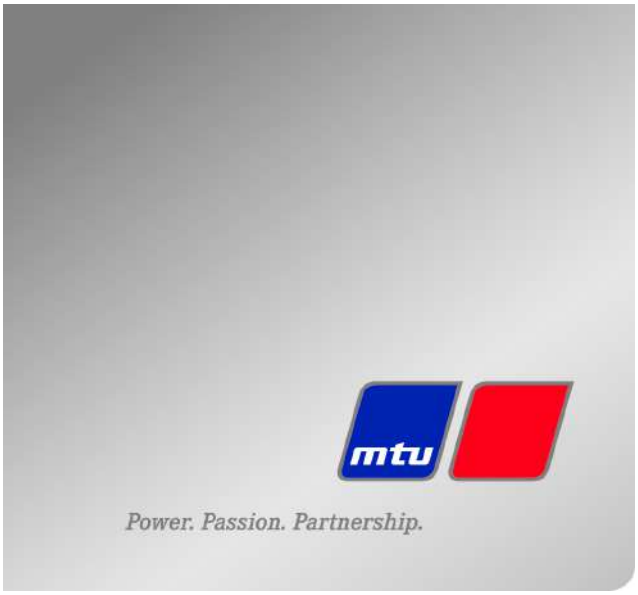
Operating Instructions

Diesel Engine
10V1600Ax0
10V1600Cx0
12V1600Ax0
12V1600Cx0

MS150100/04E



Engine model	kW/cyl.	Application group
10V1600A60	57 kW/cyl.	5B, continuous operation, variable
10V1600A70	61 kW/cyl.	5B, continuous operation, variable
10V1600C60	57 kW/cyl.	5B, continuous operation, variable
10V1600C70	61 kW/cyl.	5B, continuous operation, variable
12V1600A50	53 kW/cyl.	5B, continuous operation, variable
12V1600A60	57 kW/cyl.	5B, continuous operation, variable
12V1600A70	61 kW/cyl.	5B, continuous operation, variable
12V1600C50	53 kW/cyl.	5B, continuous operation, variable
12V1600C60	57 kW/cyl.	5B, continuous operation, variable
12V1600C70	61 kW/cyl.	5B, continuous operation, variable

Table 1: Applicability

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1 Safety

1.1 Important provisions for all products

Nameplate

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

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

All EU-certified engines delivered by MTU come with a second nameplate. When operating the machine in the EU: The second nameplate must be affixed in a prominent position as described in the accompanying specifications.

General information

This product may pose a risk of injury or damage in the following cases:
- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Noncompliance with the safety instructions and warning notices

Correct use

The product is intended 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 spare parts approved by the manufacturer in accordance with the (→ Spare Parts Catalog/MTU contact/Service partner)
- In the original as-delivered configuration or in a configuration approved by the manufacturer in writing (including engine control/parameters)
- In compliance with all safety regulations and in adherence with all warning notices in this manual
- With maintenance work performed in accordance with 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
- By contracting only workshops authorized by the manufacturer to carry out repair and overhaul

The product may only be operated in explosive atmospheres if it was certified for such operating conditions.

Any other use, in particular malpractice, shall be considered non-intended. 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.

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.

Emission regulations and emission labels

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 control units/systems may only be maintained, exchanged or repaired if the components used for this purpose are approved by the manufacturer.

Noncompliance with these regulations will invalidate the design type approval issued by the emissions regulation authorities. The manufacturer does not accept any liability for violations of the emission regulations. The maintenance schedules of the manufacturer must be observed over the entire life cycle of the product.

Replacing components with emission labels

Emission labels are attached to all MTU engines. These must remain on the engine throughout its operational life.

Engines used exclusively in land-based, military applications other than by US government agencies are excepted from this proviso.

Please note the following when replacing components with emission labels:
- Appropriate emission labels must be affixed on spare parts.
- Emission labels may not be transferred from old components to new ones.
- Emission labels on old components must be removed and destroyed.

1.2 Personnel and organizational requirements

Organizational measures of the user/manufacturer

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

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

Personnel must receive instruction on product handling and maintenance based on this manual with a special emphasis on safety requirements and warnings.

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

Personnel requirements

All work on the product shall be carried out by trained and qualified personnel only:
- Training at the Training Center of the manufacturer
- Technical personnel from the areas mechanical engineering, plant construction, and electrical engineering

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

Personnel must not be under the influence of alcohol, drugs, or strong medication.

Working clothes and personal protective equipment

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

1.3 Safety regulations for startup and operation

Safety regulations for startup

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.

When putting the product into operation, always 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 safety equipment is in place.
- No persons wearing pacemakers or any other technical body aids are present.
- The service room is adequately ventilated.
- Hazardous gases may occur as a result of the combustion of paints or oils in the first operating hours of the product. Enter the service room only with a suitable breathing protection.
- The exhaust system is leak-tight and that the gases are vented to atmosphere.
- Protect battery terminals, generator terminals or cables against accidental contact.
- Check that all connections have been correctly allocated (e.g. +/- polarity, direction).

Immediately after putting the product into operation, make sure that all control and display instruments as well as the monitoring, signaling and alarm systems are working 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 the procedures for emergencies, in particular, emergency stop, on a regular basis.

The following steps must be taken if a malfunction of the system is detected or reported by the system:
- Inform supervisor(s) in charge.
- Analyze the message.
- Respond to the emergency appropriately, e.g. execute an emergency stop.

Operation

Do not remain in the operating room when the product is running for any longer than absolutely necessary.

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.

Do not inhale the exhaust gases of the product.

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

Operation of electrical equipment

During operation of electrical devices, certain elements of these devices are live/under high voltage.

Observe the warning information applicable to the devices.

1.4 Safety precautions when working on the engine

Safety regulations prior to maintenance and repair work

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

Allow the product to cool down to less than 50 °C (risk of explosion for 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 collecting vessels of adequate capacity to catch fluids and lubricants.

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

Never carry out maintenance and repair work with the product in operation, unless:
- It is expressly permitted to do so following a written procedure.
- The product is running in the low load range and only for as long as absolutely necessary.

Lock-out the product to preclude undesired starting, e.g.
- Start interlock
- Key switch
- With hydraulic starting system: shut off supply line.

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

Disconnect the battery. Lock out circuit breakers.

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

Disconnect the control equipment from the product.

If special tools are specified, these special tools or other suitable tools must be used.

Elastomer components (e.g. engine mounts, damping elements, couplings and V-belts) must not be painted. They may only be installed after painting the engine or must be covered before painting work is carried out.

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 during maintenance and repair work

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

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

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

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

Make sure components or assemblies are placed on stable surfaces. Adopt suitable measures to avoid that components/tools fall down . Use the specified lifting equipment for all components.

Never use the product as a climbing aid.

When working high on the equipment, always use suitable ladders and work platforms. Never work on engines or components that are held in place by lifting equipment.

Keep fuel injection lines and connections clean.

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

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 retainers and dampers are installed correctly.

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

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

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

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

Pay particular attention to cleanliness at all times.

Remove any condensate from components which were chilled before assembly. If necessary, coat the components with a suitable corrosion inhibitor.

Safety regulations following maintenance and repair work

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

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

Check that all safety equipment has been installed and that all tools and loose parts have been removed (especially the barring gear).

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

Make sure the grounding device is properly connected.

Welding work

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

Before starting welding work:
- Switch off the power supply master switch.
- Disconnect the battery.
- Separate the electrical ground of electronic equipment from the ground of the unit.

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

Do not use product as ground terminal.

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

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

Hydraulic installation and removal

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

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

Do not attempt to bend or exert force on H.P. lines.

Before starting work, pay attention to the following:
- Vent the installation/removal device, the pumps and the pipework at the relevant designated points.
- During the installation procedure, screw on device with pushed-in plunger.
- During the removal procedure, screw on device with retracted plunger.

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

During hydraulic installation/removal of components, ensure that no persons are in the direct vicinity of the component being pressed.

Working with batteries

Observe the safety instructions of the battery manufacturer when working with 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 tools on the battery.

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

Working on electrical and electronic assemblies

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

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

Do not damage cabling during removal work. When 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 straps to secure cables.

Always use connector pliers to tighten union nuts on connectors.

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

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 if necessary.

Work with laser devices

Laser work must only be performed by authorized and trained personnel. When working with laser equipment, always observe the safety instructions in the manufacturer's Operating Instructions.

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

Laser devices must be equipped, in accordance with their class and usage, with protective devices for ensuring safe operation.

Measuring deviations on components

At a reference temperature of 20 °C, workpieces, components and measuring instrument are within the specified tolerances.

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

Fire prevention

Flames, naked light and smoking are prohibited.

When working with combustible indirect materials, e.g. cleaning agent, ensure area is well ventilated. The resultant steam/air mixture must be sufficiently diluted to prevent a potentially explosive atmosphere.

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

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

When starting the engine with an external power source, connect the ground cable 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.

Always have a suitable extinguishant (fire extinguisher) on hand and familiarize yourself fully with its handling.

Noise

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

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

Environmental protection and disposal

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

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

Fluids and lubricants, auxiliary materials

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

Process materials may also be hazardous or toxic. When using consumables and auxiliary materials as well as other chemical substances, observe the information contained in the safety data sheet for the product. The safety data sheet may be obtained from the relevant manufacturer or from MTU.

Take special care when using hot, chilled or caustic materials.

Used oil

Used oil contains combustion residues that are harmful to health.

Wear protective gloves!

Wash relevant areas after contact with used oil.

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Lead

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

Compressed air

Observe special safety precautions when working with compressed air:

- Unauthorized use of compressed air, e.g. forcing flammable liquids (hazard class AI, AII and B) out of containers, risks causing an explosion.
- Wear goggles when blowing dirt off workpieces or blowing away swarf.
- Blowing compressed air into thin-walled containers (e.g. containers made of sheet metal, plastic or glass) for drying purposes or to check for leaks risks bursting them.
- Pay special attention to the pressure in the compressed air system or pressure vessel.
- Assemblies or products 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).
- First shut off compressed air lines before compressed air device is disconnected from the supply line, or before device or tool is to be replaced.
- Carry out leak test in accordance with the specifications.

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.
- There must be no naked flames in the vicinity.
- No smoking.
- Observe fire-prevention regulations.
- Always wear a mask providing protection against paint and solvent vapors.

Liquid nitrogen

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

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

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

1.6 Standards for safety notices in the text

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

Safety notices

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

2 Transport

2.1 Transportation

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Crossbeam	T80092479	1

DANGER

Suspended load.
Danger to life!
- Use appropriate lifting devices and appliances.
- Never stand beneath a suspended load.

Transportation

1. Install the locking screws for the engine mounts prior to engine transportation.
2. Transport the engine by the lifting eyes provided (→ Page 16).
3. Use suitable transport and lifting gear only.
4. Transport the engine in the installation position only: max. admissible diagonal pull 10° (→ Page 16).
5. Remove any loose parts on the engine.
6. Raise and lower the engine slowly. Lifting cables/chains must not touch the engine or any of its component parts when lifting. 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 engine against tilting during transportation. Secure such as to preclude slipping and tipping when driving up or down inclines and ramps.

Placement after transport

1. Set the system down on a firm, flat surface only.
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.

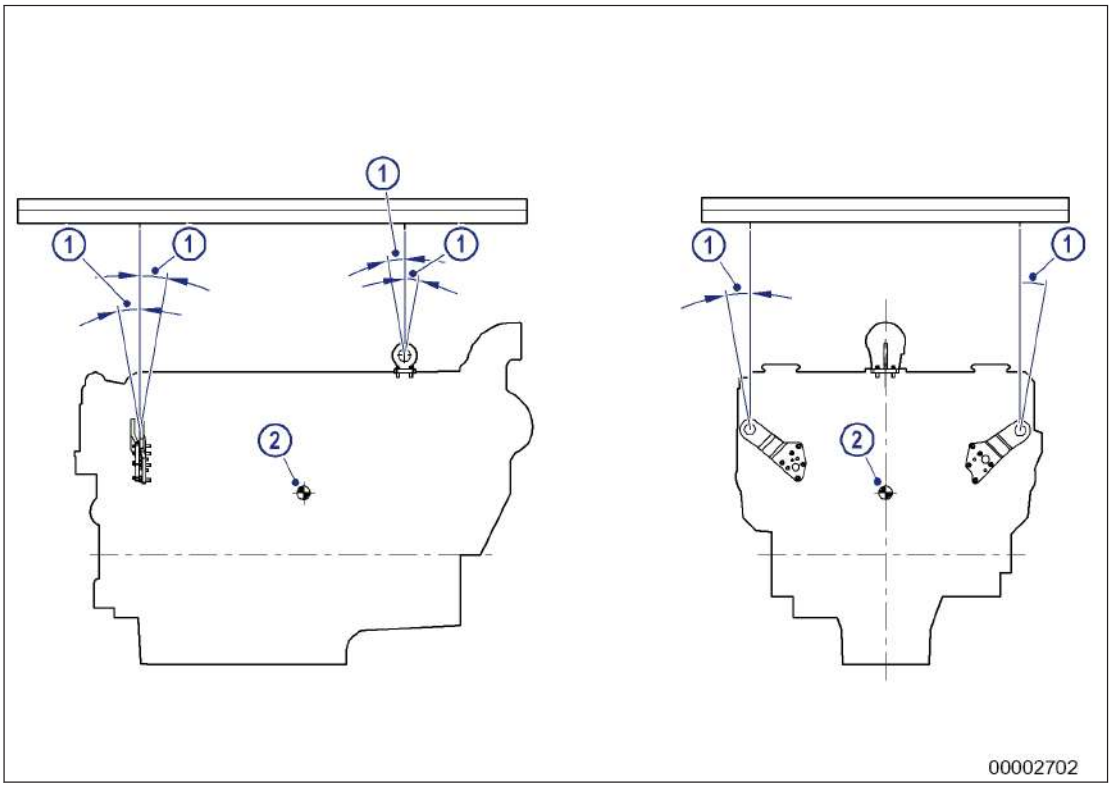
2.2 Lifting requirements

Lifting requirements

DANGER

Suspended load.
Danger to life!
- Use appropriate lifting devices and appliances.
- Never stand beneath a suspended load.

The Illustration applies similarly to 10V1600Ax0/Cx0.



1 Max. admissible diagonal pull 10° (*)
2 Center of gravity

(*) Observe max. admissible diagonal pull:
- Max. admissible diagonal pull in longitudinal direction is 10 degrees; no transverse diagonal pull is admissible in this case.
- Max. admissible diagonal pull in transverse direction is 10 degrees; no longitudinal diagonal pull is admissible in this case.

Note engine center of gravity

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

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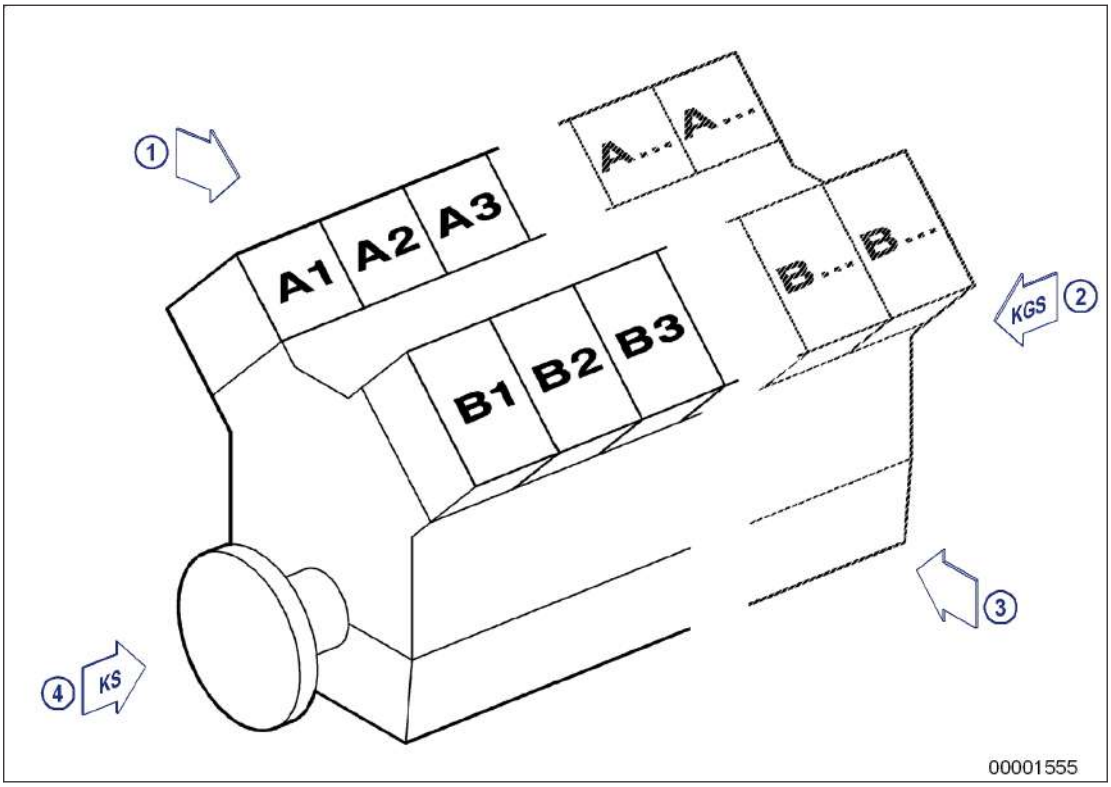
3 General Information

3.1 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)

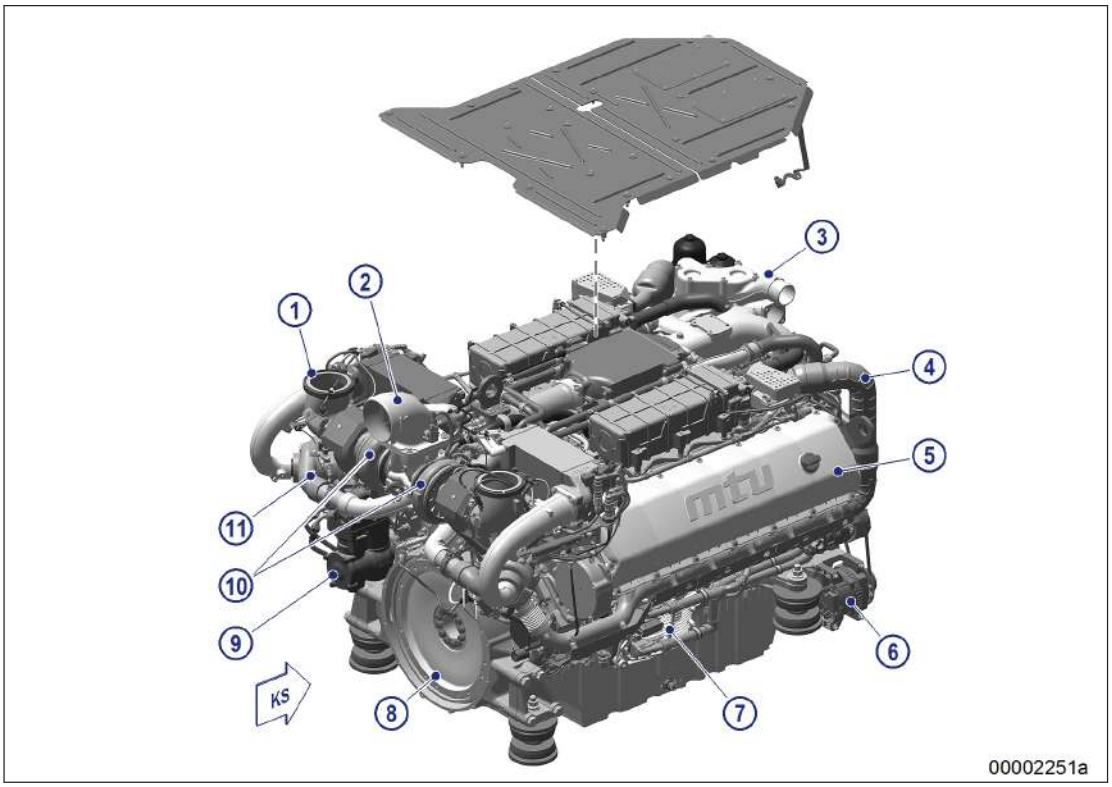
Engine sides are always designated (in accordance with DIN ISO 1204) as viewed from driving end (4).

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).

3.2 Engine layout

Illustrations apply similarly to 10V1600Ax0/Cx0.



1 Exhaust elbow
2 Intake neck
3 Thermostat housing
4 EGR pipe with insulation
5 Cylinder head
6 Battery-charging generator
7 Engine governor
8 Flywheel
9 Air compressor
10 Exhaust turbocharger (low-pressure charger)
11 Exhaust turbocharger (high pressure)
KS Driving end

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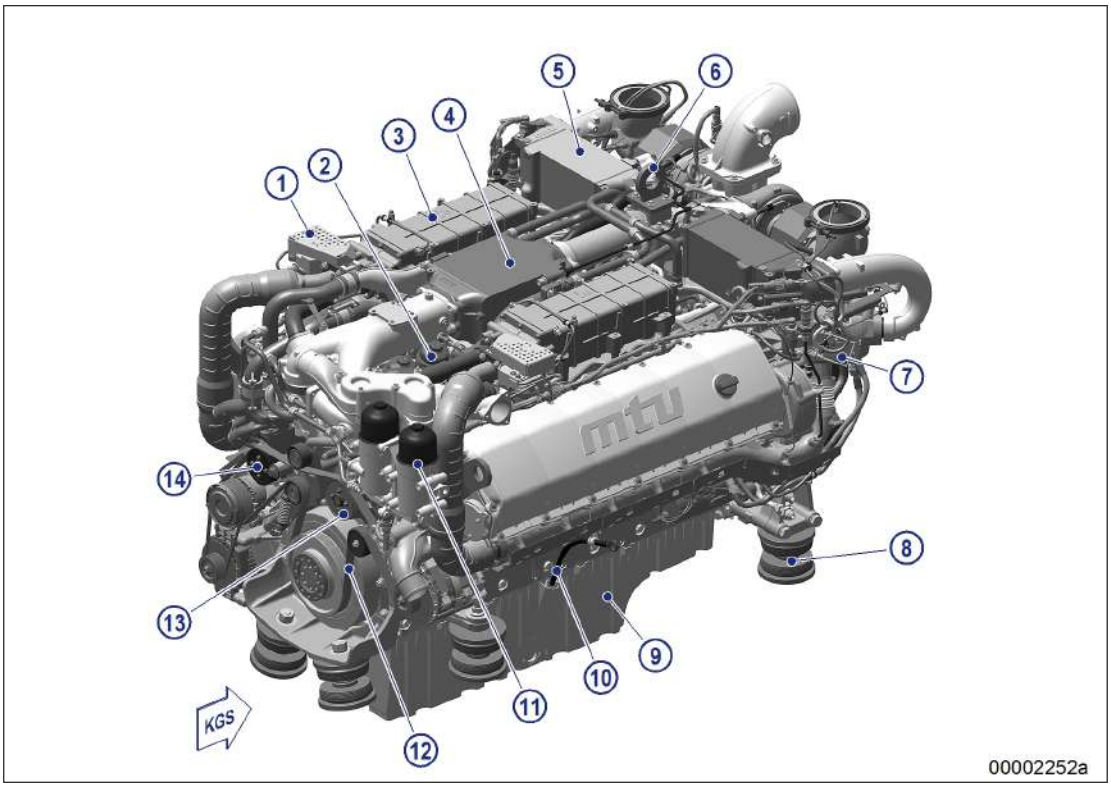

1 Exhaust flap
2 Oil module
3 EGR cooler
4 Intercooler (high-pressure)
5 Intercooler (low pressure)
6 Engine lifting equipment
7 Actuator
8 Engine mounting
9 Oil pan
10 Oil dipstick
11 Fuel filter
12 Belt
13 Engine coolant pump
14 Charge-air coolant pump
KGS Free end

Engine model designation

Key to the engine model designation 10/12V1600Ax0/Cx0	
10, 12	Number of cylinders
V	Cylinder arrangement: V engine
1600	Series
A, C	Application: Agriculture Application: C&I/Mining
x	Application segment
0	Design index

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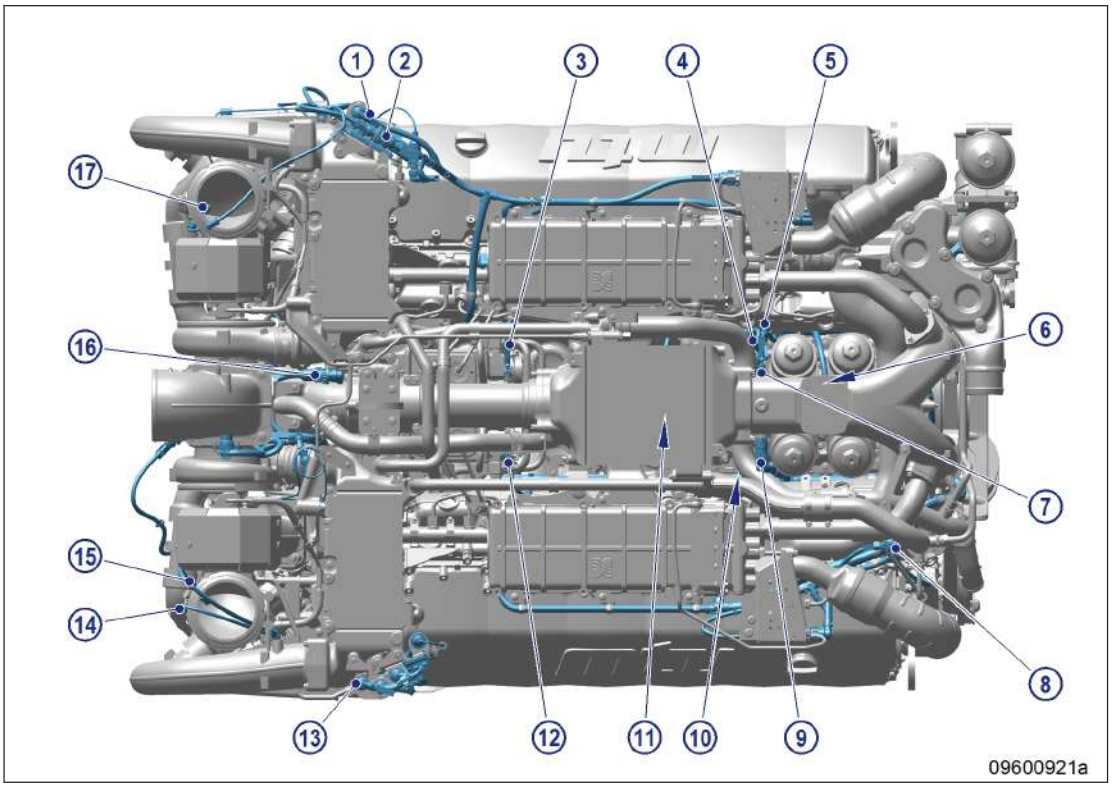
3.3 Sensors and actuators – Overview

Sensor overview – Top view



Item	Name	Description
1	B44.1	HP turbocharger speed, right side
2	M52.1	HP turbine bypass flap, left side
3	M8.1	HP fuel pump, left side
4	B5.3	Lube oil pressure before filter
5	B9.2	Charge-air temperature after exhaust gas recirculation
6	B5.1	Lube oil pressure after filter
7	B9.1	Charge-air temperature before exhaust gas recirculation
8	B26	Charge-air coolant temperature
9	B10	Charge-air pressure
10	B9.3	Charge-air temperature after exhaust gas recirculation, right side
11	B6.1	Engine coolant temperature
12	M8.2	HP fuel pump, right side (12V only)
13	B91.3	Exhaust gas pressure
14	B88.2	NO_x sensor, right side
15	B89	Lambda sensor
16	B44.3	Speed of LP turbocharger, left side
17	B88.1	NO_x sensor, left side

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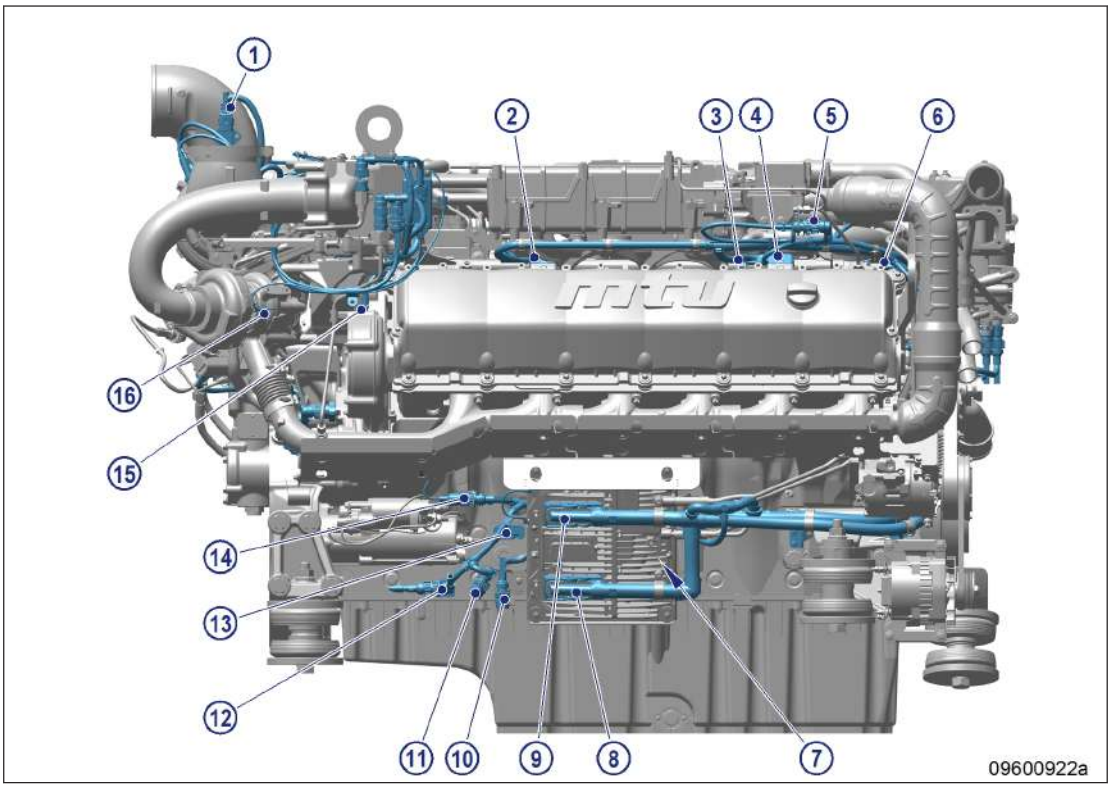
Sensor overview – Right side



Item	Name	Description
1	B90	Humidity, pressure, temperature of intake air
2	XY39B2	Injector connection
3	XY57B	Engine brake valve, right side
4	XY39B1	Injector connection
5	M53.2	EGR shut-off flap before cooler, right side
6	B48.2	HP fuel, right side (12V only)
7	B93	Oil level in oil pan
8	X2	Adaption of governor ECU9
9	X3	Adaption of governor ECU9
10	XF70	Water level in fuel prefilter
11	XF33	Engine coolant level
12	X21.2	Adaption of POM (12V only)
13	A19	EIL (Engine Ident Label)
14	B4.22	Exhaust temperature lambda sensor, right side
15	B1	Camshaft speed
16	B44.2	Speed of HP turbocharger, right side

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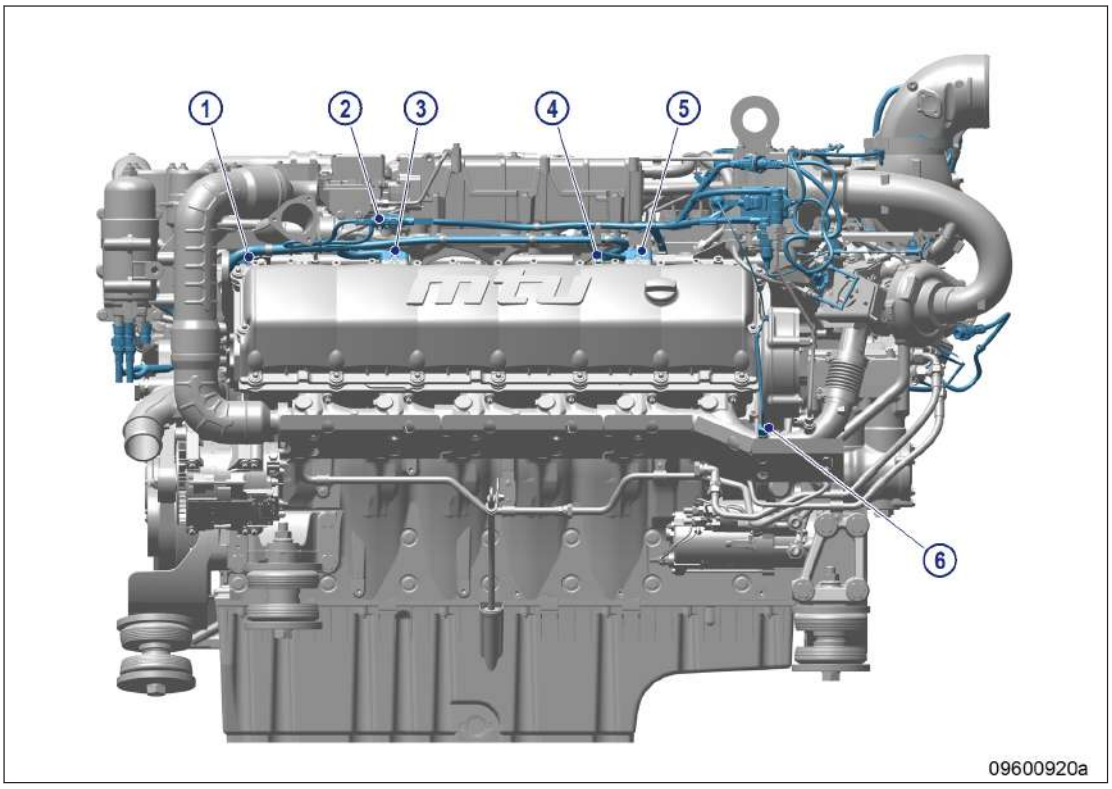
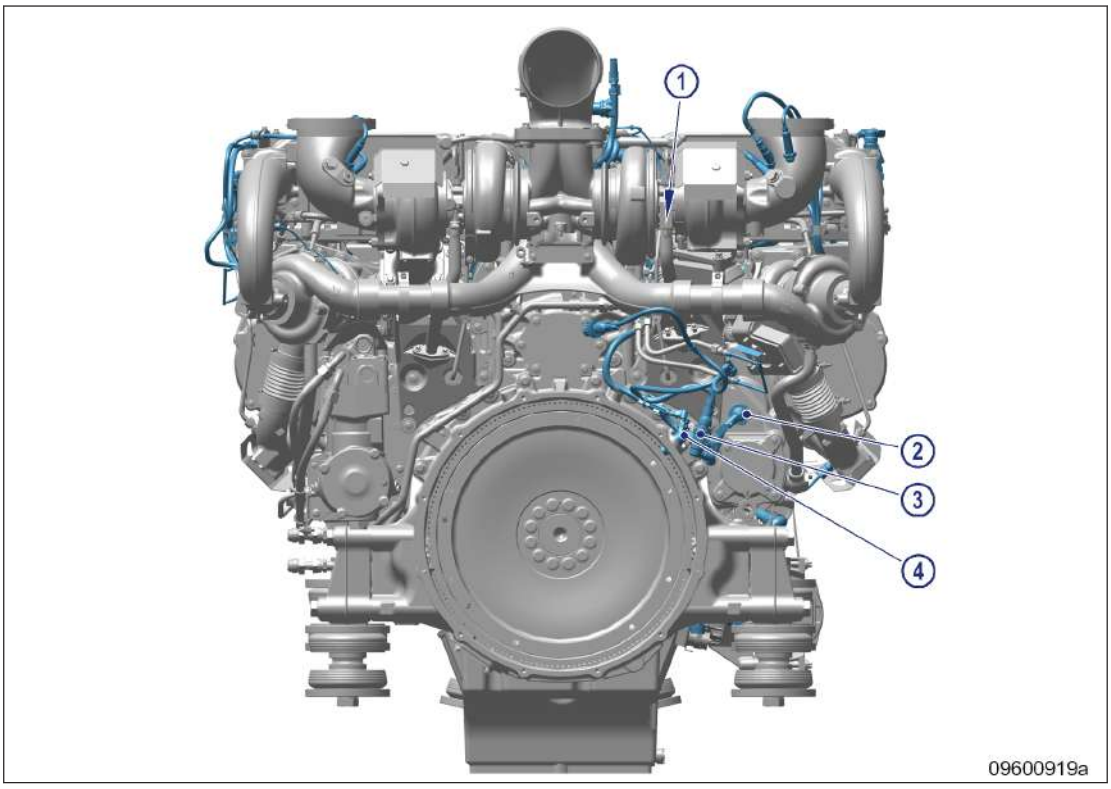
Sensor overview – Left side



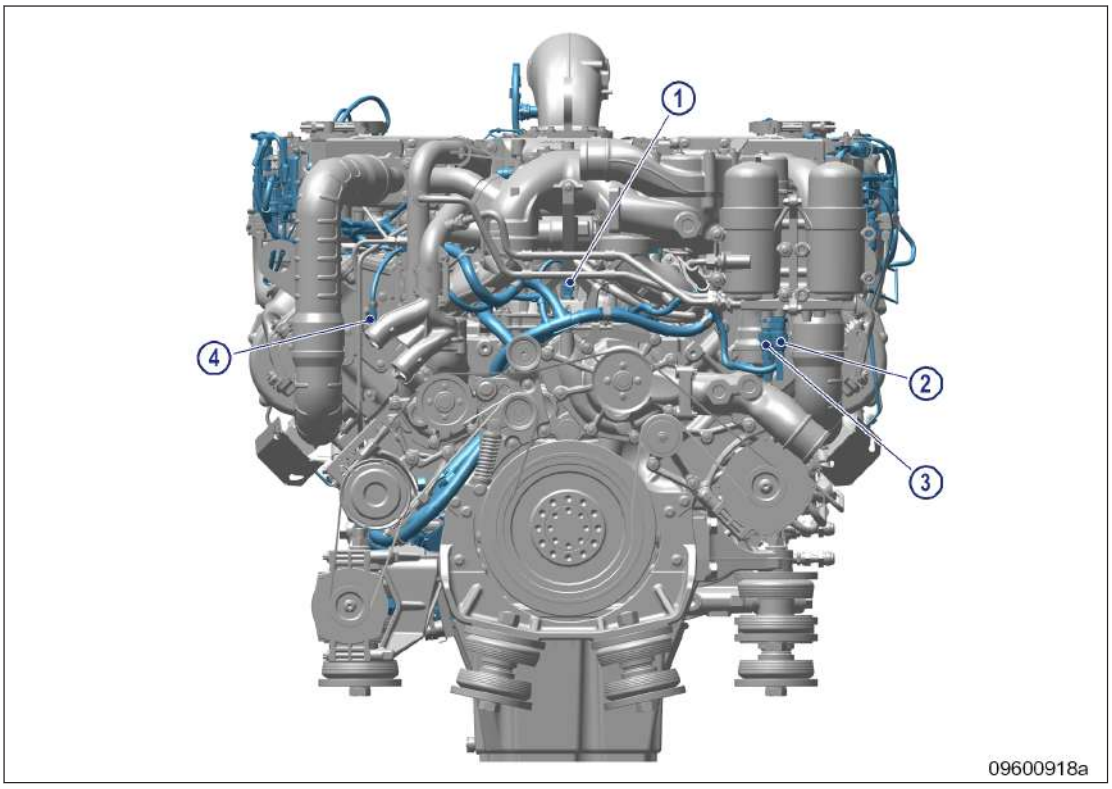
Item	Name	Description
1	B48.1	HP fuel, left side
2	M53.1	EGR shut-off flap before cooler, left side
3	XY39A2	Injector connection
4	XY57A	Engine brake valve, left side
5	XY39A1	Injector connection
6	B4.21	Exhaust temperature lambda sensor, left side

Sensor overview – Driving end (KS)



Item	Name	Description
1	B44.4	Speed of LP turbocharger, right side
2	B50	Crankcase pressure
3	M52.2	HP turbine bypass flap, right side
4	B13	Crankshaft speed

Sensor overview – Free end (KGS)



Item	Name	Description
1	B7	Lube oil temperature
2	B34.2	Fuel pressure before filter
3	B34.1	Fuel pressure after filter
4	B6.3	Coolant temperature, cylinder head

TIM-ID: 0000028030 - 004

4 Technical Data

4.1 Engine data 10V1600A60 / 10V1600A70, US EPA Nonroad Tier 4 (40 CFR 1039), emissions-optimized

Explanation

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

Reference conditions

Description			10V1600 A60	10V1600 A70
Application group			5B	5B
Charge-air coolant temperature		°C	45	45
Barometric pressure		mbar	981	981
Site altitude above sea level		m	400	400

Power-related data (power ratings are net brake power as per ISO 3046)

Description			10V1600 A60	10V1600 A70
Rated engine speed	A	rpm	2100	1900

General conditions (for maximum power)

Description			10V1600 A60	10V1600 A70
Intake depression (new filter)	A	mbar	25	25
Intake depression, max.	L	mbar	40	40
Exhaust back pressure, max.	L	mbar	50	50
Fuel temperature at engine inlet connection	R	°C	38	38
Fuel temperature at engine supply connection, max.	L	°C	70	70

Consumption

Description			10V1600 A60	10V1600 A70
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.06	0.06

Model-related data (basic design)

Description			10V1600 A60	10V1600 A70
Number of cylinders			10	10
Cylinder arrangement: V-angle		Degrees (°)	90	90
Bore		mm	122	122
Stroke		mm	150	150
Displacement, cylinder		Liters	1.75	1.75
Displacement, total		Liters	17.5	17.5
Number of inlet valves per cylinder			2	2
Number of exhaust valves per cylinder			2	2

Air / exhaust gas

Description			10V1600 A60	10V1600 A70
Charge-air pressure before cylinder under standard conditions and at a site altitude of 400 m above sea level	R	bar abs.	3.83*	3.88*
Exhaust gas temperature after exhaust turbocharger under standard conditions and at a site altitude of 400 m above sea level	R	°C	370*	420*

Coolant system (HT circuit)

Description			10V1600 A60	10V1600 A70
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95
Coolant temperature after engine, Limit 1	L	°C	107	107
Coolant temperature after engine, Limit 2	L	°C	118	118
Coolant antifreeze content, max.	L	%	55	55
Coolant pump: Inlet pressure, max.	L	bar	2.5	2.5
Thermostat: Starts to open	R	°C	79	79
Thermostat: Fully open	R	°C	92	92

Coolant system (LT circuit)

Description			10V1600 A60	10V1600 A70
Coolant antifreeze content, max.	L	%	55	55
Charge-air temperature after intercooler, max.	L	°C	90	90
Thermostat: Starts to open	R	°C	30	30
Thermostat: Fully open	R	°C	45	45

Lube oil system

Description			10V1600 A60	10V1600 A70
Lube oil operating temperature before engine, from	R	°C	112	112
Lube oil operating temperature before engine, to	R	°C	122	122
Lube oil temperature before engine, Limit 1	L	°C	125	125
Lube oil temperature before engine, Limit 2	L	°C	130	130
Lube oil operating pressure before of engine, from	R	bar	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	5.5	5.5
Lube oil operating pressure before engine, warning	L	bar	5.5	3.5
Lube oil operating pressure before engine, shutdown	L	bar	3.3	3.3

Fuel system

Description			10V1600 A60	10V1600 A70
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.65	-0.65
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.65	-0.65
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0	0

Inclinations – standard oil system (reference: waterline)

Description			10V1600 A60	10V1600 A70
Longitudinal inclination, continuous max., driving end down	L	Degrees (°)	32	32
Longitudinal inclination, continuous max., driving end up	L	Degrees (°)	32	32
Transverse inclination, continuous max.	L	Degrees (°)	32	32

Capacities

Description			10V1600 A60	10V1600 A70
Engine coolant, engine side (without cooling equipment)	R	Liters	57	57
Charge-air coolant, engine side	R	Liters	15	15
Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	55	55

Weights / main dimensions

Description			10V1600 A60	10V1600 A70
Engine dry weight (with standard accessories installed, w/o coupling)	R	kg	2200	2200

Noise

Description			10V1600 A60	10V1600 A70
Exhaust noise, unsilenced – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	110	110
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	122	122
Engine surface noise with attenuated intake noise (filter) – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	104*	103*
Engine surface noise with attenuated intake noise (filter) – BL (sound power level LW, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	121*	120*

4.2 Engine data 10V1600C60 / 10V1600C70, US EPA Nonroad Tier 4 (40 CFR 1039), emissions-optimized

Explanation

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

Reference conditions

Description			10V1600 C60	10V1600 C70
Application group			5B	5B
Charge-air coolant temperature		°C	45	45
Barometric pressure		mbar	981	981
Site altitude above sea level		m	400	400

Power-related data (power ratings are net brake power as per ISO 3046)

Description			10V1600 C60	10V1600 C70
Rated engine speed	A	rpm	2100	1900

General conditions (for maximum power)

Description			10V1600 C60	10V1600 C70
Intake depression (new filter)	A	mbar	25	25
Intake depression, max.	L	mbar	40	40
Exhaust back pressure, max.	L	mbar	50	50
Fuel temperature at engine inlet connection	R	°C	38	38
Fuel temperature at engine supply connection, max.	L	°C	70	70

Consumption

Description			10V1600 C60	10V1600 C70
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.06	0.06

Model-related data (basic design)

Description			10V1600 C60	10V1600 C70
Number of cylinders			10	10
Cylinder arrangement: V-angle		Degrees (°)	90	90
Bore		mm	122	122
Stroke		mm	150	150
Displacement, cylinder		Liters	1.75	1.75
Displacement, total		Liters	17.5	17.5
Number of inlet valves per cylinder			2	2
Number of exhaust valves per cylinder			2	2

Air / exhaust gas

Description			10V1600 C60	10V1600 C70
Charge-air pressure before cylinder under standard conditions and at a site altitude of 400 m above sea level	R	bar abs.	3.83*	3.88*
Exhaust gas temperature after exhaust turbocharger under standard conditions and at a site altitude of 400 m above sea level	R	°C	370*	420*

Coolant system (HT circuit)

Description			10V1600 C60	10V1600 C70
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95
Coolant temperature after engine, Limit 1	L	°C	107	107
Coolant temperature after engine, Limit 2	L	°C	118	118
Coolant antifreeze content, max.	L	%	55	55
Coolant pump: Inlet pressure, max.	L	bar	2.5	2.5
Thermostat: Starts to open	R	°C	79	79
Thermostat: Fully open	R	°C	92	92

Coolant system (LT circuit)

Description			10V1600 C60	10V1600 C70
Coolant antifreeze content, max.	L	%	55	55
Charge-air temperature after intercooler, max.	L	°C	90	90
Thermostat: Starts to open	R	°C	30	30
Thermostat: Fully open	R	°C	45	45

Lube oil system

Description			10V1600 C60	10V1600 C70
Lube oil operating temperature before engine, from	R	°C	112	112
Lube oil operating temperature before engine, to	R	°C	122	122

Description			10V1600 C60	10V1600 C70
Lube oil temperature before engine, Limit 1	L	°C	125	125
Lube oil temperature before engine, Limit 2	L	°C	130	130
Lube oil operating pressure before of engine, from	R	bar	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	5.5	5.5
Lube oil operating pressure before engine, warning	L	bar	5.5	3.5
Lube oil operating pressure before engine, shutdown	L	bar	3.3	3.3

Fuel system

Description			10V1600 C60	10V1600 C70
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.65	-0.65
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.65	-0.65
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0	0

Inclinations – standard oil system (reference: waterline)

Description			10V1600 C60	10V1600 C70
Longitudinal inclination, continuous max., driving end down	L	Degrees (°)	32	32
Longitudinal inclination, continuous max., driving end up	L	Degrees (°)	32	32
Transverse inclination, continuous max.	L	Degrees (°)	32	32

Capacities

Description			10V1600 C60	10V1600 C70
Engine coolant, engine side (without cooling equipment)	R	Liters	57	57
Charge-air coolant, engine side	R	Liters	15	15
Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	55	55

Weights / main dimensions

Description			10V1600 C60	10V1600 C70
Engine dry weight (with standard accessories installed, w/o coupling)	R	kg	2200	2200

Noise

Description			10V1600 C60	10V1600 C70
Exhaust noise, unsilenced – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	110	110
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	122	122
Engine surface noise with attenuated intake noise (filter) – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	104*	103*
Engine surface noise with attenuated intake noise (filter) – BL (sound power level LW, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	121*	120*

TIM-ID: 0000054312 - 001

4.3 Engine data 10V1600C60 / 10V1600C70, US EPA Nonroad Tier 4 (40 CFR 1039) compliant, emissions-optimized

Explanation

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

Reference conditions

Description			10V1600 C60	10V1600 C70
Application group			5B	5B
Charge-air coolant temperature		°C	45	45
Barometric pressure		mbar	981	981
Site altitude above sea level		m	400	400

Power-related data (power ratings are net brake power as per ISO 3046)

Description			10V1600 C60	10V1600 C70
Rated engine speed	A	rpm	2100	1900

General conditions (for maximum power)

Description			10V1600 C60	10V1600 C70
Intake depression (new filter)	A	mbar	25	25
Intake depression, max.	L	mbar	40	40
Exhaust back pressure, max.	L	mbar	50	50
Fuel temperature at engine inlet connection	R	°C	38	38
Fuel temperature at engine supply connection, max.	L	°C	70	70

Consumption

Description			10V1600 C60	10V1600 C70
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.06	0.06

TIM-ID: 0000054314 - 001

Model-related data (basic design)

Description			10V1600 C60	10V1600 C70
Number of cylinders			10	10
Cylinder arrangement: V-angle		Degrees (°)	90	90
Bore		mm	122	122
Stroke		mm	150	150
Displacement, cylinder		Liters	1.75	1.75
Displacement, total		Liters	17.5	17.5
Number of inlet valves per cylinder			2	2
Number of exhaust valves per cylinder			2	2

Air / exhaust gas

Description			10V1600 C60	10V1600 C70
Charge-air pressure before cylinder under standard conditions and at a site altitude of 400 m above sea level	R	bar abs.	3.83*	3.88*
Exhaust gas temperature after exhaust turbocharger under standard conditions and at a site altitude of 400 m above sea level	R	°C	370*	420*

Coolant system (HT circuit)

Description			10V1600 C60	10V1600 C70
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95
Coolant temperature after engine, Limit 1	L	°C	107	107
Coolant temperature after engine, Limit 2	L	°C	118	118
Coolant antifreeze content, max.	L	%	55	55
Coolant pump: Inlet pressure, max.	L	bar	2.5	2.5
Thermostat: Starts to open	R	°C	79	79
Thermostat: Fully open	R	°C	92	92

Coolant system (LT circuit)

Description			10V1600 C60	10V1600 C70
Coolant antifreeze content, max.	L	%	55	55
Charge-air temperature after intercooler, max.	L	°C	90	90
Thermostat: Starts to open	R	°C	30	30
Thermostat: Fully open	R	°C	45	45

Lube oil system

Description			10V1600 C60	10V1600 C70
Lube oil operating temperature before engine, from	R	°C	112	112
Lube oil operating temperature before engine, to	R	°C	122	122

TIM-ID: 0000054314 - 001

Description			10V1600 C60	10V1600 C70
Lube oil temperature before engine, Limit 1	L	°C	125	125
Lube oil temperature before engine, Limit 2	L	°C	130	130
Lube oil operating pressure before of engine, from	R	bar	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	5.5	5.5
Lube oil operating pressure before engine, warning	L	bar	5.5	3.5
Lube oil operating pressure before engine, shutdown	L	bar	3.3	3.3

Fuel system

Description			10V1600 C60	10V1600 C70
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.65	-0.65
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.65	-0.65
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0	0

Inclinations – standard oil system (reference: waterline)

Description			10V1600 C60	10V1600 C70
Longitudinal inclination, continuous max., driving end down	L	Degrees (°)	32	32
Longitudinal inclination, continuous max., driving end up	L	Degrees (°)	32	32
Transverse inclination, continuous max.	L	Degrees (°)	32	32

Capacities

Description			10V1600 C60	10V1600 C70
Engine coolant, engine side (without cooling equipment)	R	Liters	57	57
Charge-air coolant, engine side	R	Liters	15	15
Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	55	55

Weights / main dimensions

Description			10V1600 C60	10V1600 C70
Engine dry weight (with standard accessories installed, w/o coupling)	R	kg	2200	2200

Noise

Description			10V1600 C60	10V1600 C70
Exhaust noise, unsilenced – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	110	110
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	122	122
Engine surface noise with attenuated intake noise (filter) – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	104*	103*
Engine surface noise with attenuated intake noise (filter) – BL (sound power level LW, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	121*	120*

TIM-ID: 0000054314 - 001

4.4 Engine data 12V1600A50 / 12V1600A60 / 12V1600A70, US EPA Nonroad Tier 4 (40 CFR 1039), emissions-optimized

Explanation

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

Reference conditions

Description			12V1600 A50	12V1600 A60	12V1600 A70
Application group			5B	5B	5B
Charge-air coolant temperature		°C	45	45	45
Barometric pressure		mbar	981	981	981
Site altitude above sea level		m	400	400	400

Power-related data (power ratings are net brake power as per ISO 3046)

Description			12V1600 A50	12V1600 A60	12V1600 A70
Rated engine speed	A	rpm	1900	2100	1900

General conditions (for maximum power)

Description			12V1600 A50	12V1600 A60	12V1600 A70
Intake depression (new filter)	A	mbar	25	25	25
Intake depression, max.	L	mbar	40	40	40
Exhaust back pressure, max.	L	mbar	50	50	50
Fuel temperature at engine inlet connection	R	°C	38	38	38
Fuel temperature at engine supply connection, max.	L	°C	70	70	70

Consumption

Description			12V1600 A50	12V1600 A60	12V1600 A70
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.06	0.06	0.06

Model-related data (basic design)

Description			12V1600 A50	12V1600 A60	12V1600 A70
Number of cylinders			12	12	12
Cylinder arrangement: V-angle		Degrees (°)	90	90	90
Bore		mm	122	122	122
Stroke		mm	150	150	150
Displacement, cylinder		Liters	1.75	1.75	1.75
Displacement, total		Liters	21	21	21
Number of inlet valves per cylinder			2	2	2
Number of exhaust valves per cylinder			2	2	2

Air / exhaust gas

Description			12V1600 A50	12V1600 A60	12V1600 A70
Charge-air pressure before cylinder	R	bar abs.	3.545	3.85	3.88
Exhaust gas temperature after engine, max. in DBR/MCR performance map under standard conditions	L	°C	400	430	430
Exhaust gas temperature after engine, max. in DBR/MCR performance map under max. admissible operating conditions	L	°C	550	550	550

Coolant system (HT circuit)

Description			12V1600 A50	12V1600 A60	12V1600 A70
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95
Coolant temperature after engine, Limit 1	L	°C	107	107	107
Coolant temperature after engine, Limit 2	L	°C	118	118	118
Coolant antifreeze content, max.	L	%	55	55	55
Coolant pump: Inlet pressure, max.	L	bar	2.5	2.5	2.5
Thermostat: Starts to open	R	°C	79	79	79
Thermostat: Fully open	R	°C	92	92	92

Coolant system (LT circuit)

Description			12V1600 A50	12V1600 A60	12V1600 A70
Coolant antifreeze content, max.	L	%	55	55	55
Charge-air temperature after intercooler, max.	L	°C	90	90	90
Thermostat: Starts to open	R	°C	30	30	30
Thermostat: Fully open	R	°C	45	45	45

TIM-ID: 0000054317 - 003

Lube oil system

Description			12V1600 A50	12V1600 A60	12V1600 A70
Lube oil operating temperature before engine, from	R	°C	112	112	112
Lube oil operating temperature before engine, to	R	°C	122	122	122
Lube oil temperature before engine, Limit 1	L	°C	125	125	125
Lube oil temperature before engine, Limit 2	L	°C	130	130	130
Lube oil operating pressure before of engine, from	R	bar	4.5	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	5.5	5.5	5.5
Lube oil operating pressure before engine, warning	L	bar	3.5	3.5	3.5
Lube oil operating pressure before engine, shutdown	L	bar	3.3	3.5	3.3

Fuel system

Description			12V1600 A50	12V1600 A60	12V1600 A70
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.65	-0.65	-0.65
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.65	-0.65	-0.65
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0	0	0

Inclinations – standard oil system (reference: waterline)

Description			12V1600 A50	12V1600 A60	12V1600 A70
Longitudinal inclination, continuous max., driving end down	L	Degrees (°)	27	27	27
Longitudinal inclination, continuous max., driving end up	L	Degrees (°)	22	22	22
Transverse inclination, continuous max.	L	Degrees (°)	32	32	32

Capacities

Description			12V1600 A50	12V1600 A60	12V1600 A70
Engine coolant, engine side (without cooling equipment)	R	Liters	60	60	60
Charge-air coolant, engine side	R	Liters	15	15	15
Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	75	75	75

Weights / main dimensions

Description			12V1600 A50	12V1600 A60	12V1600 A70
Engine dry weight (with standard accessories installed, w/o coupling)	R	kg	2309*	2309*	2309*

Noise

Description			12V1600 A50	12V1600 A60	12V1600 A70
Exhaust noise, unsilenced – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	106	109	109
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	118	121	121
Engine surface noise with attenuated intake noise (filter) – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	103*	104*	103*
Engine surface noise with attenuated intake noise (filter) – BL (sound power level LW, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	120*	121*	120*

4.5 Engine data 12V1600C50 / 12V1600C60 / 12V1600C70, US EPA Nonroad Tier 4 (40 CFR 1039), emissions-optimized

Explanation

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

Reference conditions

Description			12V1600 C50	12V1600 C60	12V1600 C70
Application group			5B	5B	5B
Charge-air coolant temperature		°C	45	45	45
Barometric pressure		mbar	981	981	981
Site altitude above sea level		m	400	400	400

Power-related data (power ratings are net brake power as per ISO 3046)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Rated engine speed	A	rpm	1900	2100	1900

General conditions (for maximum power)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Intake depression (new filter)	A	mbar	25	25	25
Intake depression, max.	L	mbar	40	40	40
Exhaust back pressure, max.	L	mbar	50	50	50
Fuel temperature at engine inlet connection	R	°C	38	38	38
Fuel temperature at engine supply connection, max.	L	°C	70	70	70

Consumption

Description			12V1600 C50	12V1600 C60	12V1600 C70
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.06	0.06	0.06

Model-related data (basic design)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Number of cylinders			12	12	12
Cylinder arrangement: V-angle		Degrees (°)	90	90	90
Bore		mm	122	122	122
Stroke		mm	150	150	150
Displacement, cylinder		Liters	1.75	1.75	1.75
Displacement, total		Liters	21	21	21
Number of inlet valves per cylinder			2	2	2
Number of exhaust valves per cylinder			2	2	2

Air / exhaust gas

Description			12V1600 C50	12V1600 C60	12V1600 C70
Charge-air pressure before cylinder	R	bar abs	3.545	3.85	3.88
Exhaust gas temperature after engine, max. in DBR/MCR performance map under standard conditions	L	°C	400	430	430
Exhaust gas temperature after engine, max. in DBR/MCR performance map under max. admissible operating conditions	L	°C	550	550	550

Coolant system (HT circuit)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95
Coolant temperature after engine, Limit 1	L	°C	107	107	107
Coolant temperature after engine, Limit 2	L	°C	118	118	118
Coolant antifreeze content, max.	L	%	55	55	55
Coolant pump: Inlet pressure, max.	L	bar	2.5	2.5	2.5
Thermostat: Starts to open	R	°C	79	79	79
Thermostat: Fully open	R	°C	92	92	92

Coolant system (LT circuit)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Coolant antifreeze content, max.	L	%	55	55	55
Charge-air temperature after intercooler, max.	L	°C	90	90	90
Thermostat: Starts to open	R	°C	30	30	30
Thermostat: Fully open	R	°C	45	45	45

TIM-ID: 0000054318 - 003

Lube oil system

Description			12V1600 C50	12V1600 C60	12V1600 C70
Lube oil operating temperature before engine, from	R	°C	112	112	112
Lube oil operating temperature before engine, to	R	°C	122	122	122
Lube oil temperature before engine, Limit 1	L	°C	125	125	125
Lube oil temperature before engine, Limit 2	L	°C	130	130	130
Lube oil operating pressure before of engine, from	R	bar	4.5	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	5.5	5.5	5.5
Lube oil operating pressure before engine, warning	L	bar	3.5	3.5	3.5
Lube oil operating pressure before engine, shutdown	L	bar	3.3	3.5	3.3

Fuel system

Description			12V1600 C50	12V1600 C60	12V1600 C70
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.65	-0.65	-0.65
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.65	-0.65	-0.65
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0	0	0

Inclinations – standard oil system (reference: waterline)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Longitudinal inclination, continuous max., driving end down	L	Degrees (°)	27	27	27
Longitudinal inclination, continuous max., driving end up	L	Degrees (°)	22	22	22
Transverse inclination, continuous max.	L	Degrees (°)	32	32	32

Capacities

Description			12V1600 C50	12V1600 C60	12V1600 C70
Engine coolant, engine side (without cooling equipment)	R	Liters	60	60	60
Charge-air coolant, engine side	R	Liters	15	15	15
Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	75	75	75

Weights / main dimensions

Description			12V1600 C50	12V1600 C60	12V1600 C70
Engine dry weight (with standard accessories installed, w/o coupling)	R	kg	2309*	2309*	2309*

Noise

Description			12V1600 C50	12V1600 C60	12V1600 C70
Exhaust noise, unsilenced – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	106	109	109
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	118	121	121
Engine surface noise with attenuated intake noise (filter) – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	103*	104*	103*
Engine surface noise with attenuated intake noise (filter) – BL (sound power level LW, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	120*	121*	120*

4.6 Engine data 12V1600C50 / 12V1600C60 / 12V1600C70, US EPA Nonroad Tier 4 (40 CFR 1039) compliant, emissions-optimized

Explanation

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

Reference conditions

Description			12V1600 C50	12V1600 C60	12V1600 C70
Application group			5B	5B	5B
Charge-air coolant temperature		°C	45	45	45
Barometric pressure		mbar	981	981	981
Site altitude above sea level		m	400	400	400

Power-related data (power ratings are net brake power as per ISO 3046)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Rated engine speed	A	rpm	1900	2100	1900

General conditions (for maximum power)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Intake depression (new filter)	A	mbar	25	25	25
Intake depression, max.	L	mbar	40	40	40
Exhaust back pressure, max.	L	mbar	50	50	50
Fuel temperature at engine inlet connection	R	°C	38	38	38
Fuel temperature at engine supply connection, max.	L	°C	70	70	70

Consumption

Description			12V1600 C50	12V1600 C60	12V1600 C70
Lube oil consumption after 100 h runtime (B = hourly fuel consumption)	R	% of B	0.06	0.06	0.06

Model-related data (basic design)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Number of cylinders			12	12	12
Cylinder arrangement: V-angle		Degrees (°)	90	90	90
Bore		mm	122	122	122
Stroke		mm	150	150	150
Displacement, cylinder		Liters	1.75	1.75	1.75
Displacement, total		Liters	21	21	21
Number of inlet valves per cylinder			2	2	2
Number of exhaust valves per cylinder			2	2	2

Air / exhaust gas

Description			12V1600 C50	12V1600 C60	12V1600 C70
Charge-air pressure before cylinder	R	bar abs	3.545	3.85	3.88
Exhaust gas temperature after engine, max. in DBR/MCR performance map under standard conditions	L	°C	400	430	430
Exhaust gas temperature after engine, max. in DBR/MCR performance map under max. admissible operating conditions	L	°C	550	550	550

Coolant system (HT circuit)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95
Coolant temperature after engine, Limit 1	L	°C	107	107	107
Coolant temperature after engine, Limit 2	L	°C	118	118	118
Coolant antifreeze content, max.	L	%	55	55	55
Coolant pump: Inlet pressure, max.	L	bar	2.5	2.5	2.5
Thermostat: Starts to open	R	°C	79	79	79
Thermostat: Fully open	R	°C	92	92	92

Coolant system (LT circuit)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Coolant antifreeze content, max.	L	%	55	55	55
Charge-air temperature after intercooler, max.	L	°C	90	90	90
Thermostat: Starts to open	R	°C	30	30	30
Thermostat: Fully open	R	°C	45	45	45

TIM-ID: 0000054319 - 003

Lube oil system

Description			12V1600 C50	12V1600 C60	12V1600 C70
Lube oil operating temperature before engine, from	R	°C	112	112	112
Lube oil operating temperature before engine, to	R	°C	122	122	122
Lube oil temperature before engine, Limit 1	L	°C	125	125	125
Lube oil temperature before engine, Limit 2	L	°C	130	130	130
Lube oil operating pressure before of engine, from	R	bar	4.5	4.5	4.5
Lube oil operating pressure before engine, to	R	bar	5.5	5.5	5.5
Lube oil operating pressure before engine, warning	L	bar	3.5	3.5	3.5
Lube oil operating pressure before engine, shutdown	L	bar	3.3	3.5	3.3

Fuel system

Description			12V1600 C50	12V1600 C60	12V1600 C70
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.65	-0.65	-0.65
Fuel pressure at engine inlet connection, min. (when engine is running)	L	bar	-0.65	-0.65	-0.65
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	0	0	0

Inclinations – standard oil system (reference: waterline)

Description			12V1600 C50	12V1600 C60	12V1600 C70
Longitudinal inclination, continuous max., driving end down	L	Degrees (°)	27	27	27
Longitudinal inclination, continuous max., driving end up	L	Degrees (°)	22	22	22
Transverse inclination, continuous max.	L	Degrees (°)	32	32	32

Capacities

Description			12V1600 C50	12V1600 C60	12V1600 C70
Engine coolant, engine side (without cooling equipment)	R	Liters	60	60	60
Charge-air coolant, engine side	R	Liters	15	15	15
Engine oil, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	75	75	75

Weights / main dimensions

Description			12V1600 C50	12V1600 C60	12V1600 C70
Engine dry weight (with standard accessories installed, w/o coupling)	R	kg	2309*	2309*	2309*

Noise

Description			12V1600 C50	12V1600 C60	12V1600 C70
Exhaust noise, unsilenced – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	106	109	109
Exhaust noise, unsilenced – BL (sound power level LW, ISO 6798, +3 dB(A) tolerance)	R	dB(A)	118	121	121
Engine surface noise with attenuated intake noise (filter) – BL (free-field sound-pressure level Lp, 1 m distance, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	103*	104*	103*
Engine surface noise with attenuated intake noise (filter) – BL (sound power level LW, ISO 6798, +2 dB(A) tolerance)	R	dB(A)	120*	121*	120*

4.7 Firing order

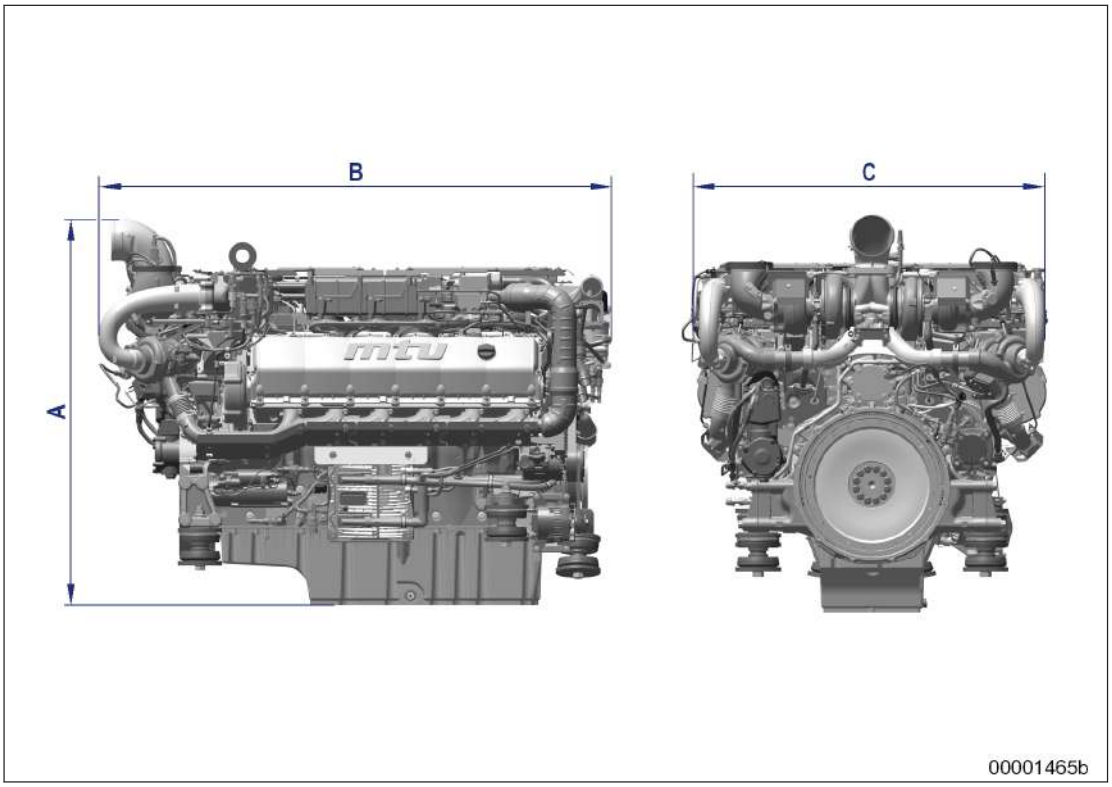
Firing order

Number of cylinders	Firing order
10V	A1–B4–A4–B3–A3–B2–A2–B5–A5–B1
12V	A1–B2–A5–B4–A3–B1–A6–B5–A2–B3–A4–B6

Direction of rotation

Direction of rotation (viewed from driving end): Counterclockwise, non-reversible.

4.8 Main engine dimensions



Engine model	Height (A)	Length (B)	Width (C)
10V1600Ax0/Cx0	Approx. 1402 mm	Approx. 1693 mm	Approx. 1231 mm
12V1600Ax0/Cx0	Approx. 1402 mm	Approx. 1865 mm	Approx. 1231 mm

5 Operation

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

Preconditions

☑ Engine is stopped and starting disabled.

Startup

Item	Action
Lube oil system	Check engine oil level (→ Page 112).
Coolant circuit	Check engine coolant level (→ Page 116); Check charge-air coolant level (→ Page 123).
Coolant circuit	Preheat engine coolant with coolant preheating unit (if fitted).
Fuel prefilter	Drain fuel prefilter (→ Page 108).
Engine control system	Switch on.

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

Preconditions

☑ Engine is stopped and starting disabled.

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

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

Item	Action
Engine	Depreserve (→ MTU Preservation and Represervation Specifications A001070/..).
Lube oil system	Check engine oil level (→ Page 112).
Fuel system	Vent (→ Page 103).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 117). Change charge-air coolant (→ Page 124).
Coolant circuit	Check engine coolant level (→ Page 116); Check charge-air coolant level (→ Page 123).
Coolant circuit	Preheat engine coolant with coolant preheating unit (if fitted).
Engine governor	Check plug-in connections (→ Page 137).
Engine control system	Switch on.

TIM-ID: 0000031877 - 003

5.3 Starting the engine

Preconditions

☑ Engine with no load.

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.

Starting the engine

Item	Measure
Engine	Start the engine (→ documentation of the vehicle manufacturer/plant manufacturer).

TIM-ID: 0000010107 - 006

5.4 Operational checks

DANGER

Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING

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

Operational checks

Item	Action
Control and display panels	Check readings of operational data (speed, temperature, pressures).
Engine oil	Check engine oil level (→ Page 112).
Engine operation	Check engine visually for leaks and general condition; Check engine for abnormal running noises, exhaust color and vibrations (→ Page 59).
Air filter	Check filter restriction indicator on the air filter (if fitted) (→ Page 111).
Exhaust system	Check exhaust color (→ Page 59).
Fuel prefilter	Check pointer position of differential pressure gage at fuel prefilter (if fitted).
Engine coolant pump	Check relief bore (→ Page 122).
Charge-air coolant pump	Check relief bore (→ Page 128).

TIM-ID: 0000032514 - 002

5.5 Engine shutdown

Preconditions

☑ Engine is not connected to load.

CAUTION

Shutting down from full-load operation may cause hot water to escape from the expansion tank.
Risk of scalding!
- Allow engine to cool down.
- Wear protective clothing, protective gloves, and safety goggles / safety mask.

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	Action
Engine	Allow the engine to cool down by running it at idle speed for approx. 5 minutes.

Stopping the engine

Item	Action
Engine	Stopping (→ Documentation of the vehicle/plant manufacturer).

5.6 After stopping the engine

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 118); Drain charge-air coolant (→ Page 125) if: • freezing temperatures are expected and the engine is to remain out of service for an extended period, but engine coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not kept at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50 % and engine-room temperature is below -40 °C.
Engine control system	Switch off.
Air intake and exhaust systems	Out-of-service-period > 1 week: • Seal engine's air and exhaust sides. Out-of-service-period > 1 month: • Preserve engine (→ MTU Preservation and Represervation Specifications A001070/..).

TIM-ID: 0000031879 - 004

5.7 Plant – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

☑ No operating voltage is applied.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
High-pressure cleaning unit	-	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.

Plant – Cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
2. Prior to putting the cleaning unit into operation, read the operating instructions of the 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 flat-mouth 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 the high-pressure jet to remove the loosened dirt.
   e) Dry engine with compressed air.

TIM-ID: 0000010171 - 032

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 112)
W0506		Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 54)
W0507	X	Drain water and contaminants from fuel prefilter.	(→ Page 108)
W1001		Replace fuel filter or fuel filter element.	(→ Page 106)
W1008		Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest.	(→ Page 114)
W1013		Replace drive belt.	(→ Page 129)
W1019	X	Check radial play.	(→ Page 134)
W1207		Check valve clearance, adjust if necessary. IMPORTANT! First adjustment after 1,000 operating hours.	(→ Page 98)
W1326		Replace battery-charging generator belt tensioner and diverter pulley.	(→ Page 132)
W1525		Replace sensor.	(→ Page 138)
W1526		Replace sensor.	(→ Page 140)
W1675	X	Replace fuel prefilter or fuel prefilter element.	(→ Page 109)

Table 2: Maintenance task reference table [QL1]

TIM-ID: 0000051995 - 002

7 Troubleshooting

7.1 Troubleshooting

Engine does not turn when starter is actuated

Cause	Corrective action
Battery low or faulty	▶ Charge or replace (→ manufacturer's documentation).
Battery: Cable connections faulty	▶ Check if cable connections are properly secured (→ manufacturer's documentation).
Starter: Engine cabling or starter faulty	▶ Check if cable connections are properly secured, contact Service.
Engine wiring defective	▶ Check (→ Page 135).
Connectors on engine governor possibly loose	▶ Check plug connections (→ Page 137).
Running gear blocked (engine cannot be barred manually)	▶ Contact Service.

Engine turns but does not fire

Cause	Corrective action
Poor rotation by starter: Battery low or faulty	▶ Charge or replace battery (→ manufacturer's documentation).
Engine wiring defective	▶ Check (→ Page 135).
Air in fuel system	▶ Vent fuel system (→ Page 103).
Engine governor defective	▶ Contact Service.

Engine fires unevenly

Cause	Corrective action
Injector defective	▶ Contact Service.
Engine wiring defective	▶ Check (→ Page 135).
Air in fuel system	▶ Vent fuel system (→ Page 103).
Engine governor defective	▶ Contact Service.

Engine does not reach rated speed

Cause	Corrective action
Fuel prefilter (if fitted) clogged.	▶ Clean or replace filter element (→ manufacturer's documentation).
Fuel filter clogged	▶ Replace (→ Page 106).
Air filter clogged	▶ Replace air filter .(→ Page 110)
Injector defective	▶ Contact Service.
Engine wiring defective	▶ Check (→ Page 135).
Engine: Overloaded	▶ Contact Service.

Engine speed not steady

Cause	Corrective action
Injector defective	▶ Contact Service.
Speed transmitter defective	▶ Contact Service.
Air in fuel system	▶ Vent fuel system (→ Page 103).
Engine governor defective	▶ Contact Service.

Charge air temperature too high

Cause	Corrective action
Engine coolant treatment incorrect	▶ Check (MTU test kit).
Intercooler clogged	▶ Contact Service.
Engine room: Air-intake temperature too high	▶ Check fans and intake/exhaust lines.

Charge-air pressure too low

Cause	Corrective action
Air filter clogged	▶ Replace air filter .(→ Page 110)
Intercooler clogged	▶ Contact Service.
Exhaust turbocharger defective	▶ Contact Service.

Coolant leaks at intercooler

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

Black exhaust gas

Cause	Corrective action
Air filter clogged	▶ Replace air filter .(→ Page 110)
Injector defective	▶ Contact Service.
Engine: Overloaded	▶ Contact Service.

Blue exhaust gas

Cause	Corrective action
Too much oil in engine	▶ Drain engine oil (→ Page 113).
Exhaust turbocharger, cylinder head, piston rings, cylinder liner defective	▶ Contact Service.

TIM-ID: 0000054488 - 001

White exhaust gas

Cause	Corrective action
Engine is not at operating temperature	▶ Run engine to reach operating temperature.
Water in fuel	▶ Check fuel system on fuel prefilter; Drain fuel prefilter (→ Page 108).
Intercooler leaky	▶ Contact Service.

7.2 Engine Control Unit ECU9 – Fault messages

Possible engine responses in case of yellow alarm:

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

Possible engine responses in case of red alarm:

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

5 – HI T-Charge Air

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

6 – SS T-Charge Air

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

9 – HI T-Coolant Intercooler

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

10 – SS T-Coolant Intercooler

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

15 – LO P-Lube Oil

Cause	Corrective action
The lube oil pressure measured at sensor B5.1 has violated limit value 1. The lube oil pressure is too low.	1. Check engine oil level (→ Page 112). 2. Contact Service.

16 – SS P-Lube Oil

Cause	Corrective action
The lube oil pressure measured at sensor B5.1 has violated limit value 2. The lube oil pressure is too low.	1. Check engine oil level (→ Page 112). 2. Contact Service.

19 – HI T-Exhaust A

Cause	Corrective action
The exhaust gas temperature measured at sensor B4.21 has violated limit value 1. The exhaust gas temperature is too high.	▶ Contact Service.

20 – SS T-Exhaust A

Cause	Corrective action
The exhaust gas temperature measured at sensor B4.21 has violated limit value 2. The exhaust gas temperature is too high.	▶ Contact Service.

21 – HI T-Exhaust B

Cause	Corrective action
The exhaust gas temperature measured at sensor B4.22 has violated limit value 1. The exhaust gas temperature is too high.	▶ Contact Service.

22 – SS T-Exhaust B

Cause	Corrective action
The exhaust gas temperature measured at sensor B4.22 has violated limit value 2. The exhaust gas temperature is too high.	▶ Contact Service.

23 – LO Coolant Level

Cause	Corrective action
The coolant level in the high-temperature circuit measured at switch F33 is too low.	1. Check engine coolant level (→ Page 116). 2. Check relief bore of engine coolant pump (→ Page 122). 3. Visually inspect cooling circuit for leakage. 4. Contact Service.

25 – HI P-Diff. Lube Oil

Cause	Corrective action
The differential oil pressure measured at sensors B5.1 and B5.3 has violated limit value 1. The differential oil pressure is too high.	1. Replace engine oil filter (→ Page 114). 2. Contact Service.

26 – SS P-Diff. Lube Oil

Cause	Corrective action
The differential oil pressure measured at sensors B5.1 and B5.3 has violated limit value 2. The differential oil pressure is too high.	1. Replace engine oil filter (→ Page 114). 2. Contact Service.

30 – SS Engine Overspeed

Cause	Corrective action
The engine speed has violated the limit value or the engine overspeed test has been tripped. Emergency engine stop has been tripped.	1. Restart the engine if the emergency stop was tripped by an engine overspeed test. 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 on the A side measured at sensor B44.1 has violated limit value 1. The turbocharger speed is too high. Cause: Fault or malfunction of another turbocharger.	1. Reduce power. 2. Contact Service.

32 – SS ETC1 Overspeed

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

TIM-ID: 0000064702 - 001

33 – HI P-Diff-Fuel

Cause	Corrective action
The differential pressure measured at sensors B34.1 and B34.2 has violated limit value 1. The differential pressure is too high.	1. Replace fuel filter (→ Page 106). 2. Contact Service.

34 – SS P-Diff-Fuel

Cause	Corrective action
The differential pressure measured at sensors B34.1 and B34.2 has violated limit value 2. The differential pressure is too high.	1. Replace fuel filter (→ Page 106). 2. Contact Service.

36 – HI ETC2 Overspeed

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

37 – SS ETC2 Overspeed

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

51 – HI T-Lube Oil

Cause	Corrective action
The lube oil temperature measured at sensor B7.has violated limit value 1. The lube oil temperature is too high.	1. Reduce power. 2. Check cooler and fan operation (plant). 3. Check engine coolant level (→ Page 116). 4. Contact Service.

52 – SS T-Lube Oil

Cause	Corrective action
The lube oil temperature measured at sensor B7.has violated limit value 2. The lube oil temperature is too high.	1. Check cooler and fan operation (plant). 2. Check engine coolant level (→ Page 116). 3. Contact Service.

59 – SS T-Coolant L3

Cause	Corrective action
The coolant temperature measured at sensor B6.1 has violated limit value 3. The coolant temperature is too high.	▶ Contact Service.

60 – SS T-Coolant L4

Cause	Corrective action
The coolant temperature measured at sensor B6.1 has violated limit value 4. The coolant temperature is too high.	▶ Contact Service.

63 – HI P-Crankcase

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

64 – SS P-Crankcase

Cause	Corrective action
The crankcase pressure measured at sensor B50 has violated 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 measured at sensor B34.1 has violated limit value 1. The fuel pressure is too low.	1. Replace fuel filter (→ Page 106). 2. Replace fuel prefilter (→ Page 109). 3. Contact Service.

66 – SS P-Fuel

Cause	Corrective action
The fuel pressure measured at sensor B34.1 has violated limit value 2. The fuel pressure is too low.	1. Replace fuel filter (→ Page 106). 2. Replace fuel prefilter (→ Page 109). 3. Contact Service.

67 – HI T-Coolant

Cause	Corrective action
The coolant temperature measured at sensor B6.1 has violated limit value 1. The coolant temperature is too high.	1. Reduce power. 2. Check cooler and fan operation (plant). 3. Check engine coolant level (→ Page 116). 4. Contact Service.

68 – SS T-Coolant

Cause	Corrective action
The coolant temperature measured at sensor B6.1 has violated limit value 2. The coolant temperature is too high.	1. Check cooler and fan operation (plant). 2. Check engine coolant level (→ Page 116). 3. Contact Service.

82 – HI P-Fuel (Common Rail)

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

83 – LO P-Fuel (Common Rail)

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

89 – SS Engine Speed too Low

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

90 – SS Starter Speed Not Reached

Cause	Corrective action
The engine has failed to reach idle speed within the set time after reaching starter disengagement speed.	▶ Contact Service.

91 – SS Release Speed Not Reached

Cause	Corrective action
The engine has failed to reach starter disengagement speed within the set time after reaching starter speed.	1. Check starter pressure supply (plant). 2. Check for additional messages. 3. Contact Service.

92 – SS Starter Speed Not Reached

Cause	Corrective action
The engine has failed to reach the set speed threshold within the set time.	1. Check starter pressure supply (plant). 2. Check for additional messages. 3. Contact Service.

93 – SS T-Preheat

Cause	Corrective action
The engine coolant temperature has not reached the set limit value 2. Preheating is out of order. Start interlock.	▶ Contact Service.

94 – LO T-Preheat

Cause	Corrective action
The engine coolant temperature has not reached the set limit value 1. Preheating is out of order.	▶ Contact Service.

118 – LO ECU Power Supply Voltage

Cause	Corrective action
The ECU supply voltage has violated the set limit value 1.	1. Check state of battery charge (plant). 2. Check plug connections to Engine Control Unit (→ Page 137). 3. Contact Service.

119 – LOLO ECU Power Supply Voltage

Cause	Corrective action
The ECU supply voltage has violated the set limit value 2.	1. Check state of battery charge (plant). 2. Check plug connections to Engine Control Unit (→ Page 137). 3. Contact Service.

120 – HI ECU Power Supply Voltage

Cause	Corrective action
The ECU supply voltage has violated the set limit value 1.	1. Check state of battery charge (plant). 2. Check plug connections to Engine Control Unit (→ Page 137). 3. Contact Service.

121 – HIHI ECU Power Supply Voltage

Cause	Corrective action
The ECU supply voltage has violated the set limit value 2.	1. Check state of battery charge (plant). 2. Check plug connections to Engine Control Unit (→ Page 137). 3. Contact Service.

122 – HI T-ECU

Cause	Corrective action
The temperature inside the ECU has violated the limit value. The internal temperature is too high.	1. Disconnect power supply. 2. Check power supply (plant). 3. 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 135). 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 135). 2. Disconnect power supply, then reconnect. 3. Contact Service.

186 – AL CAN1 Bus Off

Cause	Corrective action
CAN bus 1 to MTU automation system (e.g. ECU/MAU/SAM) disrupted or faulty.	1. Check plug connections to Engine Control Unit (→ Page 137). 2. Contact Service.

187 – AL CAN1 Error Passive

Cause	Corrective action
CAN bus 1 to MTU automation system (e.g. ECU/MAU/SAM) disrupted or faulty.	1. Check plug connections to Engine Control Unit (→ Page 137). 2. Contact Service.

188 – AL CAN2 Bus Off

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

189 – AL CAN2 Error Passive

Cause	Corrective action
CAN bus 2 to plant automation system (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 (B6.1) on the coolant distribution housing is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

203 – SD T-Charge Air

Cause	Corrective action
The signal from the charge-air coolant temperature sensor (B9) on the A side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

205 – SD T-Coolant Intercooler

Cause	Corrective action
The signal from the charge-air coolant temperature sensor (B26) downstream of the engine inlet is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

206 – SD T-Exhaust A

Cause	Corrective action
The signal from the exhaust gas temperature sensor (B4.21) in the exhaust pipe on the A side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

207 – SD T-Exhaust B

Cause	Corrective action
The signal from the exhaust gas temperature sensor (B4.22) in the exhaust pipe on the B side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

208 – SD P-Charge Air

Cause	Corrective action
The signal from the charge-air coolant pressure sensor (B10.1) downstream of the intercooler on the A side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

211 – SD P-Lube Oil

Cause	Corrective action
The signal from the lube oil pressure sensor (B5.1) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

214 – SD P-Crankcase

Cause	Corrective action
The signal from the crankcase pressure sensor (B50) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

215 – SD P-HD

Cause	Corrective action
The signal from the rail pressure sensor (B48.1) A side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

216 – SD T-Lube Oil

Cause	Corrective action
The signal from the lube oil temperature sensor (B7) is faulty or missing.	1. Check engine wiring (→ Page 135). 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 135). 2. Contact Service.

221 – SD P-Diff Lube Oil

Cause	Corrective action
The signal(s) from lube oil pressure sensors B5.3 and/or B5.1 is/are faulty or missing.	1. Check engine wiring (→ Page 135). 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 135). 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 135). 2. Contact Service.

229 – AL Stop Camshaft Sensor Defect

Cause	Corrective action
Emergency engine stop following failure of the crankshaft sensor and camshaft sensor.	▶ 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 135). 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 135). 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 135). 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 135). 2. Contact Service.

239 – SD P-Diff Fuel

Cause	Corrective action
The signal(s) from pressure sensors B34.1 and/or B34.2 is/are faulty or missing.	1. Check engine wiring (→ Page 135). 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 135). 2. Contact Service.

266 – SD Speed Demand

Cause	Corrective action
The signal for analog speed demand is missing.	1. Switch on plant automation. 2. Contact Service.

321 – AL Wiring Cylinder A1

Cause	Corrective action
Short circuit fault in injector wiring of cylinder A1 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

322 – AL Wiring Cylinder A2

Cause	Corrective action
Short circuit fault in injector wiring of cylinder A2 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

323 – AL Wiring Cylinder A3

Cause	Corrective action
Short circuit fault in injector wiring of cylinder A3 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

324 – AL Wiring Cylinder A4

Cause	Corrective action
Short circuit fault in injector wiring of cylinder A4 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

325 – AL Wiring Cylinder A5

Cause	Corrective action
Short circuit fault in injector wiring of cylinder A5 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

326 – AL Wiring Cylinder A6

Cause	Corrective action
Short circuit fault in injector wiring of cylinder A6 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

331 – AL Wiring Cylinder B1

Cause	Corrective action
Short circuit fault in injector wiring of cylinder B1 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

332 – AL Wiring Cylinder B2

Cause	Corrective action
Short circuit fault in injector wiring of cylinder B2 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

333 – AL Wiring Cylinder B3

Cause	Corrective action
Short circuit fault in injector wiring of cylinder B3 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

334 – AL Wiring Cylinder B4

Cause	Corrective action
Short circuit fault in injector wiring of cylinder B4 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

335 – AL Wiring Cylinder B5

Cause	Corrective action
Short circuit fault in injector wiring of cylinder B5 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

336 – AL Wiring Cylinder B6

Cause	Corrective action
Short circuit fault in injector wiring of cylinder B6 or injector faulty.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

341 – AL Open Load Cylinder A1

Cause	Corrective action
Disruption fault in injector wiring of cylinder A1.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

342 – AL Open Load Cylinder A2

Cause	Corrective action
Disruption fault in injector wiring of cylinder A2.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

343 – AL Open Load Cylinder A3

Cause	Corrective action
Disruption fault in injector wiring of cylinder A3.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

344 – AL Open Load Cylinder A4

Cause	Corrective action
Disruption fault in injector wiring of cylinder A4.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

345 – AL Open Load Cylinder A5

Cause	Corrective action
Disruption fault in injector wiring of cylinder A5.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

346 – AL Open Load Cylinder A6

Cause	Corrective action
Disruption fault in injector wiring of cylinder A6.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

351 – AL Open Load Cylinder B1

Cause	Corrective action
Disruption fault in injector wiring of cylinder B1.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

352 – AL Open Load Cylinder B2

Cause	Corrective action
Disruption fault in injector wiring of cylinder B2.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

353 – AL Open Load Cylinder B3

Cause	Corrective action
Disruption fault in injector wiring of cylinder B3.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

354 – AL Open Load Cylinder B4

Cause	Corrective action
Disruption fault in injector wiring of cylinder B4.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

355 – AL Open Load Cylinder B5

Cause	Corrective action
Disruption fault in injector wiring of cylinder B5.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

356 – AL Open Load Cylinder B6

Cause	Corrective action
Disruption fault in injector wiring of cylinder B6.	1. Check wiring of injector concerned (→ Page 135). 2. Contact Service.

381 – AL Wiring TOP 1

Cause	Corrective action
Short circuit or wire break on transistor output 1, plant (TOP 1).	1. Check wiring (→ Page 135). 2. Contact Service.

382 – AL Wiring TOP 2

Cause	Corrective action
Short circuit or wire break on transistor output 2, plant (TOP 2).	1. Check wiring (→ Page 135). 2. Contact Service.

383 – AL Wiring TOP 3

Cause	Corrective action
Short circuit or wire break on transistor output 3, plant (TOP 3).	1. Check wiring (→ Page 135). 2. Contact Service.

384 – AL Wiring TOP 4

Cause	Corrective action
Short circuit or wire break on transistor output 4, plant (TOP 4).	1. Check wiring (→ Page 135). 2. Contact Service.

410 – LO U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated limit value 1.	1. Check power supply (plant). 2. Check wiring (→ Page 135). 3. Contact Service.

411 – LOLO U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated limit value 2.	1. Check power supply (plant). 2. Check wiring (→ Page 135). 3. Contact Service.

412 – HI U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated limit value 1.	1. Check power supply (plant). 2. Check wiring (→ Page 135). 3. Contact Service.

413 – HIHI U-PDU

Cause	Corrective action
The ECU voltage to control the injectors has violated limit value 2.	1. Check power supply (plant). 2. Check wiring (→ Page 135). 3. Contact Service.

422 – SD T-Charge Air B

Cause	Corrective action
The signal from the charge-air temperature sensor (B9.3) on the B side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

438 – LO P-Fuel 2 (Common Rail)

Cause	Corrective action
The HP fuel pressure measured at sensor B48 2 has violated the limit value. The fuel pressure is too high.	▶ Contact Service.

439 – HI P-Fuel 2 (Common Rail)

Cause	Corrective action
The HP fuel pressure measured at sensor B48 2 has violated the limit value. The fuel pressure is too low.	▶ Contact Service.

440 – AL L1 P-Aux1

Cause	Corrective action
The value measured by the pressure measuring sensor at the pressure measuring channel has violated limit value 1. The pressure value at the pressure measuring channel is too low.	▶ Contact Service.

442 – AL L2 P-Aux1

Cause	Corrective action
The value measured by the pressure measuring sensor at the pressure measuring channel has violated limit value 2. The pressure value at the pressure measuring channel is too low.	▶ Contact Service.

444 – SD U-PDU

Cause	Corrective action
Fault in the internal power supply 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.

446 – SD P-HD2

Cause	Corrective action
The signal from the rail pressure sensor (B48.2) B side is faulty or missing.	▶ Contact Service.

448 – HI P-Charge Air

Cause	Corrective action
The charge-air pressure measured at sensor B10 has violated limit value 1. The charge-air pressure is too high.	▶ Contact Service.

449 – SS P-Charge Air

Cause	Corrective action
The charge-air pressure measured at sensor B10 has violated limit value 2. The charge-air pressure is too high.	▶ Contact Service.

454 – SS Power Reduction Active

Cause	Corrective action
Power reduction activated. A main alarm has activated power reduction.	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.	▶ Contact Service.

472 – AL Stop SD

Cause	Corrective action
This fault is signaled in case of a faulty sensor which is defined for engine stop.	▶ Contact Service.

478 – AL Comb. Alarm Yel (Plant)

Cause	Corrective action
The alarm is raised when a plant device signals the ECU to set a combined yellow alarm.	1. Check for additional messages. 2. Contact Service.

479 – AL Comb. Alarm Red (Plant)

Cause	Corrective action
The alarm is raised when a plant device signals the ECU to set a combined red alarm.	1. Check for additional messages. 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 LP turbocharger on the A side measured at sensor B44.3 has violated limit value 1. The turbocharger speed is too high. Cause: Fault or malfunction of another turbocharger.	1. Reduce power. 2. Contact Service.

489 – SS ETC3 Overspeed

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

490 – HI ETC4 Overspeed

Cause	Corrective action
The speed of the LP turbocharger on the B side measured at sensor B44.4 has violated limit value 1. The turbocharger speed is too high. Cause: Fault or malfunction of another turbocharger.	1. Reduce power. 2. Contact Service.

491 – SS ETC4 Overspeed

Cause	Corrective action
The speed of the LP turbocharger on the B side measured at sensor B44.4 has violated limit value 2. The turbocharger speed is too high. Cause: Fault or malfunction of another turbocharger.	1. Reduce power. 2. Contact Service.

536 – AL Wiring PWM_CM1

Cause	Corrective action
The HP fuel control block M8.1 (A side) of the HP fuel pump cannot be activated.	1. Check engine wiring (→ Page 135). 2. Contact Service.

549 – AL Power Failure

Cause	Corrective action
ECU operating voltage was switched off while the engine was running. Do not switch off the power supply until the engine has reached a standstill.	1. If the power supply was not disconnected manually, check the engine wiring (→ Page 135). 2. Contact Service.

558 – AL Wiring PWM_CM2

Cause	Corrective action
The HP fuel control block M8.2 (B side) of the HP fuel pump cannot be activated.	1. Check engine wiring (→ Page 135). 2. Contact Service.

582 – AL Emergency Stop Failure

Cause	Corrective action
The alarm is raised if the engine fails to reach a standstill after a certain time following an emergency stop signal.	▶ Contact Service.

587 – AL Wiring PWM_CM4

Cause	Corrective action
The exhaust brake on the B-side Y57B / MB57B cannot be activated.	▶ Contact Service.

597 – AL Wiring PWM_CM5

Cause	Corrective action
The exhaust brake on the A side Y57A / MB57A cannot be activated.	▶ Contact Service.

602 – AL CAN Engine Start Lock

Cause	Corrective action
The ECU has received a start interlock from the plant via the CAN bus.	1. Check plant control system. 2. Contact Service.

608 – AL Wiring PWM_CM6

Cause	Corrective action
Disruption or short-circuit in wiring to servomotor of bypass flap (B side) M52.2.	1. Check engine wiring (→ Page 135). 2. Contact Service.

609 – AL Wiring PWM_CM7

Cause	Corrective action
Wire break or short circuit in power supply of TriCAN sensor (B90), or NOx sensor (B88.1/ B88.2) or oil level sensor J1939 (B93).	1. Check engine wiring (→ Page 135). 2. Contact Service.

615 – AL EIL Protection

Cause	Corrective action
The engine number in the EIL does not match the engine number stored in the ECU.	1. Check engine wiring (→ Page 135). 2. Contact Service.

616 – AL EIL Error

Cause	Corrective action
The ECU does not recognize the EIL.	▶ Contact Service.

626 – AL Wiring PWM_CM8

Cause	Corrective action
Disruption or short-circuit in wiring to servomotor of bypass flap (A side) M52.1.	1. Check engine wiring (→ Page 135). 2. Contact Service.

627 – AL Wiring PWM_CM9

Cause	Corrective action
Disruption or short-circuit in wiring to servomotor of EGR shutoff flap (B side) M53.2/ MA53.2.	1. Check engine wiring (→ Page 135). 2. Contact Service.

628 – AL Wiring PWM_CM10

Cause	Corrective action
Disruption or short-circuit in wiring to servomotor of EGR shutoff flap (A side) M53.1/ MA53.1.	1. Check engine wiring (→ Page 135). 2. Contact Service.

629 – AL EGR Shutoff Flap A Faulty

Cause	Corrective action
The EGR shutoff flap on the A side (M53.1) is faulty.	▶ Contact Service.

630 – AL EGR Shutoff Flap B Faulty

Cause	Corrective action
The EGR shutoff flap on the B side (M53.2) is faulty.	▶ Contact Service.

631 – AL Bypass Flap Faulty

Cause	Corrective action
The bypass flap on the A side (M52.1) is faulty.	▶ 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.

636 – SD Lube Oil Level J1939

Cause	Corrective action
The level signal from the combined oil temperature and level sensor (B93) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

637 – SD T-Lube Oil Pan J1939

Cause	Corrective action
The temperature signal from the combined oil temperature and level sensor (B93) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

647 – SD P–Exhaust Lambda

Cause	Corrective action
The signal from the exhaust gas pressure sensor (B91.3) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

693 – AL MB Valve Fault

Cause	Corrective action
The exhaust brake on the A-side Y57B / MB57B cannot be activated.	▶ Contact Service.

727 – AL L1 Delta T-LT Intercooler

Cause	Corrective action
The differential temperature measured 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 for dirt (plant). 2. Check fan operation (plant). 3. Contact Service.

728 – AL L2 Delta T-LT Intercooler

Cause	Corrective action
The differential temperature measured 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 for dirt (plant). 2. Check fan operation (plant). 3. Contact Service.

745 – AL Emission Fault 1

Cause	Corrective action
Combined emission fault alarm	1. Check for additional messages. 2. 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, replace as necessary (→ Page 140). 2. Contact Service.

796 – AL HI T-Charge Air B

Cause	Corrective action
The charge-air temperature on the B side measured at sensor B9.3 has violated limit value 1. The charge-air temperature is too high.	▶ Contact Service.

797 – AL HIHI T-Charge Air B

Cause	Corrective action
The charge-air temperature on the B side measured at sensor B9.3 has violated limit value 2. The charge-air temperature is too high.	▶ Contact Service.

806 – SD Charger 3 Speed

Cause	Corrective action
The signal from the speed sensor (B44.3) LP turbocharger (A side) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

807 – SD Charger 4 Speed

Cause	Corrective action
The signal from the speed sensor (B44.4) LP turbocharger (B side) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

832 – AL EIL Engine Number Differs

Cause	Corrective action
The engine number in the EIL does not match the engine number stored in the ECU.	1. Check engine wiring (→ Page 135). 2. Contact Service.

833 – AL Emission Warning

Cause	Corrective action
Combined emission fault alarm	1. Check for additional messages. 2. Contact Service.

834 – AL Gas Path Warning

Cause	Corrective action
Combined emission fault alarm	1. Check for additional messages. 2. Contact Service.

835 – AL Gas Path Fault

Cause	Corrective action
Combined emission fault alarm	1. Check for additional messages. 2. Contact Service.

843 – SD T-Charge Air Before EGR

Cause	Corrective action
The signal from the charge-air temperature sensor (B9.1 / BT9.1) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

844 – AL HI T-Charge Air Before EGR

Cause	Corrective action
The charge-air temperature measured at sensor B9.1 has violated limit value 1. The charge-air temperature is too high.	▶ Contact Service.

845 – AL HIHI T-Charge Air Before EGR

Cause	Corrective action
The charge-air temperature measured at sensor B9.1 has violated limit value 2. The charge-air temperature is too high.	▶ Contact Service.

846 – AL HI T-Charge Air Diff AB

Cause	Corrective action
The differential temperature measured at sensors B9.2 and B9.3 has violated limit value 1. The charge-air temperature is too high.	▶ Contact Service.

847 – AL HIHI T-Charge Air Diff AB

Cause	Corrective action
The differential temperature measured at sensors B9.2 and B9.3 has violated limit value 2. The charge-air temperature is too high.	▶ Contact Service.

851 – AL External Start and HP Too High

Cause	Corrective action
The alarm is generated after initiating an engine start, but before the starter is engaged when the pressure in the HP accumulator has violated the limit value.	▶ Contact Service.

852 – AL Max. Blankshot Time Expired

Cause	Corrective action
The alarm is generated when the engine is at standstill if the pressure in HP accumulator could not be relieved within the set time.	▶ Contact Service.

855 – AL Flap Bypass B Faulty

Cause	Corrective action
The bypass flap on the B side (M52.2) is faulty.	▶ Contact Service.

857 – AL NOx ATO1 Sensor Faulty

Cause	Corrective action
The signal from the NOx sensor B88.1 in the exhaust pipe downstream of the LP turbocharger on the A side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Check NOx sensor, replace as necessary (→ Page 138). 3. Contact Service.

870 – AL MB Valve Fault 2

Cause	Corrective action
The exhaust brake on the B-side Y57B / MB57B cannot be activated.	▶ Contact Service.

871 – AL NOx ATO1 Communication Lost

Cause	Corrective action
The ECU can no longer detect NOx sensor B88.1 downstream of the LP turbocharger (A side) on the bus.	1. Check engine wiring (→ Page 135). 2. Check NOx sensor, replace as necessary (→ Page 138). 3. Contact Service.

872 – AL EGR FlpA Closed Limit3

Cause	Corrective action
Faulty rapid reference movement of the EGR shutoff flap on the A side (M53.1) (always executed after restarting the ECU).	1. Check state of battery charge (plant). 2. Contact Service.

876 – AL EGR FlpB Closed Limit3

Cause	Corrective action
Faulty rapid reference movement of the EGR shutoff flap on the B side (M53.2) (always executed after restarting the ECU).	1. Check state of battery charge (plant). 2. Contact Service.

877 – AL Bypass FlpA Closed Limit3

Cause	Corrective action
Faulty rapid reference movement of the bypass flap on the A side (M52.1) (always executed after restarting the ECU).	1. Check state of battery charge (plant). 2. Contact Service.

878 – AL Bypass FlpB Closed Limit3

Cause	Corrective action
Faulty rapid reference movement of the bypass flap on the B side (M52.2) (always executed after restarting the ECU).	1. Check state of battery charge (plant). 2. Contact Service.

898 – AL Trican Communication Lost

Cause	Corrective action
The ECU can no longer detect the TriCAN sensor (B90) on the bus.	1. Check engine wiring (→ Page 135). 2. Contact Service.

899 – AL OLT Communication Lost

Cause	Corrective action
The ECU can no longer detect the J1939 combined oil temperature and level sensor B93 on the bus.	1. Check engine wiring (→ Page 135). 2. Contact Service.

902 – HI T-Coolant Cylinder Head

Cause	Corrective action
The coolant temperature measured at sensor B6.3 has violated limit value 1. The coolant temperature is too high.	▶ Contact Service.

904 – SS T-Coolant Cylinder Head

Cause	Corrective action
The coolant temperature measured at sensor B6.3 has violated limit value 2. The coolant temperature is too high.	▶ Contact Service.

953 – AL Lambda value invalid

Cause	Corrective action
Status information of the lambda sensor (B89), generated in case of temporarily implausible measured values or lambda sensor defect.	1. Acknowledge alarm. 2. Replace lambda sensor (→ Page 140). 3. Contact Service.

954 – AL NOx value invalid

Cause	Corrective action
Status information of the NOx sensor (B88.1), generated in case of temporarily implausible measured values or NOx sensor defect.	1. Acknowledge alarm. 2. Replace NOx sensor (→ Page 138). 3. Contact Service.

963 – AL GPS p5 ctrlvar max active

Cause	Corrective action
The required charging pressure was not reached.	▶ Contact Service.

964 – AL GPS p5 ctrlvar min active

Cause	Corrective action
The required charging pressure was not reached.	▶ Contact Service.

970 – SD P-Exhaust

Cause	Corrective action
The signal from the exhaust gas pressure sensor (B91.3) is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Contact Service.

973 – AL Check Sum IIG

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

974 – AL CAN3 Bus Off

Cause	Corrective action
The first Engine CAN (CAN 3) connected to the engine sensors/ actuators is disrupted or faulty.	1. Check engine wiring (→ Page 135). 2. Contact Service.

975 – AL CAN3 Error Passive

Cause	Corrective action
The first Engine CAN (CAN 3) connected to the engine sensors/ actuators is faulty.	1. Check engine wiring (→ Page 135). 2. Contact Service.

976 – AL CAN4 Bus Off

Cause	Corrective action
The second Engine CAN (CAN 4) connected to the engine sensors/ actuators is disrupted or faulty.	1. Check engine wiring (→ Page 135). 2. Contact Service.

977 – AL CAN4 Error Passive

Cause	Corrective action
The second Engine CAN (CAN 4) connected to the engine sensors/ actuators is faulty.	1. Check engine wiring (→ Page 135). 2. Contact Service.

983 – AL Stop on Trigger Crashrecorder

Cause	Corrective action
The alarm indicates that the Crash Recorder was triggered and a start interlock has been activated as a result.	▶ Contact Service.

984 – AL NOx ATO2 Sensor Defect

Cause	Corrective action
The signal from the NOx sensor B88.2 in the exhaust pipe downstream of the turbocharger on the B side is faulty or missing.	1. Check engine wiring (→ Page 135). 2. Check NOx sensor, replace as necessary (→ Page 138). 3. Contact Service.

985 – AL NOx ATO2 Communication Lost

Cause	Corrective action
The ECU can no longer detect NOx sensor B88.2 downstream of the LP turbocharger (B side) on the bus.	1. Check engine wiring (→ Page 135). 2. Check NOx sensor, replace as necessary (→ Page 138). 3. Contact Service.

1015 – AL Total breakdown NOx sensors

Cause	Corrective action
Both NOx sensors (B88.1 and B88.2) indicate a Sensor Defect or an invalid value.	▶ Contact Service.

1097 – AL Flap Egr A Communication Lost

Cause	Corrective action
The ECU can no longer detect the EGR shutoff flap on the A side (M53.1/MA53.1) on the bus.	1. Check engine wiring (→ Page 135). 2. Contact Service.

1098 – AL Flap Egr A Temperature too high

Cause	Corrective action
The internal electronics of the servomotor for the EGR shutoff flap on the A side (M53.1/ MA53.1) signal excessively high temperature.	▶ Contact Service.

1099 – AL Flap Egr A Targetposition

Cause	Corrective action
The servomotor of the EGR shutoff flap on the A side (M53.1/ MA53.1) has failed to reach its target position within the set time.	▶ Contact Service.

1100 – AL Flap Egr B Communication Lost

Cause	Corrective action
The ECU can no longer detect the EGR shutoff flap on the B side (M53.2/MA53.2) on the bus.	1. Check engine wiring (→ Page 135). 2. Contact Service.

1101 – AL Flap Egr B Temperature too high

Cause	Corrective action
The internal electronics of the servomotor for the EGR shutoff flap on the B side (M53.2/ MA53.2) signal excessively high temperature.	▶ Contact Service.

1102 – AL Flap Egr B Targetposition

Cause	Corrective action
The servomotor of the EGR shutoff flap on the B side (M53.2/ MA53.2) has failed to reach its target position within the set time.	▶ Contact Service.

1103 – AL Flap BypassA Communication Lost

Cause	Corrective action
The ECU can no longer detect the bypass flap on the A side (M52.1/ MA52.1) on the bus.	1. Check engine wiring (→ Page 135). 2. Contact Service.

1104 – AL Flap BypasA Temperature too high

Cause	Corrective action
The internal electronics of the servomotor for the bypass flap on the A side (M52.1/MA52.1) signal excessively high temperature.	▶ Contact Service.

1105 – AL Flap Bypass A Targetposition

Cause	Corrective action
The servomotor of the bypass flap on the A side (M52.1/MA52.1) has failed to reach its target position within the set time.	▶ Contact Service.

1106 – AL Flap BypassB Communication Lost

Cause	Corrective action
The ECU can no longer detect the bypass flap on the B side (M52.2/ MA52.2) on the bus.	1. Check engine wiring (→ Page 135). 2. Contact Service.

1107 – AL Flap BypasB Temperature too high

Cause	Corrective action
The internal electronics of the servomotor for the bypass flap on the B side (M52.2/MA52.2) signal excessively high temperature.	▶ Contact Service.

1108 – AL Flap Bypass B Targetposition

Cause	Corrective action
The servomotor of the bypass flap on the B side (M52.2/MA52.2) has failed to reach its target position within the set time.	▶ Contact Service.

1115 – AL Difference P0 P1 Intake Air L1

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

1116 – AL Difference P0 P1 Intake Air L2

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

1120 – AL Flap Egr A Calibration Drive Err

Cause	Corrective action
The ECU has detected a calibration movement error at the EGR shutoff flap on the A side (M53.1/MA53.1). Cause: The teach-in range (angle) of the calibration movement is not plausible. The teach-in angle does not lie between the minimum and maximum range.	▶ Contact Service.

1121 – AL Flap Egr B Calibration Drive Err

Cause	Corrective action
The ECU has detected a calibration movement error at the EGR shutoff flap on the B side (M53.2/MA53.2). Cause: The teach-in range (angle) of the calibration movement is not plausible. The teach-in angle does not lie between the minimum and maximum range.	▶ Contact Service.

1122 – AL Flap BypassA Calibr. Drive Err

Cause	Corrective action
The ECU has detected a calibration movement error at the bypass flap on the A side (M52.1/ MA52.1). Cause: The teach-in range (angle) of the calibration movement is not plausible. The teach-in angle does not lie between the minimum and maximum range.	▶ Contact Service.

1123 – AL Flap BypassB Calibr. Drive Err

Cause	Corrective action
The ECU has detected a calibration movement error at the bypass flap on the B side (M52.2/ MA52.2). Cause: The teach-in range (angle) of the calibration movement is not plausible. The teach-in angle does not lie between the minimum and maximum range.	▶ 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.

1167 – AL Inplausible NOx High Limit1

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

1168 – AL Inplausible NOx Low Limit1

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

1172 – AL Inplausible NOx High Limit2

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

1173 – AL Inplausible NOx Low Limit2

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

1178 – AL J1939 Heartbeat1 Lost

Cause	Corrective action
No message on plant bus	▶ Contact Service.

1179 – AL J1939 Heartbeat2 Lost

Cause	Corrective action
No message on plant bus	▶ Contact Service.

1180 – AL NOx 2 Sensor invalid

Cause	Corrective action
Status information of the NOx sensor (B88.2), generated in case of temporarily implausible measured values or NOx sensor defect.	1. Acknowledge alarm. 2. Replace NOx sensor (→ Page 138). 3. Contact Service.

1183 – AL Inadmissible Measuring Point Config

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

1186 – AL EGR FlpA Wear Limit2

Cause	Corrective action
Faulty rapid reference movement of the EGR shutoff flap on the A side (M53.1/MA53.1) (always executed after restarting the ECU). Limit value 2.	1. Check state of battery charge (plant). 2. Contact Service.

1187 – AL EGR FlpB Wear Limit2

Cause	Corrective action
Faulty rapid reference movement of the EGR shutoff flap on the B side (M53.2/MA53.2) (always executed after restarting the ECU). Limit value 2.	1. Check state of battery charge (plant). 2. Contact Service.

1188 – AL Bypass FlpA Wear Limit2

Cause	Corrective action
Faulty rapid reference movement of the bypass flap on the A side (M52.1/MA52.1) (always executed after restarting the ECU). Limit value 2.	1. Check state of battery charge (plant). 2. Contact Service.

1189 – AL Bypass FlpB Wear Limit2

Cause	Corrective action
Faulty rapid reference movement of the bypass flap on the B side (M52.2/MA52.2) (always executed after restarting the ECU). Limit value 2.	1. Check state of battery charge (plant). 2. Contact Service.

1201 – AL Stop Start Low Supply Pow

Cause	Corrective action
Engine start is prevented by low voltage supply.	▶ Contact Service.

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	F6797674	1
Adapter	F30011619	1
Ratchet adapter	F30027340	1

DANGER

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

Barring engine manually

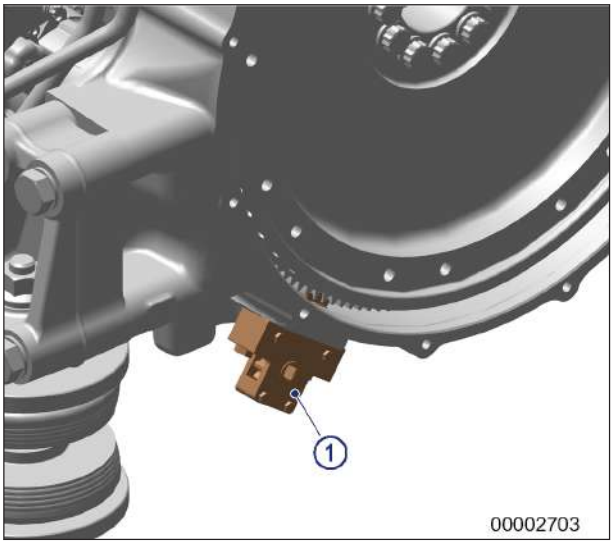
1. Remove guard plate from flywheel housing on A side.
2. Engage barring tool (1) in ring gear of flywheel and install on flywheel housing.
3. Fit adapter and ratchet on barring tool (1).

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

4. Rotate crankshaft in engine direction of rotation.

Result: Contact Service if the resistance exceeds normal compression resistance.

5. Remove in reverse order.



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8.1.2 Engine - Test run

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.

Engine – Test run

1. Start engine (→ Page 53).
2. Perform test run not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks (→ Page 54).
4. Stop engine (→ Page 55).

TIM-ID: 0000009870 - 008

8.2 Valve Drive

8.2.1 Valve clearance - Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40° C.

☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gage	Y20010128	1
Torque wrench, 20–100 Nm	F30026582	1
Box wrench, 14 mm	F30028346	1
Allen keys, 2-10 mm	F30453050	1
Barring tool	F6790714	1

Preparatory steps

1. Remove cylinder head cover (→ Page 101).
2. Install barring tool on crankshaft (→ Page 96).
3. Rotate crankshaft with barring tool in engine direction of rotation until “OT-A1” (TDC-A1) mark and pointer are aligned.

Diagram for 10V (two crankshaft positions)

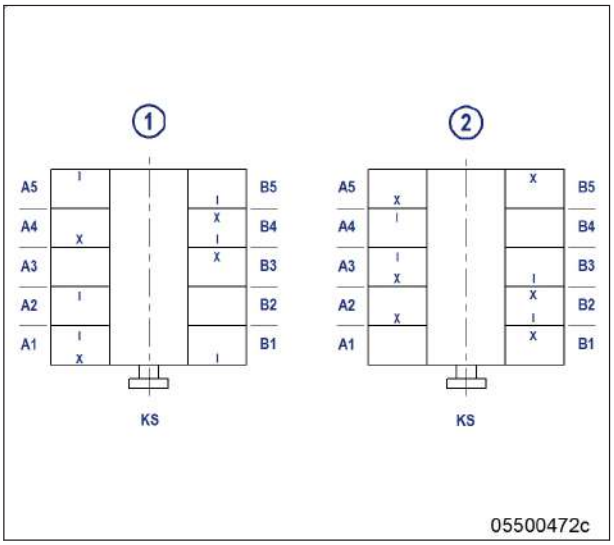

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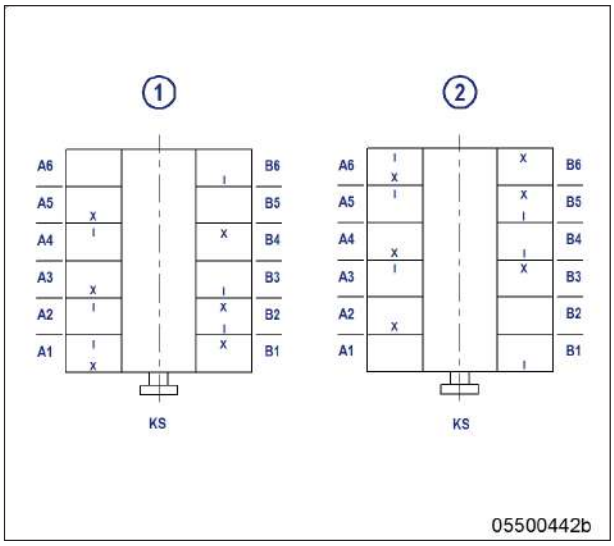
Diagram for 12V (two crankshaft positions)



Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
   - The piston is at firing TDC when the rocker arms at cylinder A1 are unloaded.
   - The piston is at overlap TDC when the rocker arms at cylinder A1 are loaded.
2. Check valve clearance with cold engine:
   - Inlet = 0.3 ±0.05 mm;
   - Exhaust = 0.6 ±0.05 mm.
3. Check all valve clearances in both crankshaft positions (firing TDC and overlap TDC at cylinder A1) in accordance with the diagram:
   - 1 Cylinder A1 is in firing TDC
   - 2 Cylinder A1 is in overlap TDC
   - I Inlet valve
   - X Exhaust valve
4. Use feeler gage to determine the distance between valve bridge and rocker arm.
5. Adjust valve clearance if the deviation from the reference value exceeds 0.1 mm.

Adjusting valve clearance

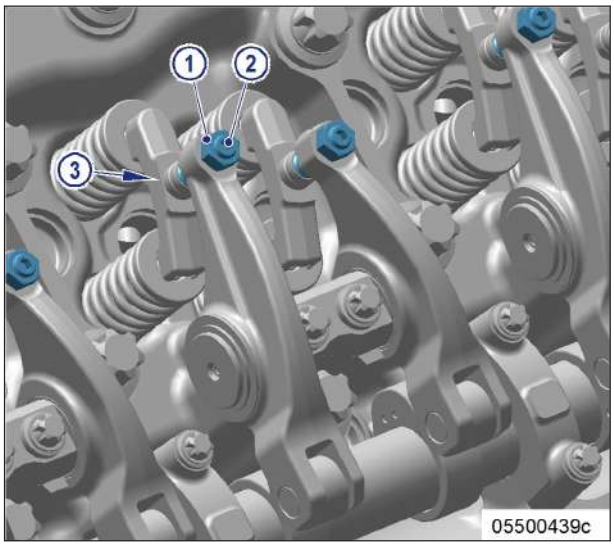
1. Loosen locknut (1) and unscrew adjusting screw (2) by a few threads.
2. Insert feeler gage between valve bridge and rocker arm (3).

Note: Replace or rectify adjusting screws and/or locknuts which do not move freely.

3. Using Allen key, set adjusting screw (2) so that the specified valve clearance is provided.

Note: Feeler gage must just pass through the gap.

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



5. Tighten locknut (1) to specified torque using a torque wrench, holding adjusting screw (2) firm with Allen key (5 mm).

Name	Size	Type	Lubricant	Value/Standard
Nut	M10x1	Tightening torque		43+4 Nm

6. Check valve clearance, readjust as necessary.

Final steps

1. Remove barring tool (→ Page 96).
2. Install cylinder head cover (→ Page 101).
3. Enable engine start.

8.2.2 Cylinder head cover – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

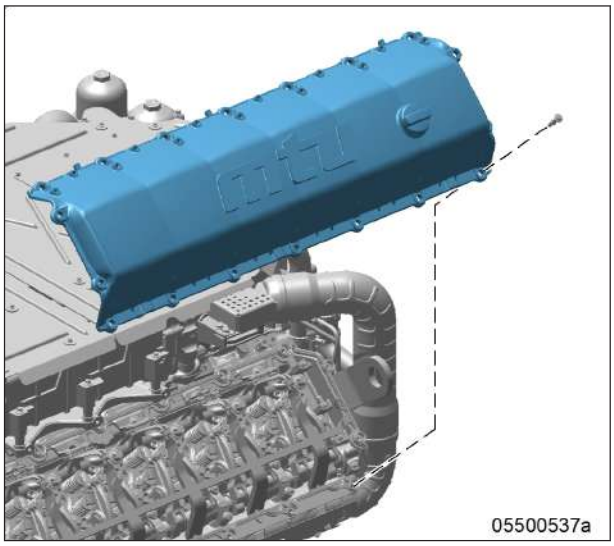
Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 8–40 Nm	F30043446	1
Engine oil		

Removing cylinder head cover

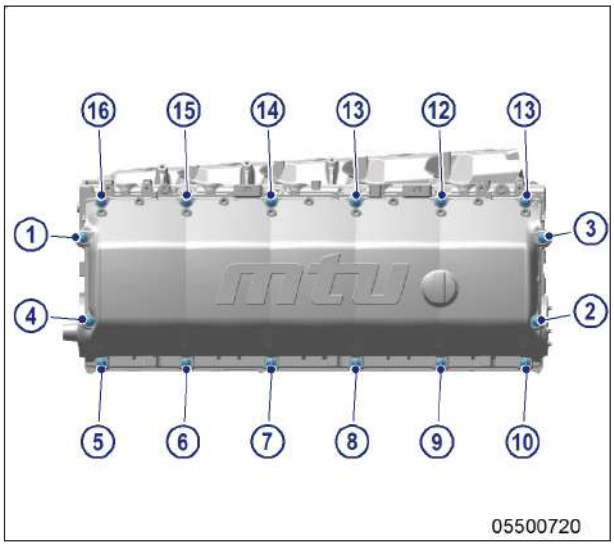
Note: Cover the engine beneath the cylinder head with cloths to collect emerging oil.

1. Undo and remove screws.
2. Remove cylinder head cover.
3. Clean installation surface.
4. Check condition of gasket and replace if required.



Installing cylinder head cover – 10V

1. Coat gasket with engine oil and install it.



2. Position cylinder head cover and screws at positions 1 to 4 and tighten with torque wrench to the prescribed initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Preload torque	(Engine oil)	10 Nm

TIM-ID: 0000028010 - 005

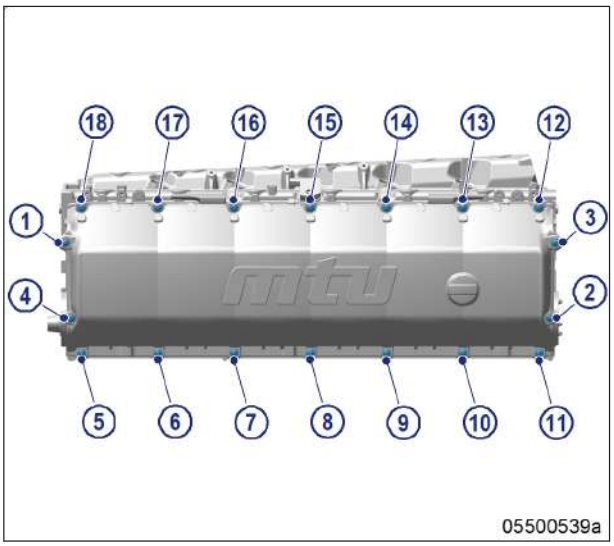
Note: Consecutive tightening sequence starting at position 1: 1 to 16

3. Tighten screws at positions 1 to 16 to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Tightening torque	(Engine oil)	20±2 Nm

Installing cylinder head cover – 12V

1. Coat gasket with engine oil and install it.



2. Position cylinder head cover and screws at positions 1 to 4 and tighten with torque wrench to the prescribed initial tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Preload torque	(Engine oil)	10 Nm

Note: Consecutive tightening sequence starting at position 1: 1 to 18

3. Tighten screws at positions 1 to 18 to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw with twin collar	M8	Tightening torque	(Engine oil)	20±2 Nm

TIM-ID: 0000028010 - 005

8.3 Fuel System

8.3.1 Fuel system - Venting

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine cooled down to ambient temperature.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 4–20 Nm	F30044239	1
Ratchet adapter	F30027340	1

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.

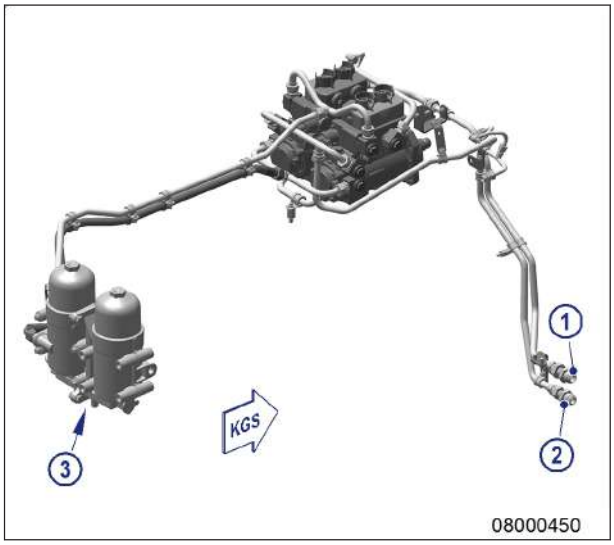
Variant A – Venting fuel system with external fuel pump

Note: Do not open the high pressure system when putting into operation and servicing.

1. Open the unpressurized return to the tank (1) and connect to the tank or a suitably large vessel.
2. Open vent valve (3) on fuel filter.

Note: The customer must establish the connection in the fuel supply line (2) as close to the connection on the engine as possible.

3. Vent fuel filter by activating electric fuel pump.
4. Close vent valve (3) on fuel filter.
5. Activate the electric fuel pump until flow can be heard at the HP pump. Fuel emerges from the return to the tank (1) now.
6. Connect return to tank (1).
7. Start engine.



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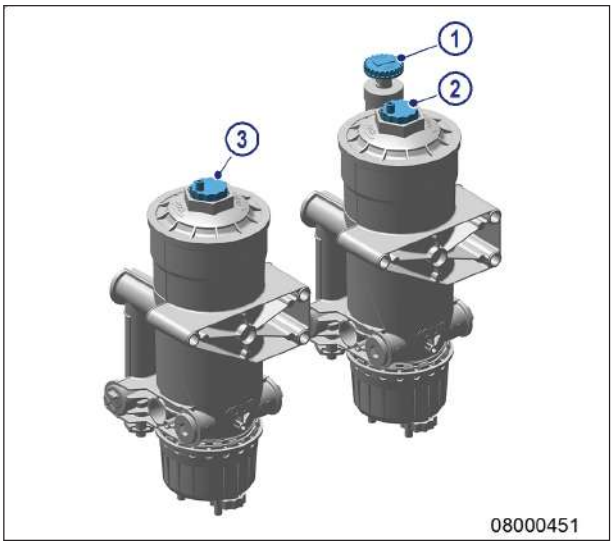
Variant B – Venting fuel system with hand pump at fuel prefilter (optional)



1. Unlock fuel priming pump, screw out handle (1).

Note: Catch emerging fuel with a suitable rag.

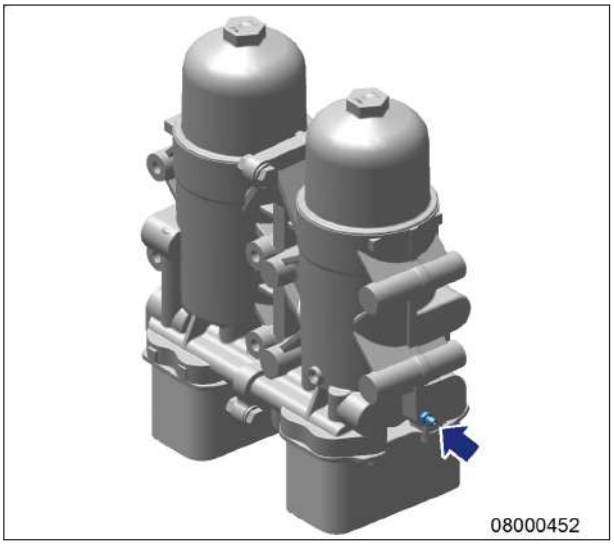
2. Undo threaded vent plug (2) and unscrew by approx. 3 to 4 revolutions.
3. Operate the pump with the handle (1) until bubble-free fuel emerges from the threaded vent plug (2).
4. Close threaded vent plug (2) and tighten by hand.

Note: Catch emerging fuel with a suitable rag.

5. Undo threaded vent plug (3) and unscrew by approx. 3 to 4 revolutions.
6. Operate the pump with the handle (1) until bubble-free fuel emerges from the threaded vent plug (3).
7. Close threaded vent plug (3) and tighten by hand.

Venting fuel filter with cooler

1. Unlock fuel priming pump at fuel prefilter, screw out handle, see above (→ Step 1).
2. Provide a suitable container in which to collect the fuel.



Note: Do not fully unscrew threaded vent plug.

3. Open threaded vent plug (arrowed).
4. Operate the pump with the handle until bubble-free fuel emerges from the threaded vent plug (arrowed).
5. Screw in threaded vent plug (arrowed) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	10	Tightening torque		6.5 Nm ±1.3 Nm

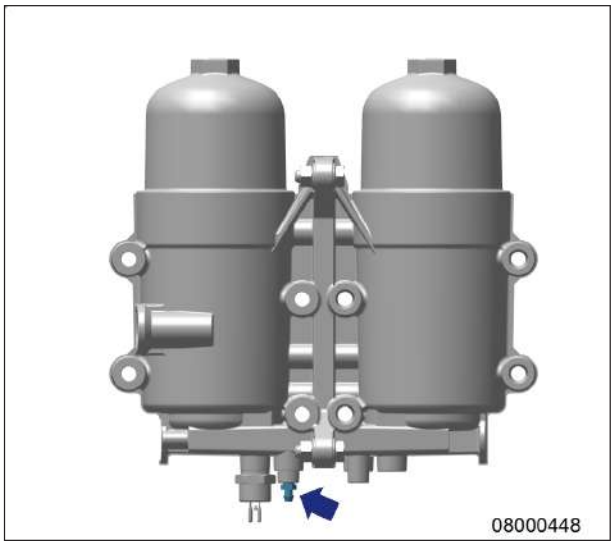
TIM-ID: 0000064753 - 001

Venting fuel filter without cooler

1. Unlock fuel priming pump at fuel prefilter, screw out handle, see above (→ Step 1).
2. Provide a suitable container in which to collect the fuel.

Note: Do not fully unscrew threaded vent plug.

3. Open threaded vent plug (arrowed).
4. Operate the pump with the handle until bubble-free fuel emerges from the threaded vent plug (arrowed).



5. Screw in threaded vent plug (arrowed) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	10	Tightening torque		6.5 Nm ±1.3 Nm

TIM-ID: 0000064753 - 001

8.4 Fuel Filter

8.4.1 Fuel filter - 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, 20–100 Nm	F30026582	1
Ratchet adapter	F30027340	1
Socket, 32 mm	F30006120	1
Engine oil		
Fuel filter element	(→ Spare Parts Catalog)	2

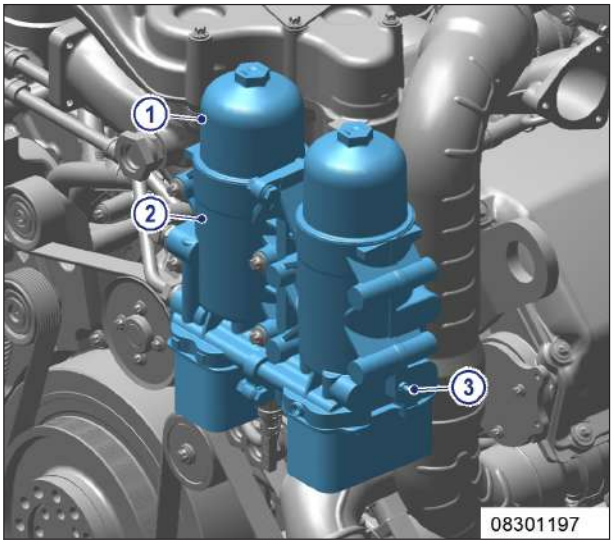
WARNING

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.

Important:

Do not prefill the filter cartridge before installing. Fill the filter cartridge after installing to prevent contaminated fuel ingressing the HP fuel system.

Variant A – Replacing fuel filter with cooler



TIM-ID: 0000028014 - 004

1. Provide a suitable container in which to collect the fuel.

Note: Do not completely remove drain plug.

2. Unscrew drain plug (3) at the side.
3. Loosen screw cap (1) on fuel filter and unscrew it approx. 3 to 4 turns.
4. Wait 10 minutes, until fuel has completely drained off from filter housing (2).
5. Remove screw cap (1) with fuel filter element and remove element by pressing it to the side at the lower edge.
6. Check condition of the sealing ring on the screw cap (1).
7. Replace sealing ring if damaged.
8. Moisten sealing ring with engine oil.
9. Insert new fuel filter element in screw cap (1) and press in until it locks in place.
10. Screw on the cap (1) with fuel filter element and tighten to the specified torque with a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw cap	A/F32	Tightening torque	(Engine oil)	40±5 Nm

11. Screw in drain plug (3) and tighten to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Drain screw	A/F10	Tightening torque	(Engine oil)	6.5±1.3 Nm

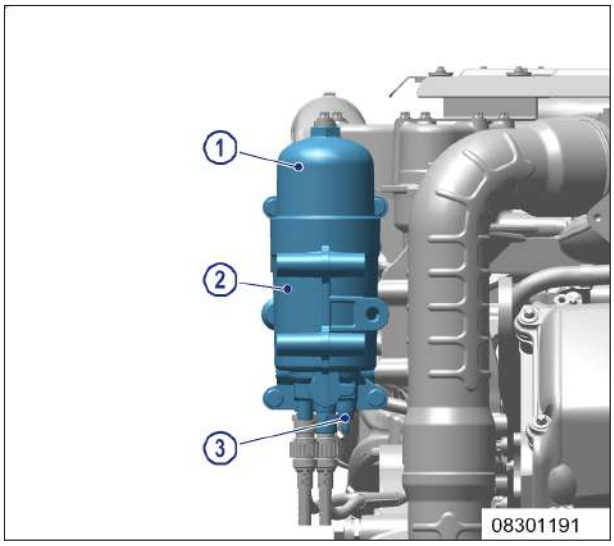
12. Vent fuel system (→ Page 103).

Variant B – Replacing fuel filter without cooler

1. Provide a suitable container in which to collect the fuel.

Note: Do not completely remove drain plug.

2. Unscrew drain plug (3) at the bottom.
3. Continue with steps (→ Step 3) to (→ Step 12).



8.4.2 Fuel prefilter – Draining

Preconditions

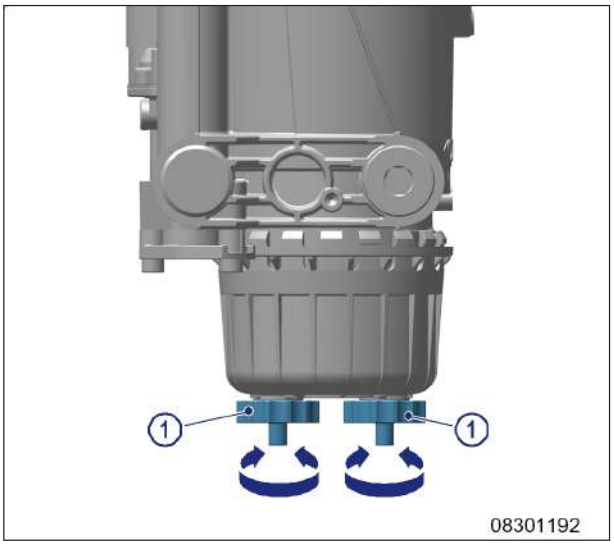
☑ Engine is stopped and starting disabled.

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.

Draining fuel prefilter

1. Provide a suitable container to collect the water.
2. Open drain screws (1).
3. Allow water to drain out.
4. Close drain screws (1) again.



TIM-ID: 0000064920 - 001

8.4.3 Fuel prefilter - Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 8–40 Nm	F30043446	1
Ratchet adapter	F30027340	1
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

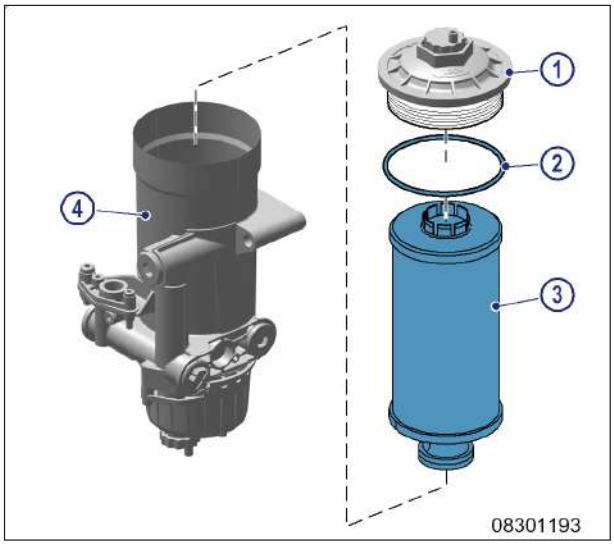
Fuels are combustible and explosive.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.
- Wear protective clothing, protective gloves, and safety glasses / facial protection.

Preparatory step

▶ Provide a suitable container in which to collect the fuel.

Replacing fuel prefilter

1. Close fuel supply.
2. Unscrew filter cover (1).
3. Remove filter cover (1) with filter element (3) from filter housing (4).
4. Remove filter element (3) from filter cover (1).
5. Install new O-ring (2) on filter cover (1).
6. Coat new O-ring (2) with fuel.
7. Insert new filter element (3) in filter cover (1).
8. Screw filter cover (1) with filter element (3) into filter housing (4).



9. Tighten filter cover (1) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Filter cover	A/F46	Tightening torque		40 Nm

Final steps

1. Open fuel inlet.
2. Vent fuel system (→ Page 103).

8.5 Air Filter

8.5.1 Air filter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Note: Component is genset manufacturer's or vehicle manufacturer's scope of supply.

Air filter – Replacement

▶ Perform tasks according to manufacturer's specifications.

8.6 Air Intake

8.6.1 Service indicator - Check

See manufacturer's documentation.

8.7 Lube Oil System, Lube Oil Circuit

8.7.1 Engine oil level - Check

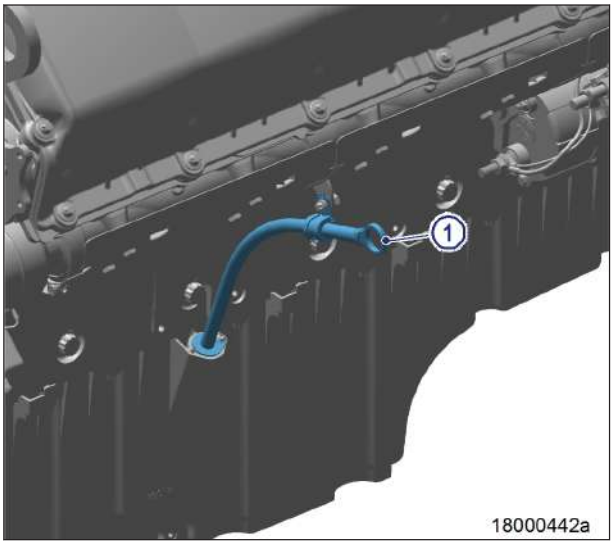
Preconditions

☑ Engine is stopped and starting disabled.

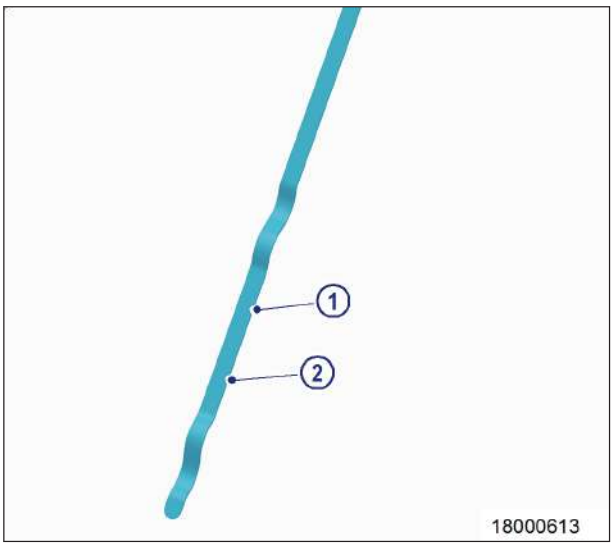
Note: After switching off an engine at operating temperature, wait approx. 5 minutes until the oil has flowed back to the oil pan.

Engine oil level – Check

1. Remove oil dipstick (1) from guide tube and wipe it.
2. Insert oil dipstick (1) into guide tube up to the stop, pull out after approx. 10 seconds and check oil level.



3. Oil level must be between "min." (2) and "max." (1) marks.
4. If necessary, top up oil to the "max." mark (1) (→ Page 113).
5. Insert oil dipstick into guide tube up to the stop.



TIM-ID: 0000030790 - 002

8.7.2 Engine oil - Change

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

Special tools, Material, Spare parts

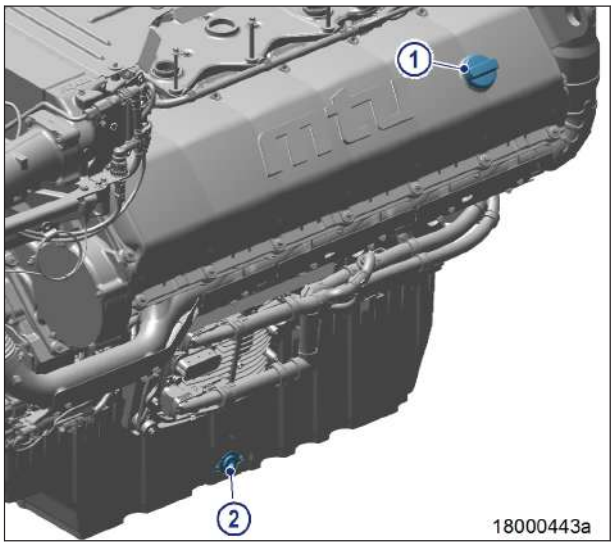
Designation / Use	Part No.	Qty.
Torque wrench, 20–100 Nm	F30026582	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

Draining oil via drain plug on oil pan

1. Provide a suitable container to collect the oil.
2. Remove drain plug (2) and drain oil.



3. Insert drain plug (2) and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Drain plug	M26x1.5	Tightening torque	(Engine oil)	100±10 Nm

4. Replace engine oil filter (→ Page 114).

Filling with new oil

1. Open cap (1) on cylinder head cover.
2. Fill with oil, oil filling capacity (→ Technical Data).
3. Close cap (1) on cylinder head cover.
4. Check engine oil level (→ Page 112).

TIM-ID: 0000028016 - 002

8.8 Oil Filtration / Cooling

8.8.1 Engine oil filter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

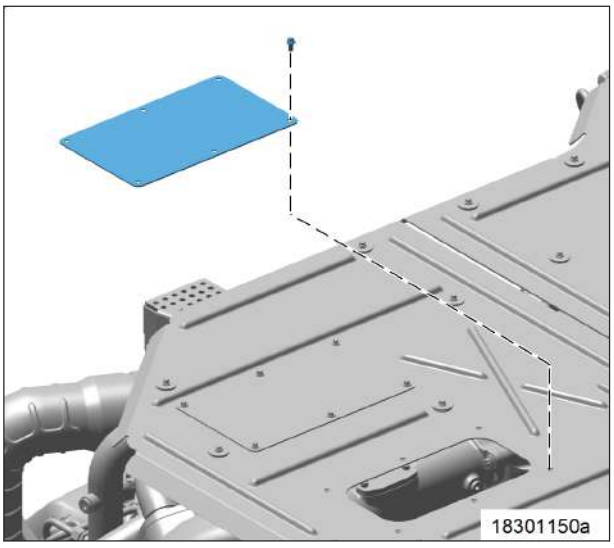
Designation / Use	Part No.	Qty.
Torque wrench, 20–100 Nm	F30026582	1
Ratchet	F30027340	1
Socket, 32 mm	F30006120	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	
Oil filter element	(→ Spare Parts Catalog)	

WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

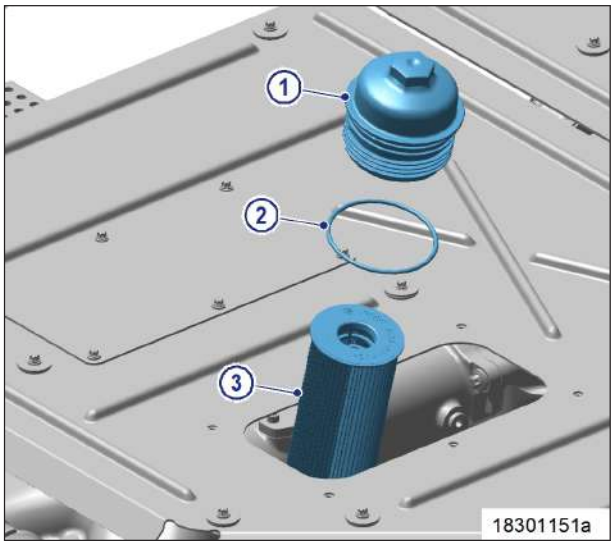
Engine oil filter – Replacement

1. Remove screws.
2. Remove cover.



TIM-ID: 0000028018 - 002

3. Unscrew the screw caps (1) of the filters approx. 3 to 4 revolutions.
4. Wait 10 minutes until the oil has drained from the filter housings.
5. Remove screw cap (1) with oil filter element (3) and remove oil filter element (3) by pressing on the bottom edge from the side.
6. Check condition of sealing ring (2) on screw cap.
7. Replace sealing ring (2) if damaged.
8. Coat sealing ring (2) with oil.
9. Insert new oil filter element (3) in screw cap (1) and press in until it locks in place.



10. Screw on screw cap (1) with oil filter element (3) and tighten to the specified torque with a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw cap		Tightening torque	(Engine oil)	35±3.5 Nm

11. Replace other engine oil filters in the same way.
12. Fit cover and tighten screws.
13. Check oil level (→ Page 112).

8.9 Coolant Circuit, General, High-Temperature Circuit

8.9.1 Engine coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

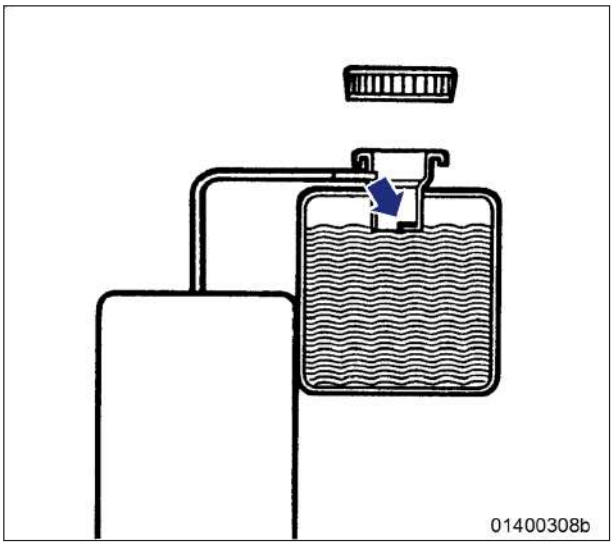
☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking engine coolant level at filler neck

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at the lower edge of the cast-in eye or at the marking plate).
4. Top up with treated coolant as necessary (→ Page 120).
5. Check breather valve (visual inspection) and clean if necessary.
6. Position breather valve on filler neck and close.



Checking engine coolant level by means of level sensor

1. Switch on engine control system and check readings on the display.
2. Top up with treated coolant as necessary (→ Page 120).

TIM-ID: 0000000911 - 005

8.9.2 Engine coolant - Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant change

1. Drain engine coolant (→ Page 118).
2. Fill with engine coolant (→ Page 120).

TIM-ID: 0000000036 - 031

8.9.3 Engine coolant - Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

WARNING

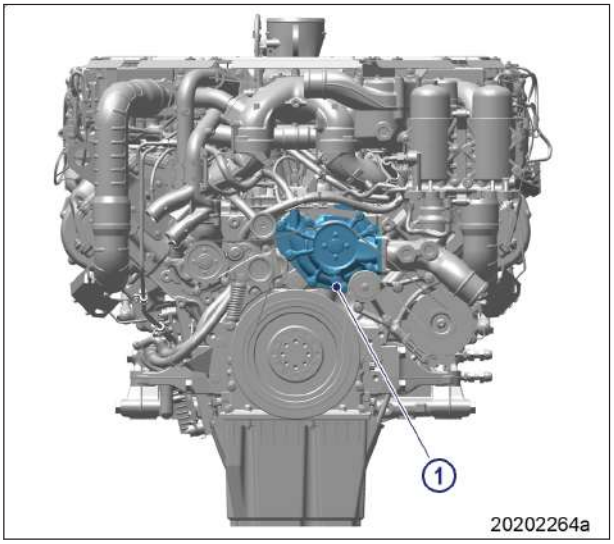
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheater, if installed.

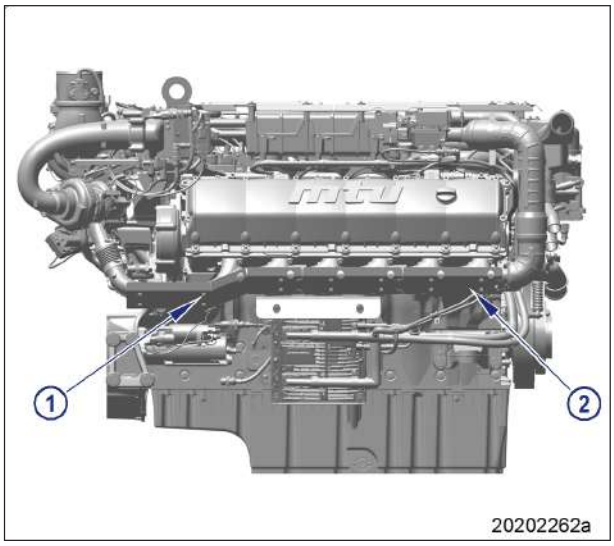
Engine coolant – Draining

1. Turn breather valve of filler neck on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
4. Open drain plug and drain off coolant at engine coolant pump (1).

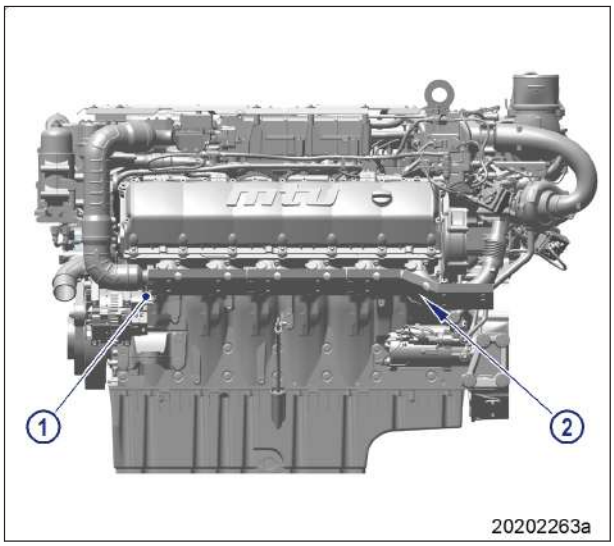


TIM-ID: 0000031871 - 002

5. Open drain plugs and drain coolant at crankcase, right side (1, 2).



6. Open drain plugs and drain coolant at crankcase, left side (1, 2).



Final steps

1. Insert drain plug with new sealing ring on engine coolant pump and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M14x1.5	Tightening torque		35+3 Nm

2. Install drain plugs with new sealing ring in crankcase.
3. Fit breather valve on filler neck and close it.

TIM-ID: 0000031871 - 002

8.9.4 Engine coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

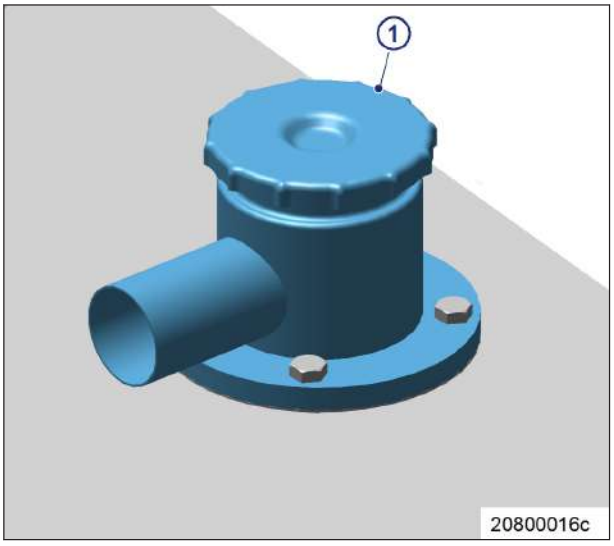
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE

Cold coolant in hot engine can cause thermal stress.
Possible formation of cracks in the engine!
- Fill / top up coolant only into cold engine.

Preparatory steps

1. Turn breather valve (1) of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn valve cover (1) counter-clockwise and remove.



TIM-ID: 0000000909 - 007

Coolant – Filling

1. Fill coolant through filler neck on expansion tank or through filling line until coolant level reaches lower edge of cast-in eye or marking plate.
2. Check proper condition of breather valve (1), clean sealing faces if required.
3. Fit breather valve (1) and close it.

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 116), top up with coolant if required.

8.9.5 Engine coolant pump – Relief bore check

DANGER

Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING

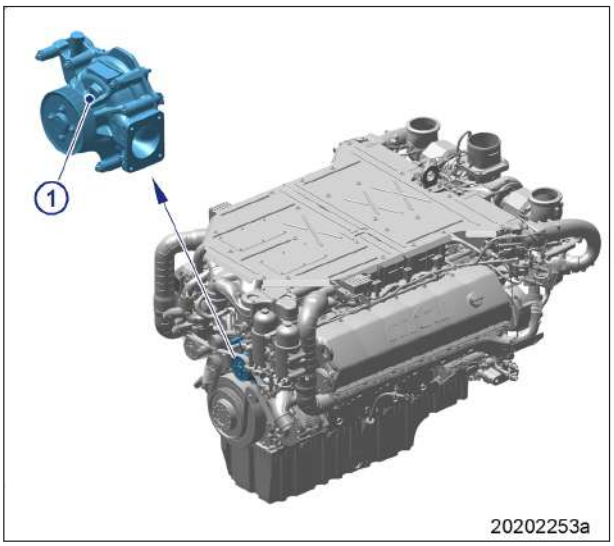
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Engine coolant pump – Relief bore check

1. Check relief bore (1) for coolant discharge.
   - Permissible coolant discharge: Up to 0.1 ml per hour respectively 100 ml per 1,000 operating hours.

Result: If discharge exceeds the specified limits, contact Service.

2. If relief bore (1) is clogged:
   - Stop engine (→ Page 55) and disable engine start.
   - Clean relief bore (1) with wire.



8.10 Low-Temperature Circuit

8.10.1 Charge-air coolant level – Check

Preconditions

☑ Engine is stopped and starting disabled.

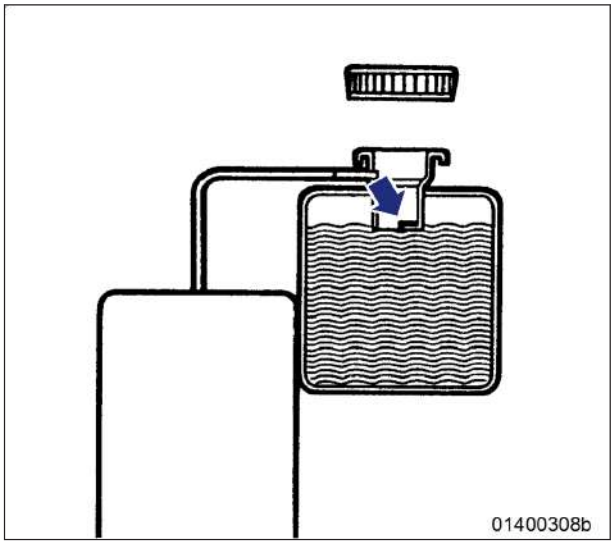
☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

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 charge-air coolant level at filler neck

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at marker plate).
4. Top up coolant if necessary (→ Page 126).
5. Check satisfactory condition of breather valve, clean sealing faces if required.
6. Fit breather valve and close it.



Checking charge-air coolant level by means of level sensor

1. Switch on engine control system and check display (coolant level is automatically monitored by engine control system).
2. Top up coolant if necessary (→ Page 126).

TIM-ID: 0000031873 - 003

8.10.2 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 125).
2. Fill with charge-air coolant (→ Page 126).

8.10.3 Charge-air coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

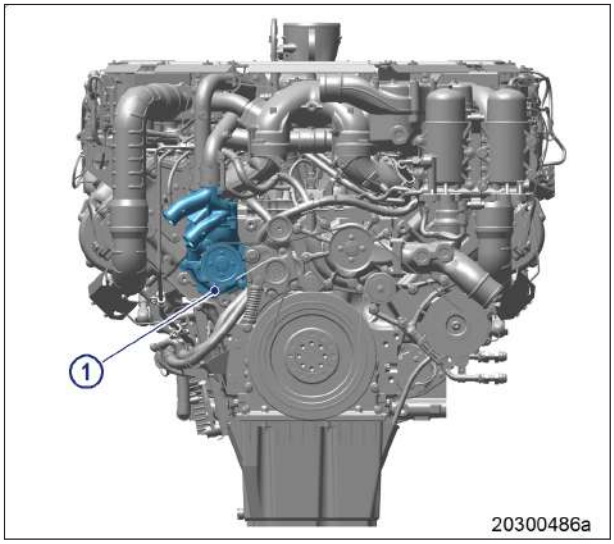
Designation / Use	Part No.	Qty.
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Charge-air coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
3. Continue to turn breather valve counterclockwise and remove.
4. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
5. Open drain plug (1) and drain off coolant at the charge-air coolant pump.



6. Insert drain plug (1) with new sealing ring on charge-air coolant pump and use torque wrench to tighten to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M14x1.5	Tightening torque		35+3 Nm

7. Fit breather valve on filler neck and close it.

8.10.4 Charge-air coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001063/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

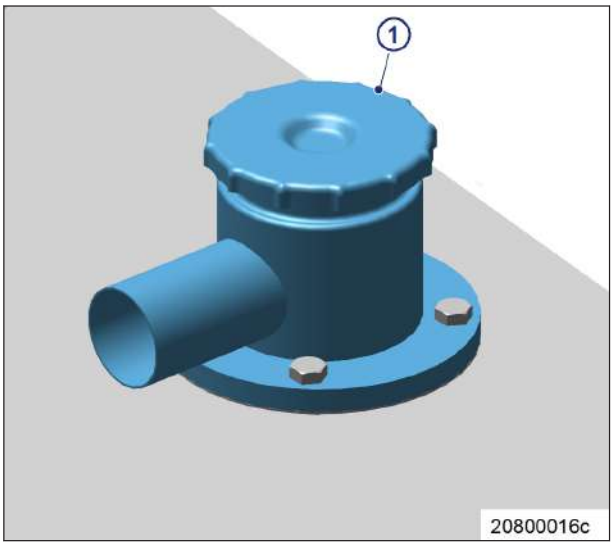
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE

Cold coolant in hot engine can cause thermal stress.
Possible formation of cracks in the engine!
- Fill / top up coolant only into cold engine.

Preparatory steps

1. Turn breather valve (1) on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve (1) counterclockwise and remove.
3. Remove plug screw from filling point on coolant line to intercooler.



TIM-ID: 0000031875 - 006

Coolant – Filling

1. Fill treated coolant through filling line or through filler neck of coolant expansion tank until coolant level reaches marker plate.
2. Install plug screws of filling points with new sealing rings.
3. Check proper condition of breather valve (1), clean sealing faces if required.
4. Fit breather valve (1) and close it.

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 123).

8.10.5 Charge-air coolant pump - Relief bore check

DANGER

Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING

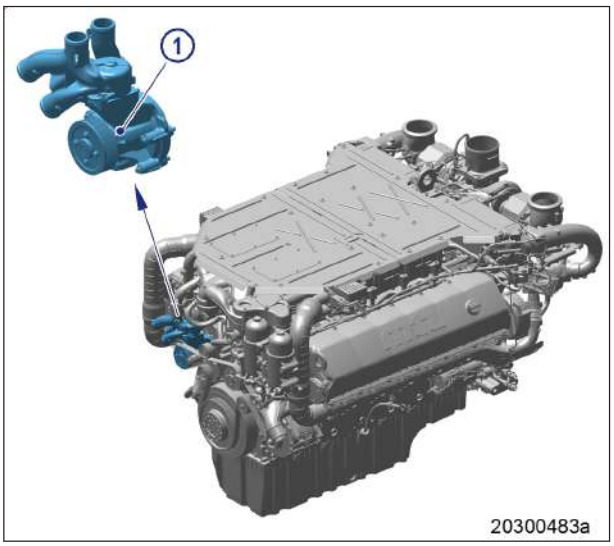
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

Charge-air coolant pump – Relief bore check

1. Check relief bore (1) for coolant discharge.
   - Permissible coolant discharge: Up to 0.1 ml per hour respectively 100 ml per 1,000 operating hours.

Result: If discharge exceeds the specified limits, contact Service.

2. If relief bore (1) is clogged:
   - Stop engine (→ Page 55) and disable engine start.
   - Clean relief bore (1) with wire.



TIM-ID: 0000031876 - 002

8.11 Belt Drive

8.11.1 Drive belt - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Assembly jig	F6794712	1
Drive belt	(→ Spare Parts Catalog)	
Elastic belt	(→ Spare Parts Catalog)	

WARNING

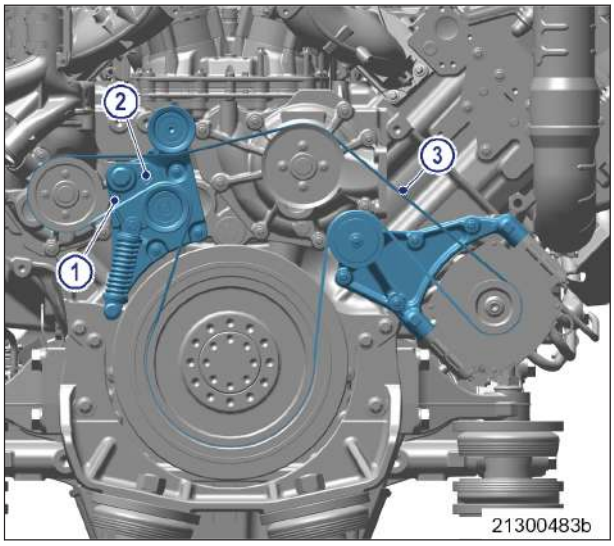
Belt tensioner spring is pretensioned.
Risk of hands being crushed!
- Lock belt tensioner in position.
- Only use specified tools and devices.

Belt drive (version A) – Drive belt replacement

1. Fit square wrench with extension into square hole (2) on belt tensioner.
2. Turn belt tensioner clockwise against the spring force almost up to the stop.
3. Insert 8 mm steel pin (e.g. punch) (1) to lock belt tensioner.
4. Remove drive belt (3).

Note: When placing the drive belt in the grooves, no force must be applied.

5. Fit new drive belt (3).
6. Turn belt tensioner clockwise against the spring force almost up to the stop to remove the 8 mm steel pin.
7. Remove 8 mm steel pin.
8. Release belt tensioner and remove square wrench with extension.
9. Make sure that drive belt (3) is correctly seated in the grooves.



TIM-ID: 0000028028 - 004

Belt drive (version B) – Drive belt replacement

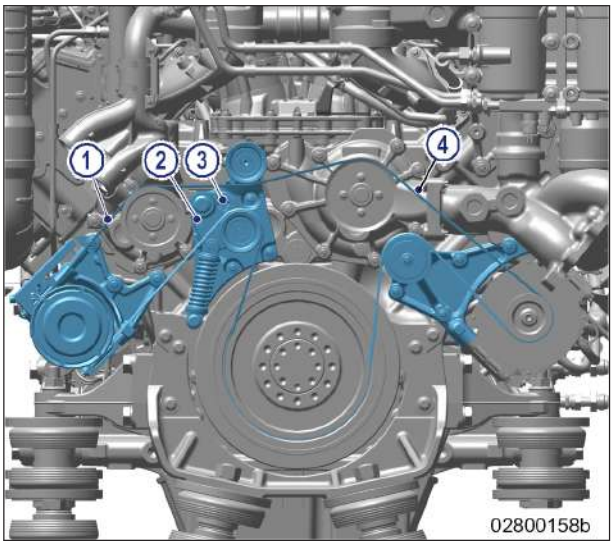
1. Cut elastic belt (1) with a suitable tool.
2. Fit square wrench with extension into square hole (3) on belt tensioner.
3. Turn belt tensioner clockwise against the spring force almost up to the stop.
4. Insert 8 mm steel pin (e.g. punch) (2) to lock belt tensioner.
5. Remove drive belt (4).

Note: When placing the drive belt in the grooves, no force must be applied.

6. Fit new drive belt (4).
7. Turn belt tensioner clockwise against the spring force almost up to the stop to remove the 8 mm steel pin.
8. Remove 8 mm steel pin.
9. Release belt tensioner and remove square wrench with extension.
10. Make sure that drive belt (4) is correctly seated in the grooves.

Note: The belt is overstretched in the course of installation and reaches normal operating tension after approx. 1 hour.

11. Install new elastic belt (1) with assembly jig.



8.12 Battery-Charging Generator

8.12.1 Battery-charging generator – Drive belt removal and installation

Preconditions

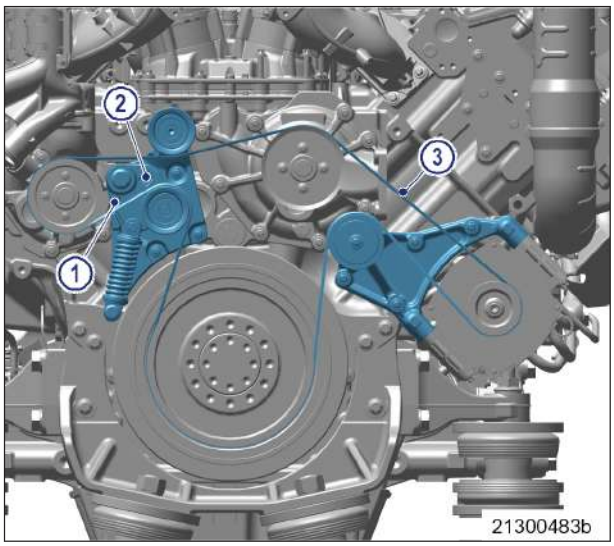
☑ Engine is stopped and starting disabled.

WARNING

Belt tensioner spring is pretensioned.
Risk of hands being crushed!
- Lock belt tensioner in position.
- Only use specified tools and devices.

Removing battery-charging generator drive belt

1. Fit square wrench with extension into square hole (2) on belt tensioner.
2. Turn belt tensioner clockwise against the spring force almost up to the stop.
3. Insert 8 mm steel pin (e.g. punch) (1) to lock belt tensioner.
4. Remove drive belt (3).
5. Turn belt tensioner clockwise against the spring force almost up to the stop to remove the 8 mm steel pin.
6. Remove 8 mm steel pin.
7. Release belt tensioner and remove square wrench with extension.

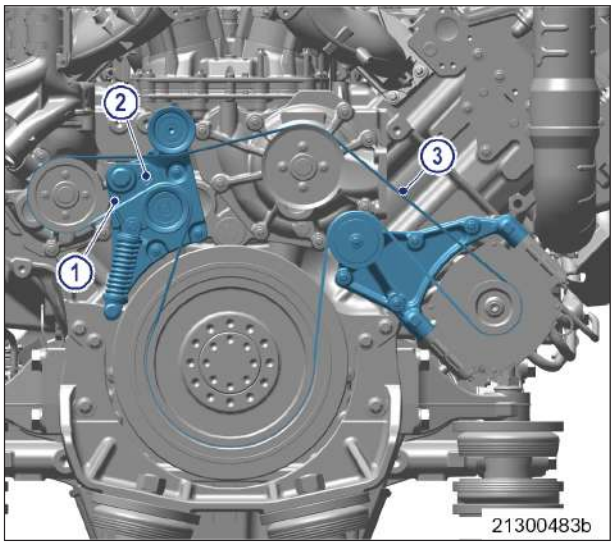


Installing battery-charging generator drive belt

1. Fit square wrench with extension into square hole (2) on belt tensioner.
2. Turn belt tensioner clockwise against the spring force almost up to the stop.
3. Insert 8 mm steel pin (e.g. punch) (1) to lock belt tensioner.

Note: When placing the drive belt in the grooves, no force must be applied.

4. Fit new drive belt (3).
5. Turn belt tensioner clockwise against the spring force almost up to the stop to remove the 8 mm steel pin.
6. Remove 8 mm steel pin.
7. Release belt tensioner and remove square wrench with extension.
8. Make sure that drive belt (3) is correctly seated in the grooves.



8.12.2 Battery-charging generator – Belt tensioner and diverter pulley replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20–100 Nm	F30026582	1
Ratchet adapter	F30027340	1
Engine oil		
Belt tensioner	(→ Spare Parts Catalog)	
Diverter pulley	(→ Spare Parts Catalog)	

WARNING

Belt tensioner spring is pretensioned.
Risk of hands being crushed!
- Lock belt tensioner in position.
- Only use specified tools and devices.

Preparatory step

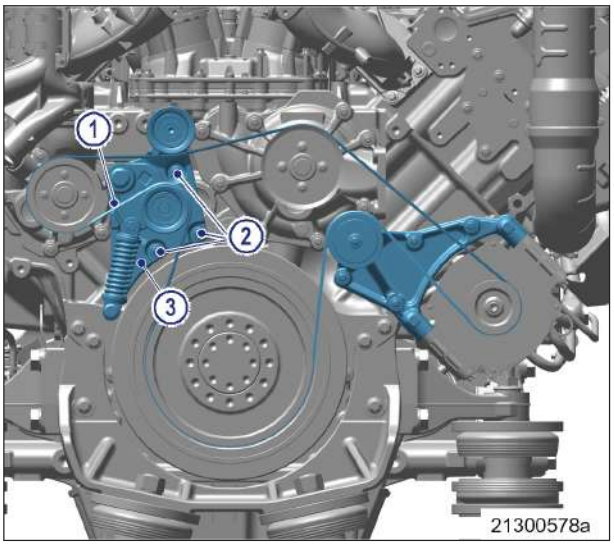
▶ Remove battery-charging generator drive belt (→ Page 131).

Replacing belt tensioner

1. Install bolts (2).
2. Remove belt tensioner (3).

Note: Leave pin (1) in new belt tensioner.

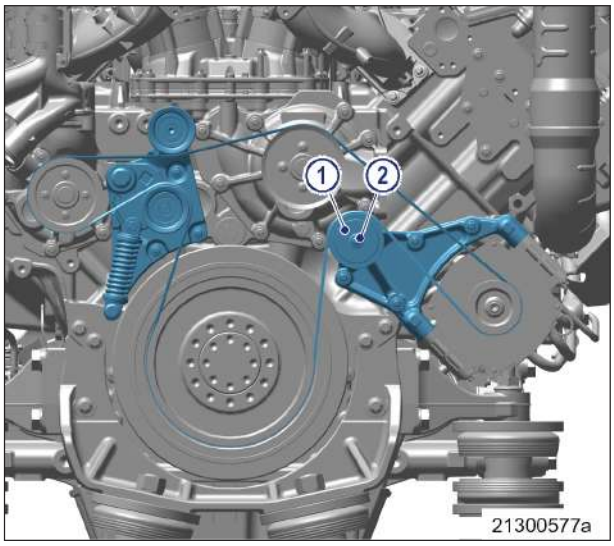
3. Install new belt tensioner (3).
4. Coat screws (2) with engine oil.
5. Tighten screws (2).



TIM-ID: 0000045462 - 005

Replacing diverter pulley

1. Remove screw (2).
2. Remove diverter pulley (1).
3. Coat thread of screw (2) with engine oil.
4. Install new diverter pulley (1) with screw (2).



5. Tighten screw (2) to specified torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	60 Nm ±10 Nm

Final steps

Note: Remove pin before relieving belt tensioner.

▶ Install battery-charging generator drive belt (→ Page 131).

8.13 Drive Systems, Driving End and Free End (Coupling)

8.13.1 Coupling - Checking radial/axial play

See manufacturer's documentation.

8.14 Wiring (General) for Engine/Gearbox/Unit

8.14.1 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.

8.15 Accessories for (Electronic) Engine Governor / Control System

8.15.1 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

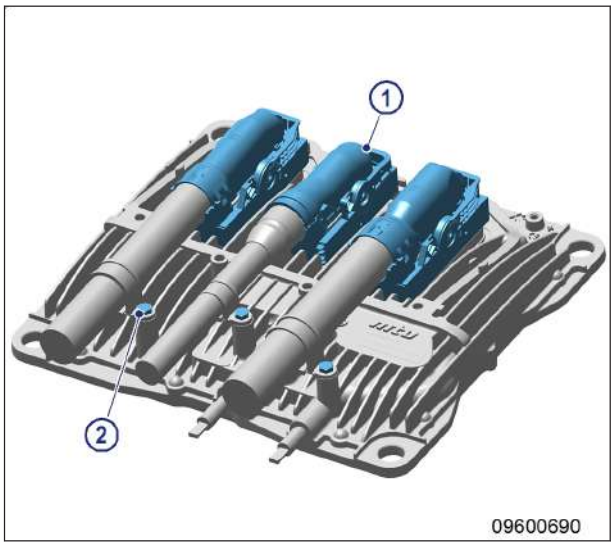
8.15.2 Engine governor – Checking plug-in connections

Preconditions

☑ Engine is stopped and starting disabled.

Checking plug-in connections on engine governor

1. Check firm seating of all connectors on the engine governor. Ensure that the clips (1) are engaged.
2. Check firm seating of all screws (2) on engine governor cable clamps. Make sure that cable clamps are not defective.



8.15.3 NOx sensor - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 8–40 Nm	F30043446	1
Torque wrench, 20–100 Nm	F30026582	1
Ratchet adapter	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

High voltage.
Risk of damage to components!
- Switch off ignition before replacing components.

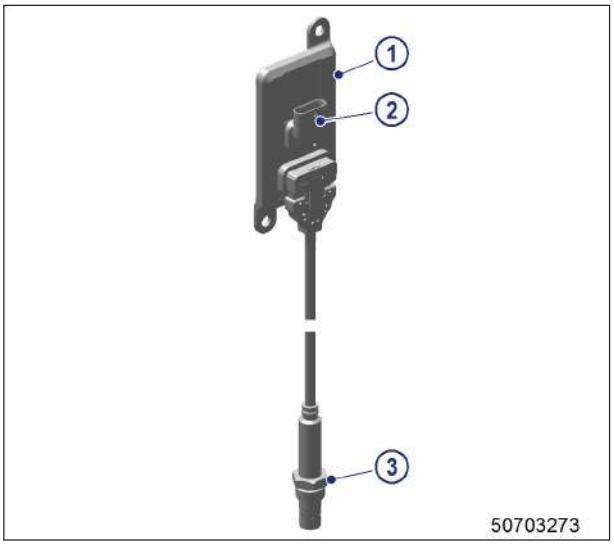
NOTICE

Ceramic cell breakage due to shock or impact.
Risk of damage to components!
- Avoid shocks and impacts.
- Exercise extreme care when handling sensors.

Removing NOx sensor

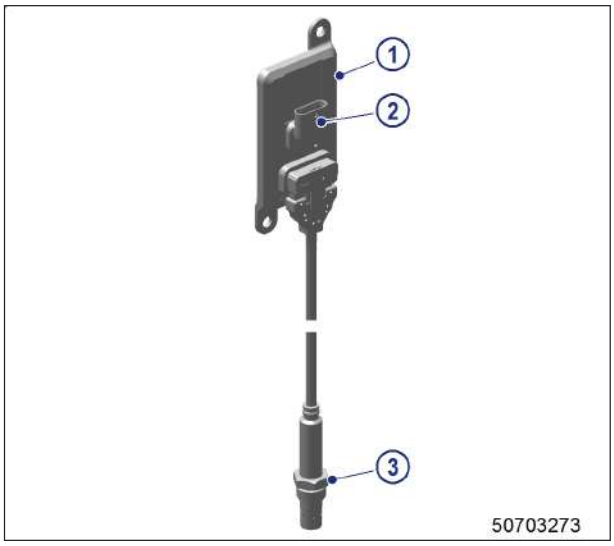
Note: Observe arrangement and position of sensor (→ Page 20).

1. Disconnect and remove male connector (2) from control unit (1).
2. Unscrew control unit (1) at the eyelets.
3. Remove sensor (3).



TIM-ID: 0000025205 - 015

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. Install control unit (1) at the eyelets and tighten screws to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M6	Tightening torque		max. 12 Nm

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 (3) thread with specified assembly compound as required.
4. Screw in sensor (3) by hand.
5. Tighten nut (3) with torque wrench to specified tightening torque.

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 - 015

8.15.4 Lambda sensor – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

☑ Power supply to engine electronics is switched off.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20–100 Nm	F30026582	1
Ratchet adapter	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

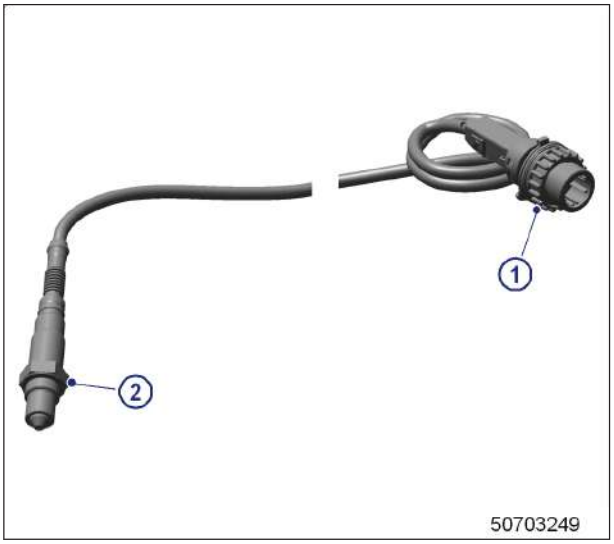
Ceramic cell breakage due to shock or impact.
Risk of damage to components!
- Avoid shocks and impacts.
- Exercise extreme care when handling sensors.

NOTICE

High voltage.
Risk of damage to components!
- Switch off ignition before replacing components.

Removing Lambda sensor

1. Observe the following general information:
   - Layout and position of sensor (→ Page 20).
2. Unplug and remove male connector (1).
3. Remove sensor (2).



TIM-ID: 0000025194 - 015

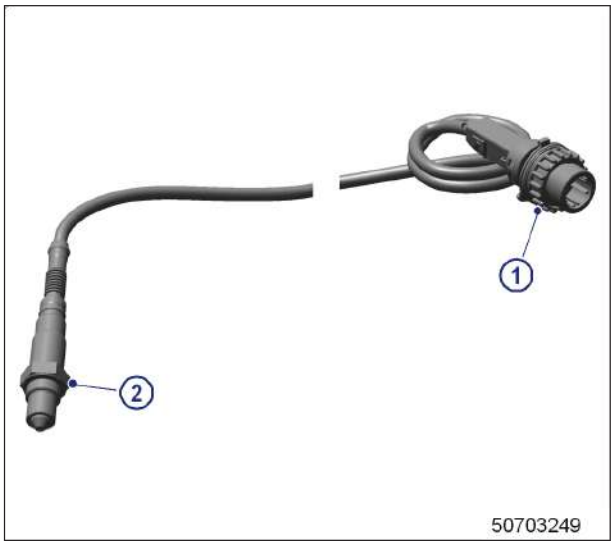
Installing Lambda sensor

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 with specified assembly compound as required.
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 - 015

9 Appendix A

9.1 Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital-Wandler	Analog/Digital converter
ADEC	Advanced Diesel Engine Controller	Engine management system
AFRS	Air Filter Restriction Sensor	
ANSI	American National Standards Institute	Association of American standardization organizations
ATL	Abgasturbolader	Exhaust turbocharger
ATS	Air Temperature Sensor	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	MTU Fluids and Lubricants Specifications, publication No. A001063/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Setting for calibration drift compensation
CEL	Check Engine Light	Signal lamp requesting elimination of a fault as soon as possible.
CKT	Circuit	
CLS	Coolant Level Sensor	
CPS	Coolant Pressure Sensor	
CTS	Coolant Temperature Sensor	
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	Diagnostic lines
DDR	Diagnostic Data Reader	Diagnostic unit
DIN	Deutsches Institut für Normung e. V.	German national standards institute. At the same time identifier of German standards (DIN = “Deutsche Industrie-Norm”)
DL	Default Lost	Alarm: Default CAN bus failure
DOC	Diesel Oxidation Catalyst	Oxidation catalyst (diesel engine)
DPF	Dieselpartikelfilter	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
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	
EGR	Exhaust Gas Recirculation	
EMU	Engine Monitoring Unit	
ETK	Ersatzteilkatalog	Spare parts catalog
EUI	Electronic Unit Injector	
FPS	Fuel Pressure Sensor	

TIM-ID: 0000035533 - 006

Abbreviation	Meaning	Explanation
FRS	Fuel Restriction Sensor	Fuel differential pressure sensor
FTS	Fuel Temperature Sensor	
FWCP	Fire Water Control Panel	Control cabinet for fire extinguishing water
GND	Ground	
HD	Hochdruck	High pressure
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit value
HT	Hochtemperatur	High temperature
IDM	Interface Data Module	Memory module for interface data
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
LED	Light Emitting Diode	
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LSG	Limiting Speed Governor	Maximum-speed governor
N/A	Not applicable, not available	
ND	Niederdruck	Low pressure
NT	Niedertemperatur	Low temperature
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	
OPS	Oil Pressure Sensor	
OTS	Oil Temperature Sensor	
OT	Oberer Totpunkt	Top Dead Center (TDC)
PAN	Panel	Control panel
PIM	Peripheral Interface Module	
PWM	Pulsweitenmodulation	Pulse Width Modulation
P-xyz	Pressure-xyz	Pressure measuring point xyz
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop Engine Light	Signal lamp requesting engine stop and elimination of fault as soon as possible.
SID	System Identifier	
SRS	Synchronous Reference Sensor	
SS	Safety System	Safety system alarm

Abbreviation	Meaning	Explanation
TBS	Turbo Boost Sensor	Turbocharger Boost Sensor
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
UT	Unterer Totpunkt	Bottom Dead Center (BDC)
VNT	Variable Nozzle Turbocharger	
VSG	Variable Speed Governor	
VSS	Vehicle Speed Sensor	
WZK	Werkzeugkatalog	Tool catalog

9.2 MTU contact persons/service partners

Our worldwide sales network with its subsidiaries, sales offices, representatives and customer service centers ensures fast and direct support on site and the high availability of our products.

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Experienced and qualified specialists place their knowledge and expertise at your disposal.

For locally available support, go to the MTU Internet site: http://www.mtu-online.com

24h hotline

With our 24h hotline and the outstanding flexibility of our service staff, we are always ready to assist you – either during operation, for preventive maintenance, corrective work in case of malfunction or changed operating conditions, or for spare parts supply.

Your contact person in our Customer Assistance Center:

E-mail: info@mtu-online.com

Tel.: +49 7541 9077777

Fax: +49 7541 9077778

Asia/Pacific: +65 6100 2688

North and Latin America: +1 248 560 8000

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Your contact at Headquarters:

E-mail: spare.parts@mtu-online.com

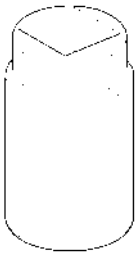
Tel.: +49 7541 908555

Fax: +49 7541 908121

10 Appendix B

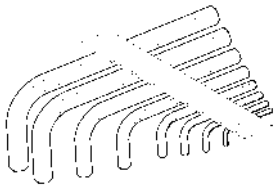
10.1 Special Tools

Adapter



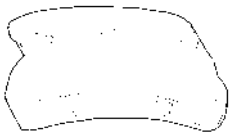
Part No.:	F30011619
Qty.:	1
Used in:	8.1.1 Engine – Barring manually (→ Page 96)

Allen keys, 2-10 mm



Part No.:	F30453050
Qty.:	1
Used in:	8.2.1 Valve clearance – Check and adjustment (→ Page 98)

Assembly jig

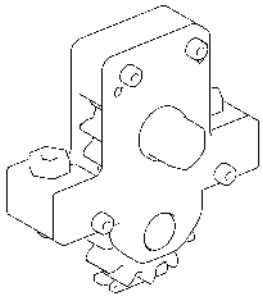


Part No.:	F6794712
Qty.:	1
Used in:	8.11.1 Drive belt – Replacement (→ Page 129)

Barring tool

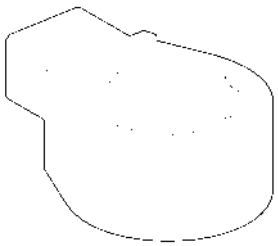
Part No.:	F6797674
Qty.:	1
Used in:	8.1.1 Engine – Barring manually (→ Page 96)

Barring tool



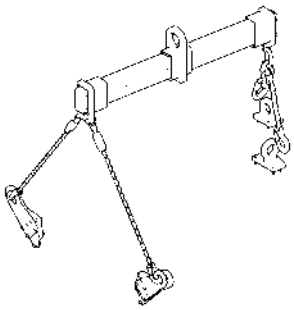
Part No.:	F6790714
Qty.:	1
Used in:	8.2.1 Valve clearance – Check and adjustment (→ Page 98)

Box wrench, 14 mm



Part No.:	F30028346
Qty.:	1
Used in:	8.2.1 Valve clearance – Check and adjustment (→ Page 98)

Crossbeam



Part No.:	T80092479
Qty.:	1
Used in:	2.1 Transportation (→ Page 15)

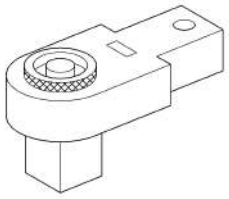
Feeler gage

Part No.:	Y20010128
Qty.:	1
Used in:	8.2.1 Valve clearance – Check and adjustment (→ Page 98)

High-pressure cleaning unit

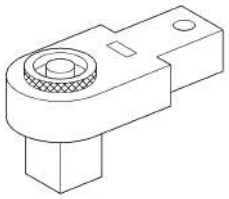
Part No.:	-
Qty.:	1
Used in:	5.7 Plant – Cleaning (→ Page 57)

Ratchet



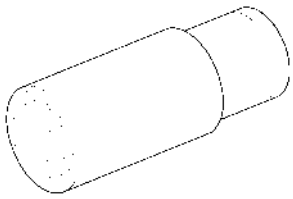
Part No.:	F30027340
Qty.:	1
Used in:	8.8.1 Engine oil filter – Replacement (→ Page 114)

Ratchet adapter



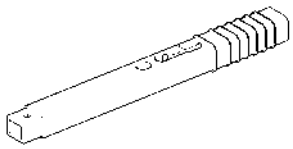
Part No.:	F30027340
Qty.:	1
Used in:	8.1.1 Engine – Barring manually (→ Page 96)
Qty.:	1
Used in:	8.3.1 Fuel system – Venting (→ Page 103)
Qty.:	1
Used in:	8.4.1 Fuel filter – Replacement (→ Page 106)
Qty.:	1
Used in:	8.4.3 Fuel prefilter – Filter element replacement (→ Page 109)
Qty.:	1
Used in:	8.12.2 Battery-charging generator – Belt tensioner and diverter pulley replacement (→ Page 132)
Qty.:	1
Used in:	8.15.3 NOx sensor – Replacement (→ Page 138)
Qty.:	1
Used in:	8.15.4 Lambda sensor – Replacement (→ Page 140)

Socket, 32 mm



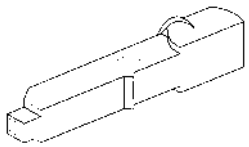
Part No.:	F30006120
Qty.:	1
Used in:	8.4.1 Fuel filter – Replacement (→ Page 106)
Qty.:	1
Used in:	8.8.1 Engine oil filter – Replacement (→ Page 114)

Torque wrench, 20–100 Nm



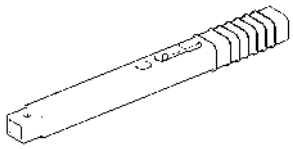
Part No.:	F30026582
Qty.: Used in:	1 8.2.1 Valve clearance – Check and adjustment (→ Page 98)
Qty.: Used in:	1 8.7.2 Engine oil – Change (→ Page 113)
Qty.: Used in:	1 8.12.2 Battery-charging generator – Belt tensioner and diverter pulley replacement (→ Page 132)
Qty.: Used in:	1 8.15.3 NOx sensor – Replacement (→ Page 138)
Qty.: Used in:	1 8.15.4 Lambda sensor – Replacement (→ Page 140)

Torque wrench, 4–20 Nm



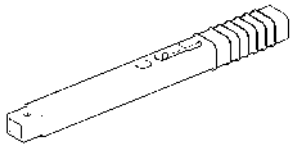
Part No.:	F30044239
Qty.: Used in:	1 8.3.1 Fuel system – Venting (→ Page 103)

Torque wrench, 8–40 Nm



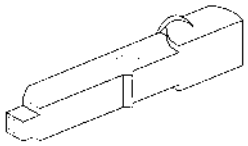
Part No.:	F30043446
Qty.: Used in:	1 8.2.2 Cylinder head cover – Removal and installation (→ Page 101)
Qty.: Used in:	1 8.4.3 Fuel prefilter – Filter element replacement (→ Page 109)
Qty.: Used in:	1 8.15.3 NOx sensor – Replacement (→ Page 138)

Torque wrench, 20–100 Nm



Part No.:	F30026582
Qty.: Used in:	1 8.4.1 Fuel filter – Replacement (→ Page 106)
Qty.: Used in:	1 8.8.1 Engine oil filter – Replacement (→ Page 114)

Torque wrench, 4–20 Nm



Part No.:	F30044239
Qty.:	1
Used in:	8.4.1 Fuel filter – Replacement (→ Page 106)

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