
- Do not inhale vapors or mist, wear breathing protection.
- Do not eat, drink, smoke when working with antifreeze.
- Wear protective clothing, protective gloves and goggles/safety mask.
- Wipe up escaped/spilled coolant immediately.

Checking charge-air coolant level at filler neck

1. Turn cover on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn cover counterclockwise and remove.

Note: Charge-air coolant must be visible at marker plate.

3. Check charge-air coolant level.
4. Top up charge-air coolant as necessary (→ Page 233).
5. Check that cover is in serviceable condition.
6. Clean sealing surfaces as necessary.
7. Fit cover and close it.



TIM-ID: 0000000042 - 009

Checking charge-air coolant level by means of level sensor

Note: The charge-air coolant level is monitored automatically by the engine control system.

1. Switch on engine control system and check readings on the display.
2. Top up with charge-air coolant as necessary (→ Page 233).

TIM-ID: 0000000042 - 009

8.16.2 Charge-air coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Charge-air coolant – Change

1. Drain charge-air coolant (→ Page 230).
2. Fill with charge-air coolant (→ Page 233).

TIM-ID: 0000000041 - 011

8.16.3 Charge-air coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

☑ Operating voltage is not applied.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench 10–60 Nm	F30452769	1
Sealing ring	(→ Spare Parts Catalog)	

WARNING

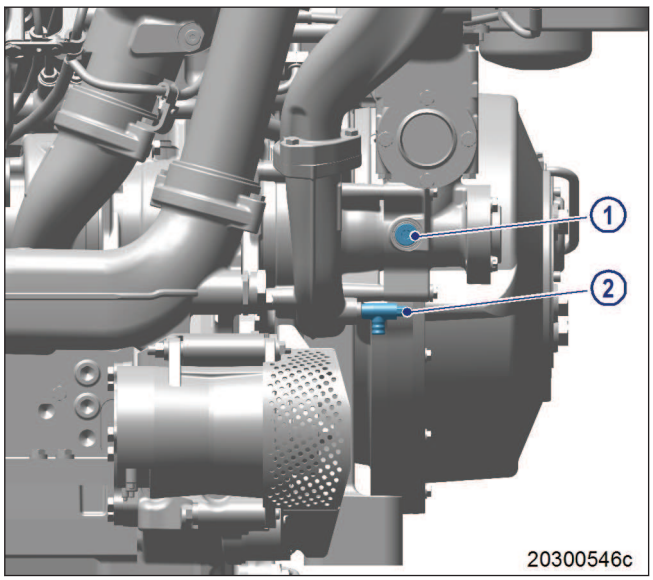
Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

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.

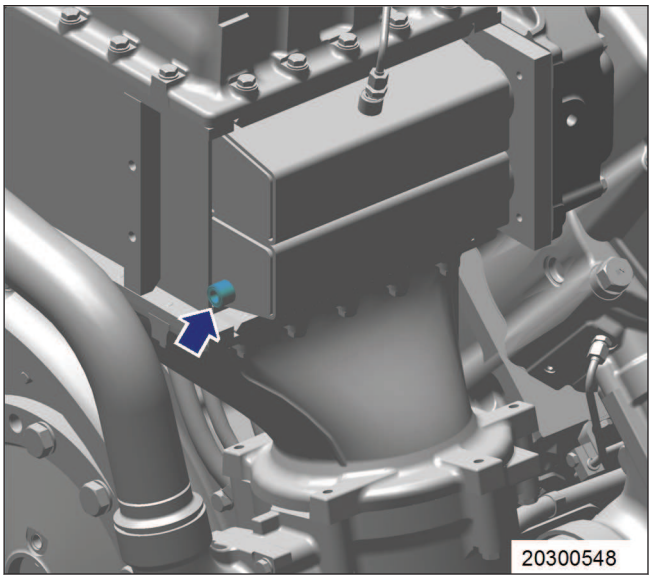
Draining charge-air coolant

1. Provide a suitable container in which to collect the charge-air coolant.
2. Turn cover on coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
3. Continue to turn cover counterclockwise and remove.
4. Extract remaining charge-air coolant in the coolant expansion tank via the filler neck.
5. Open drain valve (2) and drain charge-air coolant at charge-air coolant pump.
6. Unscrew drain screw (1) and drain charge-air coolant at thermostat housing.

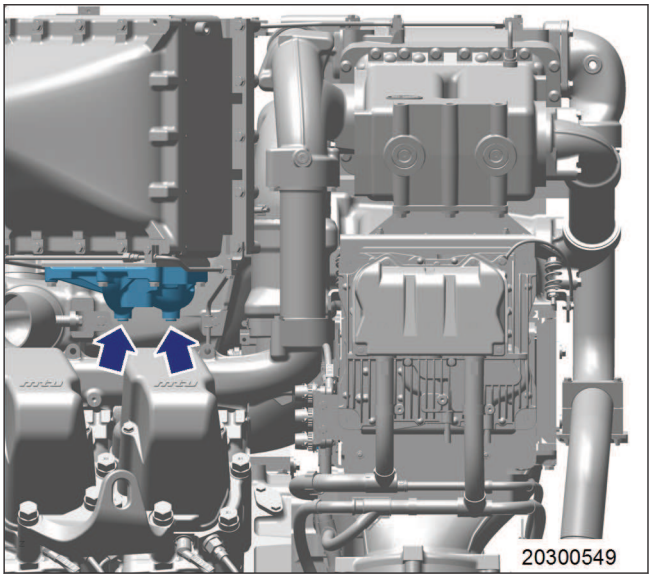


TIM-ID: 0000026956 - 008

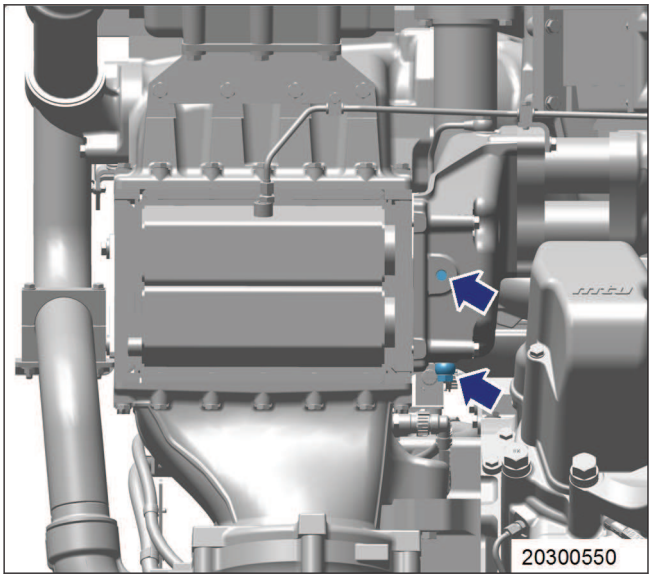
7. Drain remaining charge-air coolant at charge-air cooler (high pressure) (arrowed).



8. Drain remaining charge-air coolant at charge-air cooler (low pressure) A side (arrowed).



9. Drain remaining charge-air coolant at charge-air cooler (low pressure) B side (arrowed).



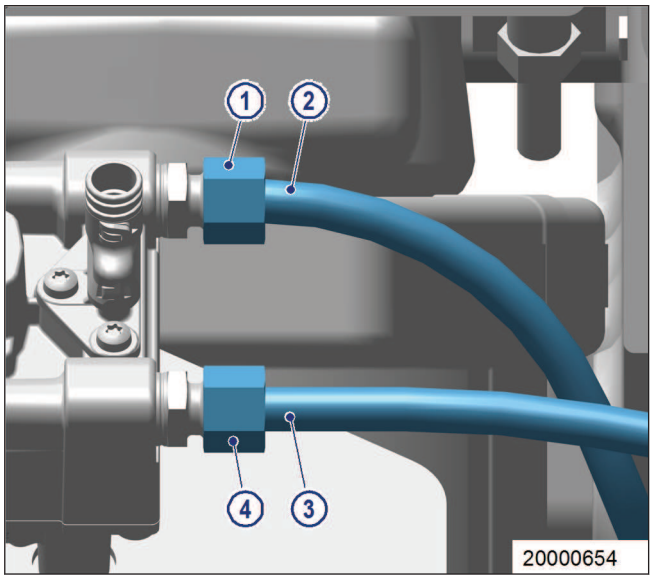
TIM-ID: 0000026956 - 008

Note:
- The procedure is only described for one exhaust flap, but also applies to the remaining exhaust flaps. Exhaust flap overview (→ Page 192).
- Collect emerging engine coolant in a suitable container.

10. Loosen the union nut (4) of the lower coolant line (3).
11. Carefully pull the coolant line (3) out of the union.
12. Loosen the union nut (1) of the upper coolant line (2).
13. Pull the coolant line (2) a little out of the union.

Note: Wait until no more coolant comes out of the lines.

14. Tighten the union nuts (1, 4) of the coolant lines (2, 3) again.



Final steps

1. Screw in all drain plugs with new sealing rings.
2. Tighten all drain valves to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Spindle	11 A/F	Tightening torque		12 Nm

3. Fit cap on filler neck and close it.

TIM-ID: 0000026956 - 008

8.16.4 Charge-air 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.
Torque wrench 10-60 Nm	F30452769	1
Charge-air coolant		

WARNING

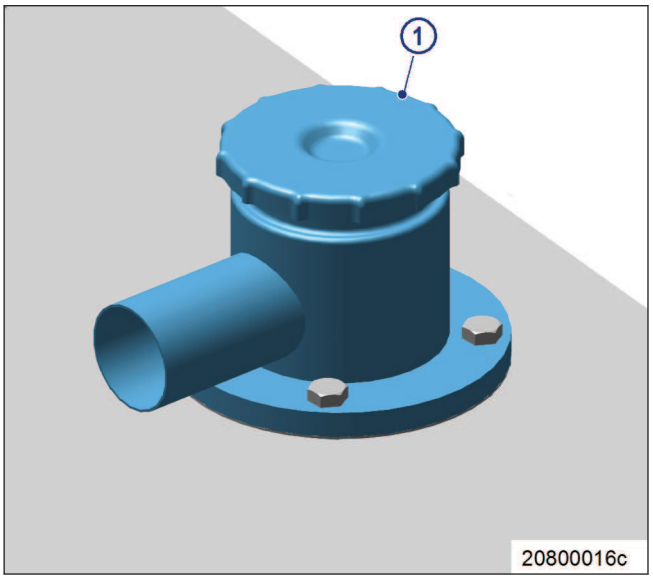
Coolant is hot and highly pressurized.
Risk of injury! Risk of scalding!
- Allow engine to cool down.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

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

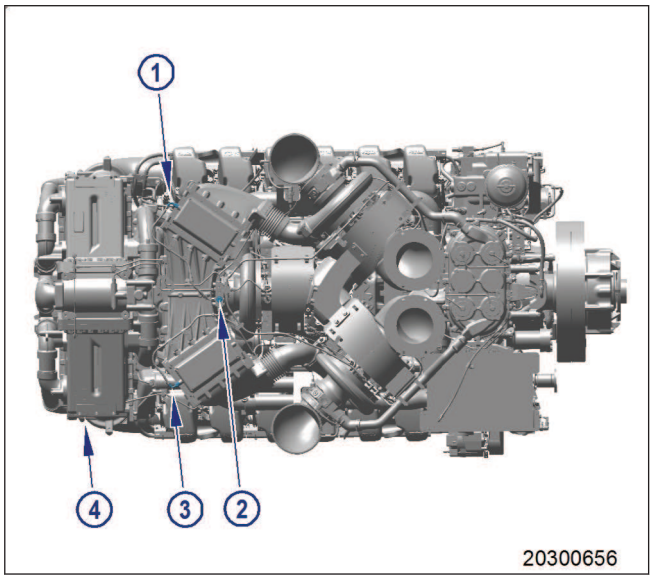
1. Turn cover (1) of coolant expansion tank (external) counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn cover (1) counterclockwise and remove.



TIM-ID: 0000054692 - 003

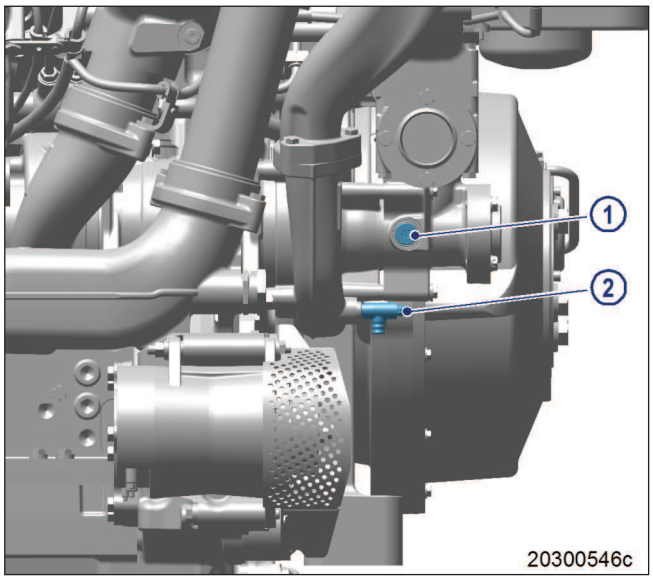
Filling with charge-air coolant through filler neck

1. Open vent points at intercooler (high pressure) (4), intercooler (low pressure) (1, 3) and distributor (2,).
2. Fill in charge-air coolant at expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
3. Check satisfactory condition of cover and clean sealing faces if required.
4. Place cover onto filler neck and close until first stop is reached.
5. Start engine (→ Page 72).
6. After 10 seconds of running the engine without load, shut down the engine (→ Page 73).
7. Turn cover counterclockwise and remove.
8. Check charge-air coolant level (→ Page 227) and top up if required:
   a) Repeat the steps from “Start engine” (→ Step 5) until charge-air coolant no longer needs to be topped up.
   b) Check satisfactory condition of cover and clean sealing faces if required.
   c) Fit cover on filler neck and close it.



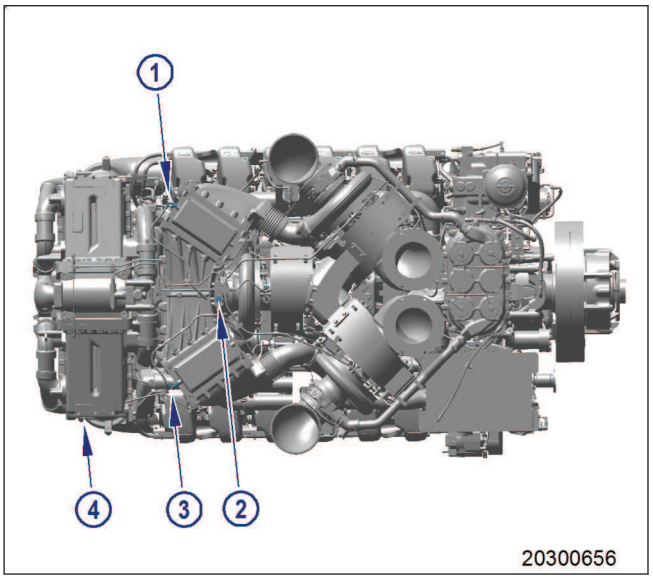
Alternatively: Filling with charge-air coolant using pump

1. Connect suitable pump with a hose to one of the drain valves (1, 2).



TIM-ID: 0000054692 - 003

2. Open vent points at intercooler (high pressure) (4), intercooler (low pressure) (1, 3) and distributor (2,).
3. Open drain valve and pump charge-air coolant into engine at 0.5 bar minimum.
4. Fill expansion tank until overflow edge is reached.



5. Tighten drain valve to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Spindle	SW11	Tightening torque		12 Nm

6. Check satisfactory condition of cover and clean sealing faces if required.
7. Fit cover on filler neck and close it.
8. Start engine (→ Page 72).
9. After 10 seconds of running the engine without load, shut down the engine (→ Page 73).
10. Turn cover on coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
11. Continue to turn cover counterclockwise and remove.
12. Check charge-air coolant level (→ Page 227) and top up if required:
    a) Fill charge-air coolant into expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Fit cover on filler neck and close it.
    c) Repeat the steps from “Start engine” (→ Step 8) until charge-air coolant no longer needs to be topped up.
    d) Disconnect pump and hose.

Final steps

1. Start the engine and run it without load for some minutes.
2. Check charge-air coolant level (→ Page 227) and top up if required.

TIM-ID: 0000054692 - 003

8.16.5 Charge-air coolant pump - Relief bore check

DANGER

Components are moving or rotating.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Operate the engine at low load only. Keep clear of the danger zone of the engine.

WARNING

High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

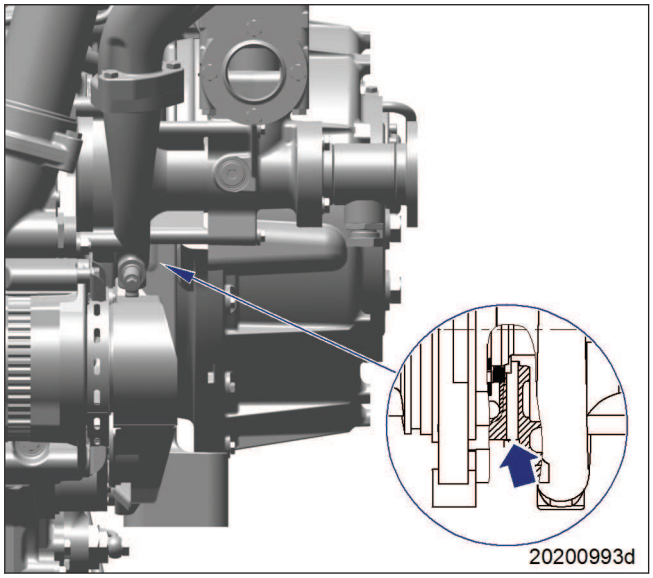
Charge-air coolant pump, relief bore check

1. Check pressure relief port (arrow) for oil and coolant discharge.

Note: Observe safety regulations when carrying out maintenance and repair work (→ Page 11).

2. Shut down engine (→ Page 73) and disable engine start.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour
   - Permissible oil discharge: up to 5 drops per hour

Result: If discharge is greater, contact Service.



TIM-ID: 0000026960 - 011

8.17 Belt Drive

8.17.1 Drive belt - Condition check

Preconditions

☑ Engine is stopped and starting disabled.

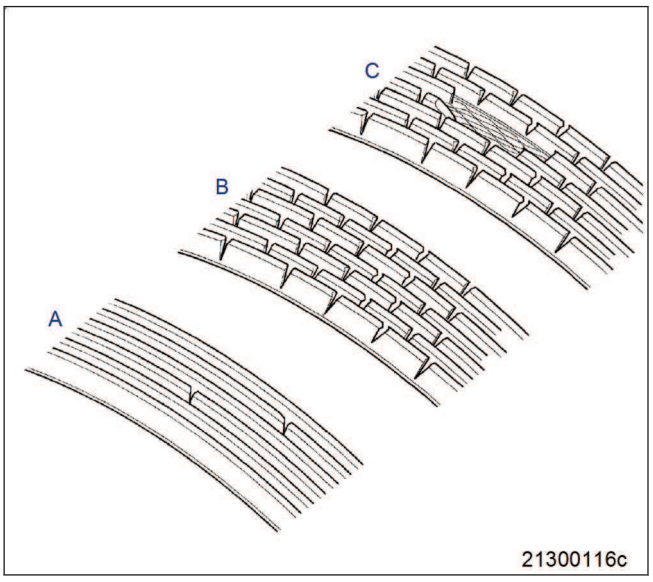
WARNING

Exposed rotating parts can eject drawn-in components or draw in body parts.
Risk of crushing, limbs or extremities may be pinched, trapped or entangled!
Risk of injury due to flying parts!

- Install rotating components at a suitable distance from other components.
- Never operate the engine without protective covers or safety guards which meet applicable accident prevention regulations.
- Ensure that the safety guards can prevent body parts from being drawn in by rotating components.

Drive belt – Condition check

1. Remove cover.



2. Checking drive belt condition:

Item	Findings	Action
Drive belt A	Singular cracks	None
Drive belt B	Cracks on entire circumference	Replace (→ Page 239)
Drive belt C	Chunking	
Drive belt	Belt is oily, shows signs of over-heating	

3. Install cover.

TIM-ID: 0000000920 - 014

8.18 Battery-Charging Generator

8.18.1 Battery-charging generator – Check

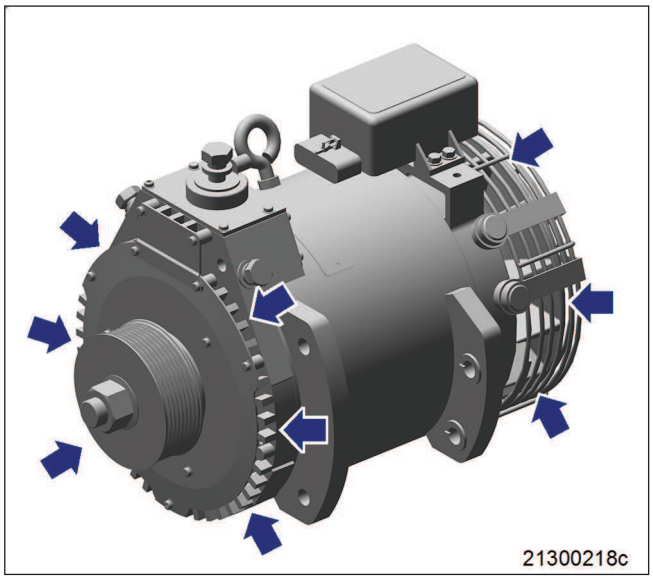
Preconditions

☑ Engine is stopped and starting disabled.

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.



Checking battery-charging generator

Item	Findings	Measure
Ventilation areas (arrows)	Clean	None
Ventilation areas (arrows)	Contaminated	Clean

Cleaning battery-charging generator

Note: Dry-clean battery-charging generator only. Do not insert sharp objects in the ventilation openings.

1. Remove coarse contamination from battery-charging generator.
2. Blow out ventilation areas (arrows) with compressed air until there is no more dust development.

TIM-ID: 0000007378 - 006

8.18.2 Battery-charging generator drive – Drive belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

WARNING



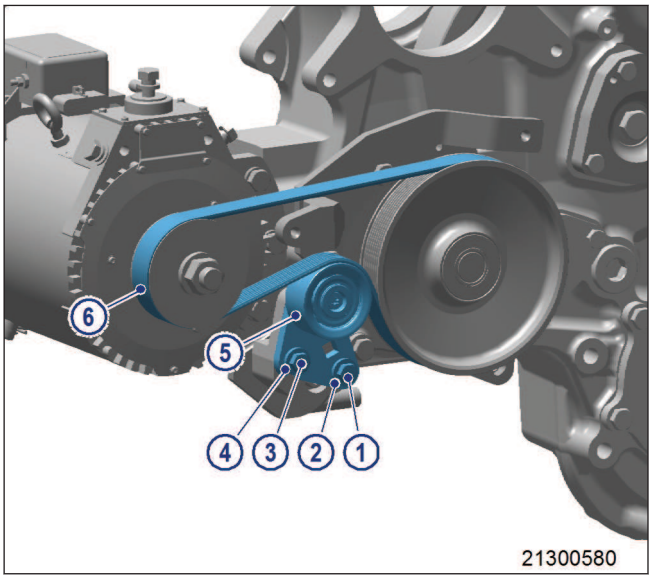
Spring/circlip/tensioning roller preload.
Risk of injury!
- Only use specified tool and equipment.

Battery-charging generator drive – Drive belt replacement

1. Remove protective cover.
2. Loosen screws (1, 3) by half a turn.
3. Remove screw (3) with washer (4).
4. Holding belt tensioner (5), continue to loosen screw (1) and allow belt tensioner (5) to move slowly downwards.
5. Remove screw (1) with washer (2) and take off belt tensioner (5).
6. Take off used drive belt (6).
7. Fit new drive belt (6) and position it on both belt pulleys.
8. Fit belt tensioner (5) and install screw (1) with washer (2).
9. Use assembly tool to press belt tensioner (5) against drive belt (6) and hold it in this position.
10. Install screw (3) with washer (4).

Note: Make sure not to damage the screw thread.

11. Slowly release belt tensioner (5), until it makes contact with the shank of screw (3).
12. Tighten screws (1, 3).
13. Install protective cover.



TIM-ID: 0000055568 - 001

8.19 Fan Drive

8.19.1 Fan drive – Drive belt tension check / adjustment

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Optibelt TT belt tension tester	Y4345711	1

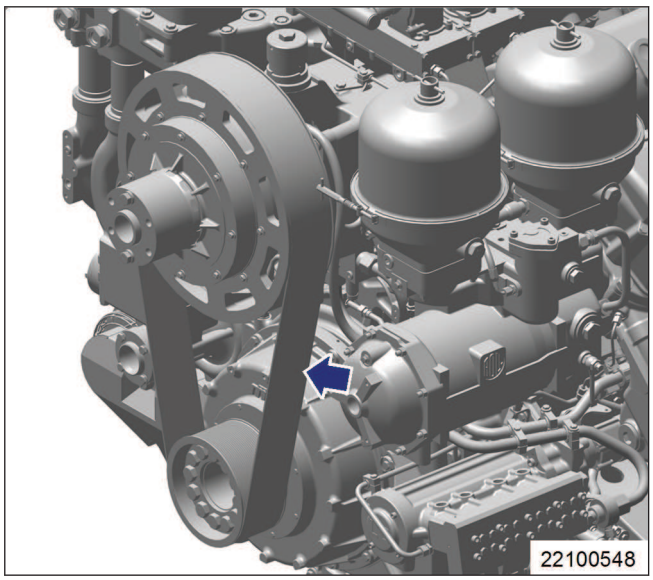
Preparatory steps

1. Remove protective cover.
2. Check belt condition visually (→ Page 237).

Result: For drive belt replacement (→ Page 242).

Checking V-belt tension – Rockford S270 fan clutch

1. Switch on belt tension tester.
2. Hold measuring tip of belt tension tester over belt drive. Tap drive belt (arrow) with a suitable tool.
3. Hold belt tension tester over belt drive until the measured value is indicated.

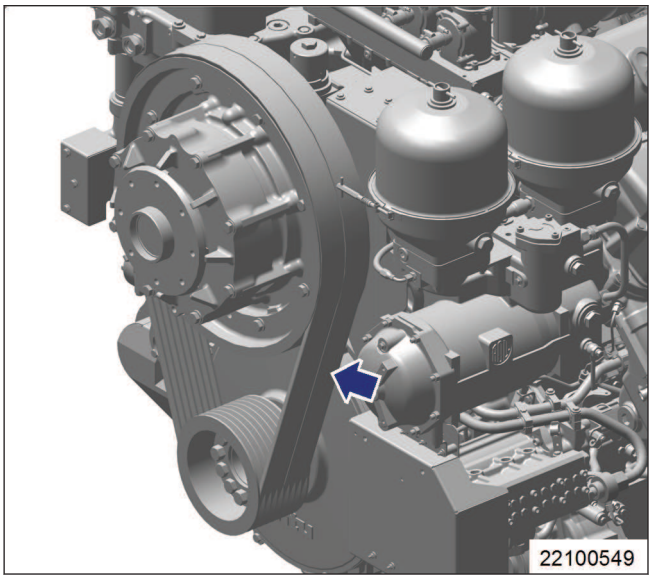


Initial assembly at MTU	Initial operation with fan	Re-tensioning
None	60 Hz ±1 Hz	52 Hz ±1 Hz

TIM-ID: 0000040744 - 002

Checking V-belt tension – Rockford S370 fan clutch

1. Switch on belt tension tester.
2. Hold measuring tip of belt tension tester over belt drive. Tap drive belt (arrow) with a suitable tool.

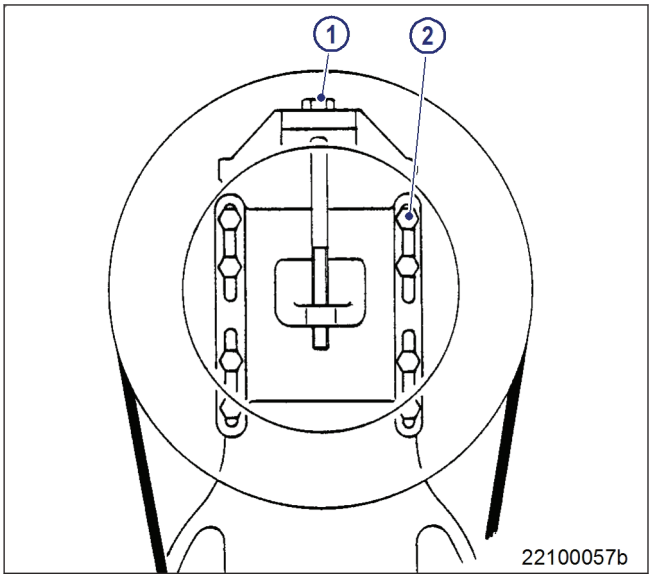


3. Hold belt tension tester over belt drive until the measured value is indicated.

Initial assembly at MTU	Initial operation with fan	Re-tensioning
36 Hz ±5 Hz	49 Hz ±2 Hz	44 Hz ±2 Hz

Adjusting drive belt tension

1. Release screws (2) until fan clutch can be moved.
2. Tighten stud (1) until the required frequency is achieved.



3. For Rockford S270 fan clutch: Tighten screws (2) to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M12x60	Tightening torque		100 Nm +10 Nm

4. For Rockford S370 fan clutch: Tighten screws (2) to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M16x80	Tightening torque		270 Nm +10 Nm

TIM-ID: 0000040744 - 002

8.19.2 Fan drive - Drive belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

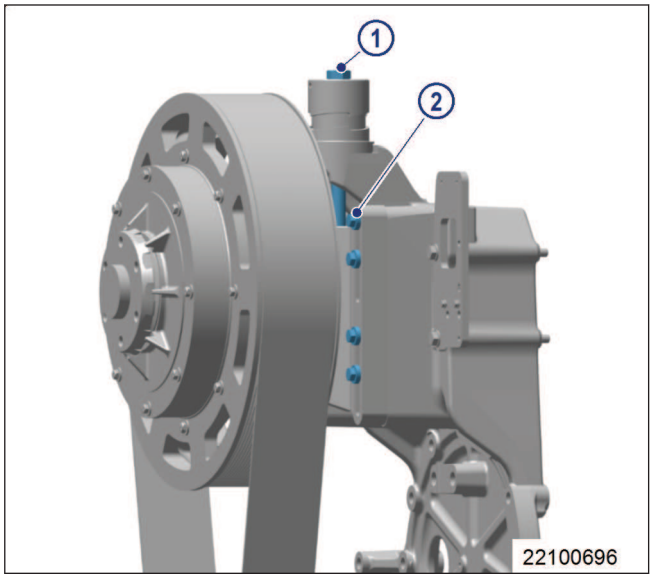
Designation / Use	Part No.	Qty.
Drive belt	(→ Spare Parts Catalog)	

Preparatory steps

1. Remove protective cover.
2. Remove fan.

Replacing drive belt

1. Release screws (2).
2. Slacken off stud (1) until drive belt can be removed.
3. Clean belt pulleys.
4. Fit new drive belt on belt pulleys, ensuring that it is not under tension.
5. Adjust belt tension (→ Page 240).



TIM-ID: 0000007457 - 005

8.19.3 Fan drive - Drive belt tension check / adjustment

Preconditions

☑ Engine is stopped and starting disabled.

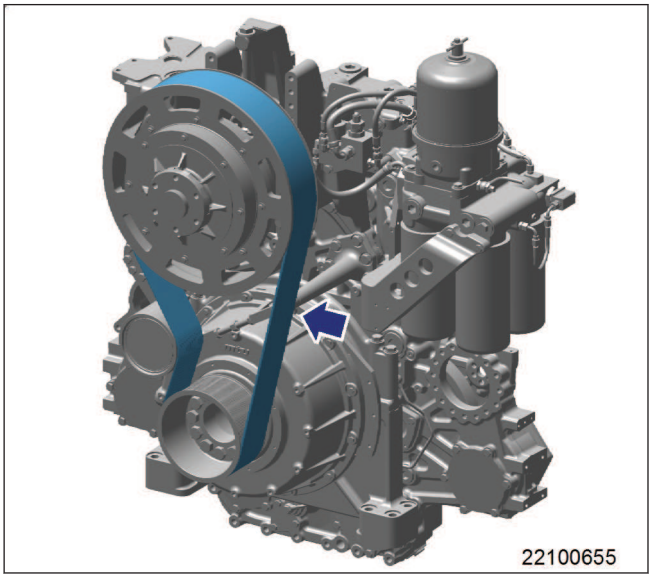
Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Optibelt TT belt tension tester	Y4345711	1
Torque wrench, 60–320 Nm	F30452768	

Preparatory steps

1. Remove protective cover.
2. Check belt condition visually (→ Page 237).

Result: For drive belt replacement, (→ Page 242).



Checking Vee belt tension

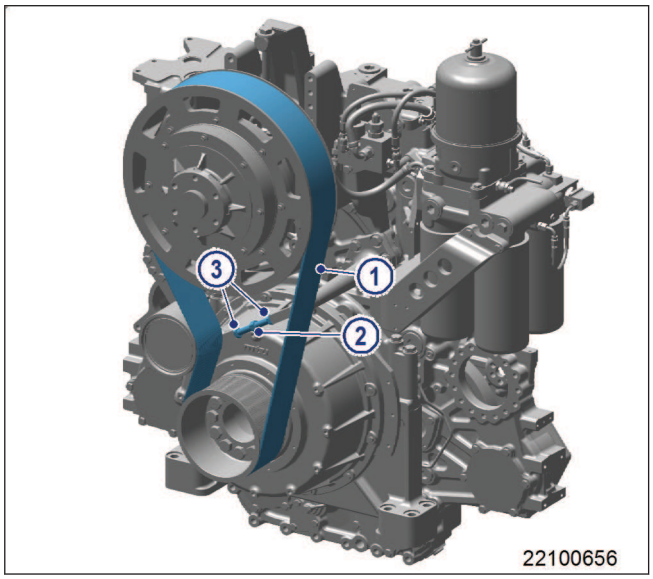
1. Switch on belt tension tester.
2. Hold measuring tip of belt tension tester over belt drive. Tap drive belt (arrow) with a suitable tool.
3. Hold belt tension tester over belt drive until the measured value is displayed.

Initial operation with fan	Belt tension adjustment
67 Hz ± 1 Hz	60 Hz ± 1 Hz

TIM-ID: 0000055054 - 002

Adjusting drive belt tension

1. Loosen hex nuts (3).
2. Tension belt (1) by turning the tie rod (2) until the required frequency (→ Table 3) is attained.
3. Turn crankshaft by minimum two rotations.
4. Tension belt (1) by turning the tie rod (2) until the required frequency (→ Table 3) is attained.



5. Tighten hex nuts (3) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Hex nut	M16	Tightening torque		70 Nm + 7 Nm

TIM-ID: 0000055054 - 002

8.19.4 Fan drive – Drive belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

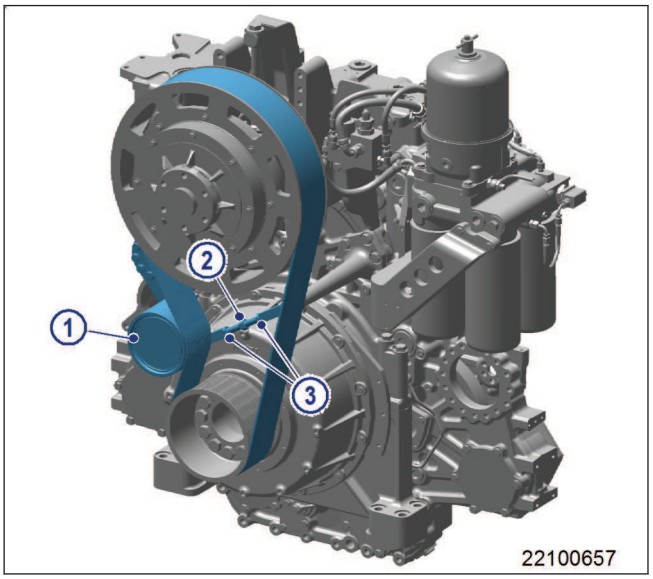
Designation / Use	Part No.	Qty.
Torque wrench, 60–320 Nm	F30452768	
Drive belt	(→ Spare Parts Catalog)	

Preparatory steps

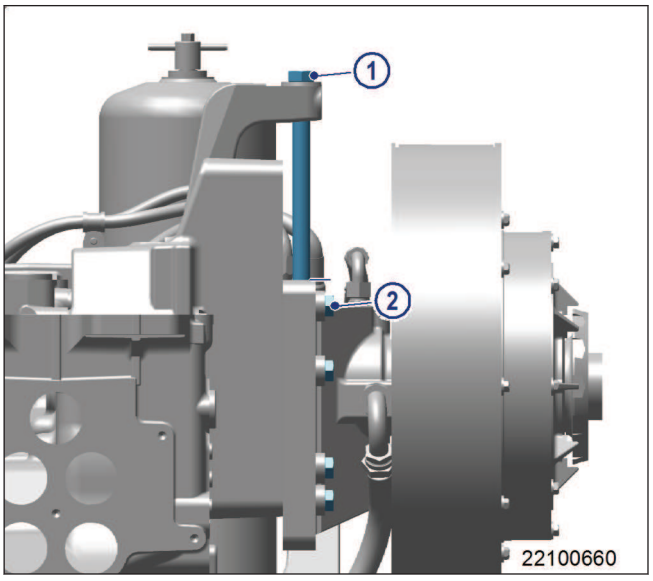
1. Remove protective cover.
2. Remove fan.

Removing drive belt

1. Loosen hex nuts (3).
2. Turn tie rod (2) to extend tie arm length until the arm is freely moveble.
3. Turn tensioning lever (1) outwards.



4. If required, loosen screws (2), release tensioning stud (1) and move fan coupling downwards.
5. Take off belt.
6. Clean belt pulleys.

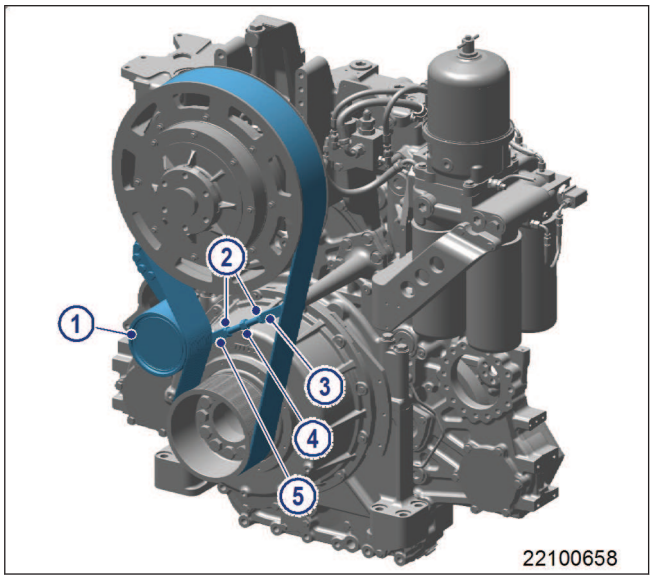


Installing drive belt

1. Fit new drive belt on belt pulleys, ensuring that it is not under tension.

TIM-ID: 0000055072 - 001

2. Turn tensioning lever (1) inwards.
3. Install tie rod (4) with swivel heads (3, 5) and hex nuts (2).
4. Adjust fan height (→ Page 246).
5. Adjust belt tension (→ Page 240).

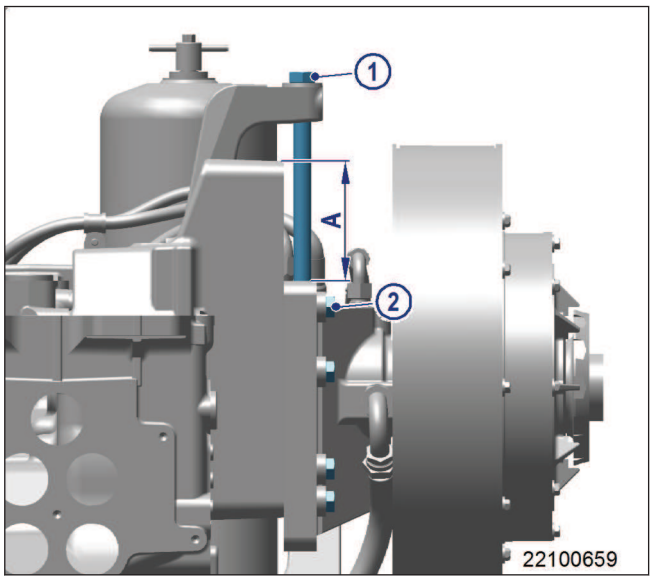


6. Tighten hex nuts (2) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Hex nut	M16	Tightening torque		70 Nm +7 Nm

Adjusting fan height

1. Loosen screws (2) or leave them snug-fit.
2. Adjust height of fan coupling with tensioning stud (1) until dimension A = 137 mm is attained.



3. Use torque wrench to tighten screws (2) to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Hex bolt	M16x75	Tightening torque		250 Nm +25 Nm

TIM-ID: 0000055072 - 001

8.20 Engine Mounting / Support

8.20.1 Engine mounting - Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 300–800 Nm	F30047798	1
Ratchet	F30450902	1
Engine oil		

NOTICE

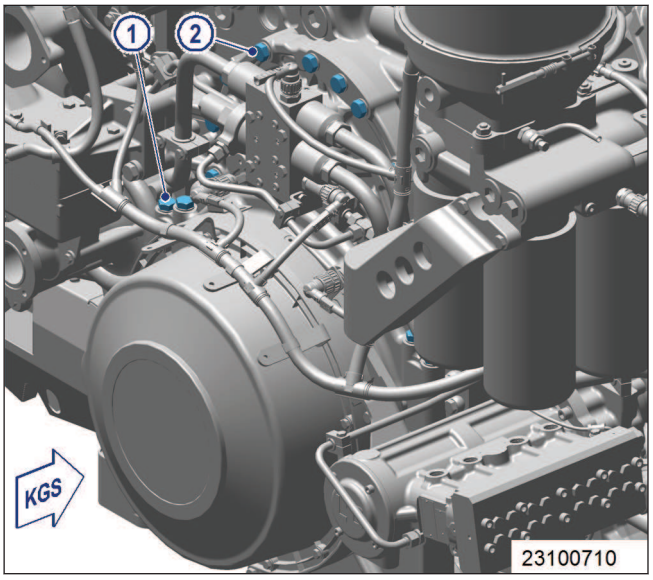
Contamination of engine mounts made of natural rubber with fuel or oil.
Engine mounts swell. Risk of shorter service life or destruction of the mounts!
- Cover engine mounts when working with fuel or oil.
- Remove contaminations on the rubber mounts immediately with a dry cloth and degrease them.

Checking general condition

Item	Findings	Action
Visually inspect mounts.	• Damage • Brittleness • Deformation • Crack formation • Swelling visible	Replace (→ Contact Service.)

Check securing screws for firm seating

1. Check securing screws (1, 2) for firm seating.



2. Tighten loose screw connections with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M20	Control torque	(Engine oil)	500 Nm +50 Nm

TIM-ID: 0000063676 - 001

3. Information on screws to connect engine mounting (6 x Ø21 or 8 x M22) to vehicle frame of vehicle manufacturer, system manufacturer or OEM must be obtained on the basis of the specific requirements. These screws must also be checked for firm seating.

TIM-ID: 0000063676 - 001

8.20.2 Engine mounting - Resilient mount check

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine filled with coolant and engine oil.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gage	Y20098771	1
Calipers	Y20001743	1
Box wrench	F30379609	1
Torque wrench 300-800 Nm	F30047798	1
Engine oil		

NOTICE

Contamination of engine mounts made of natural rubber with fuel or oil.
Engine mounts swell. Risk of shorter service life or destruction of the mounts!
- Cover engine mounts when working with fuel or oil.
- Remove contaminations on the rubber mounts immediately with a dry cloth and degrease them.

Engine mounts – Checking the condition of resilient mounts

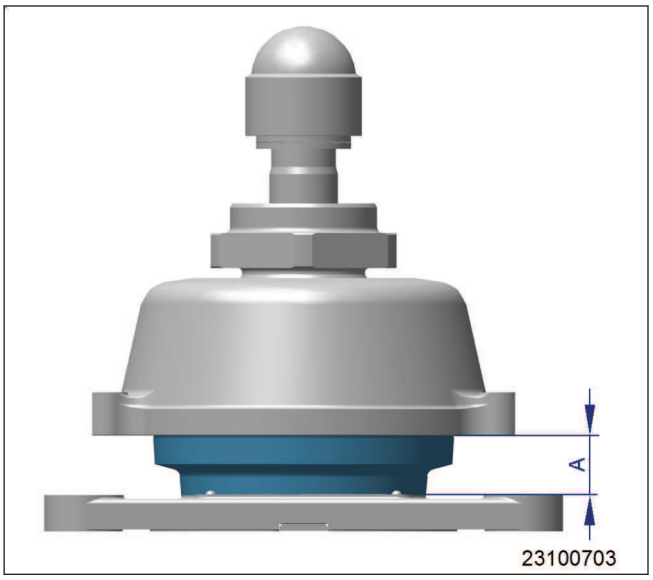
1. Wipe rubber surface with dry cloth, do not use organic detergents.
2. Check resilient mounts for crack formation and deformation by visual inspection.
3. Have cracked mounts replaced, contact Service.

Engine mounts – Measuring adjustment dimension

1. Measure dimension (A) with calipers.

Note: On new blocked mounts, the adjustment dimension is approx. 25 mm.

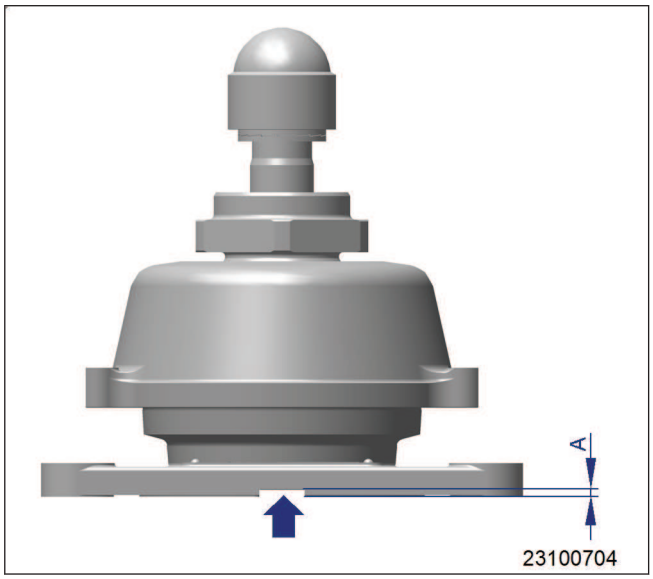
2. If the measured value of dimension A = 20 mm is lower than the specified value, the resilient mount must be replaced, contact Service.



TIM-ID: 0000063646 - 002

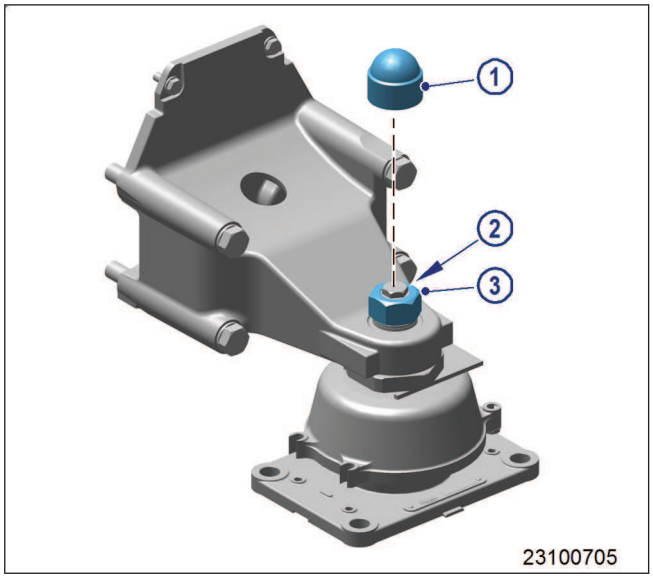
Engine mounts – Checking buffer clearance

1. Check dimension (A) with feeler gage on measuring groove (arrowed).
2. Adjust buffer clearance if dimension (A) is not 4.0 mm +0.5 mm.



Engine mounts – Adjusting buffer clearance

1. Take off protective cap (1).
2. Undo nut (3).
3. Adjust buffer clearance by turning the central buffer (2).
4. Coat mating face of nut (3) and thread of central buffer (2) with a little engine oil. Engine oil must not get in contact with the rubber elements of the resilient mount.



5. Tighten nut (3) to the specified tightening torque securing the central buffer (2) to prevent it turning.

Name	Size	Type	Lubricant	Value/Standard
Nut	M27 x 2	Tightening torque	(Engine oil)	600 Nm +60 Nm

6. Fit protective cap (1).

TIM-ID: 0000063646 - 002

8.21 Wiring (General) for Engine/Gearbox/Unit

8.21.1 Engine cabling - Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Solvent (isopropyl alcohol)	X00058037	1

Engine cabling – Check

1. Check securing screws of cable clamps on engine and tighten loose screw connections.
2. Ensure that cables are securely seated in clamps and cannot move freely.
3. Check if all cable clips are closed and intact.
4. Replace faulty cable clips.
5. Check cable clamps for secure fit, tighten loose clamps.
6. Replace faulty cable clamps.
7. Visually inspect the following electrical components for damage:
   - Connector housings
   - Contacts
   - Plug connectors
   - Cables and terminals
   - Plug-in contacts

Result: If cable conductors are damaged, contact Service.

Note: Close connectors that are not plugged in with the protective cap supplied.

8. Use isopropyl alcohol to clean dirty connector housings, plug connectors and contacts.
9. Ensure that all connecting plugs of the sensors are correctly engaged.

TIM-ID: 0000000029 - 025

8.22 Accessories for (Electronic) Engine Governor / Control System

8.22.1 Resetting CDC parameter and entering IIG with DiaSys®

Preconditions

☑ Engine is stopped and starting disabled.

Note: The engine will lose its emissions certification of the drift correction parameters (CDC) if not reset.

Parameters for drift correction (CDC) – Resetting with DiaSys®

1. Use DiaSys® to reset the CDC parameters (→ Dialog system DiaSys® E531920/..).
2. If no DiaSys® is available, contact Service.

Entering the codes for the injectors (IIG) with DiaSys®

1. Use DiaSys® to enter the IIG (→ Dialog system DiaSys® E531920/..).
2. If no DiaSys® is available, contact Service.

TIM-ID: 0000045613 - 002

8.22.2 Actuators - Visual inspection and test

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

Actuation mechanism in the exhaust and intake area closes automatically.
Risk of crushing hands!
- To carry out the teach-in routine, keep clear of the safety zone of the actuation mechanism in the intake and exhaust area.
- Switch off the operating voltage of the engine governor before starting the mechanical test.
- Wear protective goggles.

WARNING

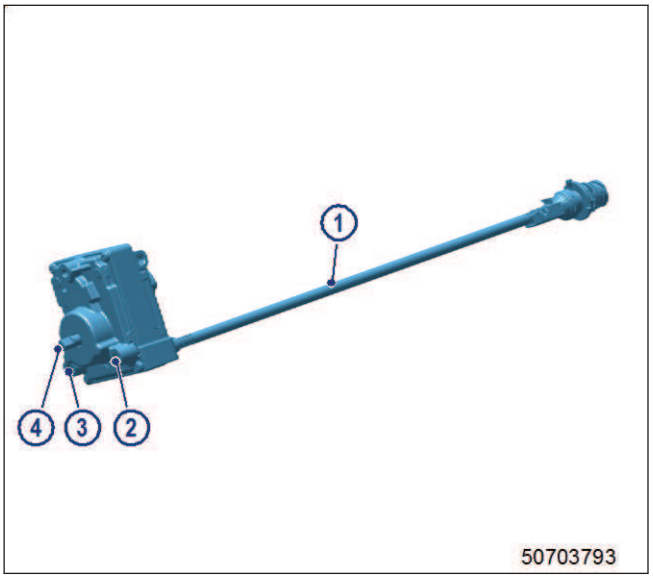
Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

NOTICE

Carry out the calibration learning run for a functional check of the servomotor. Overwriting of stop values through already existing wear.
Exceeding of emission values and engine damage are possible!
- Only carry out the calibration learning run if the servomotor of the flap is connected to the ECU for the first time or a coupling rod was been replaced.

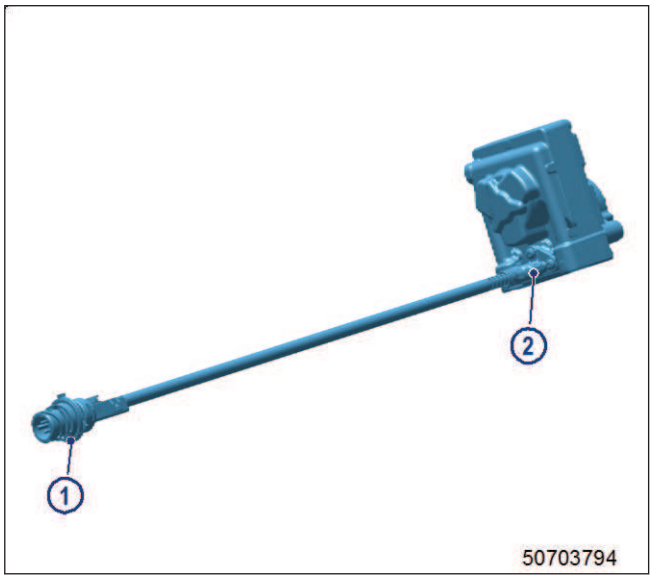
Checking actuators visually

Note
Actuators must not be interchanged or exchanged from other engines - even for test purposes. Always use new actuators.



Item	Findings	Measure
Corrugated pipe (1)	Damaged, holes or cracks.	Replace
Coolant connections (2, 3)	Traces of coolant leaks.	Replace
Output shaft (4)	Damaged	Replace

TIM-ID: 0000044543 - 007



Item	Findings	Measure
Connector (1)	Damaged	Replace actuator.
Actuator cable connection (2)	Damaged Protective cap not correctly mounted.	Replace actuator. Mount protective cap correctly.
Actuator general condition	Heavily contaminated by black exhaust.	Replace actuator.

Checking actuators with DiaSys®

Note: For installation position of exhaust flaps, refer to overview (→ Page 192).

1. Switch on ECU.

Note: A learning run must not be carried out for a functional test of the servomotor because this would result in malfunction of the wear detection of the flap.

2. For a function test, move the flap via DiaSys® in manual mode into different positions (→ Dialog system E531920/..). If no DiaSys® is available, contact Service.

TIM-ID: 0000044543 - 007

8.22.3 Engine governor and connector - Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Solvent (isopropyl alcohol)	X00058037	1

NOTICE

Insertion of unsuitable test probe, e.g. test prod.
The contacts in the plug connection can be bent!
- Carry out check of plug connection only with test connectors.

Engine governor and connector – Cleaning

1. Use isopropyl alcohol to remove coarse dirt from housing surface.
2. Use isopropyl alcohol to remove dirt from the connector and cable surfaces.
3. Check legibility of cable labels. Clean or replace illegible labels.

Heavily contaminated connectors on engine governor – Cleaning

Note: Close connectors that are not plugged in with the protective cap supplied.

1. Release latches of connectors and withdraw connectors.
2. Clean connector housings, connector socket housings and all contacts with isopropyl alcohol.
3. When connectors, sockets and all contacts are dry: Fit connectors and latch them.

TIM-ID: 0000000047 - 014

8.22.4 Engine governor plug connections – Check

Preconditions

☑ Engine stopped and starting disabled.

☑ Electronic engine management system is de-energized.

NOTICE

Insertion of unsuitable test probe, e.g. test prod.
The contacts in the plug connection can be bent!
- Carry out check of plug connection only with test connectors.

Checking plug connections at engine governor

1. Check all plug connections for secure seating.
2. Lock loose connectors.
3. Check dust cap on ECU and EXU connectors for damage and correct seating.

TIM-ID: 0000000048 - 009

8.22.5 NOx sensor - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ Power supply to electronic engine management system is switched off.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 4–20 Nm	F30044239	1
Torque wrench, 10–60 Nm	F30452769	1
Ratchet bit	F30027340	1
Assembly compound (Molykote P 37)	50564	1
NOx sensor	(→ Spare Parts Catalog)	1

WARNING

Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

NOTICE

Incorrect measurement of the sensors are possible even with small amounts of contamination during assembly and due to contaminated process materials.
Sensor damage resultant damage to components is possible!
- Prior to assembly, check sensors for particular cleanness and install with clean hands.
- Protect sensor against contamination with certain materials (e.g. thread grease, engine oil, silicone, reducing agent and others).
- The process materials must meet the requirements of the Fluids and Lubricants Specifications.

NOTICE

High voltage.
Risk of damage to components!
- Switch off ignition before replacing components.

NOTICE

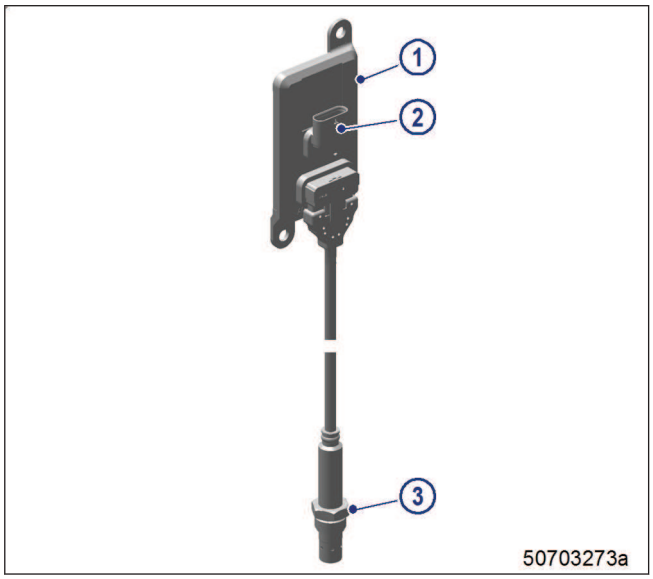
Ceramic cell breakage due to shock or impact.
Risk of damage to components!
- Avoid shocks and impacts.
- Exercise extreme care when handling sensors.

TIM-ID: 0000025205 - 018

Removing NOx sensor

Note: Observe arrangement and position of sensor (→ Page 41).

1. Disconnect and remove male connector (2) from control unit (1).
2. Unscrew control unit (1) at the eyelets.
3. Remove sensor (3).



Installing NOx sensor

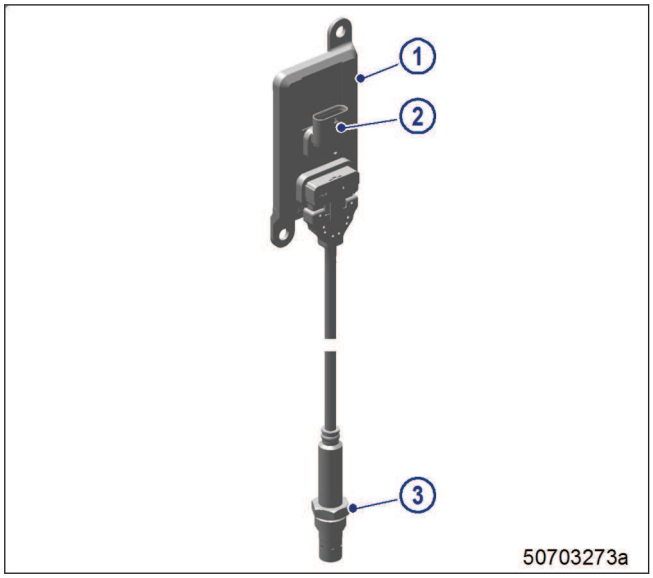
Note: Note the following:

- If the sensor (3) was subjected to shock or impact load, it is considered to be defective and may not be used.
- Always replace NOx sensor (3) together with control unit (1).

1. Screw on control unit (1) at the eyelets and tighten screws.
2. Remove protective cap on thread of sensor (3) only just before installation.

Note: Do not wipe off the thread lubricant applied by the manufacturer.

3. Coat sensor thread (3) thinly with specified assembly compound as necessary.
4. Screw in sensor (3) by hand.



5. Tighten nut (3) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Nut	M20	Tightening torque	(Assembly compound (Molykote P 37))	40 Nm +4 Nm

6. Fit male connector (2) and latch it.

TIM-ID: 0000025205 - 018

8.22.6 Lambda sensor - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ Power supply to electronic engine management system is switched off.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 10–60 Nm	F30452769	1
Ratchet bit	F30027340	1
Assembly compound (Molykote P 37)	50564	1
Lambda sensor	(→ Spare Parts Catalog)	1

WARNING

Hot components/surfaces.
Risk of burns!
- Allow the engine to cool down to below 50 °C before beginning work.
- Wear suitable protective equipment/thermal gloves.
- Avoid unprotected contact with hot surfaces.

NOTICE

Incorrect measurement of the sensors are possible even with small amounts of contamination during assembly and due to contaminated process materials.
Sensor damage resultant damage to components is possible!
- Prior to assembly, check sensors for particular cleanness and install with clean hands.
- Protect sensor against contamination with certain materials (e.g. thread grease, engine oil, silicone, reducing agent and others).
- The process materials must meet the requirements of the Fluids and Lubricants Specifications.

NOTICE

High voltage.
Risk of damage to components!
- Switch off ignition before replacing components.

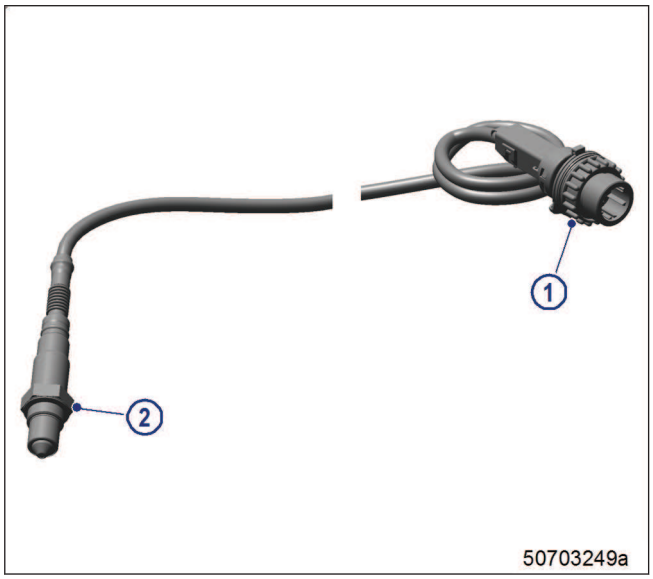
NOTICE

Ceramic cell breakage due to shock or impact.
Risk of damage to components!
- Avoid shocks and impacts.
- Exercise extreme care when handling sensors.

TIM-ID: 0000025194 - 018

Removing Lambda sensor

1. Observe the following general information:
   - Layout and position of sensor (→ Page 41).
2. Unplug and remove male connector (1).
3. Remove sensor (2).



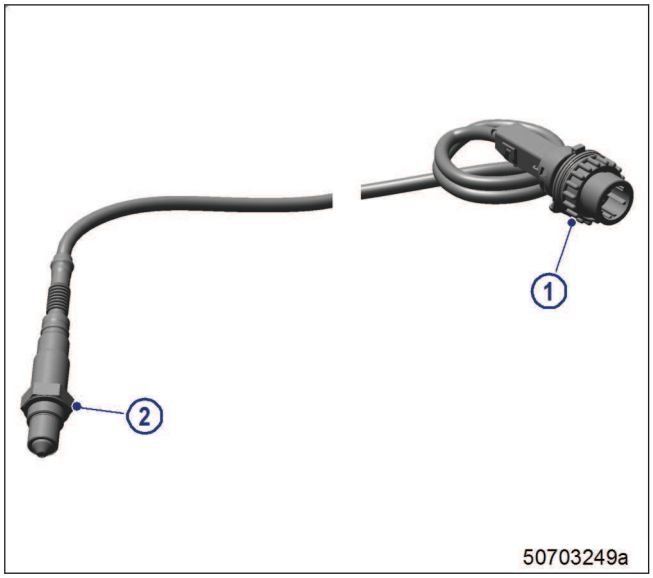
Installing Lambda sensor

Note: When the sensor was subjected to shock or impact load, it is deemed to be defective and may not be used.

1. Remove protective cap on thread only just before installation.

Note: Do not wipe off the thread lubricant applied by the manufacturer.

2. Coat sensor thread thinly with specified assembly compound as necessary.
3. Screw in sensor by hand.



4. Tighten nut (2) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Nut	M18 x 1.5	Tightening torque	(Assembly compound (Molykote P 37))	40 Nm +4 Nm

5. Fit male connector (1) and latch it.
6. Reset Lambda sensor calibration with DiaSys® (→ Dialog system DiaSys® E531920/..). If no DiaSys® is available, contact Service.

TIM-ID: 0000025194 - 018

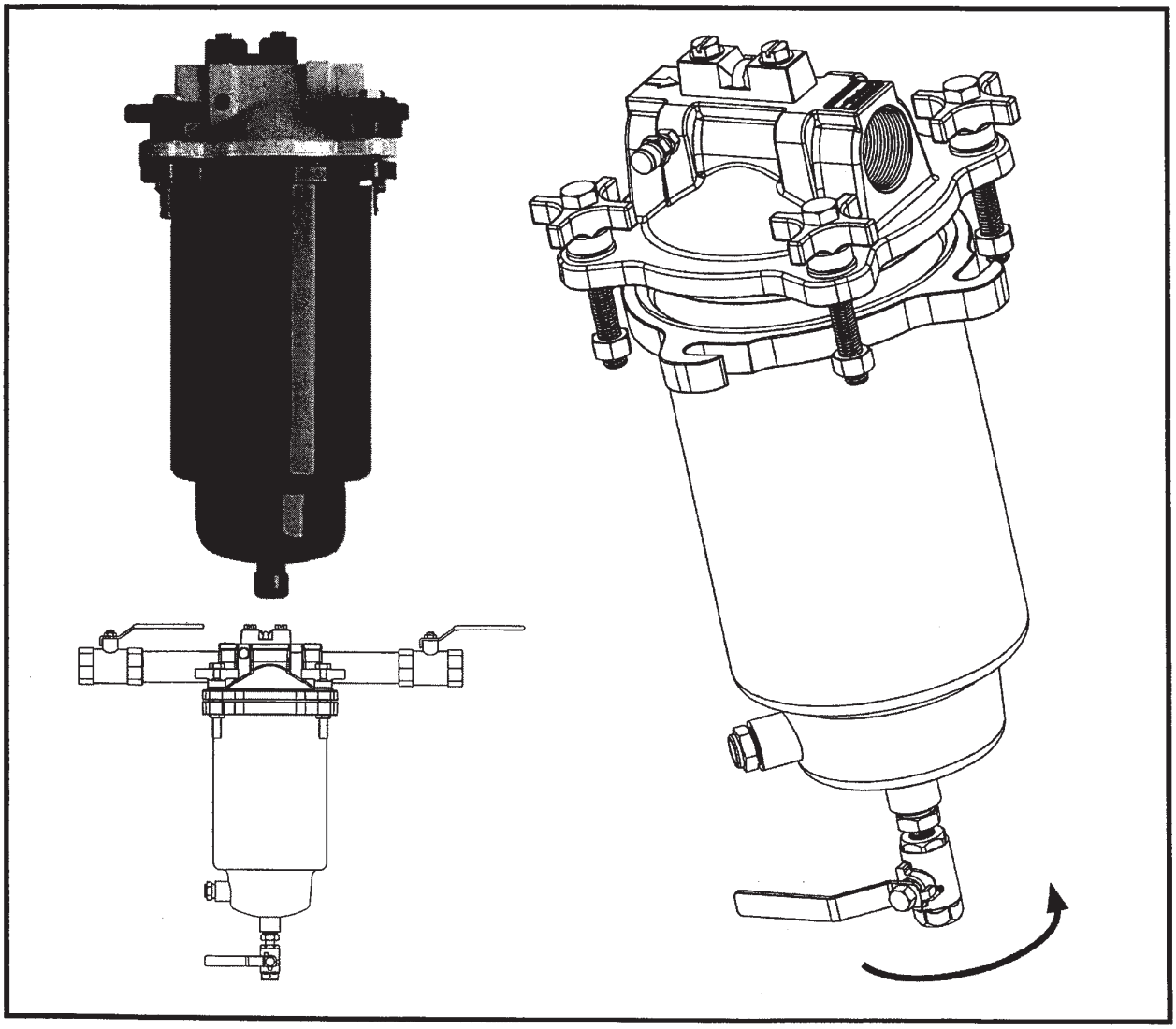
9 Manufacturer's Documentation

9.1 Prefilter Installation, Operation 263
9.2 Prefilter Installation Instructions 275

RACOR®

Racor FBO Filter Vessel Installation, Operation and Service

- **Aviation Fuel Trucks**
- **Aviation Fuel Cabinets**
- **Diesel Fuel Dispensing**
- **Marine Fuel Docks**
- **High-Flow Diesel Engine Filtration**



TIM-ID: 0000098598 - 001

Parker

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4. Warranty: Seller warrants that the items sold hereunder shall be free from defects in material or workmanship for a period of 12 months from date of shipment from Parker Hannifin Corporation. The warranty period for pumps and motors is specifically limited to 90 days from date of purchase. **THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO ITEMS PROVIDED HEREUNDER. SELLER MAKES NO OTHER WARRANTY, GUARANTEE, OR REPRESENTATION OF ANY KIND WHATSOEVER. ALL OTHER WARRANTIES, INCLUDING BUT NOT LIMITED TO, MERCHANTABILITY AND FITNESS FOR PURPOSE, WHETHER EXPRESS, IMPLIED, OR ARISING BY OPERATION OF LAW, TRADE USAGE, OR COURSE OF DEALING ARE HEREBY DISLCAIMED.**

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6. Changes, Reschedules and Cancellations: Buyer may request to modify the designs or specifications for the items sold hereunder as well as the quantities and delivery dates thereof, or may request to cancel all or part of this order, however, no such requested modification or cancellation shall become part of the contract between Buyer and Seller unless accepted by Seller in a written amendment to this Agreement. Acceptance of any such requested modification or cancellation shall be at Seller's discretion, and shall be upon such terms and conditions as Seller may require.

7. Special Tooling: A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture items sold pursuant to this contract. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the items sold hereunder, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

8. Buyer's Property: Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer, or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

9. Taxes: Unless otherwise indicated on the face hereof, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of the items sold hereunder. If any such taxes must be paid by Seller or if Seller is liable for the collection of such tax, the amount thereof shall be in addition to the amounts for the items sold. Buyer agrees to pay all such taxes or to reimburse Seller therefore upon receipt of its invoice. If Buyer claims exemption from any sales, use or other tax imposed by any taxing authority, Buyer shall save Seller harmless from and against any such tax, together with any interest or penalties thereon which may be assessed if the items are held to be taxable.

10. Indemnity For Infringement of Intellectual Property Rights: Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Part 10. Seller will defend and indemnify buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets (hereinafter 'Intellectual Property Rights'). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that an item sold pursuant to this contract infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If an item sold hereunder is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using said item, replace or modify said item so as to make it noninfringing, or offer to accept return of said item and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to items delivered hereunder for which the designs are specified in whole or part of Buyer, or infringements resulting from the modification, combination or use in a system of any item sold hereunder. The foregoing provisions of this Part 10 shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

If a claim is based on information provided by Buyer or if the design for an item delivered hereunder is specified in whole or in part by Buyer, Buyer shall defend and indemnify Seller for all costs, expenses or judgments resulting from any claim that such item infringes any patent, trademark, copyright, trade dress, trade secret or any similar right.

11. Force Majeure: Seller does not assume the risk of and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter 'Events of Force Majeure'). Events of Force Majeure shall include without limitation, accidents, acts of God, strikes or labor disputes, acts, laws, rules or regulations of any government or government agency, fires, floods, delays or failures in delivery of carries or suppliers, shortages of materials and any other cause beyond Seller's control.

12. Entire Agreement/Governing Law: The terms and conditions set forth herein, together with any amendments, modifications and any different terms or conditions expressly accepted by Seller in writing, shall constitute the entire Agreement concerning the items sold, and there are no oral or other representations or agreements which pertain thereto. This Agreement shall be governed in all respects by the law of the State of Ohio. No actions arising out of the sale of the items sold hereunder or this Agreement may be brought by either party more than two (2) years after the cause of action accrues.

TIM-ID: 0000098598 - 001

RAC 1-92

Hydrocarbon Filtration FBO-10 and FBO-14 Series Housing and Cartridges

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1	FBO Series Applications
1	FBO Features
1	Closure Hardware
1	Applications
1	Installations
1	Standard Design Features
1	Optional Accessories
2	Installation, Operation & Service Instructions Installation Instructions Operation and Service Instructions
2	Maintenance Guidelines For: Inspection of Head Gasket and Cartridge and Seal Gasket Changeout
3	Cartridge Replacement Procedures Frequency of Cartridge Element Replacement For Aviation Fuel Service For All Other Applications Cartridge Replacement Procedures (16 Steps)
4	Illustration of Typical Isolation Valve Layout
5	Illustration of Housing to Head Assembly
5	Illustration of Head/Spring/Cartridge Installation
6	Illustration and Spare Parts List

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MAXIMUM FLOW RATES

	Maximum Flow Rates				Clean Dry	Change
FBO-10	**Flow Range**	**Diesel**	**Jet Fuel**	**Gasoline**	**Delta P**	**Delta P**
Prefilter	5-40 GPM	20	40	50	**	20 PSID
Filter Separator	5-35 GPM	18	35	45	**	15 PSID
Absorber	5-25 GPM	18	35	45	**	30 PSID
FB0-14	**Flow Range**	**Diesel**	**Jet Fuel**	**Gasoline**	**Delta P**	**Delta P**
Prefilter	10-60 GPM	30	60	75	**	20 PSID
Filter Separator	10-50 GPM	25	50	65	**	15 PSID
Absorber	10-37 GPM	26	55	70	**	30 PSID

**** Varies With Fluid and Flow Rate**

ELEMENT APPLICATIONS

	Micron Rating	FBO-10	FBO-14
		6 X 10 Element	6 X 14 Element
Filter Separator	1	FBO-60327	FBO-60336
	5	FBO-60328	FBO-60337
	10	FBO-60353	FBO-60356
	25	FBO-60329	FBO-60338
Prefilter	1	FBO-60330	FBO-60339
	5	FBO-60331	FBO-60340
	10	FBO-60356	FBO-60357
	25	FBO-60332	FBO-60341
Absorptive Filter	1	FBO-60333	FBO-60342
	5	FBO-60334	FBO-60343
	10	FBO-60355	FBO-60358
	25	FBO-60335	FBO-60344

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Product Description, Installation, Operation and Service Instructions For Parker Hannifin Racor Division, Hydrocarbon Filtration FBO-10 & FBO-14 Series Housings and Cartridges

FBO SERIES PRODUCT DESCRIPTION

Racor Hydrocarbon Filtration's new FBO-10 and FBO-14 filter assemblies are designed to meet the toughest hydrocarbon refueling conditions and give maintenance personnel ease of filter changeouts.

The FBO assembly can flow 25 gpm/95 lpm or up to 60 gpm/230 lpm depending on the unit, cartridges installed and the fuels being filtered.

FBO SERIES APPLICATIONS

The FBO assembly can be used on mobile refuelers or installed in refueling cabinets.

The unit can also be used for diesel fuel dispensing pumps or as an engine primary fuel filter/water separator.

FBO FEATURES

The assembly features a *"locking ring collar,"* that attaches the filter housing to the aluminum die-cast filter head with four bolts.

The slotted *"locking ring collar"* allows maintenance personnel to hand loosen the four collar bolts, rotate and lower the bowl assembly for cartridge changeouts.

With a new cartridge installed, simply raise the bowl and rotate into position on the locking ring and hand tighten evenly.

CLOSURE HARDWARE

The closure hardware consists of stainless steel nuts, bolts and washers with metal hand knobs for ease of maintenance.

No V-Band Clamps are used. This allows one person to easily change the filter cartridge.

APPLICATIONS

Jet Fuel
Aviation Gas
Diesel Fuel
Gasoline
Kerosene
JP4, JP5, JP8

INSTALLATIONS

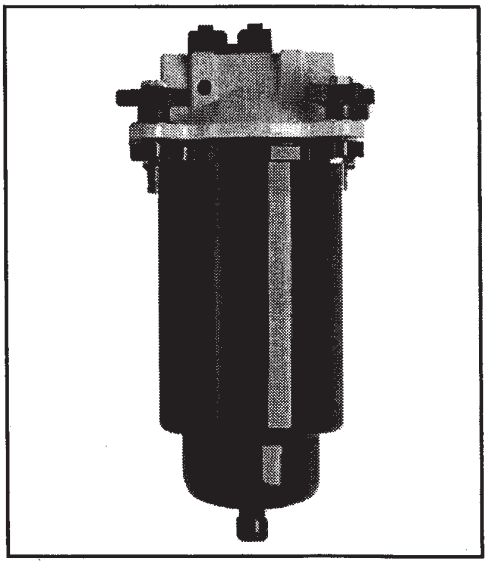
Aviation Fuel Trucks
Aviation Fueling Cabinets
Diesel Fuel Dispensing System
Marine Fuel Docks
Fuel Systems on Large Diesel Engines

STANDARD DESIGN FEATURES

Die-cast Aluminum Head
Steel Filter Bowl Assembly
Powder Coated Components
"Locking Ring Collar," No Clamps
1 1/2" NPT Inlet and Outlet
150 psi @ 240° F Maximum Design Pressure
Manual Drain Valve
Manual Vent Valve

OPTIONAL ACCESSORIES

Water Sight Glass or Electronic Water Probe
Delta P Indicator.



Cartridge Options
(1, 5, 10, 25 micron)
FP Prefilters
OCP Coalescers
FW Water Absorbing

TIM-ID: 0000098598 - 001

Installation, Operation and Service Instructions

INSTALLATION

1. Remove the housing protectors from the inlet and outlet connections.

2. Make certain that connections are free of any debris.

> **CAUTION:**
> **Be sure to correctly identify the inlet and outlet connections to avoid piping the unit backwards. *The unit will not perform properly if connections are reversed.***

3. Provide shut-off valves in the inlet and outlet piping as close to the unit as possible. *This is necessary for isolating the unit from the system when cartridge replacement is necessary. (See Illustration on page 4).*

4. Connect the housing into the piping system with a minimum number of turns and fittings, especially on the inlet side.

5. For installations on fuel dispensing pump, connect the fuel delivery hose directly to the outlet connection.

6. Provide room for the housing to clear the cartridge during change-out. *(A 2 inch base clearance is required).*

7. We recommend installation of a differential pressure gauge so the differential pressure across the housing can be monitored. This allows accurate determination of when the cartridge should be changed.

   Part numbers 72694 or 72783 are differential pressure gauges specifically designed to be used on FBO-10 and FBO-14.

8. For ***Absorptive Cartridges*** used in aviation fuel or diesel fuel service, ***ALWAYS*** install a differential pressure gauge or other means of determining the differential pressure.

   See Maximum Flow Rates Chart for applicable flow rates on page ii, before page 1.

> **CAUTION:**
> **On systems where pressures can exceed 75 psi, a pressure bypass around the pump *must be installed* to protect the cartridge and system from a high pressure shock or sudden cartridge seal-off due to a slug of water in the product.**

OPERATION AND SERVICE

Open Vent & Drain Valves Each Day

It is recommended that the vent and drain valves be opened once each day to permit the escape of entrapped air and accumulated water.

Limited Maintenance Required

Since there are no moving parts, maintenance is limited to an occasional cartridge replacement, requiring only a 2 inch (51mm) base clearance.

Maintenance Guidelines For:

Inspection of Head Gasket and Cartridge and Seal Gasket Change-Out

1. The *head gasket* should be carefully inspected for signs of damage or deterioration each time the housing is opened.

2. Each Parker Element Replacement Kit contains a *housing seal gasket.* It is recommended that the seal gasket *be replaced at every cartridge changeout.*

3. Replace the seal gasket if it shows any signs of wear.

4. We recommend the seal gasket be lubricated with petroleum jelly or oil prior to installation.

> **CAUTION:**
> **Use only non-sparking tools when performing any maintenance or service work on this equipment.**

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Cartridge Replacement Procedures

Frequency of Cartridge Element Replacement

The frequency of cartridge element replacement is dependent upon the following conditions:

For Aviation Fuel Service

Replace the cartridge when the differential pressure across the housing exceeds 15 psi; red indication on the DP gauge; after one year of service; or when there is a significant reduction in flow through the housing, whichever occurs first.

For All Other Applications

Replace the cartridge when the differential pressure exceeds 25 psi; red indication of DP gauge; after one year of service; when the flow is significantly reduced; or if the pressure has been steadily climbing then begins to decrease, whichever occurs first.

Cartridge Replacement Procedures

When any of the above noted conditions indicate that cartridge replacement is necessary, observe the following procedures.

1. Close the inlet and outlet isolation valves to isolate the filter from the system.
2. Open the drain valve on the housing bottom and allow all fluid to drain from the unit.
3. Open the vent valve on the cover of the housing and allow the unit to thoroughly vent before opening the cover.
4. Loosen the four (4) knobs attaching the head to the housing flange.
5. Remove the head gasket and discard.
6. Remove and discard the expended cartridge in a FIRE-SAFE place, in accordance with local and national regulations.
7. Flush the interior of the housing with clean, processed, filtered product or a suitable solvent. A nonmetallic bristle brush will help to remove caked-on debris. Rinse the housing and unit cover with a clean solvent and dry with soft, lint-free wiping cloths.

CAUTION:
Due to the toxic effects of some additives used in filtered fluids, care should be exercised in handling the expended cartridges and/or all internal parts that have been in contact with the filtered product.

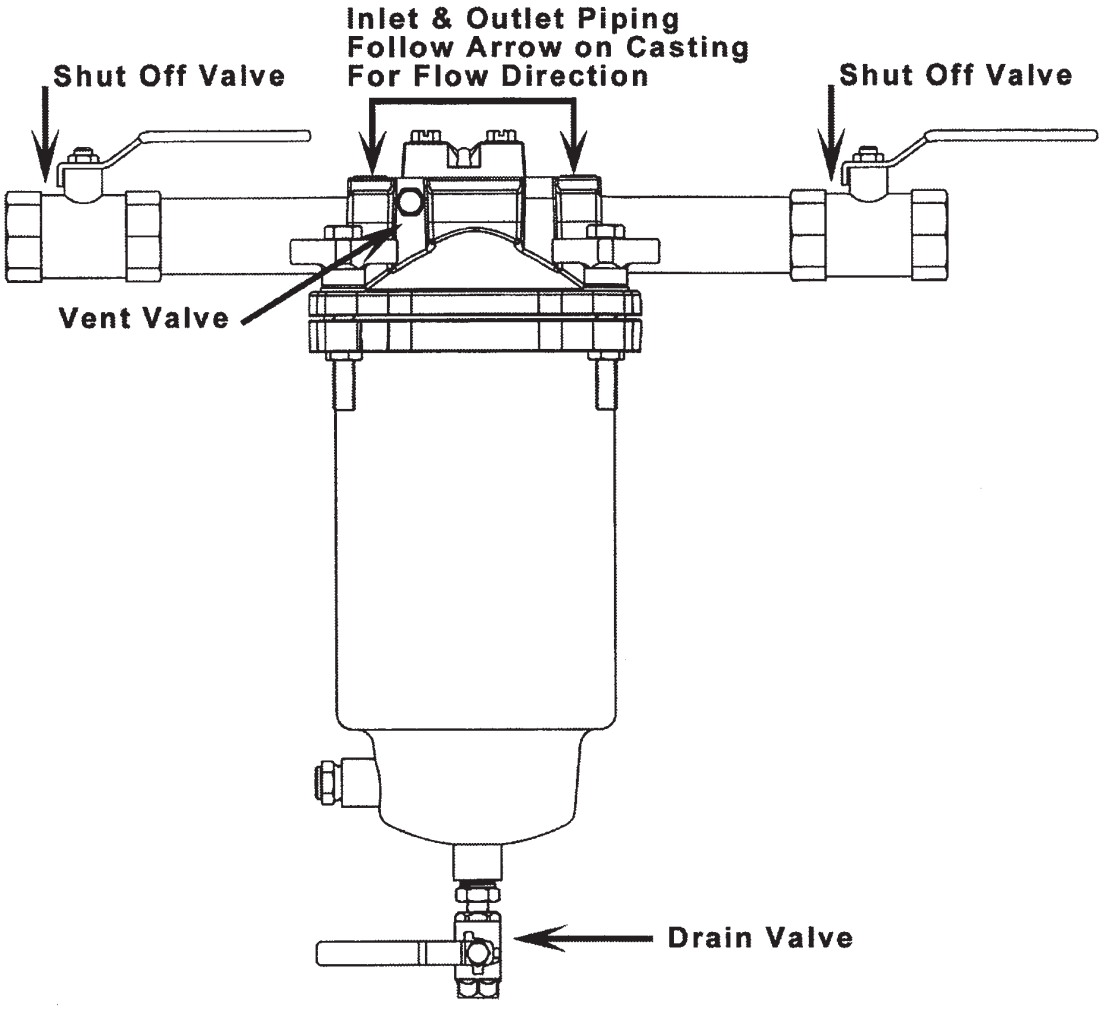
8. Lightly lubricate new head gasket with Vaseline or Petroleum Jelly and position it on the head. If Vaseline is not available, lubricate the gasket with the fuel or oil that it will be used in.
9. Insert a new cartridge into the housing. Position housing (with cartridge) underneath filter head. Push/twist cartridge onto head spigot. The head "conical spring" will seat/seal the cartridge in the housing. *(See head/spring/cartridge installation instruction on page 5.)*
10. "Rotate" housing onto the collar bolts. Hand tighten knobs until head is "snug" to housing. *See Illustration on Page 5.*

NOTE:
A TORQUE WRENCH IS RECOMMENDED. TIGHTEN ALL COLLAR BOLTS TO 50 IN LBS.

11. Close the drain plug or valve on the bottom of the housing.
12. SLOWLY open the inlet and outlet valves; allow the unit to fill completely.
13. Leave the vent valve on top of the unit open; to allow entrapped air to escape while filling.
14. When a small amount of fluid flows from the vent valve, close it tightly.
15. During the initial filling and after the above maintenance, and while unit is in operation, examine housing and all connections for leaks,including head/flange junction
16. Assure any and all leaks are identified and repaired before allowing fuel to flow through housing.

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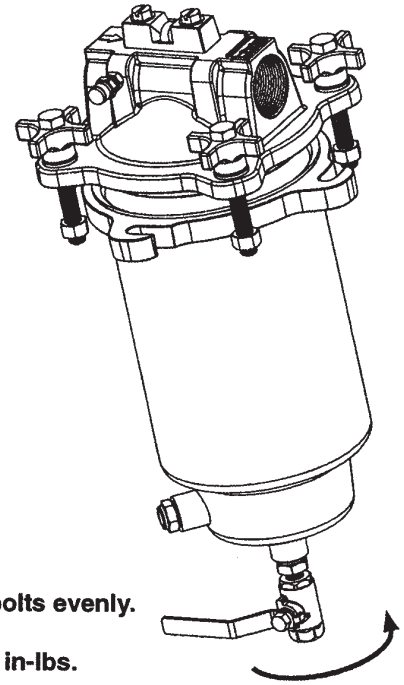
Illustration:
Typical Isolation Valve Layout



NOTE:
Valves should be installed on each side of the filter assembly, so the fuel flow can be shut off during element changeouts or filter assembly maintenance.

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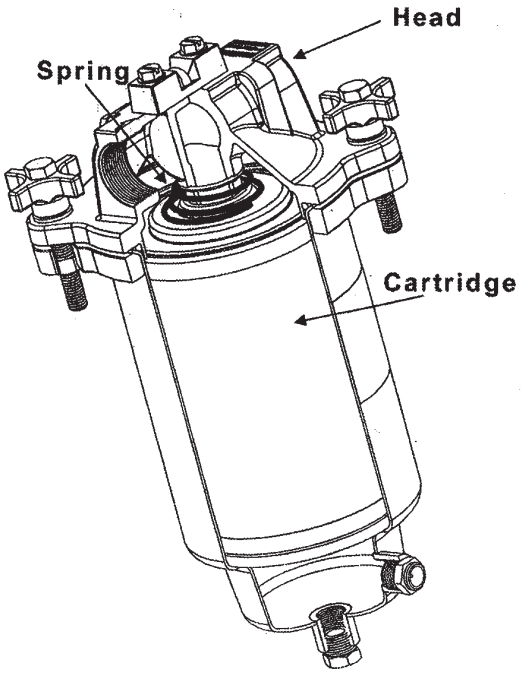
Illustration:
Housing to Head Assembly



NOTE:

1. **Hand tighten all four collar bolts evenly.**
2. **If a torque wrench is used; torque each collar bolt to 50 in-lbs.**

Illustration:
Head/Spring/Cartridge Installation

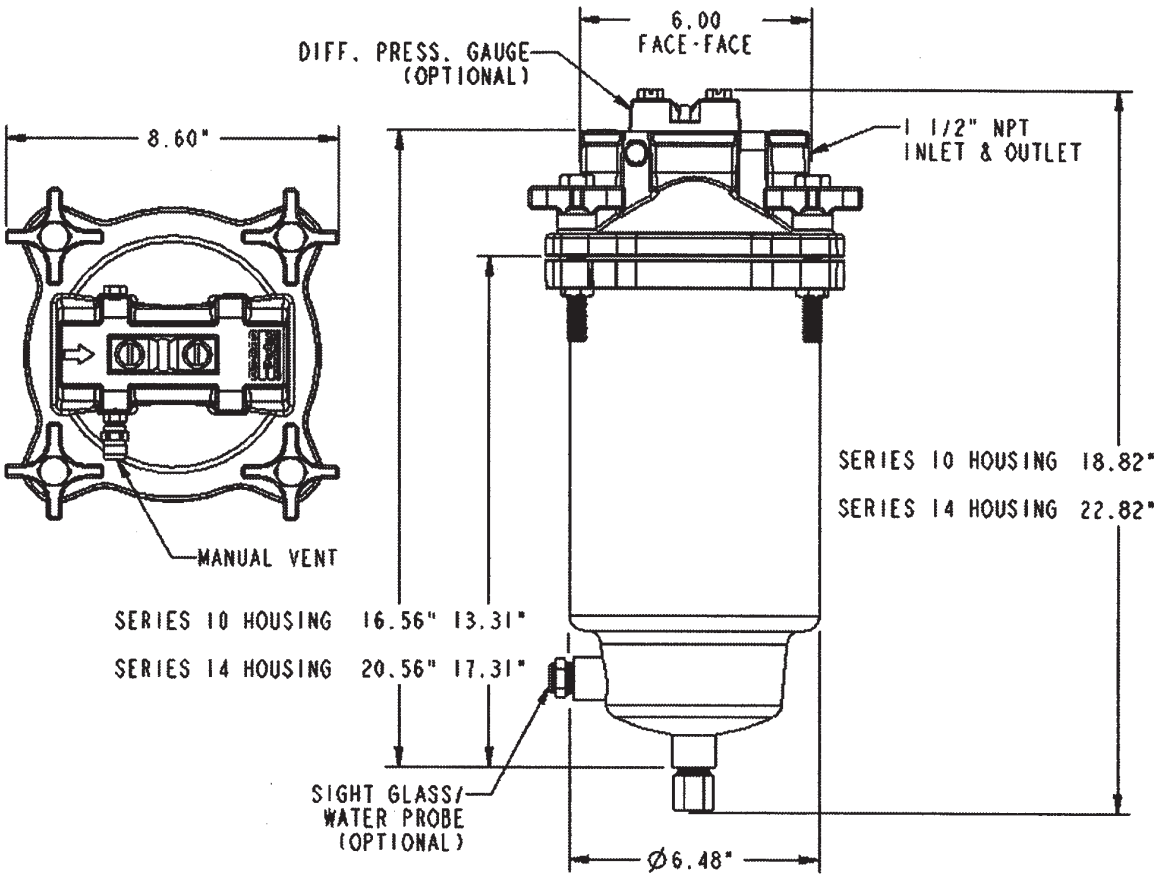


NOTE:

1. **Location of Spring**

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Illustration and Spare Parts List



Spare Parts List

Description	Part Number	Quantity
½" Washer	71328	4
½" Hex Nut	71329	4
Spring	72368	1
Purge Valve	72695	1
O-Ring	72699	1
1/8" Pipe Plug	72700	1
½" Pipe Plug	72701	1
¼" Pet Cock	72702	1
½" – ¼" Bushing	72709	1
Handle Assembly (knob)	72712	4
Sight Glass	72710	1
DP Gauge 15 psid	72694	1
DP Gauge 30 psid	72783	1
Water Probe	RK 30880	1
Housing Assembly FBO-10	72805	1
Housing Assembly FBO-14	72806	1
Head, with DP Gauge Ports	72531	1
Head , without DP Gauge Ports	72718	1
¼" NPT Close Nipple	72812	1
¼" NPT Ball Valve	71943-.25	1

TIM-ID: 0000098598 - 001

Also Available From Racor

Filter Vessels

Racor manufactures filter vessels with flow rates up to 5,000 gallons per minute. Those vessels include prefilters, vertical filter separators, horizontal filter separators, clay treaters and fuel monitors.

API/IP Qualified Elements

Racor currently produces coalescers and fuel monitors to API/IP qualifications. Qualification reports of each test are available by contacting Racor. These include applications for both vertical and horizontal filter separators and fuel monitor elements.

RVFS Filter Vessels

Racor RVFS filter vessels offer economical systems for flow rates up to 150 gallons per minute for aviation fuels and up to 75 gallons per minute for diesel fuels. RVFS units can be supplied in single units or as duplex systems, with optional electronic monitoring systems. These units are being used with high flow diesel engines as prefilters or as fuel dispensing systems for aviation fuels or diesel fuel.

Filter Elements

Racor manufactures a full range of API/IP coalescers, IP fuel monitors, prefilters, coalescers, separators, synthetic pleated media elements, clay bags and canisters, activated carbon cartridges, fuel monitors, water absorbing elements and spin-on filters, oily water separator elements, and natural gas coalescers.

For more information on Racor Hydrocarbon Filters ask for brochure #7537 or call (800) 451-7299.

Racor also offers a full line of mobile and marine fuel, oil, air and coolant filters for all gasoline, diesel fuel and natural gas powered engines.

For more information on mobile and marine products, call (800) 344-3286.

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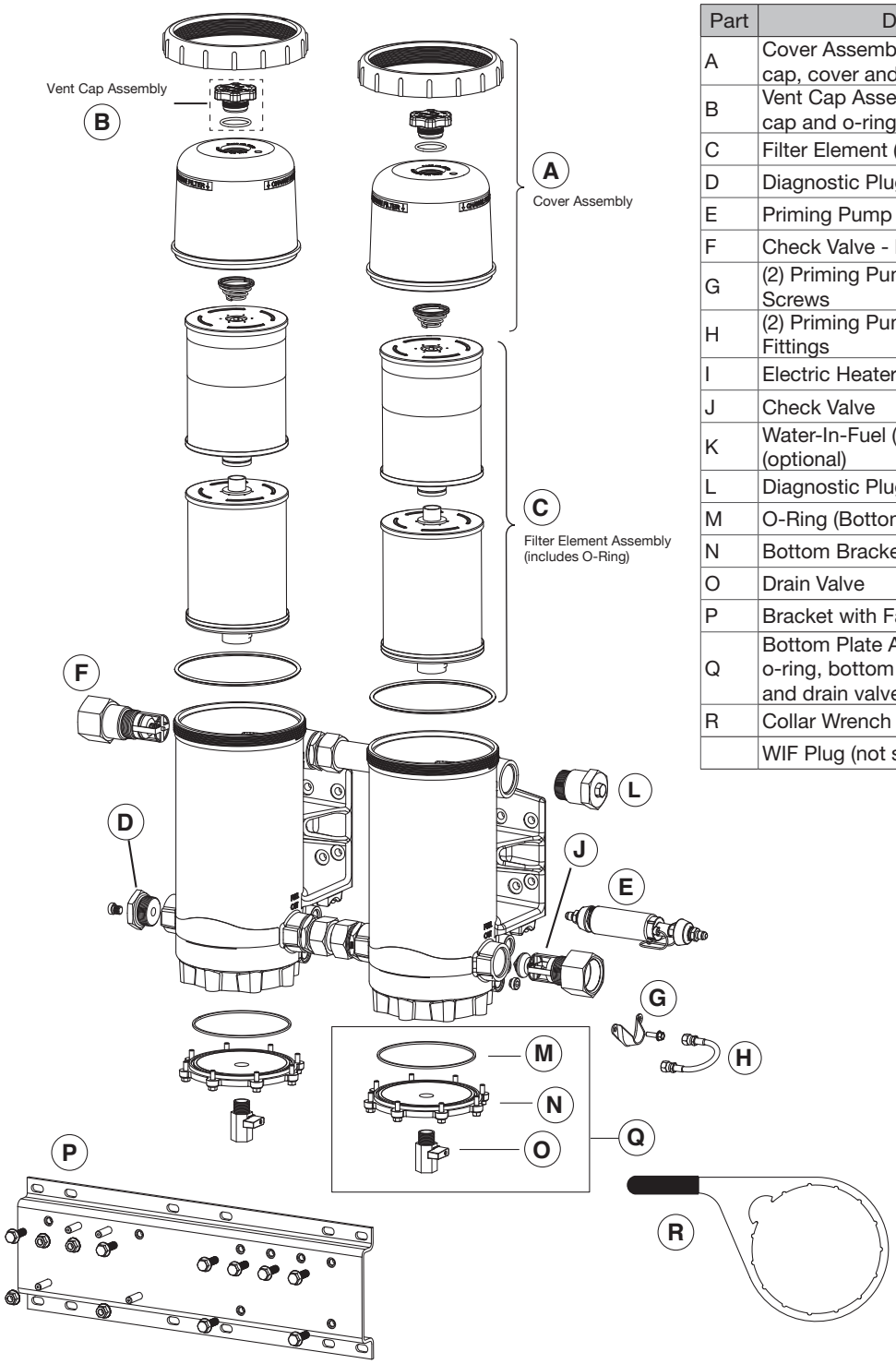
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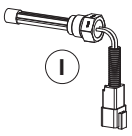
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Industrial Pro
Installation Instructions

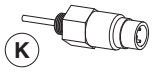


Part	Description	P/N
A	Cover Assembly (includes, collar, vent cap, cover and spring)	
B	Vent Cap Assembly (includes vent cap and o-ring)	
C	Filter Element (includes o-ring)	
D	Diagnostic Plug Fitting	
E	Priming Pump (includes Isolators)	
F	Check Valve - Extended	
G	(2) Priming Pump Clamps and (4) Screws	
H	(2) Priming Pump Hoses and (4) Fittings	
I	Electric Heaters (optional)	
J	Check Valve	
K	Water-In-Fuel (WIF) Sensor (optional)	
L	Diagnostic Plug Fitting - Extended	
M	O-Ring (Bottom Plate)	
N	Bottom Bracket & Bolts	
O	Drain Valve	
P	Bracket with Fasteners	
Q	Bottom Plate Assembly (includes o-ring, bottom plate with fasteners and drain valve)	
R	Collar Wrench	
	WIF Plug (not shown)	

Electric Heaters (optional)



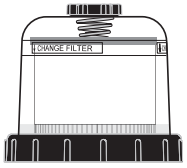
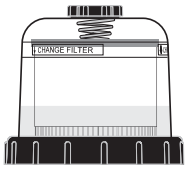
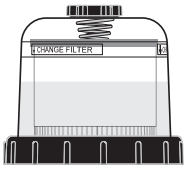
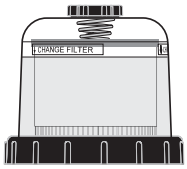
WIF (optional)



TIM-ID: 0000083486 - 002

“SEEING IS BELIEVING”®

- *See when NOT to change the fuel filter.*
- *See the condition of the fuel.* Seeing what collects on the filter media or what’s happening inside the clear cover can help diagnose many fuel and mechanical conditions.
- *“Filter on Top”* configuration. Water and debris removed from the fuel falls to the lower chamber and stays away from the filter media resulting in longer filter life.
- *Built in protection when priming the fuel filter.* Unfiltered fuel is kept on the “dirty” side of the filter media during priming ensuring only clean fuel reaches the engine.

	
When new, the fuel level in the filter will be very low with minimal restriction. As the filter is used, contaminants collect on the filter from the bottom up. Fuel rises on the filter indicating remaining filter life.	Fuel level increases in clear cover. As contaminants collect on the filter, the fuel rises to a non-contaminated section of the filter, providing optimal filtration while maintaining lowest restriction.
	
Fuel level at filter wrap level. Even though the fuel level is now more than half of the filter element, the fuel is still flowing through clean media at minimal restriction levels. The filter still has significant life remaining.	The filter element is now completely covered by fuel. At this point, all of the media’s surface area is utilized. Restriction is increasing and the filter element should be changed at the next scheduled maintenance interval.

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Fuel Processor Installation

This system must be installed between the fuel tank and the transfer fuel pump on the suction side of the fuel system.

⚠ **WARNING:** Fuels are combusible.

- **RISK OF FIRE OR EXPLOSION:**
  - Avoid open flames, electrical sparks or ignition sources
  - Do not smoke.

⚠ **WARNING:** When diesel fuel is circulated through an operating engine, it can become very hot. To prevent personal injury,

⚠ Scalding hazard: Do not allow fuel to come in contact with eyes or unprotected skin. Allow the engine and fuel to cool to ambient temperature before replacing the fuel filter or performing service operations which could result in spillage of fuel from the fuel system. If this is not possible, protective equipment (face shield, insulated hat, gloves, and apron) must be worn.

⚠ Always perform engine or vehicle fuel system maintenance in a well ventilated area that is kept free of bystanders.

⚠ CAUTION: To ensure priming pump hoses are not kinked by mishandling, do not lift or handle the fuel processor by the hoses. Do not allow the weight of the processor to rest on the hoses.

Installation Steps

1. With the engine shut down and at ambient temperature, close the fuel shutoff valve (if equipped) and place a suitable container under the fuel filters.
2. Remove the primary fuel filter element assembly, sedimenter, and/or water separator. Drain the used element and dispose of it in an environmentally responsible manner, according to state and/or federal (EPA) recommendations. The fuel can be returned to the tank.
3. **Installation of the Industrial Pro should be on the suction side of the fuel system. Do not exceed 22 lb/in2 (15 kPa) inlet pressure to the fuel processor.**
4. Mount the Industrial Pro in the desired location keeping the following points in mind:

- Mounting the Industrial Pro directly on the engine is NOT RECOMMENDED.
- Mount vertically with the cover and element pointing up.
- Make sure there is enough top and side clearance for the cover to be conveniently removed for filter replacement. Filter service clearance: Dual Tall: 6.0" (152 mm) minimum

⚠ CAUTION: The Industrial Pro functions BEST when installed so that the Filter Element is above the "FULL" level of the fuel tank. The housing can be installed up to 6' (1.8 m) below the "FULL" level of the fuel tank. Installing below the "FULL" level causes the starting level to be higher than normal. If mounted below full tank level, a shut off valve will be required at the inlet to allow filter changes without overflow of fuel. Mounting below 6' (1.8 m) eliminates the "SEEING IS BELIEVING" functionality.

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5. Securely mount the Industrial Pro using twelve bolts (3/8"-24UNF or M10). (See Figure 1)

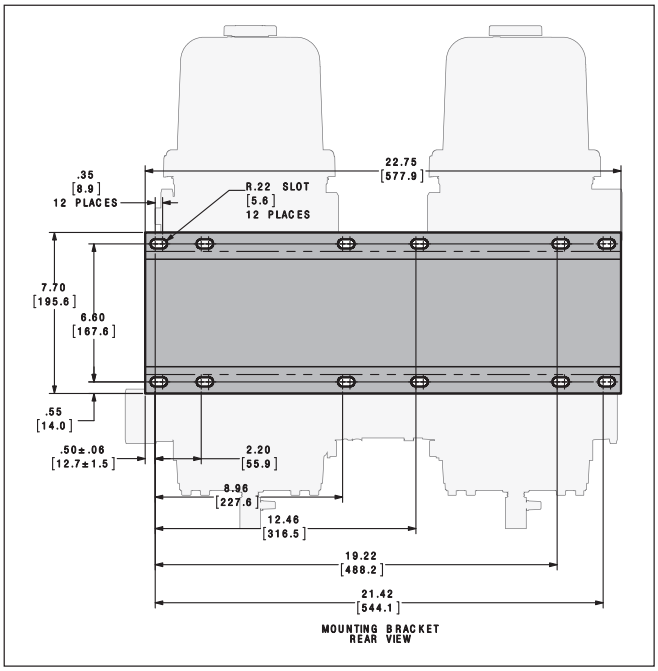


Figure 1 - Mounting Dimensions

6. Route the fuel supply line from the fuel tank to Industrial Pro inlet (see Figure 2). Route a fuel line from the Industrial Pro outlet to the fuel pump inlet.

⚠ CAUTION: To avoid fuel line water traps that can freeze in cold conditions and restrict, or block, the flow of fuel to the engine, be certain that there are no low spots in the hoses when routing them in the engine compartment.

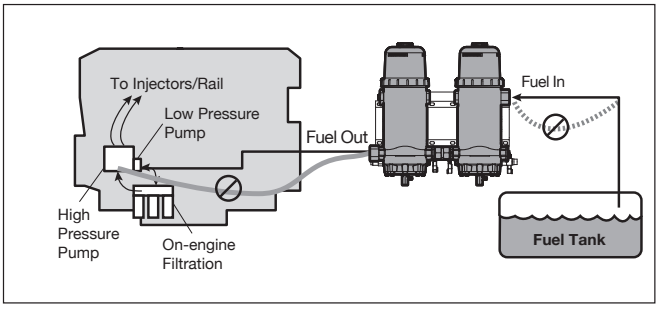


Figure 2 - Industrial Pro Connections

Note: When the engine is shut off, fuel levels may drop until the engine is restarted.

To minimize restrictions, observe the following guidelines when plumbing the system.

. Keep the fuel line routing as smooth as possible with no low hanging loops which can trap water.

. Use 90° elbows only when necessary.

. If the fuel hoses are made up to length on the job, be sure that the inner liner of the fuel hose is not cut by the fitting, creating potential check valve effects. Also make sure hoses are clean and free of debris before installing.

⚠ CAUTION: To avoid damaging the aluminum fuel housing, do not over-tighten fuel lines or line fittings. Do not exceed 65 ft-lbs (88 N·m). See the table of torque values on page 10.

7. Apply liquid thread sealant to the inlet and outlet hose threads and connect the hoses to the unit.

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Installing a WIF (Water In Fuel) Sensor With Optional Indicator (LED)

⚠ **WARNING:** Fuels are combusible.

- **RISK OF FIRE OR EXPLOSION:**
  - Avoid open flames, electrical sparks or ignition sources
  - Do not smoke.

⚠ **Before Installation:**

- Check that the engine is stopped and starting is disabled.
- Switch off the operating voltage to the engine ECU.

1. Screw the WIF sensor (See Figure 3) (3) with the sealing ring A18x22 (4) in the Industrial Pro WIF sensor port by hand.
2. Tighten the sensor (3) with torque wrench to max. 30 Nm (22 ft-lbs) tightening torque.
3. Connect the F70 plug (1) of the WIF sensor harness (5) to the WIF sensor (3) and tighten the bayonet lock (2).

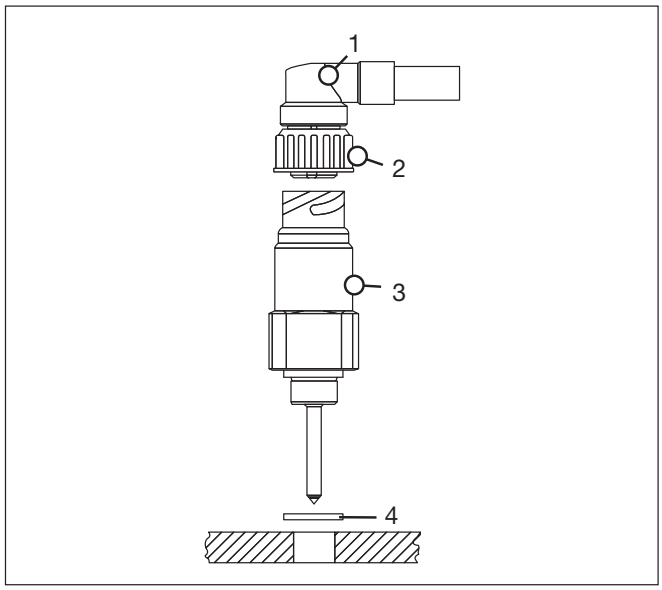


Figure 3 - WIF Sensor Installation

4. Route the WIF sensor harness (5) from the Industrial Pro to the XF70 connector on the engine. Securely route and support the the WIF sensor harness in the equipment.
5. Connect the XF70 plug of the WIF sensor harness (Figure 4) (5) to the XF70 connector on the engine and tighten the bayonet lock (2) (Figure 3).

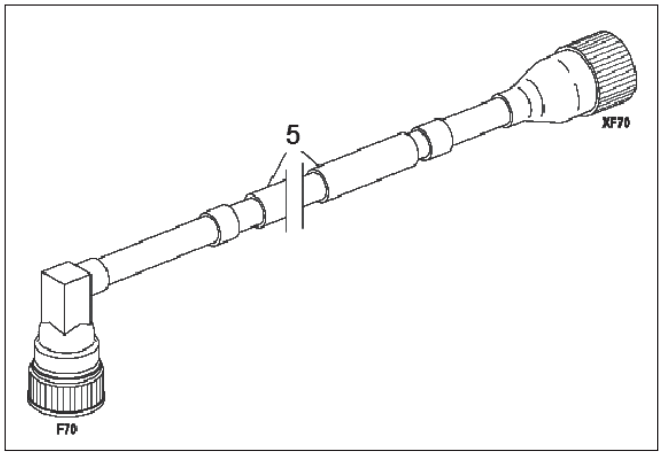


Figure 4 - WIF Sensor Harness

Note: The WIF sensor must be activated in the engine ECU for proper monitoring.

TIM-ID: 0000083486 - 002

Priming Pump Electrical Specifications

Supply Voltage: 24V

Maximum Current 6A@24V

Recommended Fuse: 10 Amp

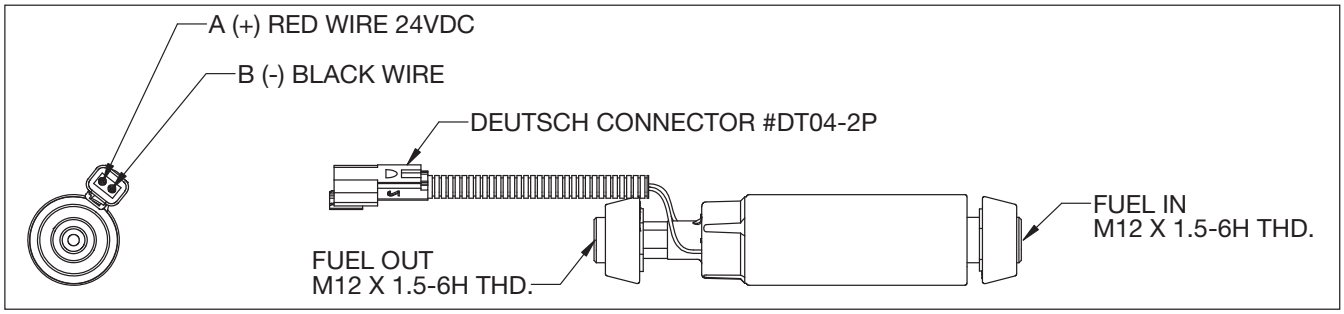


Figure 5 - Priming Pump Electrical Connections

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Primer Pump Service

⚠ **WARNING:** Fuels are combusible.

- **RISK OF FIRE OR EXPLOSION:**
  - Avoid open flames, electrical sparks or ignition sources
  - Do not smoke.

Disassembly

1. Open the vent cap and then open the drain valve - drain the Industrial Pro below the primer pump connections points.
2. Close the drain valve. Dispose of the fuel in an environmentally safe manner.
3. Disconnect the primer pump electrical connection.
4. Disconnect the fuel hoses at the fittings on the primer pump.
5. Remove the fittings (use backup wrench as needed) and set aside for later use. If the unit has 90° fittings, note the fitting orientation.
6. Remove the fitting on the end of the pump using two wrenches to hold the end stationary as the fitting is loosened. See Figure 6.
7. The washer on the fittings MUST be in place when reassembled.

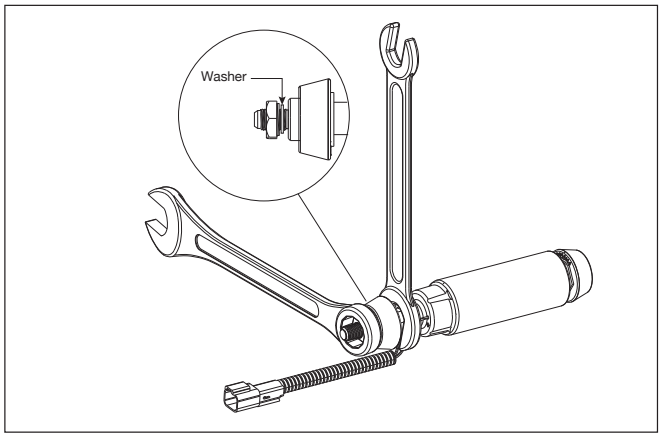


Figure 6 – Removing the Primer Pump Fitting

8. Remove the primer pump mounting strap bolts and straps.
9. Remove primer pump.

Assembly

1. Install the new primer pump with fuel flow arrow aimed towards fuel outlet. (See Figure 7)

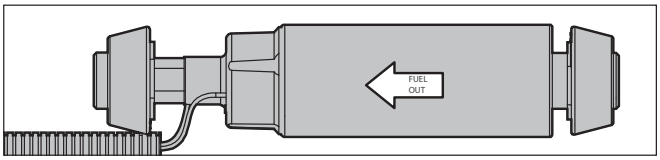


Figure 7 - Primer Pump

2. Install the primer pumps straps and bolts and torque to 8-10 ft-lbs.
3. Install the primer pump fittings aimed as originally installed (noted during disassembly).

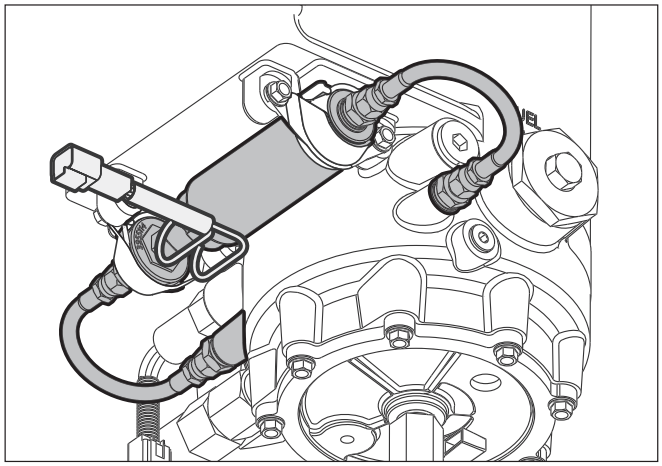


Figure 8 - Primer Pump Location

4. Torque the primer pump fitting jam nuts to 10-15 ft-lbs (use backup wrench as needed).
5. Connect the fuel hoses to the primer pump and torque to 10-15 ft-lbs (use backup wrench as needed).
6. Connect the primer pump electrical connection.

Priming

Use primer pump to prime the Industrial Pro or follow manual process listed below.

1. Prime the unit by filling the clear cover with clean diesel fuel until it reaches the top of the filter.
2. Install the vent cap.
3. Start the engine and run for one minute.
4. Slowly open the vent cap and allow the fuel to drop to about one inch above the collar.
5. Close the vent cap.

Note: It is normal for the fuel level to vary after the initial start-up and during.

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Installing an Optional Electric Heater

⚠ **WARNING:** Fuels are combusible.

- **RISK OF FIRE OR EXPLOSION:**
  - Avoid open flames, electrical sparks or ignition sources

Do not smoke. All units come with pre-drilled ports to allow for pre-heaters (dual units require two pre-heaters):

Dual Tall: Four ports (two per body). (See Figure 9)

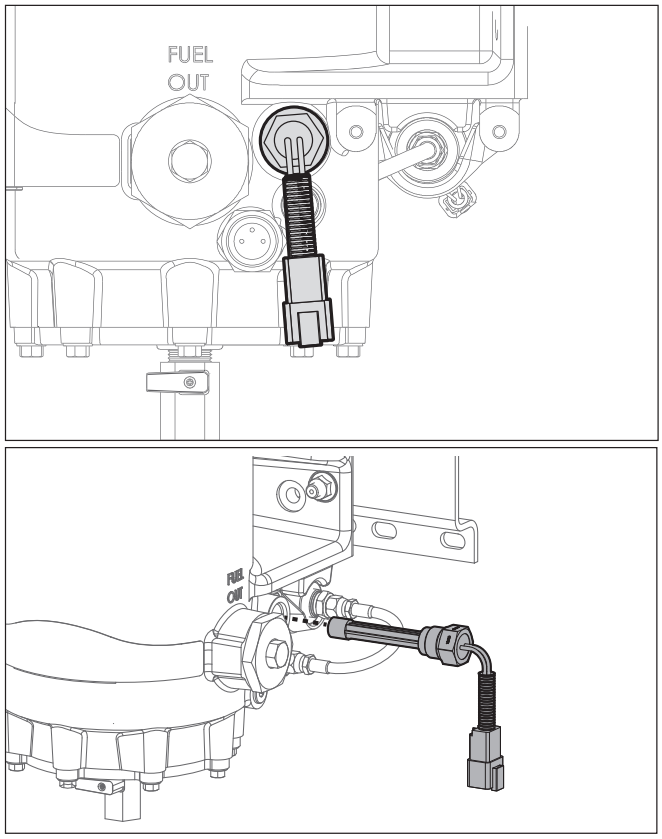


Figure 9 - Pre-heater Installation

To install, thread heater into housing and torque to 15-30 ft-lbs (20.3-40.7 N-m). Follow the wiring diagram in Figures 10 and 11.

Refer to equipment owner's manual for more specific information related to wiring diagrams of the equipment to which the unit will be applied.

Note: When wiring the electric preheater, use a fuse NOT a circuit breaker.

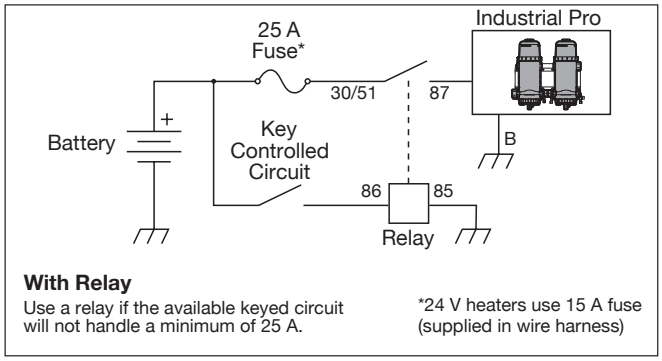


Figure 10 - Wiring with Relay

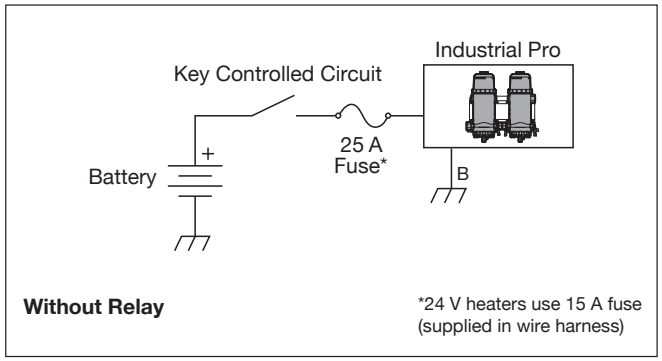


Figure 11 - Wiring without Relay

Note: For systems with multiple Industrial Pro® units, the pre-heater power supply wiring must be split in the junction box. See Figure 12 for wiring a Dual system.

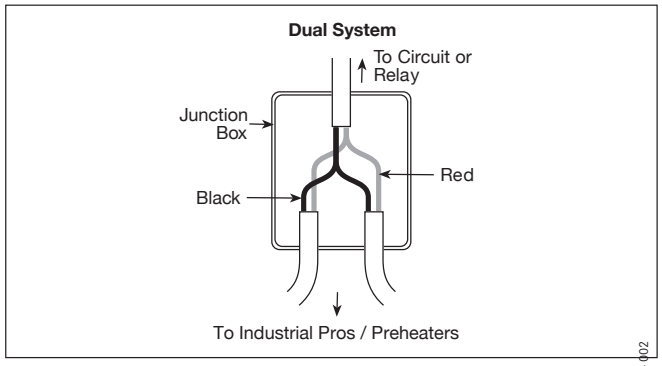


Figure 12 — Wiring Dual Filter Systems

TIM-ID: 0000083486 - 002

Filter Change Procedure

⚠ **WARNING:** Fuels are combusible.

- **RISK OF FIRE OR EXPLOSION:**
  - Avoid open flames, electrical sparks or ignition sources

Note: Do not smoke. Change the filter only when the fuel level reaches and remains at the top of the black band on the filter. The filter may become dark, however, there is additional filter capacity and restriction will remain low until the fuel reaches the black band.

1. Turn off the engine. Remove the vent cap and dispose of the O-ring. Clean the threads of the vent cap and on the top of the cover. Set the vent cap aside.
2. Open the drain valve and drain the fuel completely from the unit, then close the drain valve. The unit must be completely drained to prevent contamination of the clean side of the filtration system.
3. Using the collar wrench loosen the collar. (See Figure 13) Remove the clear cover and collar from the Industrial Pro. Discard the cover O-ring and install a new O-ring (supplied with the filter) on the cover. Clean the threads on the collar and body of the Industrial Pro.

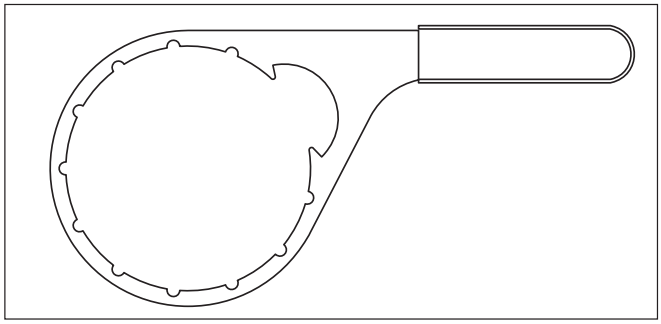


Figure 13 – Collar Wrench

4. Install the new O-ring on the vent cap (supplied with the filter).
5. Remove the filter element(s) from the Industrial Pro by pulling upward.
6. Install the new filter element. Figure 14 shows a key of the filter which fits into a keyway on the center boss. Position the filter element so the filter element key is lined up with the keyway on the center boss of the housing and press the filter element into the housing. Ensure the filter element is fully seated by firmly pushing on the end plate.

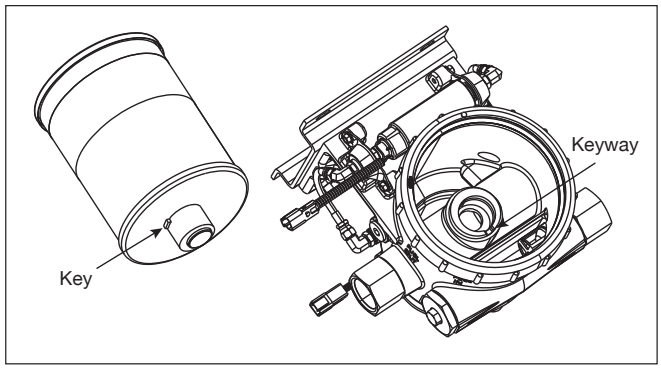


Figure 14 – Keyway

7. After checking to make sure the new o-ring seal is seated correctly on the base of the cover, install the cover and collar. Simultaneously apply modest pressure to the top of the cover and turn the collar until it no longer spins freely. Using the collar wrench, tighten the collar the distance of two additional ribs.
8. Prime the fuel system according to the steps in the "Priming the Fuel System" section in this manual. (The vent cap will be returned to the Industrial Pro during the priming process).

Priming the Fuel System

1. Check to make sure the drain valve at the base of the Industrial Pro is closed. Close the fuel shutoff valve (if equipped).
2. Remove the vent cap from the top of the clear cover. Fill the Industrial Pro full of clean fuel. Tighten the vent cap **(tighten by hand only)** until it “clicks”.
3. Open the fuel shutoff valve (if equipped). Start the engine. When the lubrication system reaches its normal operating pressure, increase engine speed to high idle for one to two minutes. Loosen the vent cap until the fuel level drops to just above the collar. Tighten the vent cap (tighten by hand only) until it “clicks”.

Note: The clear filter cover will not fill completely during engine operation. It will gradually fill over time and the fuel level will rise as the filter becomes clogged.

TIM-ID: 0000083486 - 002

Draining Contaminants

1. Turn off the engine and open the vent cap.
2. Place a suitable container under the drain valve at the base of the Industrial Pro and open the drain valve.
3. Water will flow into the container. When fuel begins to flow out of the drain, close the drain valve.
4. Tighten the vent cap by hand until it “clicks.”
5. Start the engine. Raise the RPM for one minute to purge the air from the system.

Suggested Preventive Maintenance

Weekly – Drain water.

Every Filter Change – Change o-rings.

Every 12 Months – Check all electrical connections for corrosion. Check all fuel fittings for leaks.

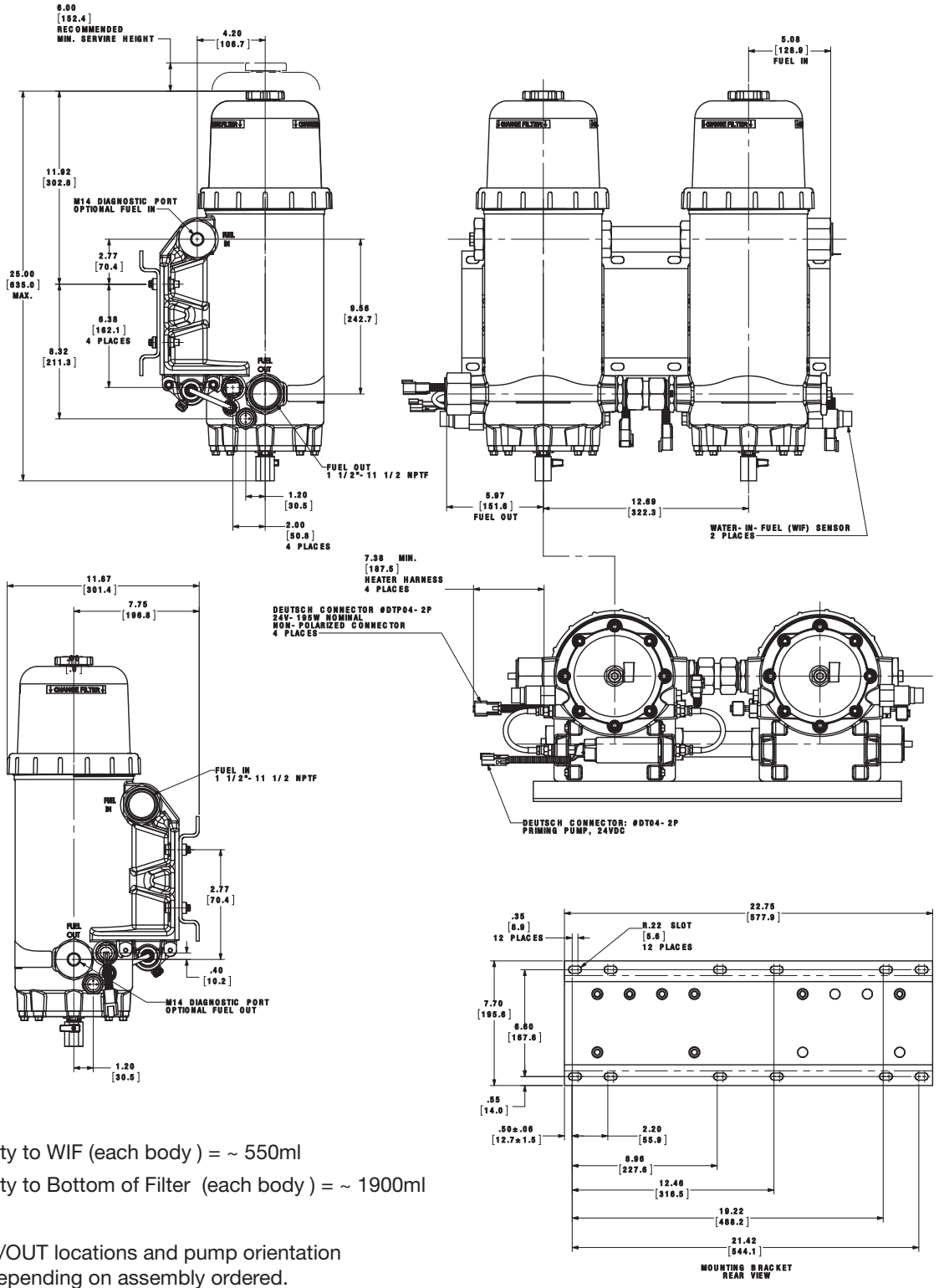
Extreme winter or salt corrosion environments may require lubrication of the top collar threads with antiseize lubricant every 180 days.

Torque Values

Application	Torque	
	ft-lb	N-m
WIF Probe to Housing	22	30
Fuel Connection Fittings to Housing Body	55-65	74.6-88.1
Heater to Housing	15-30	20.3-40.7
Drain Valve to Bottom Plate	10-15	13.6-20.3
Primer Pump Strap to Body	8-10	10.8-13.6
Primer Pump Fittings to Housing Body	13-15	17.6-20.3
Pump Inlet/Outlet Hose to Fittings	10-15	13.6-20.3
Assembly to Mounting Bracket	35-50	47.5-67.8
Bottom Plate	8-10	10.8-13.6

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Dimensions



Water Capacity to WIF (each body) = ~ 550ml

Water Capacity to Bottom of Filter (each body) = ~ 1900ml

Note: Fuel IN/OUT locations and pump orientation will change depending on assembly ordered.

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10 Appendix A

10.1 Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital converter	Converter: converts sensor voltages into digital values
ADEC	Advanced Diesel Engine Controller	Engine management system
AFRS	Air Filter Restriction Sensor	
AL	alarm	
ANSI	American National Standards Institute	Association of American standardization organizations
ATS	Air Temperature Sensor	
BR	Series	
BV	Betriebsstoffvorschrift	Fluids and Lubricants Specifications, MTU Publication No. A001061/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Drift correction setting with DiaSys in engine governor
CEL	Check Engine Lamp	1st function: Warning lamp (rectify fault as soon as possible) 2nd function: Read out fault codes
CKT	Circuit	
CLS	Coolant level sensor	Monitors coolant level
CM	Current Measurement	Current measured value
CPS	Coolant pressure sensor	Monitors coolant pressure
CR	Common Rail	
CTS	Coolant temperature sensor	Monitors coolant temperature
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	Diagnostic lines
DDR	Diagnostic Data Reader	Diagnostic unit
DiaSys®	Electronic dialog system	
DIN	Deutsches Institut für Normung e. V.	At the same time identifier of German standards (DIN = “Deutsche Industrie-Norm”)
DL	Default Lost	Alarm: Default CAN bus failure
DMC	Data Matrix Code	
DOC	Diesel Oxidation Catalyst	Oxidation catalyst upstream of the diesel particulate filter
DPF	Diesel Particulate Filter	
DT	Diagnostic Tool	Diagnostic unit
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Memory module for engine data

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Abbreviation	Meaning	Explanation
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	Electronic accelerator pedal
EGR	Exhaust Gas Recirculation	
EIL	Engine Ident Label	
EIM-ID	Emission Identification Number	
EMU	Engine Monitoring Unit	
ESCM	Extreme Site Condition Management	Power reduction for operation in extreme conditions
ESD	Einzelspeicherdruck	Injector accumulator pressure
ETC	Exhaust turbocharger/exhaust turbocharging	
EUI	Electronic Unit Injector	Electronic injection nozzle unit
FO	Frequency Output	
FPS	Fuel Pressure Sensor	Monitors fuel pressure
FRS	Fuel Restriction Sensor	Monitors differential fuel pressure
FTS	Fuel Temperature Sensor	Monitors fuel temperature
FWCP	Fire Water Control Panel	Control cabinet
GND	Ground	
HP	High Pressure	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit
HT	High Temperature	
IDM	Interface Data Module	Memory module for interface data
IIG	Initial injector equalization	Initial input of injector code in Engine Control Unit with DiaSys
INJ	Injector	
ISO	International Organization for Standardization	International umbrella organization for all national standardization institutes
KGS	Kupplungsgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kupplungsseite	Engine driving end in accordance with DIN ISO 1204
L1	Limit 1	Limit value, limit 1
L2	Limit 2 Reference surface for heights above sea level	Limit value, limit 2
LED	Light Emitting Diode	Light emitting diode
LLK	Ladeluftkühlung	Charge-air cooling
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LP	Low Pressure	
LSG	Limit Speed Governor	Maximum-speed governor
LSU	Lambda Sonde Universal	Universal Lambda probe
LT	Low Temperature	

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Abbre-viation	Meaning	Explanation
MCR	Maximum Continuous Rating	Torque limitation curve
N/A	Not Applicable	
NN	Normal Null	Reference surface for heights above sea level
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	Monitors oil level
OPS	Oil pressure sensor	Monitors oil pressure
OTS	Oil Temperature Sensor	Monitors oil temperature
OT	Oberer Totpunkt	Top Dead Center (TDC)
PAN	Panel	Control panel
PIM	Peripheral Interface Module	
PWM	Pulse Width Modulation	Modulated signal
P-xyz	Pressure-xyz	Pressure measuring point xyz
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
rpm	Revolutions per minute	
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop Engine Lamp	1st function: Warning lamp (stop engine and rectify fault); 2nd function: Read out fault codes
SID	System Identifier	
SPC	Spare Parts Catalog	
SRS	Synchronous Reference Sensor	TDC cylinder 1
SS	Safety System / Security Shutdown	Safety system alarm
TBS	Turbocharger Boost Sensor	Monitors charge-air pressure
TC	Tool Catalog	
TCI	Turbo Compressor Inlet	
TCO	Turbo Compressor Outlet	
TD	Transmitter Deviation	Alarm: Sensor comparison fault
TPS	Throttle Position Sensor	
TRS	Timing Reference Sensor	
T-xyz	Temperature-xyz	Temperature measuring point xyz
U_PDU	Voltage Power Driver Unit	Distribution voltage for solenoid valve output stages
UDV	Überdruckventil	Pressure relief valve
UT	Unterer Totpunkt	Bottom Dead Center (BDC)
VNT	Variable nozzle turbine	
VSG	Variable-speed governor	
VSS	Vehicle Speed Sensor	
ZKP	Zuordnung - Kategorie - Parameter	A number allocated to a parameter describing its function and assignment

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10.2 MTU Contact/Service Partners

The worldwide network of the sales organization with subsidiaries, sales offices, representatives and customer service centers ensure fast and direct support on site and ensure 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 high flexibility, we're your contact around the clock: during each operating phase, preventive maintenance and corrective operations in case of a malfunction, for information on changes in conditions of use and for supplying spare parts.

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 9077777

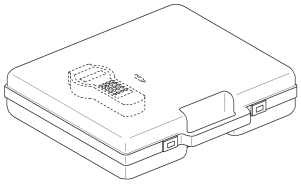
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TIM-ID: 0000000873 - 016

11 Appendix B

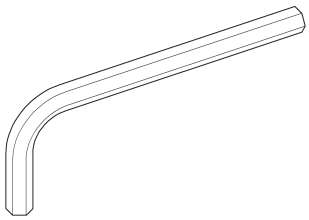
11.1 Special Tools

Optibelt TT belt tension tester



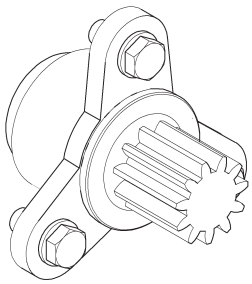
Part No.:	Y4345711
Qty.: Used in:	1 8.19.1 Fan drive – Drive belt tension check / adjustment (→ Page 240)
Qty.: Used in:	1 8.19.3 Fan drive – Drive belt tension check / adjustment (→ Page 243)

Allen key



Part No.:	F30002815
Qty.: Used in:	1 8.5.3 Valve clearance – Check and adjustment (→ Page 168)

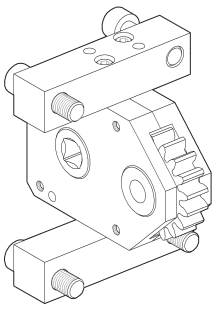
Barring tool



Part No.:	F6787910
Qty.: Used in:	1 8.1.1 Engine – Barring manually (→ Page 154)

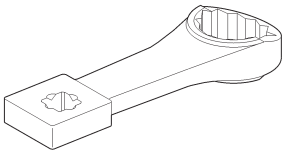
DCL-ID: 0000038896 - 005

Barring tool



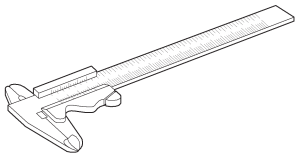
Part No.:	F6555766
Qty.:	1
Used in:	8.3.1 Cylinder liner – Endoscopic examination (→ Page 159)

Box wrench



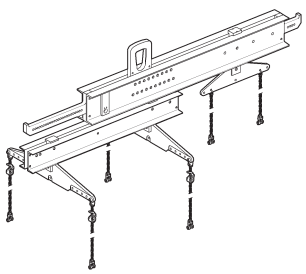
Part No.:	F30379609
Qty.:	1
Used in:	8.20.2 Engine mounting – Resilient mount check (→ Page 249)

Calipers



Part No.:	Y20001743
Qty.:	1
Used in:	8.20.2 Engine mounting – Resilient mount check (→ Page 249)

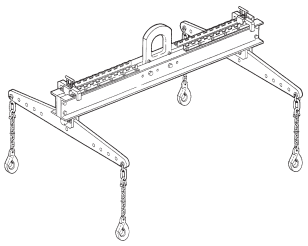
Crossbeam



Part No.:	T80091826
Qty.:	1
Used in:	2.1 Transportation (→ Page 18)

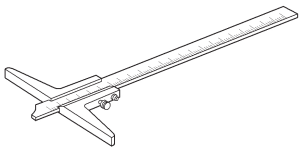
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Crossbeam



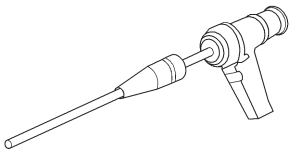
Part No.:	T80092360
Qty.:	1
Used in:	2.1 Transportation (→ Page 18)

Depth gauge, 200 mm



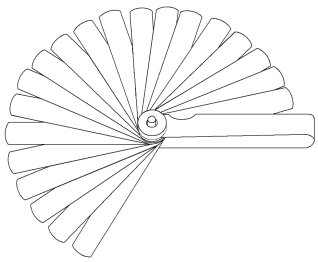
Part No.:	Y20000918
Qty.:	1
Used in:	8.5.2 Valve protrusion – Measurement (→ Page 166)

Endoscope



Part No.:	Y20097353
Qty.:	1
Used in:	8.3.1 Cylinder liner – Endoscopic examination (→ Page 159)

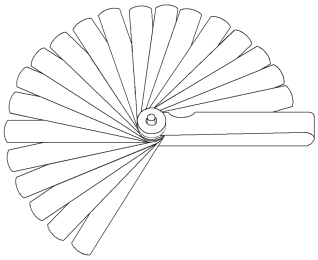
Feeler gage



Part No.:	Y20098771
Qty.:	1
Used in:	8.20.2 Engine mounting – Resilient mount check (→ Page 249)

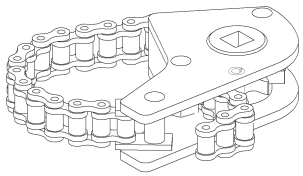
DCL-ID: 0000038896 - 005

Feeler gauge



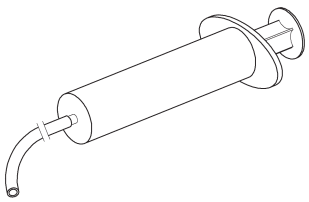
Part No.:	Y20098771
Qty.:	1
Used in:	8.5.3 Valve clearance – Check and adjustment (→ Page 168)

Filter wrench



Part No.:	F30379104
Qty.:	1
Used in:	8.9.1 Fuel filter – Replacement (→ Page 185)
Qty.:	1
Used in:	8.9.4 Additional fuel filter – Replacement (→ Page 190)
Qty.:	
Used in:	8.14.1 Engine oil filter – Replacement (→ Page 208)

Fuel suction device



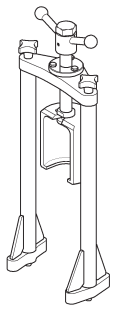
Part No.:	F30378207
Qty.:	1
Used in:	8.6.1 HP fuel pump – Filling with engine oil (→ Page 174)

High-pressure cleaner

Part No.:	
Qty.:	1
Used in:	5.9 Plant – Cleaning (→ Page 75)

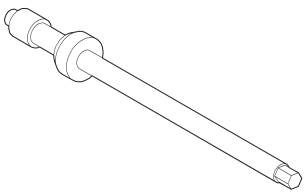
DCL-ID: 0000038896 - 005

Installation/removal jig



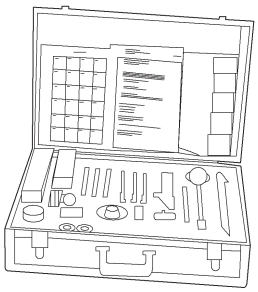
Part No.:	F6796646
Qty.:	1
Used in:	8.7.2 Injector – Removal and installation (→ Page 177)

Milling cutter



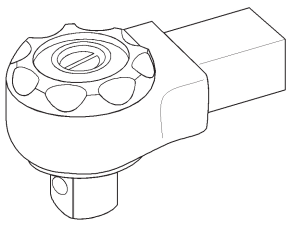
Part No.:	F30452739
Qty.:	1
Used in:	8.7.2 Injector – Removal and installation (→ Page 177)

MTU test kit



Part No.:	5605892099/00
Qty.:	1
Used in:	8.13.4 Engine oil – Sample extraction and analysis (→ Page 206)

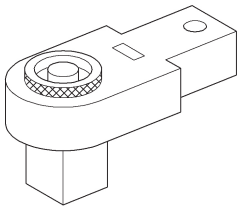
Ratchet



Part No.:	F30450902
Qty.:	1
Used in:	8.20.1 Engine mounting – Check (→ Page 247)

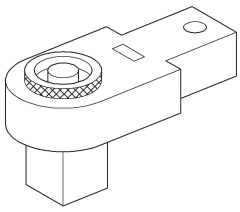
DCL-ID: 0000038896 - 005

Ratchet adapter



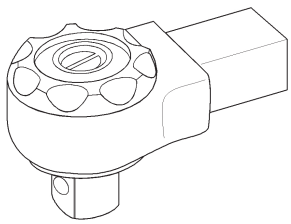
Part No.:	F30027340
Qty.: Used in:	1 2.3 Crankshaft – Transport locking device (→ Page 20)
Qty.: Used in:	1 8.11.3 Exhaust flaps – Coupling rod replacement (→ Page 197)

Ratchet bit



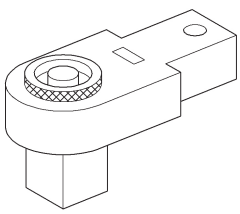
Part No.:	F30027341
Qty.: Used in:	1 8.13.3 Engine oil – Change (→ Page 204)

Ratchet bit



Part No.:	F30450902
Qty.: Used in:	1 8.13.3 Engine oil – Change (→ Page 204)

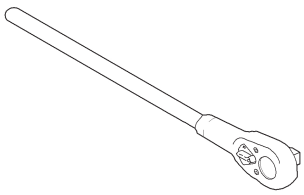
Ratchet bit



Part No.:	F30027340
Qty.: Used in:	1 8.22.5 NOx sensor – Replacement (→ Page 257)
Qty.: Used in:	1 8.22.6 Lambda sensor – Replacement (→ Page 259)

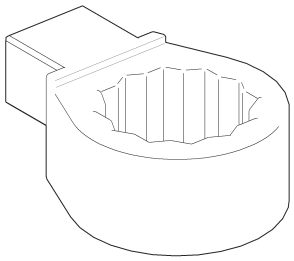
DCL-ID: 0000038896 - 005

Ratchet with extension



Part No.:	F30006212
Qty.: Used in:	1 8.1.1 Engine – Barring manually (→ Page 154)
Qty.: Used in:	1 8.3.1 Cylinder liner – Endoscopic examination (→ Page 159)

Socket wrench, 24 mm

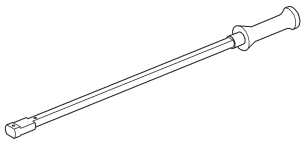


Part No.:	F30039526
Qty.: Used in:	1 8.5.3 Valve clearance – Check and adjustment (→ Page 168)

Test kit

Part No.:	F6798833
Qty.: Used in:	1 8.15.6 Engine coolant – Sample extraction and analysis (→ Page 225)

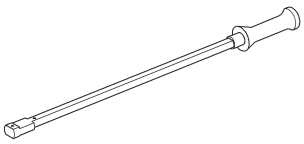
Torque wrench 10-60 Nm



Part No.:	F30452769
Qty.: Used in:	1 8.15.4 Engine coolant – Filling (→ Page 221)
Qty.: Used in:	1 8.16.4 Charge-air coolant – Filling (→ Page 233)

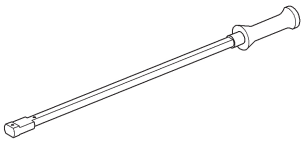
DCL-ID: 0000038896 - 005

Torque wrench 300-800 Nm



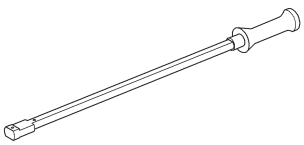
Part No.:	F30047798
Qty.: Used in:	1 8.20.2 Engine mounting – Resilient mount check (→ Page 249)

Torque wrench, 10–60 Nm



Part No.:	F30452769
Qty.: Used in:	1 2.3 Crankshaft – Transport locking device (→ Page 20)
Qty.: Used in:	1 8.6.1 HP fuel pump – Filling with engine oil (→ Page 174)
Qty.: Used in:	1 8.7.2 Injector – Removal and installation (→ Page 177)
Qty.: Used in:	1 8.13.3 Engine oil – Change (→ Page 204)
Qty.: Used in:	1 8.14.3 Centrifugal oil filter – Cleaning and filter-sleeve replacement (→ Page 213)
Qty.: Used in:	1 8.22.5 NOx sensor – Replacement (→ Page 257)
Qty.: Used in:	1 8.22.6 Lambda sensor – Replacement (→ Page 259)

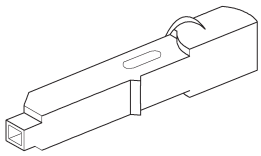
Torque wrench, 300–800 Nm



Part No.:	F30047798
Qty.: Used in:	1 8.13.3 Engine oil – Change (→ Page 204)
Qty.: Used in:	1 8.20.1 Engine mounting – Check (→ Page 247)

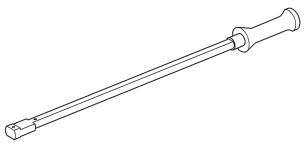
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Torque wrench, 4–20 Nm



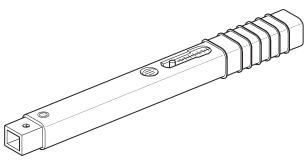
Part No.:	F30044239
Qty.: Used in:	1 8.4.1 Oil mist fine separator – Replacement (→ Page 163)
Qty.: Used in:	1 8.5.4 Cylinder head cover – Removal and installation (→ Page 172)
Qty.: Used in:	1 8.7.2 Injector – Removal and installation (→ Page 177)
Qty.: Used in:	1 8.14.3 Centrifugal oil filter – Cleaning and filter-sleeve replacement (→ Page 213)
Qty.: Used in:	1 8.22.5 NOx sensor – Replacement (→ Page 257)

Torque wrench, 60–320 Nm



Part No.:	F30452768
Qty.: Used in:	1 2.3 Crankshaft – Transport locking device (→ Page 20)
Qty.: Used in:	1 8.5.3 Valve clearance – Check and adjustment (→ Page 168)
Qty.: Used in:	1 8.7.2 Injector – Removal and installation (→ Page 177)
Qty.: Used in:	1 8.13.3 Engine oil – Change (→ Page 204)
Qty.: Used in:	1 8.14.3 Centrifugal oil filter – Cleaning and filter-sleeve replacement (→ Page 213)
Qty.: Used in:	1 8.19.3 Fan drive – Drive belt tension check / adjustment (→ Page 243)
Qty.: Used in:	1 8.19.4 Fan drive – Drive belt replacement (→ Page 245)

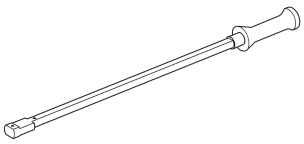
Torque wrench, 6–50 Nm



Part No.:	F30027336
Qty.: Used in:	1 8.11.3 Exhaust flaps – Coupling rod replacement (→ Page 197)

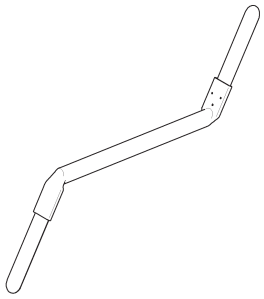
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Torque wrench 10–60 Nm



Part No.:	F30452769
Qty.: Used in:	1 8.15.3 Engine coolant – Draining (→ Page 219)
Qty.: Used in:	1 8.15.6 Engine coolant – Sample extraction and analysis (→ Page 225)
Qty.: Used in:	1 8.16.3 Charge-air coolant – Draining (→ Page 230)

Valve adjusting gauge



Part No.:	Y4349603
Qty.: Used in:	1 8.5.3 Valve clearance – Check and adjustment (→ Page 168)

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