

MTU_ValueService **Technical Documentation**

Diesel Engine

12 V 2000 G25, G45, G65, G85

16 V 2000 G25, G45, G65, G85

18 V 2000 G65, G85

12 V 2000 G25-TB, G45-TB, G65-TB, G85-TB

16 V 2000 G25-TB, G45-TB, G65-TB, G85-TB

18 V 2000 G65-TB, G85-TB

Applications group 3B

Operating Instructions

MS15019/00E



Printed in Germany

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Subject to alterations and amendments.

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Die Informationen der Inbetriebnahmemeldung sind Grundlage für den vertraglich vereinbarten Logistik-Support (Gewährleistung, Ersatzteile etc.).

Please complete and return the “Commissioning Note” card below to MTU Friedrichshafen GmbH.

The Commissioning Note information serves as a basis for the contractually agreed logistic support (warranty, spare parts, etc.).

Veillez séparer la carte “Signalisation de mise en service“ et la renvoyer à la MTU Friedrichshafen GmbH.

Les informations contenues dans la signalisation de mise en service constituent la base pour l'assistance en exploitation contractuelle (garantie, rechanges, etc.).

Rogamos separen la tarjeta “Aviso de puesta en servicio“ y la devuelvan rellena a MTU Friedrichshafen GmbH.


Las informaciones respecto al aviso de puesta en servicio constituyen la base para el soporte logístico contractual (garantía, piezas de repuesto, etc.).

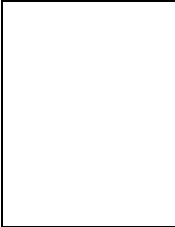
Ritagliare “Avviso di messa in servizio“ e rispedirlo debitamente compilato alla MTU Friedrichshafen GmbH.

Le informazioni ivi registrate sono la base per il supporto logistico contrattuale (garanzia, ricambi, ecc.).

É gentileza cortar o cartão "Participação da colocação em serviço", preenchê-lo e devolvê-lo a MTU Friedrichshafen.

Os dados referentes à colocação em serviço representam a base para o suporte logístico (garantia, peças sobressalentes, etc.) estabelecido contratualmente.





Postcard

MTU Friedrichshafen GmbH
Department MST
88040 Friedrichshafen
GERMANY

Bitte in Blockschrift ausfüllen!
Please use block capitals!
Prière de remplir en lettres capitales!
¡A rellenar en letras de imprenta!
Scrivere in stampatello!
Favor preencher com letras de forma!



Motornr.: Engine No.: N° du moteur: N° de motor: Motore N.: No. do motor:
--

Auftragsnr.: MTU works order No.: N° de commande: N° de pedido: N. commessa: No. do pedido:
--

**Inbetriebnahme-
meldung**

**Commissioning
Note**

Motortyp: Engine model: Type du moteur: Tipo de motor: Motore tipo: Tipo do motor:

Inbetriebnahmedatum: Date put into operation: Mise en service le: Fecha de puesta en servicio: Messa in servizio il: Data da colocação em serviço:

**Notice de mise
en service**

**Aviso de puesta
en servicio**

Eingebaut in: Installation site: Lieu de montage: Lugar de montaje: Installato: Incorporado em:
--

Schiffstyp / Schiffshersteller: Vessel/type/class / Shipyard: Type du bateau / Constructeur: Tipo de buque / Constructor: Tipo di barca / Costruttore Tipo de embarcação/estaleiro naval:
--

**Avviso di messa
in servizio**

Endabnehmer/Anschrift: End user's address: Adresse du client final: Dirección del cliente final: Indirizzo del cliente finale: Usuário final/endereço:

**Participação da
colocação em
serviço**

Bemerkung: Remarks: Remarques: Observaciones: Commento: Observações:

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1 Safety

1.1 General conditions

General

In addition to the instructions in this publication, the applicable country-specific legislation and other compulsory regulations regarding accident prevention must be observed. This engine is a state-of-the art product and conforms with all applicable specifications and regulations. Nevertheless, persons and property may be at risk in the event of:

- Incorrect use
- Operation, maintenance and repair by unqualified personnel
- Modifications or conversions
- Non-compliance with the Safety Instructions

Correct use

The engine is intended exclusively for the application specified in the contract or defined at the time of delivery. Any other use is considered improper use. The manufacturer will accept no liability for any resultant damage. The responsibility is borne by the user alone.

Correct use also includes observation of and compliance with the maintenance specifications.

Modifications or Conversions

Modifications made by the customer to the engine may affect safety.

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

Spare parts

Only genuine MTU spare parts must be used to replace components or assemblies. In the event of any damage caused by the use of other spare parts, no liability nor warranty claims vis-à-vis the engine manufacturer will be accepted.

1.2 Personnel and organizational requirements

Personnel

Work on the engine must only be carried out by properly qualified and instructed personnel.

The specified legal minimum age must be observed.

Responsibilities of the operating, maintenance and repair personnel must be specified.

Organization

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

It must be kept at hand near the engine and accessible at any time to all personnel involved in operation, maintenance, repair or transportation.

The personnel must be instructed on engine operation and repair by means of this publication, and in particular the safety instructions must be explained.

This is especially important for personnel who work on the engine only on an occasional basis. Such personnel must be given instructions repeatedly.

Working clothes and protective equipment

Wear proper work clothing for all work.

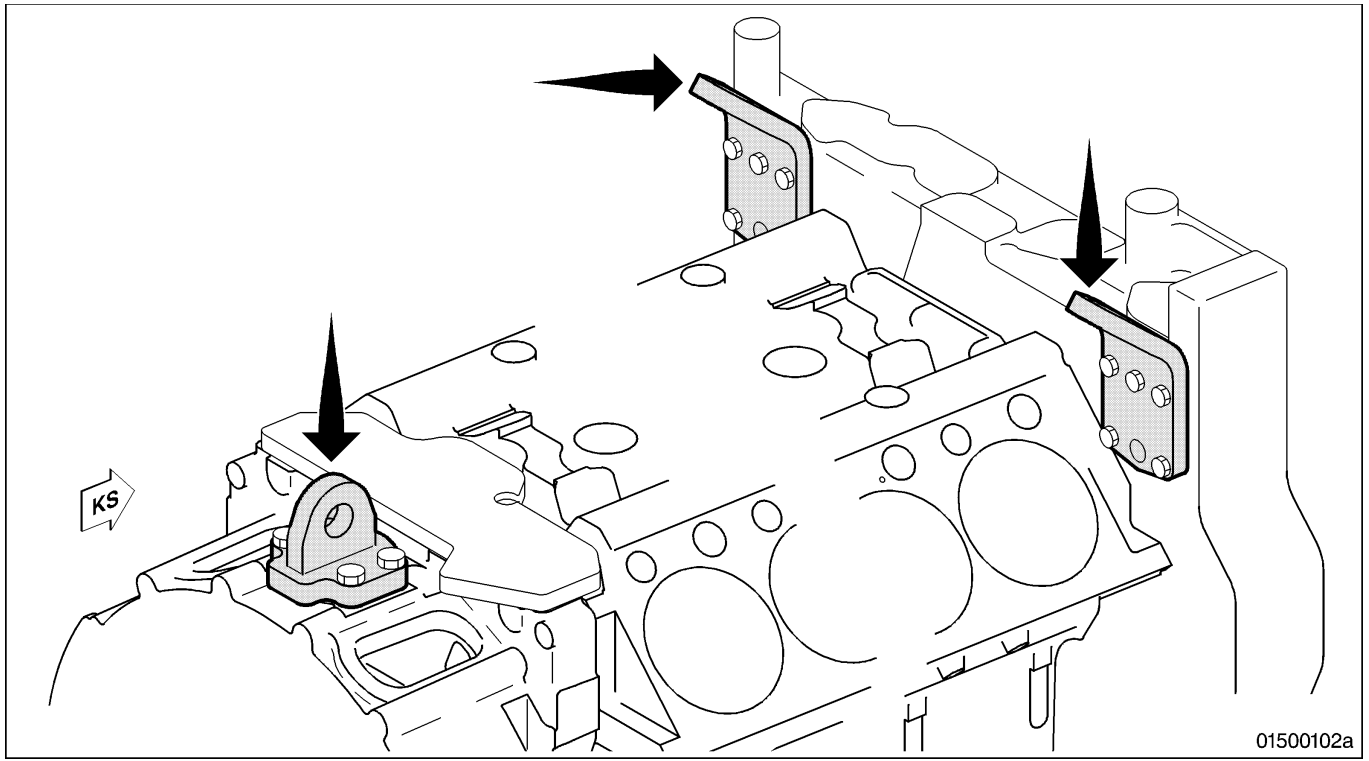
Depending on the kind of work, use additional protective equipment, e.g. protective goggles, gloves, helmet, apron.

Work clothing must be tight fitting so that it does not catch on rotating or projecting components.

Do not wear jewelry (e.g. rings, chains etc.).

1.3 Transport

Transport



Lift the engine only with the lifting eyes provided.

Use only the transport and lifting equipment approved by MTU.

Take note of the engine center of gravity.

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

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

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

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

Setting the engine down after transport

Place the engine only on an even, firm surface.

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

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

1.4 Safety requirements when working on the engine

Safety precautions when putting the equipment into operation

Prior to initial operation, the product must have been installed correctly and approved according to MTU specifications.

Before putting the device or the system into operation, always ensure

- that all maintenance and repair work is completed
- that all loose components have been removed from rotating parts
- that nobody is standing in the danger zone of moving engine components.

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

Safety requirements for operators

Procedures for cases of emergency must be practised regularly.

The operator must be familiar with the controls and displays.

The operator must know the consequences of each operation to be carried out.

The operator must carry out the individual operations according to the documentation.

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

The following steps must be taken if a malfunction of the system is recognized or reported by the system:

- notify the supervisory personnel in charge
- analyze the message
- if required, carry out emergency operations e.g. emergency engine stop.

Engine operation

When the engine is running, always wear ear protectors.

Ensure that the engine room is well ventilated.

Mop up any leaked or spilt fluids and lubricants immediately or soak up with a suitable bonding agent.

Exhaust gases from combustion engines are poisonous. Inhalation of poisonous exhaust gases is a health hazard. The exhaust pipework must be free of leaks and discharge the gases to atmosphere.

During engine operation, do not touch battery terminals, generator terminals or cables.

Inadequate protection of electrical components can lead to electric shocks and serious injuries.

When the engine is running, never release coolant, oil, fuel, compressed-air or hydraulic lines.

Maintenance and repair

Strict adherence to the maintenance and repair schedule is an essential safety factor.

Never carry out maintenance and repair work with the engine running unless expressly instructed to do so.

Lock-out/tag-out the engine to preclude undesired starting. Disconnect the battery when electrical starters are fitted. Close the main valve on the compressed-air system and vent the compressed air line when air starters are fitted. Post the "Do Not Start" sign in the operating room or affix it to the controlling device! Persons not involved must keep clear.

Never attempt to rectify faults or carry out repairs if you do not have the necessary experience or special tools required. Have maintenance and repair work carried out by qualified and authorized personnel only.

Use only proper, calibrated tools.

Do not work on engines or components which are only held by lifting equipment or crane. Always support by suitable means which conform with the applicable regulations before commencing maintenance or repair work.

Before barring the engine, make sure that nobody is standing in the danger zone. After completing work on the engine, check that all protective devices/safety guards have been installed and that all tools and loose parts have been removed from the engine.

Fluids emerging under high pressure can penetrate clothing and skin and may cause serious injury. Before starting work, relieve pressure in systems and H.P. lines which are to be opened.

Never bend a fuel line and do not install bent lines. Keep fuel injection lines and connections clean.

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

Take care not to damage fuel lines during maintenance and repair work. To tighten the connections when installing the lines, use the correct tightening torque and ensure that all retainers and dampers are installed correctly.

Ensure that all fuel injection lines and pressurized oil lines have sufficient distance to other components to avoid contact with them. Do not place fuel or oil lines near hot components, except when necessary for design reasons during installation.

Elastomers (e.g. "Viton" sealing rings) are stable under normal operating conditions. The material decomposes when exposed to fire or temperatures exceeding 300 °C. Hydrogen fluoride vapors are released in this case. The resulting acid leads to serious burning if it contacts the skin. Do not touch elastomeric seals if they have carbonized or resinous appearance. Wear protective gloves!

Take care with hot fluids in lines, pipes and chambers ⇒ Risk of injury!

Note cooling period for components which are heated for installation or removal ⇒ Risk of injury!

Never touch hot parts of the compressor and exhaust system ⇒ Risk of burning!

Take special care when removing ventilation or plugs from engine. In order to avoid discharge of highly pressurized liquids, hold a cloth over the screw or plug. It is even more dangerous if the engine has recently been shut down, as the liquids can still be hot.

Take special care when draining hot fluids. ⇒ Risk of injury!

When draining, collect fluids in a suitable container, mop up any spilt fluids or wipe or soak them with a suitable bonding agent.

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

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

In order to prevent back injuries when lifting heavy components adults, depending on age and sex, should only lift weights between max. 10 kg and 30 kg, therefore:

- Use lifting gear or seek assistance.
- Ensure that all chains, hooks, slings, etc. are tested and authorized, are sufficiently strong and that hooks are correctly positioned. Lifting eyes must not be unevenly loaded.

Observe special cleanliness when conducting maintenance and repair work on the engine plant. After completion of maintenance and repair work, make sure that no loose objects are in/on the engine plant.

Welding work

Never carry out welding work on the engine or engine-mounted units.

Never use the engine as a ground connection. This prevents the welding current passing through the engine resulting in burnt/scorched bearings, sliding surfaces and tooth flanks which may lead to bearing seizure and/or other material damage.

Never route the welding lead over or near the wiring harnesses of MTU systems. The welding current may otherwise induce an interference voltage in the wiring harnesses which could conceivably damage the electrical system.

The welding unit ground connection must not be more than 60 cm from the weld point.

If components (e.g. exhaust manifold) are to be welded, they must be removed from the engine.

It is not necessary to remove the connector and the connections when carrying out welding operation on MTU electronics if the master switch for power supply is switched from "ON" to "OFF" and the wire is disconnected from the negative and positive poles on the battery.

Hydraulic installation and removal

Only the hydraulic installation and removal equipment specified in the work schedule and in the assembly instructions must be used.

The max. permissible push-on pressure specified for the equipment must not be exceeded.

The H.P. lines for hydraulic installation and removal are tested with 3800 bar.

Do not attempt to bend or apply force to lines.

Before starting work, pay attention to the following:

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

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

During hydraulic installation and removal, ensure that nobody is standing in the immediate vicinity of the component to be installed/removed. As long as the system is under pressure, there is the risk that the component to be installed/removed may be suddenly released from the pressure connection.

Before use, the tools must be checked at regular intervals (crack test).

Working on electrical/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. Any measures requiring a power supply are expressly defined as such at the appropriate place in the manual.

Gases released from the battery are explosive. Avoid sparks and naked flames. Do not allow battery acids to come in contact with skin or clothing. Wear protective goggles. Do not place tools on the battery. Before connecting the cable to the battery, check battery polarity. Battery pole reversal may lead to injury through the sudden discharge of acid or bursting of the battery body.

Do not damage wiring during removal work and when reinstalling wiring and ensure that during operation it is not damaged by contact with sharp objects, by rubbing against other component or by a hot surface.

Do not secure wiring to fluid-carrying lines.

On completion of the maintenance and repair work, any cables which have become loose must be correctly connected and secured.

On completion of all repair work, the component and system must be subjected to a function check. Separate testing of the repaired component without system integration is insufficient.

If wires are installed beside mechanical components and there is a risk of chafing, use cable clamps to properly support the wires.

For this purpose, no cable binders must be used as, during maintenance and / or repair work, the binders can be removed but not installed a second time.

Spare parts shall be properly stored prior to replacement, i.e. particularly protected against moisture. Defective electronic components and assemblies must be suitably packed when dispatched for repair, i.e. particularly protected against moisture and impact and wrapped in antistatic foil if necessary.

Working with laser equipment

When working with laser equipment, always wear special laser-protection goggles.

Laser equipment can generate extremely intensive, concentrated radiation by the effect of stimulated emission in the range of visible light or in the infrared or ultraviolet spectral range. The photochemical, thermal and optomechanical effects of the laser can cause damage. The main danger is irreparable damage to the eyes.

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

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

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

Operation of electrical equipment

When operating electrical equipment, certain components of this equipment are live.

Noncompliance with the warning instructions given for this equipment may result in serious injury or damage to property.

1.5 Auxiliary materials, fire prevention and environmental protection

Fire prevention

Rectify any fuel or oil leaks immediately; even splashes of oil or fuel on hot components can cause fires - therefore always keep the engine in a clean condition. Do not leave cloths soaked with fluids and lubricants lying around on the engine. Do not store combustible materials near the engine.

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

When starting the engine with a foreign power source, connect the ground lead last and remove it first.

To avoid sparks in the vicinity of the battery, connect the ground lead from the foreign power source to the ground lead of the engine or to the ground terminal of the starter.

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

Noise

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

At all workplaces with a sound pressure level over 85 dB (A), always wear ear protectors (protective wadding, plugs or capsules).

Environmental protection

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

Manipulation of the injection control system can influence the engine performance and exhaust emissions.

As a result, compliance with environmental regulations may no longer be guaranteed.

Only fuels of the specified quality required to achieve emission limits must be used.

In Germany, the VAWS (= regulations governing the use of materials that may affect water quality) is applicable, which means work must only be carried out by authorized specialist companies (MTU is such a company).

Auxiliary materials

Use only fluids and lubricants that have been tested and approved by MTU.

Fluids and lubricants must be kept in suitable, properly designated containers. When using fluids, lubricants and other chemical substances, follow the safety instructions applicable to the product. Take care when handling hot, chilled or caustic materials. When using inflammable materials, avoid sparks, flames and do not smoke.

Lead

- When working with lead or lead-containing pastes, avoid direct contact to the skin and do not inhale lead vapors.
- Adopt suitable measures to avoid the formation of lead dust!
- Switch on fume extraction system.
- After coming into contact with lead or lead-containing materials, wash hands!

Acids and alkaline solutions

- When working with acids and alkalis, wear protective goggles or face mask, gloves and protective clothing.
- Immediately remove clothing wetted by acids and alkalis!
- Rinse injuries with plenty of water!
- Rinse eyes immediately with eyedrops or clean tap water.

Paints

- When painting anywhere other than in spray booths equipped with extractors, ensure good ventilation. Make sure that adjacent work areas are not affected.
- No naked flames!
- No smoking.
- Observe fire prevention regulations!
- Wear masks providing protection against paint and solvent fumes.

Liquid nitrogen

- Store liquid nitrogen only in small quantities and always in regulation containers without fixed covers.
- Do not bring liquid nitrogen in contact with the body (eyes, hands), as this causes frostbite and loss of tissue.
- Wear protective clothing, including gloves, closed shoes and protective goggles!

- Ensure that the room is well ventilated. Nitrogen concentration exceeding 88% of breathing air leads to suffocation.
- Avoid all knocks and jars to the containers, fixtures or workpieces.

Compressed air

Compressed air is air compressed at excess pressure and is stored in vessels from which it can be extracted.

The pressure at which the air is kept can be read off at pressure gauges which must be connected to the compressed air vessels and the compressed air lines.

When working with compressed air, safety precautions must be constantly observed:

- Pay special attention to the pressure level in the compressed air network and pressure vessel!
- Devices and equipment connected must either be designed for this pressure or, if the permitted pressure for the connected elements is lower than the pressure required, a pressure reducing valve and safety valve (set to permitted pressure) must form an intermediate connection. Hose coupling and connections must be securely attached!
- Always wear protective goggles when blowing off tools or chips!
- The snout of the air nozzle should be provided with a protective disc (e.g. rubber disc), which prevents air-borne particles being deflected and thereby prevents injury to eyes.
- First shut off compressed air lines before compressed air equipment is disconnected from the supply line or before equipment or tools are exchanged!
- Unauthorized use of compressed air, e.g. forcing flammable liquids (hazard class A1, A11 and B) out of containers, carries the risk of explosion!
- Forcing compressed air into thin-walled containers (e.g. containers made of tin, plastic and glass) for drying purposes or to check for leaks, results in a risk of shattering!
- Do not use compressed air to clean contaminated clothing whilst it is being worn.




Used oil

Used oil may contain health-threatening combustion residues.

Rub barrier cream into hands!

Wash hands after contact with used oil.

1.6 Standards for warning notices in the publication

 DANGER	In the event of immediate danger. Consequences: Death or serious injury. <ul style="list-style-type: none">• Preventive measures
 WARNING	In the event of possibly dangerous situations. Consequences: Death or serious injury. <ul style="list-style-type: none">• Preventive measures
 CAUTION	In the event of dangerous situations. Consequences: Slight injury or material damage. <ul style="list-style-type: none">• Preventive measures

Note: This Publication contains especially emphasized safety instructions in accordance with the American standard ANSI Z535, which begin with one of the above signal words according to the degree of danger:

Warning notices

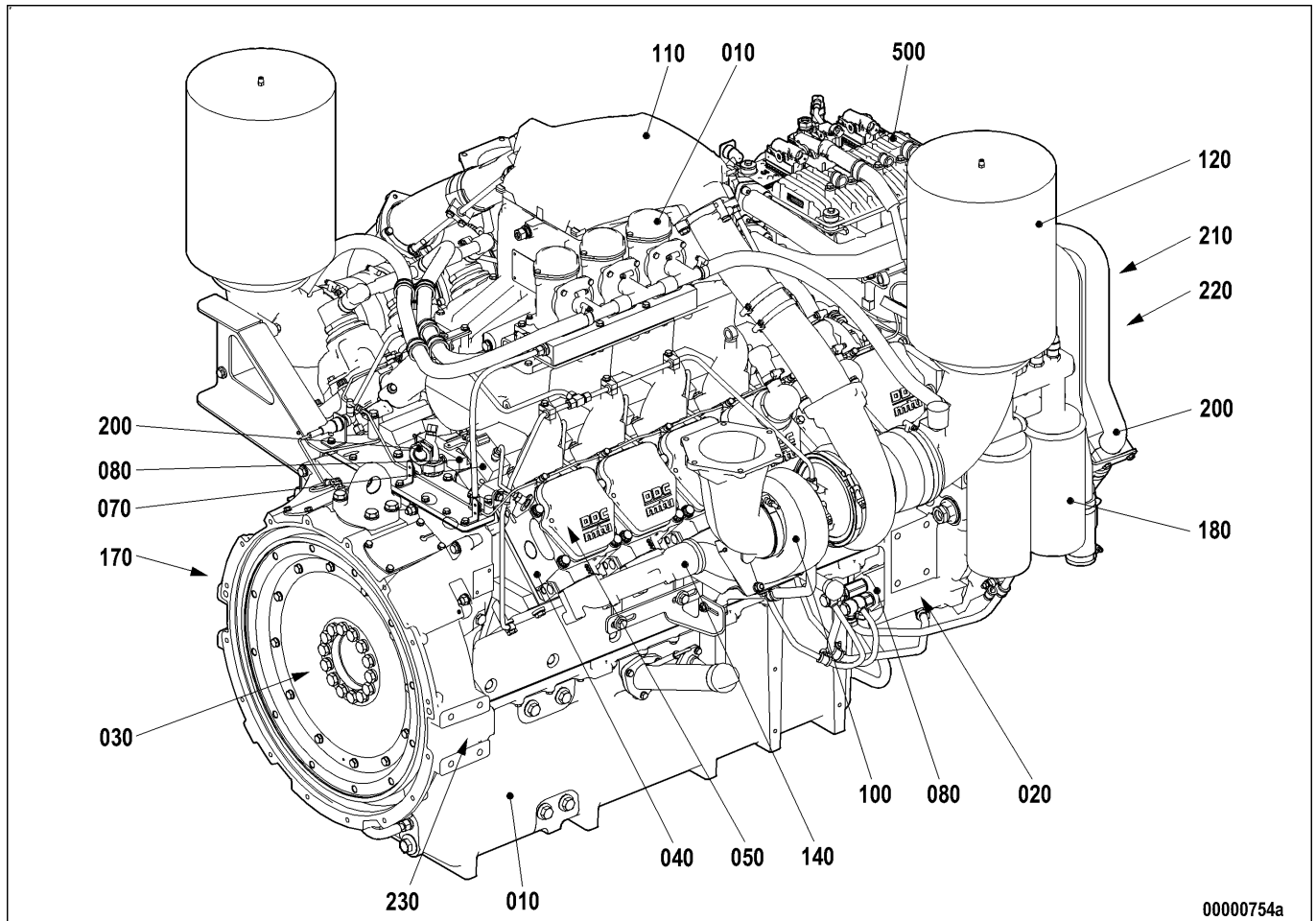
1. Read and become acquainted with all cautions and symbols before operating or repairing this product.
2. Pass on all safety instructions to your operating, maintenance, repair and transport personnel!

2 Product Summary

2.1 Engine Overview

2.1.1 Engine layout

Illustration is applicable to 12/16/18 V 2000 Gxy engines (with water-cooled intercooler)



- | | |
|-------------------------------|---|
| 010 Crankcase and attachments | 140 Exhaust system |
| 020 Gear train | 170 Starting equipment |
| 030 Running gear | 180 Lube oil system |
| 040 Cylinder head | 200 Coolant system |
| 050 Valve gear | 210 Power generation/supply, engine-side |
| 070 HP fuel system | 220 Cooling air system |
| 080 LP fuel system | 230 Mounting / support |
| 100 Exhaust turbocharger | 500 Monitoring and control system, general electric devices |
| 110 Intercooler | |
| 120 Air intake / air supply | |

Engine model designation

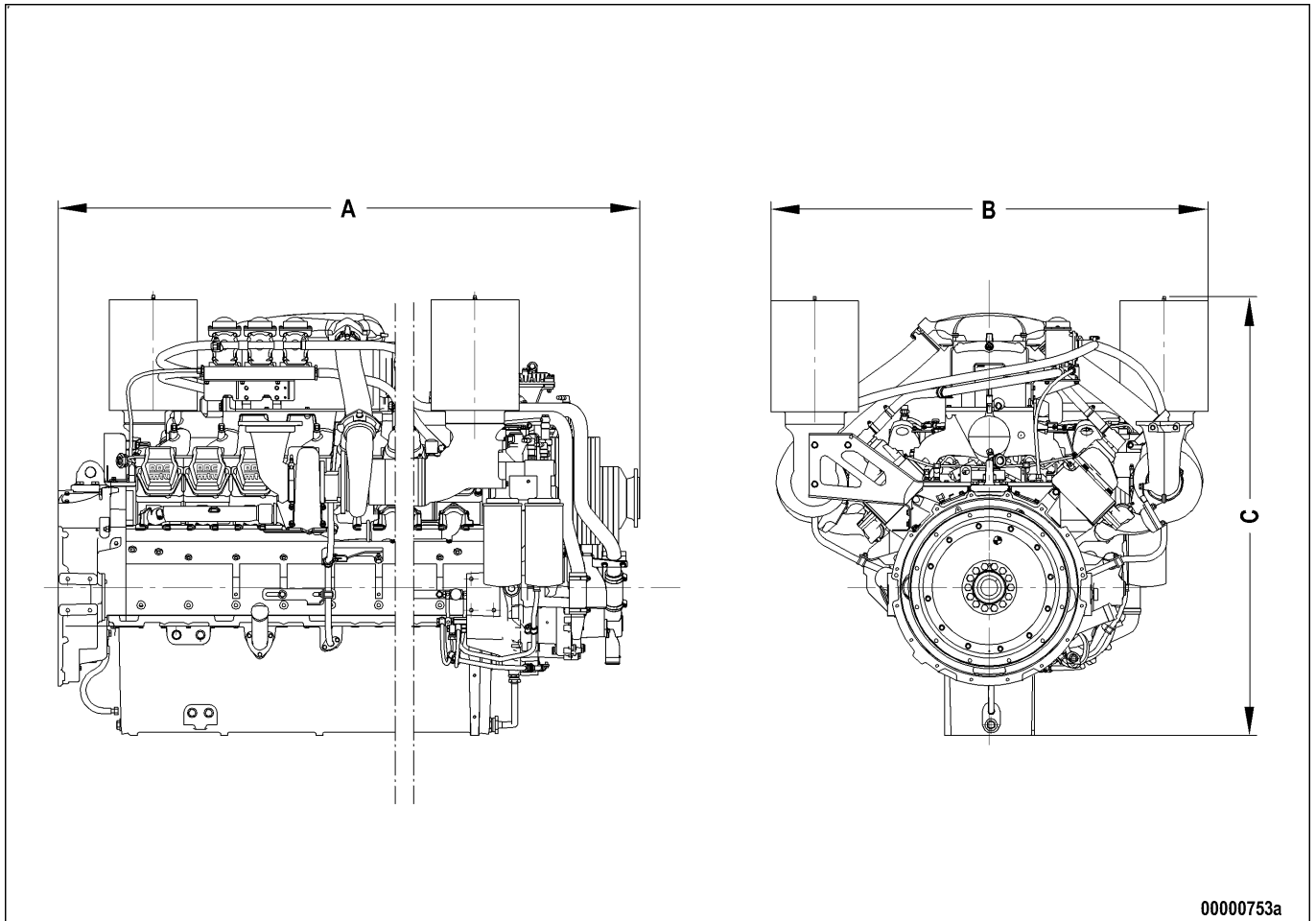
Key to the engine model designations 12/16/18V 2000 Gxy

12/16/18	Number of cylinders
V	Cylinder configuration: Vee engine
2000	Series
G	Application
x	Application segment (2, 4, 6, 8)
y	Design index (0,1, 2,...)

2.2 Main Engine Dimensions

2.2.1 Engine – Main dimensions

Main engine dimensions



00000753a

Engine model	12V 2000 Gxy	16V 2000 Gxy	18V 2000 Gxy
Length (A)	approx. 1885 mm	approx. 2230 mm	approx. 2400 mm
Width (B)	approx. 1580 mm	approx. 1580 mm	approx. 1580 mm
Height (C)	approx. 1585 mm	approx. 1585 mm	approx. 1620 mm

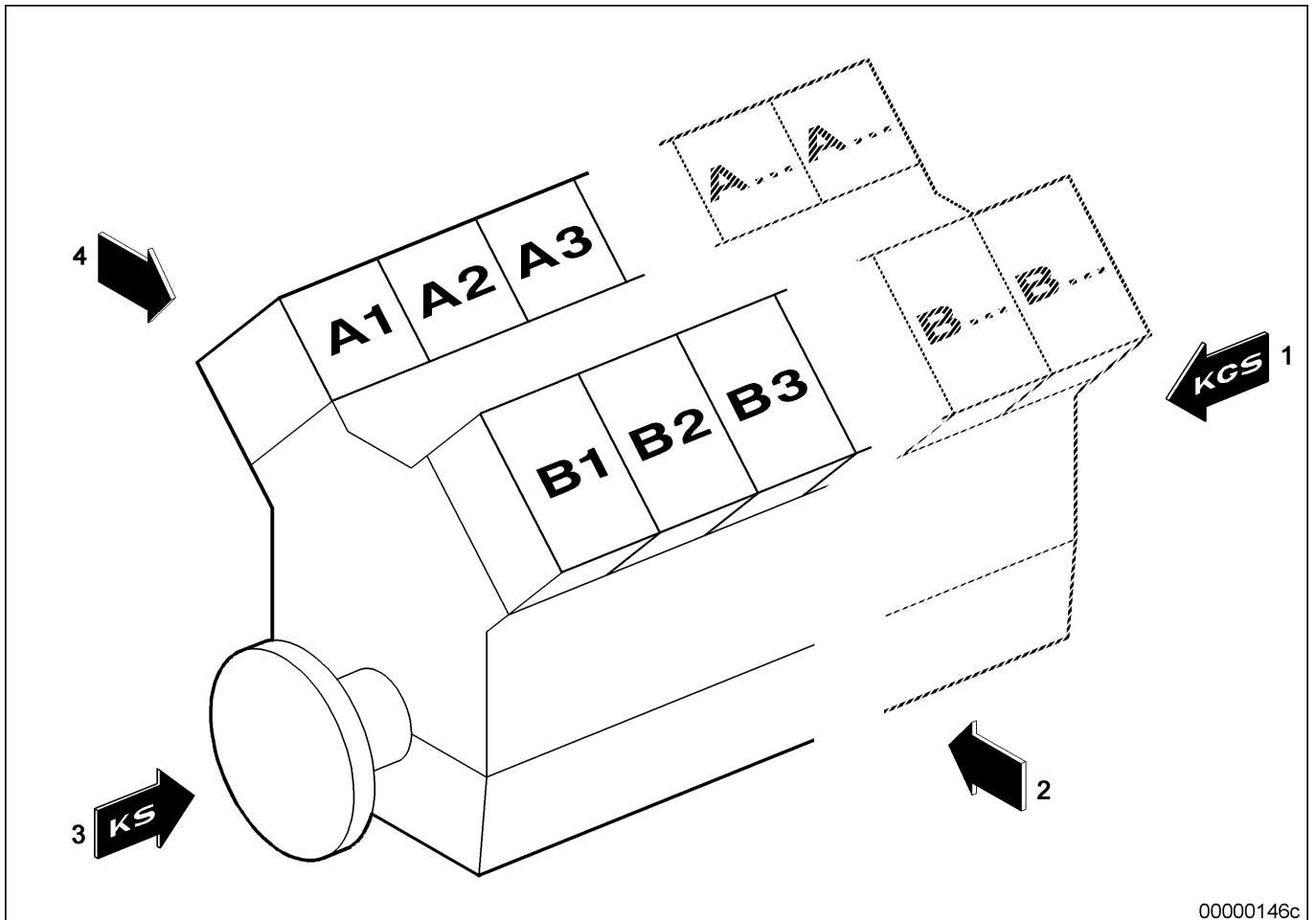
2.3 Engine Side and Cylinder Designations

2.3.1 Engine side and cylinder designations

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

The cylinders of the left engine side are designated "A" and those of the right side "B" (as per DIN ISO 1204). The cylinders of each bank are numbered consecutively, starting with No. 1 at the driving end.

The numbering of engine components is also from the driving end, starting with No. 1.



00000146c

1 KGS = Free end
2 Right side

3 KS = Driving end
4 Left side

2.4 Firing Order

2.4.1 Firing order

Firing order

12 V	A1-B2-A5-B4-A3-B1-A6-B5-A2-B3-A4-B6
16 V	A1-B5-A3-A5-B2-B8-A2-A8-B3-A7-B4-B6-A4-A6-B1-B7
18 V	A1-B6-A3-B4-A5-B2-A7-B1-A9-B3-A8-B5-A6-B7-A4-B9-A2-B8

2.5 Technical Data

2.5.1 12/16/18 V 2000 Gx5 engine data, optimized fuel consumption

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

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

N Not yet defined value

- Not applicable

X Applicable

REFERENCE CONDITIONS

Engine model			12V 2000 G25	12V 2000 G65	16V 2000 G25	16V 2000 G65	18V 2000 G65
Application group			3B	3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25	25
Barometric pressure		mbar	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100

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

Number of cylinders			12	12	16	16	18
Rated engine speed	A	rpm	1500	1500	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	580	695	810	890	1000

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12	12	16	16	18
Intake air depression (new filter)	A	mbar	15	15	15	15	15
Intake air depression, max.	L	mbar	50	50	50	50	50
Exhaust pressure	A	mbar	30	30	30	30	30
Exhaust pressure, max.	L	mbar	85	85	85	85	85

MODEL RELATED DATA (basic design)

Number of cylinders			12	12	16	16	18
Engine with exhaust turbocharging (ETC) and charge air cooling (CAC)			x	x	x	x	x
Exhaust piping, non-cooled			x	x	x	x	x
Working method: four-cycle, diesel, single-acting			x	x	x	x	x
Combustion method: Direct fuel injection			x	x	x	x	x
Cooling system: conditioned water			x	x	x	x	x
Direction of rotation: c.c.w. (facing driving end)			x	x	x	x	x
Number of cylinders			12	12	16	16	18
Cylinder configuration: V angle		Degrees	90	90	90	90	90
Bore		mm	130	130	130	130	130
Stroke		mm	150	150	150	150	150
Displacement per cylinder		liters	1.99	1.99	1.99	1.99	1.99
Displacement, total		liters	23.88	23.88	31.84	31.84	35.82
Compression ratio			16	16	16	16	16
Cylinder heads: single-cylinder			x	x	x	x	x
Cylinder liners: wet, replaceable			x	x	x	x	x
Inlet valves per cylinder			2	2	2	2	2
Exhaust valves per cylinder			2	2	2	2	2
Standard flywheel housing flange (engine main PTO)		SAE	0	0	0	0	0
Flywheel interface		DISC	18"	18"	18*	18"	18"

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			12	12	16	16	18
Charge air pressure before cylinder - DL	R	bar abs	2.8	3.2	3.0	3.2	3.1

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	12	16	16	18
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95	95	95
Coolant temperature after engine, alarm	R	°C	97	97	97	97	97
Coolant temperature after engine, shutdown	L	°C	102	102	102	102	102
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

LUBE-OIL SYSTEM

Number of cylinders			12	12	16	16	18
Lube oil operating temperature before engine, from	R	°C	88	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98	98
Lube-oil temperature before engine, alarm	R	°C	100	100	100	100	100
Lube-oil temperature before engine, shutdown	L	°C	105	105	105	105	105
Lube-oil operating pressure before engine, from	R	bar	6.2	6.2	5.5	5.5	6.0
Lube-oil operating pressure before engine, to	R	bar	7.5	7.5	6.5	6.5	8.0
Lube-oil pressure before engine, alarm	R	bar	4.4	4.4	4.4	4.4	4.4
Lube-oil pressure before engine, shutdown	L	bar	3.9	3.9	3.9	3.9	3.9

FUEL SYSTEM

Number of cylinders			12	12	16	16	18
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3	-0.3	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	+0.5	+0.5	+0.5	+0.5	+0.5

GENERAL OPERATING DATA

Number of cylinders			12	12	16	16	18
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	0**	0**	0**	0**	0**
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32	32
Firing speed, from	R	rpm	100	100	100	100	100
Firing speed, to	R	rpm	120	120	120	120	120

CAPACITIES

Number of cylinders			12	12	16	16	18
Engine coolant capacity, engine side (without cooling equipment)	R	liters	90	90	110	130	120
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	liters	77	77	102	102	130
Oil change capacity, max. (standard oil system)	R	liters	N	N	N	N	N
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liters	74	74	99	99	114
Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations)	L	liters	50	50	69	69	87
Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations)	L	liters	67	67	92	92	110

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12	12	16	16	18
Engine weight, dry (basic engine configuration acc. to scope of supply specification)	R	kg	2490	2490	3100	3100	3500

ACOUSTICS

Number of cylinders			12	12	16	16	18
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	120	127	119	120	120
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	117	118	120	121	123

2.5.2 12/16/18 V 2000 Gx5-TB engine data, optimized fuel consumption

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

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

N Not yet defined value

- Not applicable

X Applicable

REFERENCE CONDITIONS

Engine model			12V 2000 G25-TB	12V 2000 G65-TB	16V 2000 G25-TB	16V 2000 G65-TB	18V 2000 G65-TB
Application group			3B	3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25	25
Charge-air coolant temperature		°C	55	55	55	55	55
Raw water inlet temperature		°C	-	-	-	-	-
Barometric pressure		mbar	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100

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

Number of cylinders			12	12	16	16	18
Rated engine speed	A	rpm	1500	1500	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	580	695	810	890	1000

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12	12	16	16	18
Intake air depression (new filter)	A	mbar	15	15	15	15	15
Intake air depression, max.	L	mbar	50	50	50	50	50
Exhaust pressure	A	mbar	30	30	30	30	30
Exhaust pressure, max.	L	mbar	85	85	85	85	85

MODEL RELATED DATA (basic design)

Number of cylinders			12	12	16	16	18
Engine with exhaust turbocharging (ETC) and charge air cooling (CAC)			x	x	x	x	x
Exhaust piping, non-cooled			x	x	x	x	x
Working method: four-cycle, diesel, single-acting			x	x	x	x	x
Combustion method: Direct fuel injection			x	x	x	x	x
Cooling system: conditioned water			x	x	x	x	x
Direction of rotation: c.c.w. (facing driving end)			x	x	x	x	x
Number of cylinders			12	12	16	16	18
Cylinder configuration: V angle		Degrees	90	90	90	90	90
Bore		mm	130	130	130	130	130
Stroke		mm	150	150	150	150	150
Displacement per cylinder		liters	1.99	1.99	1.99	1.99	1.99
Displacement, total		liters	23.88	23.88	31.84	31.84	35.82
Compression ratio			16	16	16	16	16
Cylinder heads: single-cylinder			x	x	x	x	x
Cylinder liners: wet, replaceable			x	x	x	x	x
Inlet valves per cylinder			2	2	2	2	2
Exhaust valves per cylinder			2	2	2	2	2
Standard flywheel housing flange (engine main PTO)		SAE	0	0	0	0	0
Flywheel interface		DISC	18"	18"	18"	18"	18"

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			12	12	16	16	18
Charge air pressure before cylinder - DL	R	bar abs	2.8	3.2	3.0	3.2	3.1

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	12	16	16	18
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95	95	95
Coolant temperature after engine, alarm	R	°C	97	97	97	97	97
Coolant temperature after engine, shutdown	L	°C	102	102	102	102	102
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

COOLANT SYSTEM (LT circuit)

Number of cylinders			12	12	16	16	18
Coolant temperature before intercooler (at engine inlet from cooling equipment)	A	°C	55	55	55	55	55
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

LUBE-OIL SYSTEM

Number of cylinders			12	12	16	16	18
Lube oil operating temperature before engine, from	R	°C	88	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98	98
Lube-oil temperature before engine, alarm	R	°C	100	100	100	100	100
Lube-oil temperature before engine, shutdown	L	°C	105	105	105	105	105
Lube-oil operating pressure before engine, from	R	bar	6.2	6.2	5.5	5.5	6.0
Lube-oil operating pressure before engine, to	R	bar	7.5	7.5	6.5	6.5	8.0
Lube-oil pressure before engine, alarm	R	bar	4.4	4.4	4.4	4.4	4.4
Lube-oil pressure before engine, shutdown	L	bar	3.9	3.9	3.9	3.9	3.9

FUEL SYSTEM

Number of cylinders			12	12	16	16	18
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3	-0.3	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	+0.5	+0.5	+0.5	+0.5	+0.5

GENERAL OPERATING DATA

Number of cylinders			12	12	16	16	18
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	0**	0**	0**	0**	0**
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32	32
Firing speed, from	R	rpm	100	100	100	100	100
Firing speed, to	R	rpm	120	120	120	120	120

CAPACITIES

Number of cylinders			12	12	16	16	18
Engine coolant capacity, engine side (without cooling equipment)	R	liters	110	110	130	130	140
Charge-air coolant, engine side	R	liters	20	20	20	20	20
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	liters	77	77	102	102	130
Oil change capacity, max. (standard oil system)	R	liters	N	N	N	N	N
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liters	74	74	99	99	114
Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations)	L	liters	50	50	69	69	87
Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations)	L	liters	67	67	92	92	110

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12	12	16	16	18
Engine weight, dry (basic engine configuration acc. to scope of supply specification)	R	kg	2570	2570	3180	3180	3580

ACOUSTICS

Number of cylinders			12	12	16	16	18
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	120	122	119	120	120
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	117	118	120	121	123

2.5.3 12V 2000 Gx5 engine data, optimized exhaust emission

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

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

N Not yet defined value

- Not applicable

X Applicable

REFERENCE CONDITIONS

Engine model			12V 2000 G25	12V 2000 G45	12V 2000 G65	12V 2000 G85
Application group			3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25
Barometric pressure		mbar	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100

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

Number of cylinders			12	12	12	12
Rated engine speed	A	rpm	1500	1800	1500	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	580	710	695	810

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12	12	12	12
Intake air depression (new filter)	A	mbar	15	15	15	15
Intake air depression, max.	L	mbar	30	50	30	50
Exhaust pressure	A	mbar	30	30	30	30
Exhaust pressure, max.	L	mbar	50	85	50	85

MODEL RELATED DATA (basic design)

Number of cylinders			12	12	12	12
Engine with exhaust turbocharging (ETC) and charge air cooling (CAC)			x	x	x	x
Exhaust piping, non-cooled			x	x	x	x
Working method: four-cycle, diesel, single-acting			x	x	x	x
Combustion method: Direct fuel injection			x	x	x	x
Cooling system: conditioned water			x	x	x	x
Direction of rotation: c.c.w. (facing driving end)			x	x	x	x
Number of cylinders			12	12	12	12
Cylinder configuration: V angle		Degrees	90	90	90	90
Bore		mm	130	130	130	130
Stroke		mm	150	150	150	150
Displacement per cylinder		liters	1.99	1.99	1.99	1.99
Displacement, total		liters	23.88	23.88	23.88	23.88
Compression ratio			16	16	16	16
Cylinder heads: single-cylinder			x	x	x	x
Cylinder liners: wet, replaceable			x	x	x	x
Inlet valves per cylinder			2	2	2	2
Exhaust valves per cylinder			2	2	2	2
Standard flywheel housing flange (engine main PTO)		SAE	0	0	0	0
Flywheel interface		DISC	18"	18"	18"	18"

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			12	12	12	12
Charge air pressure before cylinder - DL	R	bar abs	3.6	3.2	4.0	3.35

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	12	12	12
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95	95
Coolant temperature after engine, alarm	R	°C	97	97	97	97
Coolant temperature after engine, shutdown	L	°C	102	102	102	102
Coolant antifreeze content, max.	L	%	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7

LUBE-OIL SYSTEM

Number of cylinders			12	12	12	12
Lube oil operating temperature before engine, from	R	°C	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98
Lube-oil temperature before engine, alarm	R	°C	100	103	100	103
Lube-oil temperature before engine, shutdown	L	°C	105	-	105	-
Lube-oil operating pressure before engine, from	R	bar	6.2	6.5	6.2	6.5
Lube-oil operating pressure before engine, to	R	bar	7.5	7.8	7.5	7.8
Lube-oil pressure before engine, alarm	R	bar	4.6	-	4.6	5.5
Lube-oil pressure before engine, shutdown	L	bar	4.1	-	4.1	5.0

FUEL SYSTEM

Number of cylinders			12	12	12	12
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	+0.5	+0.5	+0.5	+0.5

GENERAL OPERATING DATA

Number of cylinders			12	12	12	12
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	0**	0**	0**	0**
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32
Firing speed, from	R	rpm	100	100	100	100
Firing speed, to	R	rpm	120	120	120	120

CAPACITIES

Number of cylinders			12	12	12	12
Engine coolant capacity, engine side (without cooling equipment)	R	liters	90	90	90	90
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	liters	77	77	77	77
Oil change capacity, max. (standard oil system)	R	liters	N	N	N	N
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liters	74	74	74	74
Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations)	L	liters	50	50	50	50
Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations)	L	liters	67	67	67	67

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12	12	12	12
Engine weight, dry (basic engine configuration acc. to scope of supply specification)	R	kg	2490	2490	2490	2490

ACOUSTICS

Number of cylinders			12	12	12	12
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	123	126	126	129
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	117	117	118	120

2.5.4 16/18V 2000 Gx5 engine data, optimized exhaust emission

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

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

N Not yet defined value

- Not applicable

X Applicable

REFERENCE CONDITIONS

Engine model			16V 2000 G25	16V 2000 G45	16V 2000 G65	16V 2000 G85	18V 2000 G65	18V 2000 G85
Application group			3B	3B	3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25	25	25
Barometric pressure		mbar	1000	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100	100

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

Number of cylinders			16	16	16	16	18	18
Rated engine speed	A	rpm	1500	1800	1500	1800	1500	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	810	915	890	1010	1000	1191

GENERAL CONDITIONS (for maximum power)

Number of cylinders			16	16	16	16	18	18
Intake air depression (new filter)	A	mbar	15	15	15	15	15	15
Intake air depression, max.	L	mbar	30	50	30	50	30	50
Exhaust pressure	A	mbar	30	30	30	30	30	30
Exhaust pressure, max.	L	mbar	50	85	50	85	50	85

MODEL RELATED DATA (basic design)

Number of cylinders			16	16	16	16	18	18
Engine with exhaust turbocharging (ETC) and charge air cooling (CAC)			x	x	x	x	x	x
Exhaust piping, non-cooled			x	x	x	x	x	x
Working method: four-cycle, diesel, single-acting			x	x	x	x	x	x
Combustion method: Direct fuel injection			x	x	x	x	x	x
Cooling system: conditioned water			x	x	x	x	x	x
Direction of rotation: c.c.w. (facing driving end)			x	x	x	x	x	x
Number of cylinders			16	16	16	16	18	18
Cylinder configuration: V angle		Degrees	90	90	90	90	90	90
Bore		mm	130	130	130	130	130	130
Stroke		mm	150	150	150	150	150	150
Displacement per cylinder		liters	1.99	1.99	1.99	1.99	1.99	1.99
Displacement, total		liters	31.84	31.84	31.84	31.84	35.82	35.82

Number of cylinders			16	16	16	16	18	18
Compression ratio			16	16	16	16	16	16
Cylinder heads: single-cylinder			x	x	x	x	x	x
Cylinder liners: wet, replaceable			x	x	x	x	x	x
Inlet valves per cylinder			2	2	2	2	2	2
Exhaust valves per cylinder			2	2	2	2	2	2
Standard flywheel housing flange (engine main PTO)		SAE	0	0	0	0	0	0
Flywheel interface		DISC	18"	18"	18"	18"	18"	18"

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			16	16	16	16	18	18
Charge air pressure before cylinder - DL	R	bar abs	3.6	3.2	3.8	3.4	3.9	3.3

COOLANT SYSTEM (HT circuit)

Number of cylinders			16	16	16	16	18	18
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95	95	95	95
Coolant temperature after engine, alarm	R	°C	97	97	97	97	97	97
Coolant temperature after engine, shutdown	L	°C	102	102	102	102	102	102
Coolant antifreeze content, max.	L	%	50	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7	0.7

LUBE-OIL SYSTEM

Number of cylinders			16	16	16	16	18	18
Lube oil operating temperature before engine, from	R	°C	88	88	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98	98	98
Lube-oil temperature before engine, alarm	R	°C	100	103	100	103	100	103
Lube-oil temperature before engine, shutdown	L	°C	105	-	105	-	105	-
Lube-oil operating pressure before engine, from	R	bar	5.5	6.0	5.5	6.0	6.0	6.5
Lube-oil operating pressure before engine, to	R	bar	6.5	7.0	6.5	7.0	8.0	8.5
Lube-oil pressure before engine, alarm	R	bar	4.6	5.5	4.6	5.5	4.6	5.5
Lube-oil pressure before engine, shutdown	L	bar	4.1	5.0	4.1	5.0	4.1	5.0

FUEL SYSTEM

Number of cylinders			16	16	16	16	18	18
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	+0.5	+0.5	+0.5	+0.5	+0.5	+0.5

GENERAL OPERATING DATA

Number of cylinders			16	16	16	16	18	18
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	0**	0**	0**	0**	0**	0**
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32	32	32
Firing speed, from	R	rpm	100	100	100	100	100	100
Firing speed, to	R	rpm	120	120	120	120	120	120

CAPACITIES

Number of cylinders			16	16	16	16	18	18
Engine coolant capacity, engine side (without cooling equipment)	R	liters	110	110	110	110	120	120
Charge-air coolant, engine side	R	liters	-	-	-	-	-	-
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	liters	102	102	102	102	130	130
Oil change capacity, max. (standard oil system)	R	liters	N	N	N	N	N	N
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liters	99	99	99	99	114	114
Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations)	L	liters	69	69	69	69	87	87
Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations)	L	liters	92	88	92	88	110	110

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			16	16	16	16	18	18
Engine weight, dry (basic engine configuration acc. to scope of supply specification)	R	kg	3100	3150	3100	3150	3500	3500

ACOUSTICS

Number of cylinders			16	16	16	16	18	18
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	122	128	123	128	124	129
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	120	121	121	122	122	123

2.5.5 12/16/18V 2000 Gx5-TB engine data, optimized exhaust emission

Explanation:

DL Ref. value: Continuous power

BL Ref. value: Fuel stop power

A Design value

G Guaranteed value

R Guideline value

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

N Not yet defined value

- Not applicable

X Applicable

REFERENCE CONDITIONS

Engine model			12V 2000 G45-TB	12V 2000 G85-TB	16V 2000 G45-TB	16V 2000 G85-TB	18V 2000 G85-TB
Application group			3B	3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25	25
Charge-air coolant temperature		°C	45	45	45	45	55
Raw water inlet temperature		°C	-	-	-	-	-
Barometric pressure		mbar	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100

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

Number of cylinders			12	12	16	16	18
Rated engine speed	A	rpm	1800	1800	1800	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	710	810	915	1010	1191

GENERAL CONDITIONS (for maximum power)

Number of cylinders			12	12	16	16	18
Intake air depression (new filter)	A	mbar	15	15	15	15	15
Intake air depression, max.	L	mbar	50	50	50	50	50
Exhaust pressure	A	mbar	30	30	30	30	30
Exhaust pressure, max.	L	mbar	85	85	85	85	85

MODEL RELATED DATA (basic design)

Number of cylinders			12	12	16	16	18
Engine with exhaust turbocharging (ETC) and charge air cooling (CAC)			x	x	x	x	x
Exhaust piping, non-cooled			x	x	x	x	x
Working method: four-cycle, diesel, single-acting			x	x	x	x	x
Combustion method: Direct fuel injection			x	x	x	x	x
Cooling system: conditioned water			x	x	x	x	x
Direction of rotation: c.c.w. (facing driving end)			x	x	x	x	x
Number of cylinders			12	12	16	16	18
Cylinder configuration: V angle		Degrees	90	90	90	90	90
Bore		mm	130	130	130	130	130
Stroke		mm	150	150	150	150	150
Displacement per cylinder		liters	1.99	1.99	1.99	1.99	1.99
Displacement, total		liters	23.88	23.88	31.84	31.84	35.82
Compression ratio			16	16	16	16	16
Cylinder heads: single-cylinder			x	x	x	x	x
Cylinder liners: wet, replaceable			x	x	x	x	x
Inlet valves per cylinder			2	2	2	2	2
Exhaust valves per cylinder			2	2	2	2	2
Standard flywheel housing flange (engine main PTO)		SAE	0	0	0	0	0
Flywheel interface		DISC	18"	18"	18"	18"	18"

COMBUSTION AIR / EXHAUST GAS

Number of cylinders			12	12	16	16	18
Charge air pressure before cylinder - DL	R	bar abs	3.2	3.35	3.2	3.4	3.3

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	12	16	16	18
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	95	95	95	95	95
Coolant temperature after engine, alarm	R	°C	97	97	97	97	97
Coolant temperature after engine, shutdown	L	°C	102	102	102	102	102
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

COOLANT SYSTEM (LT circuit)

Number of cylinders			12	12	16	16	18
Coolant temperature before intercooler (at engine inlet from cooling equipment)	A	°C	45	45	45	45	45
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

LUBE-OIL SYSTEM

Number of cylinders			12	12	16	16	18
Lube oil operating temperature before engine, from	R	°C	88	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98	98
Lube-oil temperature before engine, alarm	R	°C	103	103	103	103	103
Lube-oil temperature before engine, shutdown	L	°C	-	-	-	-	-
Lube-oil operating pressure before engine, from	R	bar	6.5	6.5	6.0	6.0	6.5
Lube-oil operating pressure before engine, to	R	bar	7.8	7.8	7.0	7.0	8.5
Lube-oil pressure before engine, alarm	R	bar	5.5	5.5	5.5	5.5	5.5
Lube-oil pressure before engine, shutdown	L	bar	5.0	5.0	5.0	5.0	5.0

FUEL SYSTEM

Number of cylinders			12	12	16	16	18
Fuel pressure at engine supply connection, min. (when engine is starting)	L	bar	-0.3	-0.3	-0.3	-0.3	-0.3
Fuel pressure at engine supply connection, max. (when engine is starting)	L	bar	+0.5	+0.5	+0.5	+0.5	+0.5

GENERAL OPERATING DATA

Number of cylinders			12	12	16	16	18
Cold start capability: Air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	0**	0**	0**	0**	0**
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32	32
Firing speed, from	R	rpm	100	100	100	100	100
Firing speed, to	R	rpm	120	120	120	120	120

CAPACITIES

Number of cylinders			12	12	16	16	18
Engine coolant capacity, engine side (without cooling equipment)	R	liters	110	110	130	130	140
Charge-air coolant, engine side	R	liters	20	20	20	20	20
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	liters	77	77	102	102	130
Oil change capacity, max. (standard oil system)	R	liters	N	N	N	N	N
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	liters	74	74	99	99	114
Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations)	L	liters	50	50	69	69	87
Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations)	L	liters	67	67	88	88	110

WEIGHTS / MAIN DIMENSIONS

Number of cylinders			12	12	16	16	18
Engine weight, dry (basic engine configuration acc. to scope of supply specification)	R	kg	2570	2570	3180	3180	3500

ACOUSTICS

Number of cylinders			12	12	16	16	18
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	126	129	128	128	129
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	117	120	121	122	123

3 Operation

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

Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specification (A001061/..) is available.

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

Item	Task
Engine	Depreserve (→MTU Fluids and Lubricants Specification A001061/..).
Lube oil system	Check oil level (→ Page 131);
Fuel prefilter	Prime (→ Page 124).
Fuel prefilter, pressure gauge	Align adjustable pointer with position of pressure indicator (→ Page 119).
Fuel system	Vent (→ Page 115).
Cooling system	If engine is out of service for more than one year, change engine coolant (→ Page 136); Change charge-air coolant (→ Page 142).
Cooling system	Check engine coolant level (→ Page 137); Check charge-air coolant level (→ Page 143).
Cooling system	Preheat coolant with preheating unit.
ECU	Check plug-in connections (→ Page 154).
Monitoring equipment	Carry out lamp test (see manufacturer's documentation).
Engine/generator control system	Switch ON; Select operating mode, e.g. MANUAL OPERATION, AUTOMATIC OPERATION.

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

Preconditions

- Engine is stopped and starting disabled.


Putting the engine into operation

Item	Task
Lube oil system	Check oil level (→ Page 131);
Cooling system	Check engine coolant level (→ Page 137); Check charge-air coolant level (→ Page 143).
Cooling system	Preheat coolant with preheating unit.
Fuel prefilter	Drain (→ Page 120).
Monitoring equipment	Carry out lamp test (see manufacturer's documentation).
Engine/generator control system	Switch ON; Select operating mode, e.g. MANUAL OPERATION, AUTOMATIC OPERATION.

3.3 Starting the engine in manual mode

Preconditions

- Generator is not connected to network.
- External start interlock is not activated.

 DANGER	Unguarded rotating and moving engine components. Risk of serious injury — danger to life! <ul style="list-style-type: none"> • Before barring or starting the engine, ensure that nobody is in the danger zone.
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 WARNING	Engine noise above 85 dB (A). Risk of damage to hearing! <ul style="list-style-type: none"> • Wear ear protectors.
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Preparation

Item	Task
Operating mode selector switch (if provided)	Change to manual mode.
Preheating pump (if provided)	Switch ON.



Starting the engine

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	If coolant temperature is <ul style="list-style-type: none"> • > 40 °C (with preheating pump), or • > 10 °C (60 Hz generator, without preheating pump), or • > 5 °C (50 Hz generator, without preheating pump): Press start button. <ul style="list-style-type: none"> • Automatic starting procedure is performed; • Tachometer indicates increasing crankshaft speed; • After the starting procedure is completed, engine is running at rated speed.

Connecting the generator to network, running the engine to reach operating temperature

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	Close the generator circuit breaker.
Engine	Run engine at 10 to 15 % of rated power to reach operating temperature. Apply full load only after engine has reached operating temperature (coolant temperature approx. 75 °C).

3.4 Bypassing the safety system (Override)

 CAUTION	<p>Safety functions and engine shutdown alarms will be disregarded.</p> <p>Serious damage to plant!</p> <ul style="list-style-type: none"> • Initiate emergency start only in emergency situations.
 CAUTION	<p>Inadmissible operational condition.</p> <p>Major material damage!</p> <ul style="list-style-type: none"> • Use override function only in hazardous situations to ensure full maneuverability in case of engine malfunctions.



Preparation

Note: This function is only available when a pushbutton is provided.

Bypassing the safety system (Override)

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	Activate pushbutton for Override input of the ECU. <ul style="list-style-type: none"> • Certain shutdown criteria and/or starting prerequisites are ignored.
Switchgear cabinet, control panel etc. (depending on manufacturer)	Actuate start button, for further starting sequence see Engine start (→ Page 49).
Control and display panels	During operation, check the displayed operational data (speed, temperature, pressures). Constantly monitor plant limit values.

3.5 Operational checks

 DANGER	Unguarded rotating and moving engine components. Risk of serious injury – danger to life! <ul style="list-style-type: none"> • Take special care when working on a running engine.
 WARNING	Engine noise above 85 dB (A). Risk of damage to hearing! <ul style="list-style-type: none"> • Wear ear protectors.

Operational checks

Item	Task
Control and display panels	Check indicated operating parameters (speed, temperatures, pressures).
Engine under load, Engine at nominal speed	Check engine/plant and pipework for leaks, rectify any leaks with the engine stopped; Check for abnormal running noises and vibration.
Fuel prefilter	Check whether indicated differential pressure is within the limit (→ Page 119).
Exhaust system	Check exhaust color (→ Page 61).
Intercooler	Check condensate drain(s) for water discharge and obstruction (→ Page 126).
Air filter	Check signal ring position of service indicator (→ Page 129). Replace air filter (→ Page 127), if the signal ring is completely visible in the red area of the service indicator control window.
Coolant pump	Check relief bore (→ Page 138).
Compressed-air system (if installed)	Check operating pressure at pressure gauge; Fill compressed-air tank to maximum pressure; Drain condensate from compressed-air tank, pressure drop must not exceed 1 bar.

3.6 Stopping the engine in manual mode

Preconditions

- Generator is not connected to network.
- Engine is running in manual mode.



Stopping the engine when it is running at full load causes extreme stress to the engine.

Risk of overheating, damage to components!

- Before stopping the engine, operate it at idle speed until operating temperatures decrease and stable values are indicated.

Preparation

Item	Task
Engine	After the generator circuit breaker has been opened, allow the engine to cool down by running it idle for approx. 5 minutes.

Stopping the engine

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	Press stop button. <ul style="list-style-type: none"> • Automatic stopping procedure is performed; • Engine is stopped.

After stopping the engine

Item	Task
Cooling pump	Operate for approx. 5 minutes after engine stop.

3.7 Emergency stop



An emergency stop causes extreme stress to the engine.
Risk of overheating, damage to components!

- Initiate emergency stop only in emergency situations.

Emergency stop from LOP

Item	Task
EMERGENCY STOP button	Press. <ul style="list-style-type: none"> • Engine is stopped by switching off power supply to ECU; • Signalization (e.g. by horn, flashing lamp) is released.

After emergency stop from LOP

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	Press button for alarm acknowledgement. <ul style="list-style-type: none"> • Audible and visual signalization stops.

3.8 After stopping the engine – engine remains ready for operation

After stopping the engine

Item	Task
Engine/generator control system	Select operating mode, e.g. MANUAL OPERATION, AUTOMATIC OPERATION.

3.9 After stopping the engine – putting the engine out of service

Preconditions

- MTU Fluids and Lubricants Specification (A001061/..) is available.

After stopping the engine

Item	Task
Cooling system	Drain engine coolant (→ Page 135); Drain charge-air coolant (→ Page 141) if: <ul style="list-style-type: none"> • freezing temperatures are expected and the engine is to remain out of service for an extended period and coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not maintained 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/generator control system	Switch OFF.
Air intake and exhaust system	If the engine is to remain out of service for more than 1 week, seal the engine's air and exhaust sides. If the engine is to remain out of service for more than 1 month, carry out preservation (→MTU Fluids and Lubricants Specification A001061/..).

4 Maintenance

4.1 Preface

MTU maintenance concept

The maintenance system for MTU products is based on a preventive maintenance concept. Preventive maintenance facilitates advance planning and ensures a high level of equipment availability.

The maintenance schedule is based on the load profile / load factor specified below. The time intervals at which the maintenance work is to be carried out and the relevant checks and tasks involved are average values based on operational experience and are therefore to be regarded as guidelines only. Special operating conditions and technical requirements may require additional maintenance work and/or modification of the maintenance intervals. In order to be authorized to carry out the individual maintenance jobs, maintenance personnel must have achieved a level of training and qualification appropriate to the complexity of the task in hand. The various Qualification Levels QL1 to QL4 reflect the levels of training offered in MTU courses and the contents of the tool kits required.

QL1: Operational monitoring and maintenance which can be carried out during a break in operation without disassembling the engine.

QL2: Component exchange (only corrective).

QL3: Maintenance work which requires partial disassembly of the engine.

QL4: Maintenance work which requires complete disassembly of the engine.

The maintenance schedule matrix usually ends with extended component maintenance. Following this, maintenance work is to be continued at the intervals indicated.

The "Task" numbers stated in the list of jobs to be done/action to be taken indicate the relevant maintenance item. They provide a reference to the scope of parts required and appear on the labels of the appropriate replacement parts.

Preventive maintenance instructions

Specifications for fluids and lubricants, guideline values for their maintenance and change intervals and lists of recommended fluids and lubricants are contained in the MTU Fluids and Lubricants Specifications A001061 and in the fluids and lubricants specifications produced by the component manufacturers. They are therefore not included in the maintenance schedule (exception: deviations from the Fluids and Lubricants Specifications). All fluids and lubricants used must meet MTU specifications and be approved by the relevant component manufacturer.

Amongst other items, the operator/customer must carry out the following additional maintenance work:

- Protect components made of rubber or synthetic material from oil. Never treat them with organic detergents. Wipe with a dry cloth only.
- Fuel prefilter:

Maintenance depends on how dirty fuel is. The paper elements of the fuel prefilters must be renewed after 2 years at the latest (Task 9998).

- Battery:

Battery maintenance depends on the level of use and the ambient conditions. The battery manufacturer's instructions must be obeyed.

The relevant manufacturer's instructions apply with respect to the maintenance of any components which do not appear in this maintenance schedule.

Items which are included in this Maintenance Schedule but not applicable to the engine configuration of the engine concerned can be disregarded.

Out-of-service periods

If the engine is to remain out of service for more than 1 month, carry out engine preservation procedures according to the Fluids and Lubricants Specifications, MTU Publication No. A001061.

Application group

3B Continuous operation, variable

4.2 Maintenance schedule matrix

0-10,000 operating hours

Item	Limit, years	Operating hours [h]																					
		Daily	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500	10,000	
Engine oil filter	2																						
Engine operation	-	X																					
Crankcase breather	-		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fuel filter	2		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Valve gear	-		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Coolant cooler	1		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fuel injectors	-							X						X							X		
Pressure pipe neck	-							X						X							X		
Belt drive	2							X						X							X		
Air filter	3							X						X							X		
Combustion chambers	4							X						X							X		
Fuel pressure maintaining valve	-													X									
Fuel injection pump(s)	-													X									
Exhaust turbocharger	-																						X
Component maintenance	-																						X
Cylinder head	-																						X
Extended component maintenance	18																						X

4.3 Maintenance tasks

Qualification	Interval		Item	Maintenance tasks	Task
	[hours]	[years]			
QL1	-	2	Engine oil filter	Replace engine oil filter when changing the oil or when the interval/years is reached, at the latest (→ Page 133).	W1008
QL1	-	-	Engine operation	Check engine oil level (→ Page 131). Check engine visually for leaks and general condition (→ Page 51). Check intercooler condensate drain (if fitted) (→ Page 126). Check signal-ring position of service indicator on air filter (→ Page 129). Check relief bores of water pump(s) (→ Page 138). Check for abnormal running noise, exhaust color and vibrations (→ Page 51). Drain water and contaminants from fuel prefilter (if fitted) (→ Page 120). Check position of adjustable pointer on fuel prefilter differential pressure gauge (if fitted) (→ Page 119).	W0500 W0501 W0502 W0503 W0505 W0506 W0507 W0508
QL1	500	2	Fuel filter	Replace fuel filter or fuel filter element (→ Page 117).	W1001
QL1	500	-	Valve gear	Check valve clearance (→ Page 99).	W1002
QL1	500	1	Coolant cooler	Coolant cooler: Check cooler elements for external contamination (see manufacturer's documentation).	W1010
QL1	500	-	Crankcase breather	Clean wire meshes of crankcase breather (→ Page 98)	W1140
QL1	3000	-	Fuel injectors	Replace injectors (→ Page 107).	W1006
QL1	3000	-	Pressure pipe neck	Replace pressure pipe neck in cylinder head (→ Page 111).	W1178
QL1	3000	2	Belt drive	Check drive belt condition and tension, replace as necessary (→ Page 144) (→ Page 147).	W1003
QL1	3000	3	Air filter	Replace air filter (→ Page 127).	W1005
QL1	3000	4	Combustion chambers	Perform endoscopic examination (→ Page 92).	W1011
QL1	6000	-	Fuel pressure maintaining valve	Replace fuel pressure maintaining valve (→ Page 113).	W1056
QL1	6000	-	Fuel injection pump(s)	Replace fuel injection pump(s) (→ Page 103).	W1007
QL3	10000	-	Exhaust turbocharger	Replace exhaust turbocharger (→Maintenance Manual).	W1041
QL3	10000	-	Component maintenance	Before starting maintenance work, drain coolant and flush coolant circuits. Clean air ducting (→Maintenance Manual). Clean intercooler and check for leaks (→Maintenance Manual). Check vibration damper (→Maintenance Manual). Replace wire meshes of crankcase breather (→Maintenance Manual) Clean coolant cooler, check for leaks if possible (→Maintenance Manual). Check engine alignment (see installation drawing).	W2000 W2002 W2003 W2011 W2014 W2017 W2036

Qualification	Interval		Item	Maintenance tasks	Task
	[hours]	[years]			
				Replace engine coolant pump (→Maintenance Manual). Replace coolant thermostat insert (→Maintenance Manual). Check rocker arms, valve bridge, pushrods and ball joints for wear (→Maintenance Manual). Replace seals of all disassembled components.	W2072 W2073 W2074 W2062
QL3	10000	-	Cylinder head	Overhaul cylinder heads, inspect piston crowns and running pattern of cylinder liners (→Maintenance Manual).	W1063
QL4	10000	18	Extended component maintenance	Perform complete engine disassembly. Inspect engine components acc. to assembly instructions; repair or replace as necessary (→Workshop Manual). Replace all elastomer components and seals. Replace piston rings (→Workshop Manual). Replace conrod bearings (→Workshop Manual). Replace crankshaft bearings (→Workshop Manual). Replace cylinder liners (→Workshop Manual). Replace fuel delivery pump (→Workshop Manual). Overhaul starter (→Workshop Manual). Overhaul battery-charging generator (→Workshop Manual). Replace wire meshes of crankcase breather (→Workshop Manual)	W3000 W3001 W3002 W3003 W3004 W3005 W3010 W3041 W3042 W3056
				Replace plastic fuel lines (if fitted) (→Workshop Manual)	W3081

5 Troubleshooting

5.1 Troubleshooting

Engine does not turn when starter is actuated

Component	Probable Cause	Task
Battery	Low or defective	Charge or replace (see manufacturer's documentation).
	Cable connections defective	Check if cable connections are properly secured (see manufacturer's documentation).
Starter	Engine wiring or starter defective	Check if cable connections are properly secured, contact Service.
Engine wiring	Defective	Check (→ Page 151).
Engine/generator control system	Secure seating of assemblies or connectors not provided	Perform visual inspection (see manufacturer's documentation).
ECU	Plug-in connections are loose	Check plug-in connections (→ Page 154).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Probable Cause	Task
Starter	Poor rotation: Battery low or defective	Charge or replace battery (see manufacturer's documentation).
Engine wiring	Defective	Check (→ Page 151).
Fuel system	Not vented	Vent fuel system (→ Page 115).
ECU	Defective	Contact Service.

Engine fires unevenly

Component	Probable Cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 107).
	Injection pump defective	Replace (→ Page 104).
Engine wiring	Defective	Check (→ Page 151).
Fuel system	Not vented	Vent fuel system (→ Page 115).
ECU	Defective	Contact Service.

Engine does not reach nominal speed

Component	Probable Cause	Task
Fuel supply	Fuel prefilter clogged	Replace (→ Page 124).
	Fuel filter clogged	Replace (→ Page 117).
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 129).
Fuel injection equipment	Injector defective	Replace (→ Page 107).
	Injection pump defective	Replace (→ Page 104).
Engine wiring	Defective	Check (→ Page 151).
Engine	Overloaded	Contact Service.

Engine speed not steady

Component	Probable Cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 107).
	Injection pump defective	Replace (→ Page 104).
Speed sensor	Defective	Contact Service.
Fuel system	Not vented	Vent fuel system (→ Page 115).
ECU	Defective	Contact Service.

Charge-air temperature too high

Component	Probable Cause	Task
Engine coolant	Incorrect coolant concentration	Check (MTU test kit).
Intercooler	Contaminated	Contact Service.
Engine room	Air-intake temperature too high	Check fans and air supply / ventilation ducts.

Charge air pressure too low

Component	Probable Cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 129).
Intercooler	Contaminated	Contact Service.
Exhaust turbocharger	Defective	Contact Service.

Coolant leaks on intercooler

Component	Probable Cause	Task
Intercooler	Leaking, major coolant discharge	Contact Service.

Exhaust gas black

Component	Probable Cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 129).
Fuel injection equipment	Injector defective	Replace (→ Page 107).
	Injection pump defective	Replace (→ Page 104).
Engine	Overloaded	Contact Service.

Exhaust gas blue

Component	Probable Cause	Task
Engine oil	Too much oil in engine	Drain engine oil (→ Page 132).
	Oil separator of crankcase breather contaminated	Replace (→ Page 96).
Exhaust turbocharger, cylinder head, piston rings, cylinder liner	Defective	Contact Service.

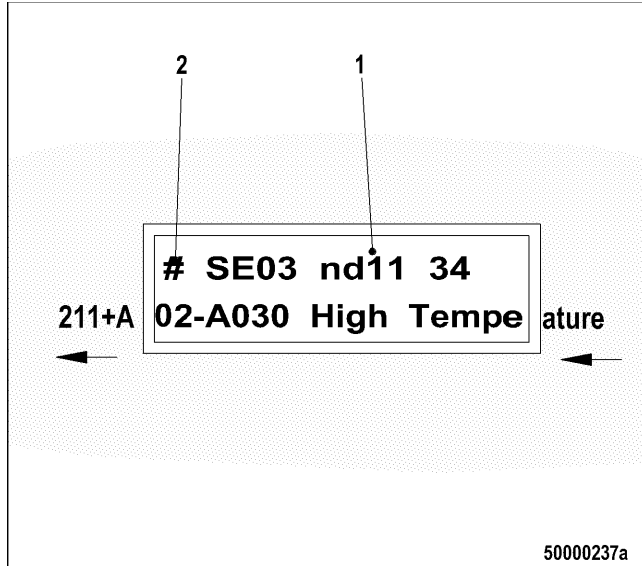
Exhaust gas white

Component	Probable Cause	Task
Engine	Not at operating temperature	Run engine to reach operating temperature.
Fuel system	Water in fuel	Check fuel system on fuel prefilter. Drain fuel prefilter (→ Page 120).
Intercooler	Leaking	Contact Service.

5.2 Fault indication on SAM display – Genset applications

SAM fault messages

SAM display



- 1 2-line LC display
- 2 Time indicator for alarms

The structure of the display (1) is as follows:

- First line
 - Fault indication
 - # (2) = Alarm is no longer active, does not appear on next power-up,
 - A = Currently active alarms,
 - B = Alarm was active during the last hour,
 - C = Alarm was active during the last four hours,
 - C = Alarm was active during the last four to twelve hours,
 - E = Alarm was active more than twelve hours ago.
 - Fault type (e.g. SE03).
 - Node number at which the fault occurred (e.g. nd05).
- Second line (option)
 - Running text, providing more information about the fault currently displayed

Proceed to the next alarm by pressing key (↓ ↑).

Fault type – fault message text

SE No.	Fault message text
0	Sensor Temperature Defect
1	Temperature failure
2	Sensor Voltage Defect
3	Voltage failure
4	CAN Bus- 1 Error/Bus Defec
5	CAN Bus- 1 Overrun
6	CAN Bus- 2 Error/Bus Defec
7	CAN Bus- 2 Overrun
8	Temperature Compensation Error
9	I/O-Module Slot2 Defect
10	I/O-Module Slot3 Defect
11	I/O-Module Slot4 Defect
12	Serial Connection Lost
13	CAN Bus- 3 Error/Bus Defec
14	CAN Bus- 3 Overrun
15	S/A Bus Faulty
16	PAN 1 Defect
17	PAN 2 Defect
18	PAN 3 Defect
19	PAN 4 Defect
20	PAN 5 Defect
21	PAN 6 Defect
22	I/O-Module Slot1 Defect
23	I/O-Module Slot5 Defect
24	I/O-Module Slot6 Defect
25	I/O-Module Slot7 Defect
26	I/O-Module Slot8 Defect
27	Download Server Collision
28	not projected node

Engine governor messages
Recommended action in case of alarm

Yellow alarm:

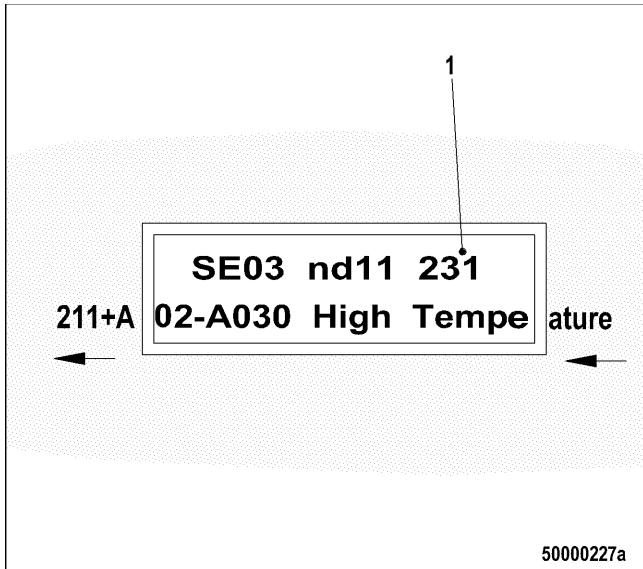
The engine can still be operated providing that automatic engine shutdown to protect the engine has not been configured or is not tripped. Contact Service immediately/start fault rectification.

Red alarm:

Caution, the engine is running at its limits. Shut down manually without further delay if the engine does not shut itself down immediately after a red alarm is signalled.

Fault and alarm messages

The fault code numbers are generated by the Engine Control Unit and transmitted to the following display.



The fault code (1) comprises three numbers.

Fault messages may also be caused by faulty sensors/actuators. Contact Service to have sensors/actuators checked and replaced as necessary should troubleshooting as prescribed in the table below prove unsuccessful.

IMPORTANT NOTE:

The information provided in the columns “Meaning” and “Action” applies to the standard default state of the genset on delivery. Differing system responses requiring different action may result when settings are changed by the OEM. The OEM is responsible for documenting any changes and defining appropriate counteraction.

The table below lists possible fault codes:

Fault code no.	Designation	Meaning	Action	Setting parameter no.
003	HI T-Fuel	Prewarning fuel temperature too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check tank temperature, contact Service if no fault detected.	2.0122931
004	SS T-Fuel	Main warning fuel temperature too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check tank temperature, contact Service if no fault detected.	2.0122932
005	HI T-Charge Air	Prewarning charge-air temperature too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cooler, check intercooler, contact Service if no fault detected.	2.0121.931

Fault code no.	Designation	Meaning	Action	Setting parameter no.
006	SS T-Charge Air	Main warning charge-air temperature too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cooler, check intercooler, contact Service if no fault detected.	2.0121.932
009	HI T-Coolant Intercooler	Prewarning coolant temperature in intercooler too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cooler, contact Service if no fault detected.	2.0124.931
010	SS T-Coolant Intercooler	Main warning coolant temperature in intercooler too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cooler, contact Service if no fault detected.	2.0124.932
015	LO P-Lube Oil	Prewarning lube oil pressure too low (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check oil level, contact Service if no fault detected.	2.0100.921
016	SS P-Lube Oil	Main warning lube oil pressure too low (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Automatic engine shutdown.	Check oil level, contact Service.	2.0100.922
024	SS Coolant Level	Coolant level too low (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Automatic engine shutdown.	Check coolant level in expansion tank, check for leakage and seal any leaks as necessary.	2.0152.912
030	SS Engine Overspeed	Engine overspeed (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Automatic engine shutdown.	Attempt to restart engine.	2.2510.932
044	LO Coolant Level Intercooler	Intercooler coolant level too low (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Automatic engine shutdown.	Check coolant level in expansion tank, check for leakage and seal any leaks as necessary.	2.0153.921
051	HI T-Lube Oil	Lube oil temperature too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check cooling system.	2.0125.931

Fault code no.	Designation	Meaning	Action	Setting parameter no.
052	SS T-Lube Oil	Lube oil temperature too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Automatic engine shutdown.	Check cooling system, contact Service if cooling system is in order.	2.0125.932
065	LO P-Fuel	Fuel inlet pressure too low (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check filter, check genset fuel supply.	2.0102.921
066	SS P-Fuel	Fuel inlet pressure too low (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check filter, check genset fuel supply.	2.0102.922
067	HI T-Coolant	Coolant temperature too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check cooling system.	2.0120.931
068	SS T-Coolant	Coolant temperature too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Automatic engine shutdown.	Check cooling system. Contact Service if cooling system is in order.	2.0120.932
081	AL Rail Leakage	Pressure gradient in rail too low on starting or too high on stopping, HP system leaking (alarm configuration parameter, see PR 2.8008.100 for explanation).	On stopping: Seal off system, contact Service; On starting: Check engine for leakage, if none found, attempt restarting as per operating instructions (air in system).	1.8004.046
082	HI P-Fuel (Common Rail)	Rail pressure is greater than set value (alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check HP fuel control block cabling, if no fault detected, contact Service.	2.0104.931
083	LO P-Fuel (Common Rail)	Rail pressure is less than set value (alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check HP fuel control block cabling, check HP system for leakage, if no fault detected, contact Service.	2.0104.921
089	SS Engine Speed too Low	Engine speed too low (alarm configuration parameter, see PR 2.8008.100 for explanation). Engine stop.	Check for additional messages.	2.2500.030

Fault code no.	Designation	Meaning	Action	Setting parameter no.
090	SS Idle Speed Not Reached	Idling speed not reached (alarm configuration parameter, see PR 2.8008.100 for explanation). Start terminated.	Check for additional messages.	2.1090.925
091	SS Release Speed Not Reached	Runup speed not reached (alarm configuration parameter, see PR 2.8008.100 for explanation). Start terminated.	Check for additional messages. Recharge battery. Engine under load: Check fuel supply; if no fault detected, contact Service.	2.1090.924
092	SS Starter Speed Not Reached	Starter speed not reached (alarm configuration parameter, see PR 2.8008.100 for explanation). Start terminated. Starter does not turn or turns slowly.	Check for additional messages. Recharge battery. Engine under load: Check fuel supply; if no fault detected, contact Service.	2.1090.923
093	SS T-Preheat	Preheating temperature too low (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Engine start interlock is active as coolant temperature is too low for engine start, preheating necessary.	2.1090.922
094	LO T-Preheat	Preheating temperature too low (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Engine start interlock is active as coolant temperature is too low for engine start, preheating necessary.	2.1090.921
095	AL Prelubrication Fault	Priming oil pressure not reached (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.1090.920
102	AL Fuel Cons. Counter Defect	Electronic fault: Consumption counter faulty (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace engine governor at next opportunity.	1.8004.624
104	AL Eng Hours Counter Defect	Electronic fault: Hour meter faulty (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace engine governor at next opportunity.	1.8004.623
118	LO ECU Power Supply Voltage	Supply voltage too low (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check batteries and charge as necessary; check generator.	2.0140.921

Fault code no.	Designation	Meaning	Action	Setting parameter no.
119	LOLO ECU Power Supply Voltage	Supply voltage too low (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check batteries and charge as necessary; check generator.	2.0140.922
120	HI ECU Power Supply Voltage	Supply voltage too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check batteries and generator.	2.0140.931
121	HIHI ECU Power Supply Voltage	Supply voltage too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check batteries and generator.	2.0140.932
122	HI T-ECU	Electronics temperature too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation). Warning.	Check engine room ventilation.	2.0132.921
176	AL LifeData not available	No (suitable) LifeData backup system available, backup system has no LifeData function when timeout following engine governor reset expires or CAN bus to backup system is disrupted (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.4000.004
177	AL LifeData restore incomplete	This fault message is generated when a CRC is faulty (stated for each module) or upload is incomplete during a restore data upload process (into ADEC) (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.4000.006
180	AL CAN1 Node Lost	Connection to a station on CAN bus 1 has failed (alarm configurations parameter, see PR 2.8008.100 for explanation).	Test devices connected to CAN, test cabling.	2.0500.680
181	AL CAN2 Node Lost	Connection to a station on CAN bus 2 has failed (alarm configurations parameter, see PR 2.8008.100 for explanation).	Check devices connected to CAN.	2.0500.681
182	AL CAN Wrong Parameters	Incorrect parameter values entered in data record (alarm configuration parameter, see PR 2.8008.100).		2.0500.682

Fault code no.	Designation	Meaning	Action	Setting parameter no.
183	AL CAN No PU-Data	A CAN mode has been selected in which communication with the PU data module is initialized. However, the required PU data module is unavailable or invalid (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check devices connected to CAN.	2.0500.683
184	AL CAN PU-Data Flash Error	Programming error on attempting to copy a received PU data module into the Flash module (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0500.684
186	AL CAN1 Bus Off	CAN controller 1 is in "Bus Off" state, automatic switching to CAN2 results. Causes are e.g. short circuit, massive disruptions or baud rate incompatibility (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0500.686
187	AL CAN1 Error Passive	CAN controller 1 has signalled a warning. Causes are e.g. missing listening nodes, minor disruptions and temporary bus overload (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0500.687
188	AL CAN2 Bus Off	CAN controller 2 is in "Bus Off" state, automatic switching to CAN1 results. Causes are e.g. short circuit, massive disruptions or baud rate incompatibility (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0500.688
189	AL CAN2 Error Passive	CAN controller 2 has signalled a warning. Causes are e.g. missing listening nodes, minor disruptions and temporary bus overload (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0500.689
201	SD T-Coolant	SD alarm configuration, coolant temperature sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B6), replace as necessary.	1.8004.570

Fault code no.	Designation	Meaning	Action	Setting parameter no.
202	SD T-Fuel	SD alarm configuration, fuel temperature sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B33), replace as necessary.	1.8004.572
203	SD T-Charge Air	SD alarm configuration, charge-air temperature sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B9), replace as necessary.	1.8004.571
205	SD T-Coolant Intercooler	SD alarm configuration, coolant temperature sensor of intercooler faulty, short circuit or cabling damage.	Check sensor and cabling (B26), replace as necessary.	1.8004.574
208	SD P-Charge Air	SD alarm configuration, charge-air pressure sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B10), replace as necessary.	1.8004.566
211	SD P-Lube Oil	SD alarm configuration, lube oil pressure sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B5), replace as necessary.	1.8004.563
215	SD P-HD	SD alarm configuration, rail pressure sensor faulty, HP controller in emergency mode, short circuit or cabling damage.	Check sensor and cabling (B48), replace as necessary.	1.8004.567
216	SD T-Lube Oil	SD alarm configuration, lube oil temperature sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B7), replace as necessary.	1.8004.575
219	SD T-Intake Air	SD alarm configuration, intake air temperature sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B3), replace as necessary.	1.8004.573
220	SD Level Coolant Water	SD alarm configuration, coolant level sensor faulty, short circuit or cabling damage.	Check sensor and cabling (F33), replace as necessary. Fault is rectified when electronics are switched back on	1.8004.584
223	SD Level Coolant Intercooler	SD alarm configuration, coolant level sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B57), replace as necessary. Fault is rectified when electronics are switched back on.	1.8004.583

Fault code no.	Designation	Meaning	Action	Setting parameter no.
229	AL Stop Camshaft Sensor Defect	Engine stop due to camshaft sensor fault (and a prior crankshaft sensor fault in the same operating cycle). Alarm configuration parameter, see PR 2.8008.100 for explanation.	Check connector and cabling to sensor B1, replace as necessary. Fault is rectified when engine is restarted. If camshaft and crankshaft sensor are both faulty check connector and cabling to sensor B1 and B13. Restart. Fault is rectified when engine is restarted, contact Service if this is not the case.	1.8004.562
230	SD Crankshaft Speed	SD alarm configuration, crankshaft sensor faulty, short circuit or cabling damage, engine remains operational.	Check sensor and cabling (B13), attempt restart, fault may be rectified when engine is restarted. Contact Service if this is not the case	1.8004.498
231	SD Camshaft Speed	SD alarm configuration, camshaft sensor faulty, short circuit or cabling damage, engine remains operational.	Check sensor and cabling (B1), attempt restart, fault may be rectified when engine is restarted. Contact Service if this is not the case.	1.8004.499
240	SD P-Fuel	SD alarm configuration, engine remains operational, fuel pressure sensor faulty, short circuit or cabling damage.	Check sensor and cabling (B34), replace as necessary.	1.8004.565
245	SD ECU Power Supply Voltage	SD alarm configuration, internal engine governor fault.	Execute engine governor self-test, replace engine governor in case of fault.	2.8006.589
266	SD Speed Demand	SD alarm configuration, analog speed setting faulty, short circuit or cabling damage.	Check speed setting transmitter and cabling, replace as necessary. Fault is rectified when engine is restarted.	2.8006.586
269	SD Loadp.Analog filt	SD alarm configuration, filtered analog signal of load pulse not available, short circuit or cabling damage	Check cabling, replace as necessary. Fault is rectified when engine is restarted.	2.8006.588
270	SD Frequency Input	SD alarm configuration, frequency input faulty, short circuit or cabling damage.	Contact Service.	2.8006.590

Fault code no.	Designation	Meaning	Action	Setting parameter no.
301	AL Timing Cylinder A1	Time-of-flight measuring fault injector cylinder A1: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.500
302	AL Timing Cylinder A2	Time-of-flight measuring fault injector cylinder A2 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.501
303	AL Timing Cylinder A3	Time-of-flight measuring fault injector cylinder A3: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.502
304	AL Timing Cylinder A4	Time-of-flight measuring fault injector cylinder A4 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.503
305	AL Timing Cylinder A5	Time-of-flight measuring fault injector cylinder A5 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.504
306	AL Timing Cylinder A6	Time-of-flight measuring fault injector cylinder A6 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.505
307	AL Timing Cylinder A7	Time-of-flight measuring fault injector cylinder A7 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.506

Fault code no.	Designation	Meaning	Action	Setting parameter no.
308	AL Timing Cylinder A8	Time-of-flight measuring fault injector cylinder A8 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.507
309	AL Timing Cylinder A9	Time-of-flight measuring fault injector cylinder A9 Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.508
310	AL Timing Cylinder A10	Time-of-flight measuring fault injector cylinder A10: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.509
311	AL Timing Cylinder B1	Time-of-flight measuring fault injector cylinder B1: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.510
312	AL Timing Cylinder B2	Time-of-flight measuring fault injector cylinder B2: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.511
313	AL Timing Cylinder B3	Time-of-flight measuring fault injector cylinder B3: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	18004.512
314	AL Timing Cylinder B4	Time-of-flight measuring fault injector cylinder B4: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.513

Fault code no.	Designation	Meaning	Action	Setting parameter no.
315	AL Timing Cylinder B5	Time-of-flight measuring fault injector cylinder B5: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.514
316	AL Timing Cylinder B6	Time-of-flight measuring fault injector cylinder B6: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.515
317	AL Timing Cylinder B7	Time-of-flight measuring fault injector cylinder B7: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.516
318	AL Timing Cylinder B8	Time-of-flight measuring fault injector cylinder B8: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.517
319	AL Timing Cylinder B9	Time-of-flight measuring fault injector cylinder B9: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.518
320	AL Timing Cylinder B10	Time-of-flight measuring fault injector cylinder B10: Time-of-flight value measured extremely small or large (alarm configuration parameter, see PR 2.8008.100 for explanation).	Replace plug-in pump if this occurs frequently.	1.8004.519
321	AL Wiring Cylinder A1	Cabling fault in injector cabling cylinder A1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.520

Fault code no.	Designation	Meaning	Action	Setting parameter no.
322	AL Wiring Cylinder A2	Cabling fault in injector cabling cylinder A2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.521
323	AL Wiring Cylinder A3	Cabling fault in injector cabling cylinder A3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.522
324	AL Wiring Cylinder A4	Cabling fault in injector cabling cylinder A4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.523
325	AL Wiring Cylinder A5	Cabling fault in injector cabling cylinder A5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.524
326	AL Wiring Cylinder A6	Cabling fault in injector cabling cylinder A6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.525
327	AL Wiring Cylinder A7	Cabling fault in injector cabling cylinder A7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.526

Fault code no.	Designation	Meaning	Action	Setting parameter no.
328	AL Wiring Cylinder A8	Cabling fault in injector cabling cylinder A8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.527
329	AL Wiring Cylinder A9	Cabling fault in injector cabling cylinder A9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.528
330	AL Wiring Cylinder A10	Cabling fault in injector cabling cylinder A10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.529
331	AL Wiring Cylinder B1	Cabling fault in injector cabling cylinder B1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.530
332	AL Wiring Cylinder B2	Cabling fault in injector cabling cylinder B2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.531
333	AL Wiring Cylinder B3	Cabling fault in injector cabling cylinder B3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.532

Fault code no.	Designation	Meaning	Action	Setting parameter no.
334	AL Wiring Cylinder B4	Cabling fault in injector cabling cylinder B4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.533
335	AL Wiring Cylinder B5	Cabling fault in injector cabling cylinder B5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.534
336	AL Wiring Cylinder B6	Cabling fault in injector cabling cylinder B6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004535
337	AL Wiring Cylinder B7	Cabling fault in injector cabling cylinder B7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.536
338	AL Wiring Cylinder B8	Cabling fault in injector cabling cylinder B8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.537
339	AL Wiring Cylinder B9	Cabling fault in injector cabling cylinder B9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.538

Fault code no.	Designation	Meaning	Action	Setting parameter no.
340	AL Wiring Cylinder B10	Cabling fault in injector cabling cylinder B10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004539
341	AL Open Load Cylinder A1	Disruption fault in injector cabling cylinder A1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.540
342	AL Open Load Cylinder A2	Disruption fault in injector cabling cylinder A2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.541
343	AL Open Load Cylinder A3	Disruption fault in injector cabling cylinder A3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.542
344	AL Open Load Cylinder A4	Disruption fault in injector cabling cylinder A4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.543
345	AL Open Load Cylinder A5	Disruption fault in injector cabling cylinder A5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.544
346	AL Open Load Cylinder A6	Disruption fault in injector cabling cylinder A6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.545

Fault code no.	Designation	Meaning	Action	Setting parameter no.
347	AL Open Load Cylinder A7	Disruption fault in injector cabling cylinder A7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.546
348	AL Open Load Cylinder A8	Disruption fault in injector cabling cylinder A8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.547
349	AL Open Load Cylinder A9	Disruption fault in injector cabling cylinder A9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.548
350	AL Open Load Cylinder A10	Disruption fault in injector cabling cylinder A10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.549
351	AL Open Load Cylinder B1	Disruption fault in injector cabling cylinder B1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.550
352	AL Open Load Cylinder B2	Disruption fault in injector cabling cylinder B2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.551
353	AL Open Load Cylinder B3	Disruption fault in injector cabling cylinder B3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.552

Fault code no.	Designation	Meaning	Action	Setting parameter no.
354	AL Open Load Cylinder B4	Disruption fault in injector cabling cylinder B4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.553
355	AL Open Load Cylinder B5	Disruption fault in injector cabling cylinder B5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.554
356	AL Open Load Cylinder B6	Disruption fault in injector cabling cylinder B6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.555
357	AL Open Load Cylinder B7	Disruption fault in injector cabling cylinder B7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.556
358	AL Open Load Cylinder B8	Disruption fault in injector cabling cylinder B8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.557
359	AL Open Load Cylinder B9	Disruption fault in injector cabling cylinder B9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.558
360	AL Open Load Cylinder B10	Disruption fault in injector cabling cylinder B10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector cabling, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.559

Fault code no.	Designation	Meaning	Action	Setting parameter no.
361	AL Power Stage Low	Internal electronic fault (electronics may be defective). If parameter 1.1020.021 (Power Stage Failure: Stop Engine) is set, engine is stopped here additionally (alarm configuration parameter, see PR 2.8008.100 for explanation).	Start engine governor self-test. Replace engine governor in case of fault; if self-test diagnoses "Electronics OK" check for additional fault messages (e.g. cabling fault).	1.8004.496
362	AL Power Stage High	Internal electronic fault (electronics may be defective). If parameter 1.1020.021 (Power Stage Failure: Stop Engine) is set, engine is stopped here additionally (alarm configuration parameter, see PR 2.8008.100 for explanation).	Start engine governor self-test. Replace engine governor in case of fault; if self-test diagnoses "Electronics OK" check for additional fault messages (e.g. cabling fault).	1.8004.497
363	AL Stop Power Stage	Internal electronic fault (electronics may be defective). If parameter 1.1020.021 (Power Stage Failure: Stop Engine) is set, engine is stopped here additionally (alarm configuration parameter, see PR 2.8008.100 for explanation).	Start engine governor self-test. Replace engine governor in case of fault; if self-test diagnoses "Electronics OK" check for additional fault messages (e.g. cabling fault).	1.8004.560
365	AL Stop MV-Wiring Ground	Injector cabling fault. Engine stop configurable (alarm configuration parameter, see PR 2.8008.100 for explanation). Possible causes: 1. Injector positive connection of one or more injectors shorting to ground. 2. Injector negative connection of one or more injectors shorting to ground.	Check cabling, replace wiring harness as necessary.	1.8004.561
381	AL Wiring TOP 1	Short circuit or line break at transistor output 1 plant side (TOP 1, alarm configurations parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.638
382	AL Wiring TOP 2	Short circuit or line break at transistor output 2 plant side (TOP 2, alarm configurations parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.639
383	AL Wiring TOP 3	Short circuit or line break at transistor output 3 plant side (TOP 3, alarm configurations parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.640

Fault code no.	Designation	Meaning	Action	Setting parameter no.
384	AL Wiring TOP 4	Short circuit or line break at transistor output 4 plant side (TOP 4, alarm configurations parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.641
390	AL MCR exceeded	DBR/MCR function: MCR (maximum continuous rate) exceeded. Engine power is limited to admissible continuous power (alarm configuration parameter, see PR 2.8008.100 for explanation).	None.	1.1085.009
400	AL Open Load Digital Input 1	Line disruption at digital input 1, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.625
401	AL Open Load Digital Input 2	Line disruption at digital input 2, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.626
402	AL Open Load Digital Input 3	Line disruption at digital input 3, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.627
403	AL Open Load Digital Input 4	Line disruption at digital input 4, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.628
404	AL Open Load Digital Input 5	Line disruption at digital input 5, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.629
405	AL Open Load Digital Input 6	Line disruption at digital input 6, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.630
406	AL Open Load Digital Input 7	Line disruption at digital input 7, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.631

Fault code no.	Designation	Meaning	Action	Setting parameter no.
407	AL Open Load Digital Input 8	Line disruption at digital input 8, cabling faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check cabling	2.8006.632
408	AL Open Load Emerg. Stop Input ESI	Line disruption at input for emergency stop, cabling faulty or no resistance via switch	Check cabling	2.8006.633
410	LO U-PDU	Injector voltage too low (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Execute engine governor self-test, replace engine governor in case of fault.	2.0141.921
411	LOLO U-PDU	Injector voltage too low (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Execute engine governor self-test, replace engine governor in case of fault.	2.0141.922
412	HI U-PDU	Injector voltage too high (limit value 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Execute engine governor self-test, replace engine governor in case of fault.	2.0141.931
413	HIHI U-PDU	Injector voltage too high (limit value 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Execute engine governor self-test, replace engine governor in case of fault.	2.0141.932
444	SD U-PDU	SD alarm configuration, sensor fault at injector output stage. Engine governor internal fault. Engine governor replacement.	Replace engine governor.	1.8004.578
450	SD Idle/End-Torque Input [%]	SD alarm configuration, input signal for initial/final torque faulty, short circuit or cabling damage	Check signal transmitter and cabling, replace as necessary. Fault is rectified when engine is restarted.	2.8006.592
454	SS Power Reduction Active	Power reduction activated, engine operating outside standard limits. The following variables may also combine to lead to this message: Intake depression, exhaust back pressure, charge-air coolant temperature, intake air temperature. Alarm configuration parameter, see PR 2.8008.100 for explanation.	None.	2.7000.011

Fault code no.	Designation	Meaning	Action	Setting parameter no.
463	SD AUX 2	SD alarm configuration, analog input signal for Aux 2 faulty, short circuit or cabling damage.	Check signal transmitter and cabling, replace as necessary.	1.8004.591
464	SD P-AUX 1	SD alarm configuration, analog input signal for pressure Aux 1 faulty, short circuit or cabling damage.	Check pressure transmitter and cabling, replace as necessary.	1.8004.589
468	SD T-AUX 1	Analog input for temperature Aux 1 faulty, short circuit or cabling damage	Check signal transmitter and cabling, replace as necessary.	1.8004.579
469	SD AUX 1	SD alarm configuration, analog input signal for Aux 1 faulty, short circuit or cabling damage.	Check signal transmitter and cabling, replace as necessary.	1.8004.590
470	SD T-ECU	Engine governor faulty.	Replace engine governor at next opportunity.	1.8004.587
471	SD Coil Current	SD alarm configuration, HP fuel control block activation, short circuit or cabling damage.	Check sensor and cabling, replace as necessary. Fault is rectified when engine is restarted.	1.8004.592
472	AL Stop SD	Engine stop as shutdown channels have "sensor fault" (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.8006.593
474	AL Wiring FO	Line break or short circuit at channel FO (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.8006.655
475	AL CR Trigger Engine Stop	Tripped by crash recorder triggering due to engine shutdown.	Replace engine governor at next opportunity.	1.8010.009
476	AL Crash Rec. Init. Error	Crash recorder initialization error.	Contact Service.	1.8010.007
478	AL Comb. Alarm Yel (Plant)	YELLOW combined alarm from plant (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.8006.001
479	AL Comb. Alarm Red (Plant)	RED combined alarm from plant (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.8006.002

Fault code no.	Designation	Meaning	Action	Setting parameter no.
480	AL Ext. Engine Protection	External engine protection feature active (alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0291.921
555	AL Call MTU Field Service	Power reduction caused by maintenance feature (maintenance concept, alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0555.001

6 Task Description

6.1 Engine

6.1.1 Engine – Barring manually

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Barring tool for 12V engines	F6558556	1
Barring tool for 16/18V engines	F6558557	1



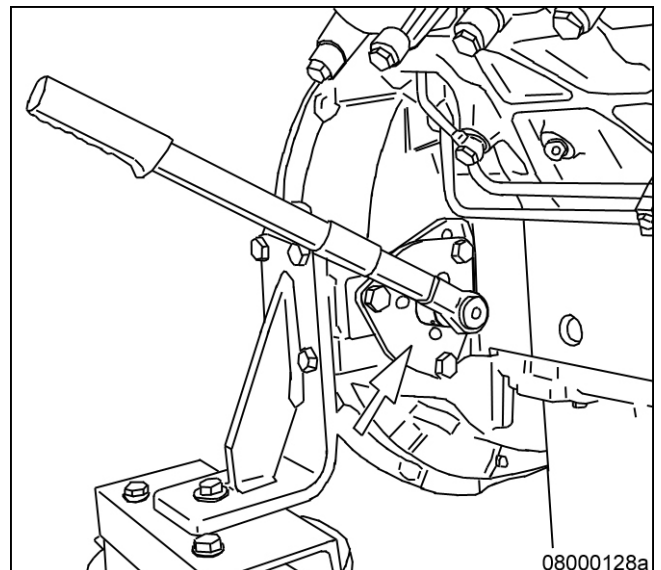
Unguarded rotating and moving engine components.

Risk of serious injury - danger to life!

- Before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

Engine – Barring manually

1. Remove cover from flywheel housing.
2. Install barring tool (arrow) on flywheel housing.
3. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no abnormal resistance.
Result: If the resistance exceeds the normal compression resistance, contact Service.
4. For barring-tool removal follow reverse sequence of working steps.



6.1.2 Engine - Barring with starting system

Preconditions

- External pushbutton “Bar engine without starting” is provided.



DANGER

Unguarded rotating and moving engine components.

Risk of serious injury - danger to life!

- Before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

Engine - Barring with starting system

1. Press pushbutton “Bar engine without starting” and keep depressed.
2. Let the crankshaft rotate until oil pressure is indicated, but not longer than 10 seconds.
3. Repeat this procedure after approx. 20 seconds if required.

6.1.3 Engine test run



Unguarded rotating and moving engine components.

Risk of serious injury — danger to life!

- Before barring or starting the engine, ensure that nobody is in the danger zone.



Engine noise above 85 dB (A).

Risk of damage to hearing!

- Wear ear protectors.

Engine test run

1. Start engine (→ Page 49).
2. Perform test run at not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks (→ Page 51).
4. Stop engine (→ Page 52).

6.2 Cylinder Liner

6.2.1 Cylinder liner – Endoscopic examination

Preconditions

- Engine is stopped and starting disabled.

Special tools

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

Preparatory steps

1. Remove cylinder-head cover (→ Page 102).
2. Remove injector (→ Page 108).

Positioning crankshaft at BDC

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

Cylinder liner - Endoscopic examination

Findings	Task
<ul style="list-style-type: none"> • Thin carbon coating on carbon scraper ring • Slight localized additive deposits at top edge • Localized smooth areas at lower edge • Carbon deposits on entire circumference between top piston ring and lower edge of carbon scraper ring • First signs of marks left by top piston ring • Bright mark on entire circumference • Faultless, even honing pattern • First signs of marks left by lower cooling bores • Running pattern seems darker 	No actions required
<ul style="list-style-type: none"> • Darker areas of even or varying color intensity • Beginning and end of the discoloration are not sharply defined and do not cover the entire stroke area • Dark areas in the upper section of the cooling bore, remaining circumference cannot be faulted • Piston rings cannot be faulted 	Further endoscopic examination required as part of maintenance work
<ul style="list-style-type: none"> • On the entire circumference not only bright discoloration (not critical for operation) clearly visible darker stripes that begin at the top piston ring • Heat discoloration in the direction of stroke and honing pattern damage • Heat discoloration of piston rings 	Cylinder liner must be replaced; Service must be contacted

1. Compile endoscopy report using the table.
2. Use technical terms for description of the liner surface (→ Page 94).
3. Depending on findings:
 - Do not take any action or
 - carry out further endoscopic examination as part of maintenance work or
 - contact Service: cylinder liner must be replaced.

Final steps

1. Install injector (→ Page 108).
2. Install cylinder-head cover (→ Page 102).

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

Terms used for endoscopic examination

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

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

Evaluation of findings and further measures

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

6.3 Crankcase Ventilation

6.3.1 Crankcase breather – Oil separator replacement, diaphragm check and replacement

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Torque wrench 6-50 Nm	F30027336	1

Spare parts

Designation / Use	Part No.	Qty.
Filter element		
Diaphragm		
Seal		



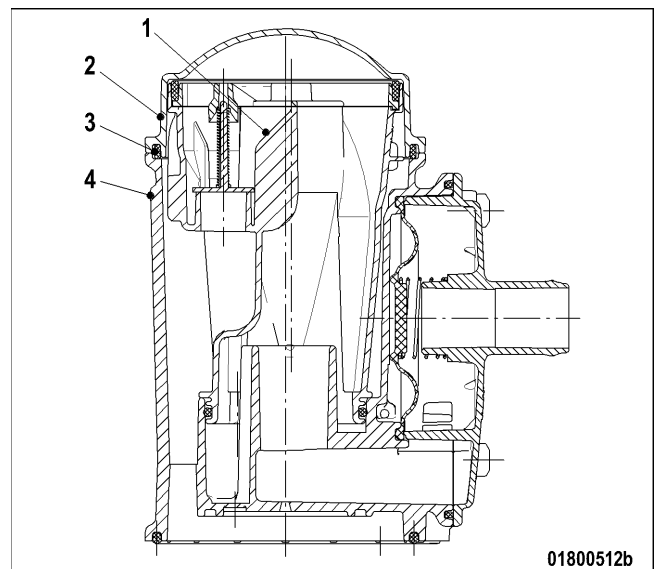
Hot oil.
Oil can contain combustion residues which are harmful to health.

Risk of injury and poisoning!

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

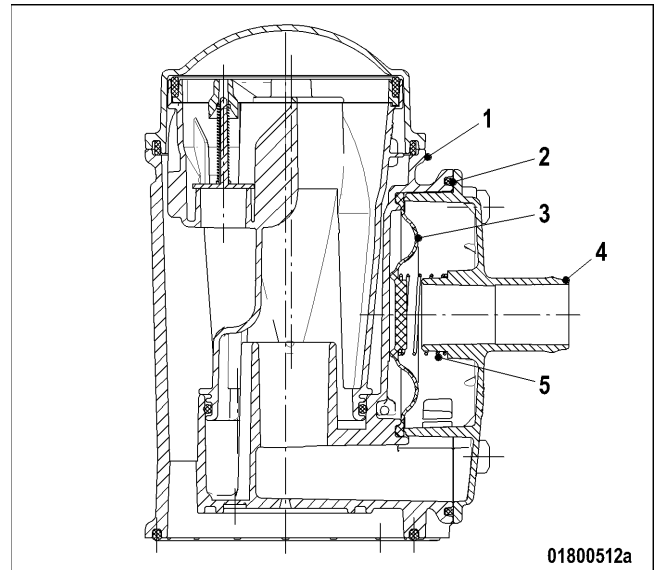
Replacing oil separator

1. Remove cover (2) with O-ring (3).
2. Remove filter element (1) from housing (4).
3. Insert new filter element in housing (4).
4. Fit cover (2) with new O-ring.
5. Use torque wrench to tighten the screws of cover (2) to specified torque 10 Nm -2 Nm.
6. Replace further oil separator elements in the same way.



Checking diaphragm

1. Remove cover (4).
2. Take off spring (5), seal (2) and diaphragm (3).
3. Check diaphragm (3) for damage, fit new diaphragm if used one is damaged.
4. Mount diaphragm (3) on housing (1).
5. Install new seal (2) and spring (5) together with cover (4).
6. Use torque wrench to tighten the screws of cover (4) to specified torque 10 Nm -2 Nm.
7. Check diaphragms in further oil separators in the same way.



6.3.2 Crankcase breather – Wire mesh cleaning

Material

Designation / Use	Part No.	Qty.
Cleaner		
Diesel fuel		
Petroleum jelly		

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		



Fuels are combustible.

Risk of fire and explosion!

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



Compressed air.

Risk of injury!

- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.



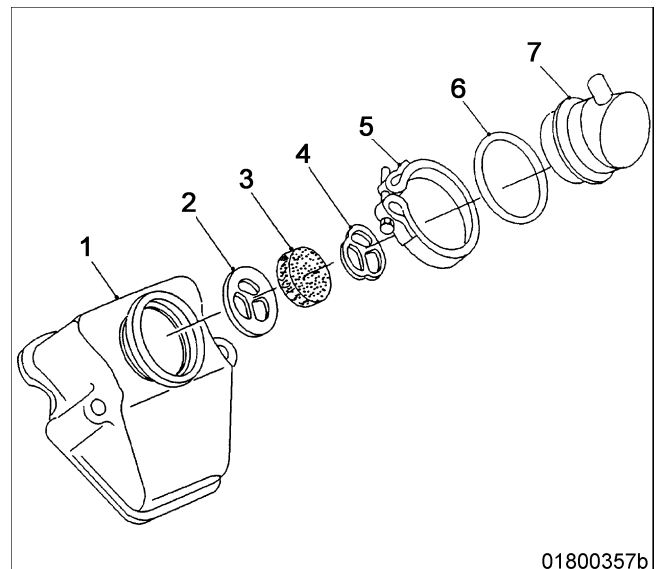
Excessive reaction time of cleaning agents on components.

Damage to component!

- Observe manufacturer's instructions.
- Wear protective clothing, gloves, and goggles / safety mask.

Crankcase breather – Wire mesh cleaning

1. Remove hose.
2. Loosen clamp (5).
3. Remove oil separator cover (7).
4. Remove individual parts from oil separator cover (7).
5. Wash filter element (wire mesh) (3) with diesel fuel.
6. Blow out filter element (wire mesh) (3) with compressed air.
7. Clean residual parts with cleaner.
8. Remove cleaner.
9. Coat sealing ring (6) with petroleum jelly and insert in groove in the oil separator cover (7).
10. Insert both holders (2, 4) and filter element (wire mesh) (3) into the oil separator cover (7), ensuring correct installation sequence.
11. Install oil separator cover (7) with clamp (5) on cylinder head cover (1).
12. Install hose, ensuring that it is not subjected to tension.



01800357b

6.4 Valve Drive

6.4.1 Valve clearance – Check and adjustment

Preconditions

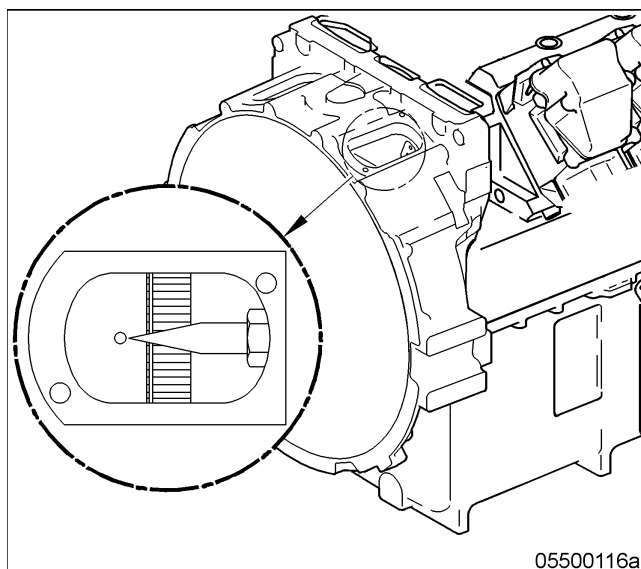
- Engine is stopped and starting disabled.
- Engine coolant temperature is max. 40 °C.
- Valves are closed.

Special tools

Designation / Use	Part No.	Qty.
Feeler gauge	Y4342013	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1

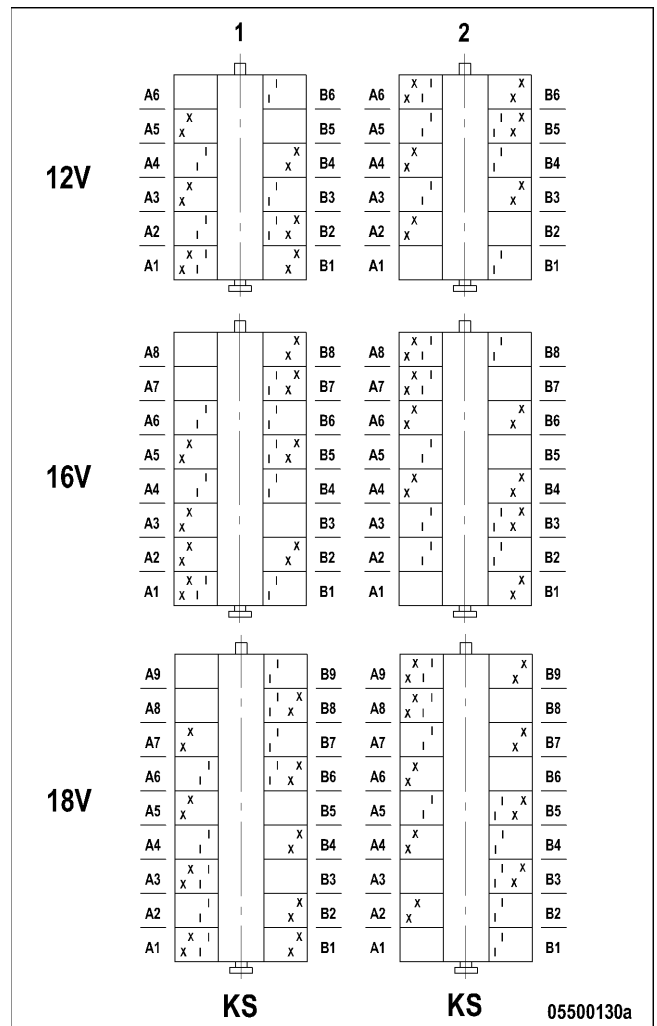
Preparatory steps

1. Remove cylinder head cover (→ Page 102).
2. Bar engine with barring tool in engine direction of rotation (→ Page 89) until the marks are aligned.



Checking valve clearance at two crankshaft positions

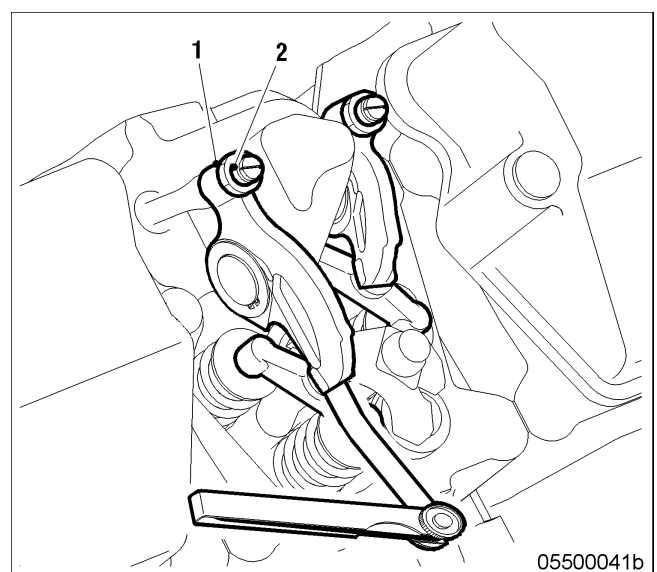
1. Check TDC position of piston in cylinder A1:
 - If the rocker arms are not under load on cylinder A1, the piston is in firing TDC.
 - If the rocker arms are under load on cylinder A1, the piston is in overlap TDC.
2. Check valve clearance with cold engine:
 - Inlet = 0.4 mm;
 - Exhaust = 0.6 mm;
3. Check all valve clearances at two crankshaft positions (firing and overlap TDC for cylinder A1) as per diagram.
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.



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

Adjusting valve clearance

1. Loosen locknut (1) and unscrew adjusting screw (2) by a few threads.
2. Insert feeler gauge between valve bridge and rocker arm.
3. Readjust adjusting screw (2) so that the feeler gauge just passes through the gap.
4. Tighten locknut (1) to 50 Nm, holding adjusting screw (2) firmly.
5. Check if the feeler gauge just passes through between valve bridge and rocker arm.
 Result: If not, adjust valve clearance.



Final steps

1. Remove barring tool.
2. Install cylinder head cover (→ Page 102).
3. Install plug.

6.4.2 Cylinder-head cover – Removal and installation

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Torque wrench 8-40 Nm	F30043446	1
Ratchet adapter	F30027340	1

Spare parts

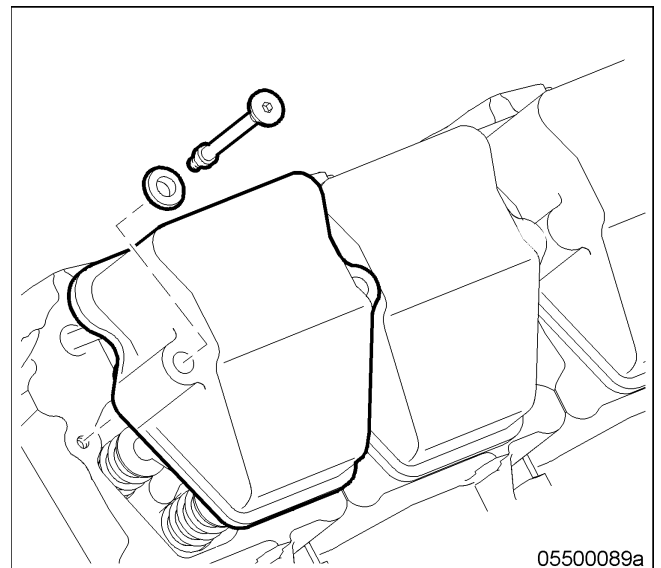
Designation / Use	Part No.	Qty.
Gasket		

Preparatory steps

1. On cylinder-head covers with crankcase breather: Loosen clamps.
2. Slide rubber sleeves onto the pipe.

Cylinder-head cover – Removal and installation

1. Remove screws.
2. Remove cylinder-head cover with gasket from cylinder head.
3. Clean mating faces.
4. Check condition of gasket in cylinder-head cover.
5. Replace damaged gasket(s).
6. Place cylinder-head covers onto crankcase and tighten screws to 20 Nm.



Final steps

1. Slide rubber sleeves onto the relevant pipe connection.
2. Tighten all clamps.

6.5 Injection Pump / H.P. Pump

6.5.1 Injection pump replacement

Spare parts

Designation / Use	Part No.	Qty.
Injection pump		

Remove injection pump and install new one (→ Page 104).

6.5.2 Injection pump – Removal and installation

Preconditions

- Engine is stopped and starting disabled.

Special tools



Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1
Adapter	F30006234	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot wrench, 22 mm	F30027425	1
Torque wrench, 0.5-5 Nm	0015384230	1

Material

Designation / Use	Part No.	Qty.
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		
Sealing ring		

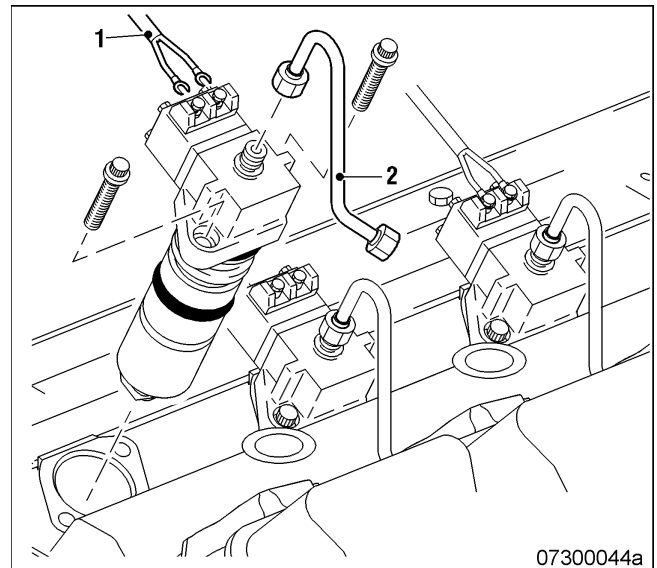
 DANGER	Unguarded rotating and moving engine components. Risk of serious injury — danger to life! <ul style="list-style-type: none"> • Before barring the engine, ensure that nobody is in the danger zone.
 WARNING	Fuels are combustible. Risk of fire and explosion! <ul style="list-style-type: none"> • Avoid naked flames, electrical sparks and ignition sources. • Do not smoke.

Preparatory steps

1. Shut off fuel supply line before fuel filter.
2. Remove engine control system (→ Page 155).
3. Drain fuel (→ Page 114).
4. Remove charge-air manifolds and all seals.

Removing injection pump

1. Mark installation position of injection pump.
2. Disconnect wiring (1) from injection pump.
3. Remove fuel line (2).
4. Unscrew securing screws of injection pump by approx. 6 mm.
 - The pretensioned compression spring presses the injection pump out of the crankcase, if not:
 - 4.1. Turn crankshaft using barring device (→ Page 89)
 - The pump cam presses the injection pump out of the crankcase, if not:
 - 4.2. Carefully press out injection pump at the recess in the injection pump head.
5. Remove injection pump securing screws.
6. Remove injection pump.
7. Remove sealing rigs from injection pump.
8. Seal all openings with appropriate covers after removal.

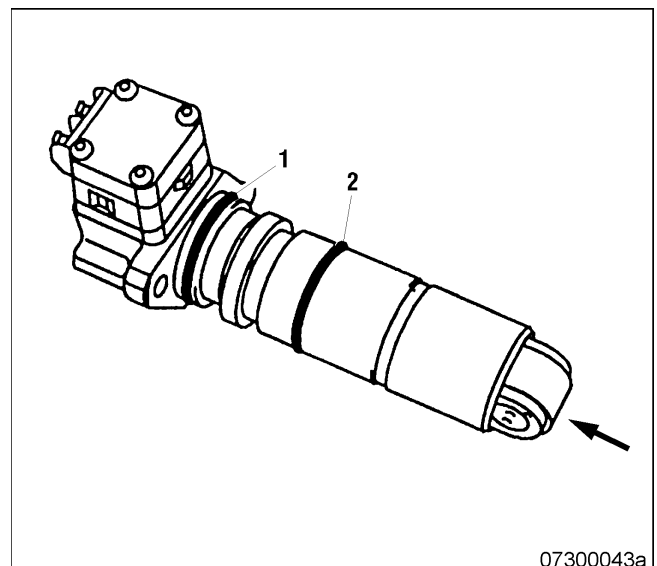


Installing injection pump

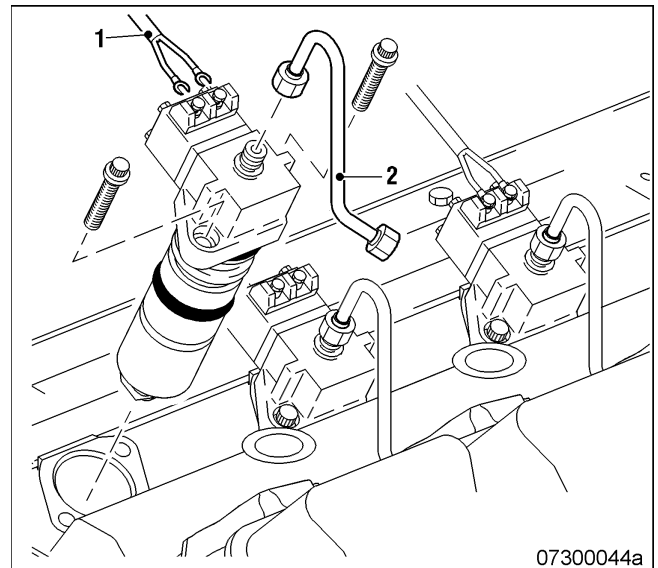
1. Remove all blanking plugs and covers.
2. Clean mating face of injection pump and roller.

Note: Sealing ring (1) Ø47 mm
3. Coat sealing ring (1) with grease and fit onto injection pump.

Note: Sealing ring (2) Ø45 mm
4. Coat sealing ring (2) with grease and fit onto injection pump.
5. Coat roller (arrowed) with engine oil.
6. Clean sealing face and fuel bores in crankcase.
7. Using barring device, set pump cam on camshaft to base circle (→ Page 89)



8. Install injection pump, observing marked installation position.
9. Install securing screws of injection pump and tighten with torque wrench to specified torque 60 Nm +12 Nm.
10. Install fuel line (2).
11. Use torque wrench to tighten union nut at injection pump to specified torque 35 Nm +3 Nm.
12. Use torque wrench to tighten union nut on pressure pipe neck to specified torque 35 Nm +3 Nm.
13. Install injection pump wiring (1).
14. Tighten screws to specified torque 1.0 Nm \pm 0.2 Nm using torque wrench.



Final steps

1. Remove barring device (→ Page 89).
2. Clean mating faces on cylinder head and charge-air manifold.
3. Check gaskets for damage and replace them, if required.
4. Coat gaskets with grease and place onto cylinder head.
5. Install charge-air manifolds.
6. Install engine control system (→ Page 155).
7. Open fuel supply line before fuel filter.
8. Vent fuel system (→ Page 115).

6.6 Injector

6.6.1 Injector – Replacement

Spare parts

Designation / Use	Part No.	Qty.
Injector		

Remove injector and install new one (→ Page 108).

6.6.2 Injector – Removal and installation

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Impact extractor	F30377999	1
Fuel suction device	F30378207	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1
Adapter	F30006234	1
Open end socket wrench	F30025897	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot wrench, 22 mm	F30027425	1
Double box wrench	F30011450	1

Material

Designation / Use	Part No.	Qty.
Grease (Kluthé Hakuform 30-10/Emulgier)	X00029933	

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		
Sealing ring		



WARNING

Fuels are combustible.

Risk of fire and explosion!

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



WARNING

Compressed air.

Risk of injury!

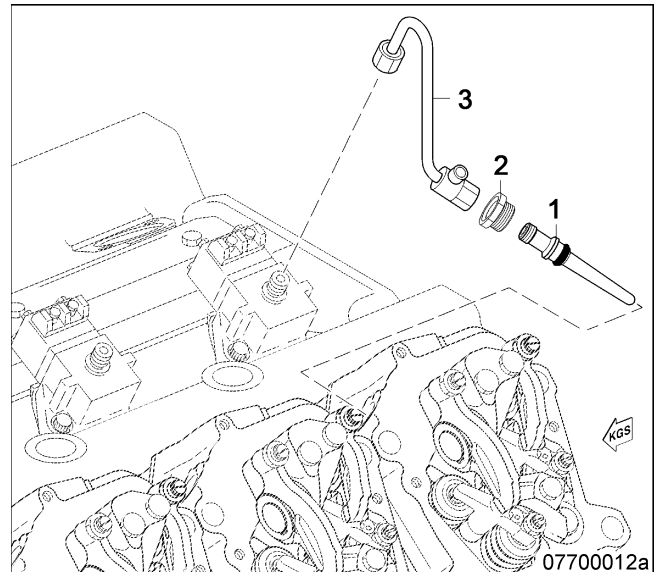
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

Preparatory steps

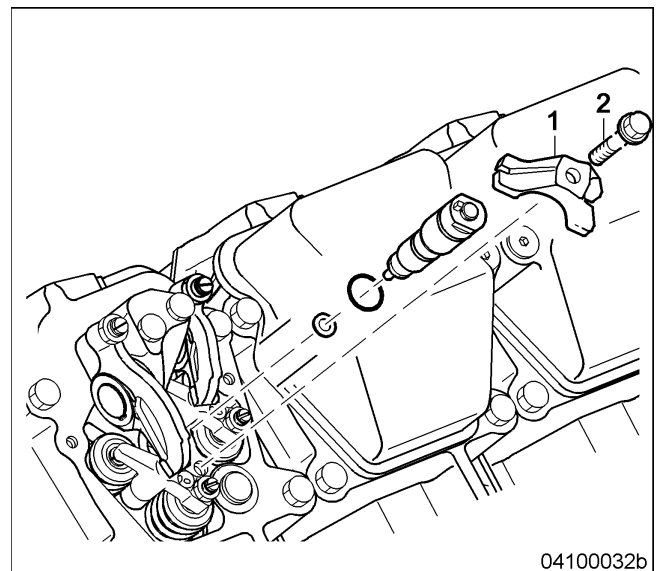
1. Remove cylinder head cover (→ Page 102).
2. Drain fuel (→ Page 114).

Removing injector

1. Remove leak-off-fuel lines.
2. Remove fuel line (3).
3. Remove thrust screw (2).
4. Pull off pressure pipe neck (1).
5. Extract fuel from the exposed bores using the suction device.



6. Remove screw (2).
7. Take off clamp (1).
8. Screw extractor into injector.
9. Remove injector using the extractor.
10. Remove sealing ring using a self-made hook.
11. Seal all openings with appropriate covers after removal.



Installing injector

1. Remove all covers before installation.
2. Clean sealing surface on cylinder head and protective sleeve.
3. Coat sealing ring (1) with grease and fit onto injector.
4. Coat sealing ring (2) with grease and fit onto injector.
5. Press injector into cylinder head by hand.

Result:

- The pin is at 11-o'clock position to the transversal axis of the engine.
- The pin is engaged in the groove of the clamp (4).

6. Install clamp (4) with screw (5), positioning it correctly.

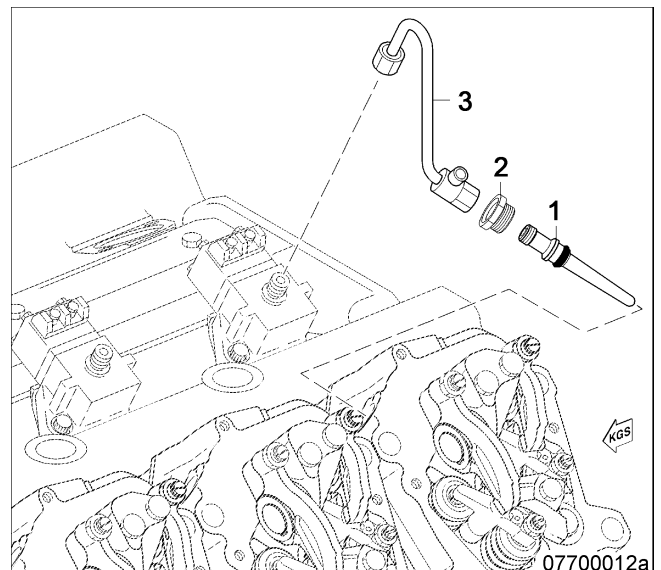
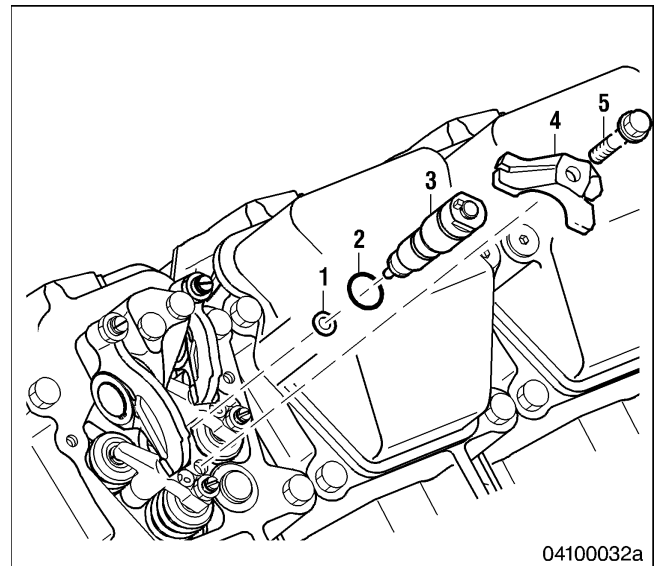
Result:

- Pin at injector is in the groove of the clamp.
- Forked clamp end is engaged in the cover recess.

7. Tighten screw (5) of the clamp by hand.

Result: Injector can still be rotated.

8. Blow out fuel line (3) and pressure pipe neck (1) with compressed air.
9. Coat sealing ring with grease and fit onto pressure pipe neck (1).
10. Coat sealing cone of pressure pipe neck with engine oil.
11. Insert pressure pipe neck into cylinder head until the sealing ring is in contact with cylinder head.
12. Fully press in pressure pipe neck (1) by hand.
13. Tighten thrust screw (2) to specified torque 40 Nm \pm 5 Nm using torque wrench.
14. Use torque wrench to tighten screw for clamp at injector to specified torque 50 Nm.
15. Install fuel line (3).
16. Use torque wrench to tighten union nut at injection pump to specified torque 35 Nm +3 Nm.
17. Use torque wrench to tighten union nut on pressure pipe neck to specified torque 35 Nm +3 Nm.
18. Install leak-off-fuel lines.



Final steps

1. Install cylinder head cover (→ Page 102).
2. Vent fuel system (→ Page 115).

6.7 Fuel System

6.7.1 Fuel injection line – Pressure pipe neck replacement

Preconditions

- Engine is stopped and starting disabled.

Special tools


Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1
Adapter	F30006234	1
Socket wrench, 19 mm	F30025897	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot wrench, 22 mm	F30027425	1
Double box wrench	F30011450	1


Material

Designation / Use	Part No.	Qty.
Grease (Kluth Hakuform 30-10/Emulgier)	X00029933	
Engine oil		

Spare parts

Designation / Use	Part No.	Qty.
Pressure pipe neck		

 WARNING	Fuels are combustible. Risk of fire and explosion! <ul style="list-style-type: none"> • Avoid naked flames, electrical sparks and ignition sources. • Do not smoke.
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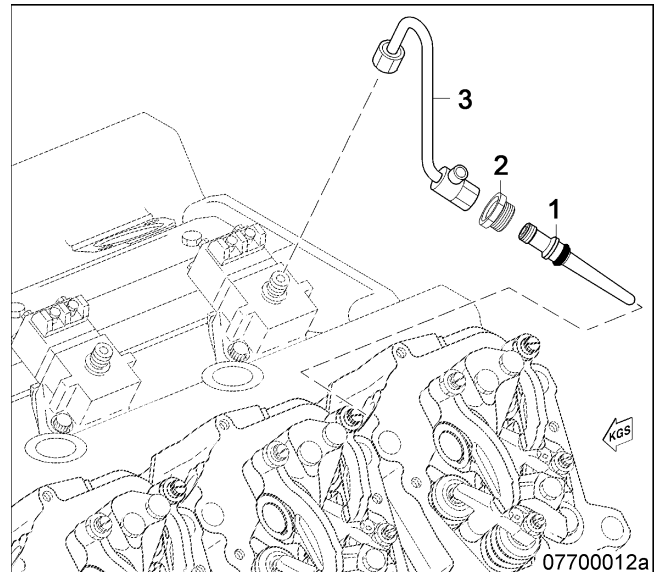
 WARNING	Compressed air. Risk of injury! <ul style="list-style-type: none"> • Do not direct compressed-air jet at persons. • Wear protective goggles / safety mask and ear protectors.
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Preparatory steps

1. Remove cylinder head cover (→ Page 102).
2. Drain fuel (→ Page 114).

Replacing pressure pipe neck

1. Remove fuel line (3).
2. Remove thrust screw (2).
3. Pull off pressure pipe neck (1).
4. Coat sealing ring with grease and fit on new pressure pipe neck (1).
5. Blow out fuel line (3) with compressed air.
6. Coat sealing cone of pressure pipe neck with engine oil.
7. Insert pressure pipe neck into cylinder head until the sealing ring is in contact with cylinder head.
8. Fully press in pressure pipe neck (1) by hand.
9. Tighten thrust screw (2) to specified torque 40 Nm +5 Nm using torque wrench.
10. Install fuel line (3).
11. Use torque wrench to tighten union nut at injection pump to specified torque 35 Nm +3 Nm.
12. Use torque wrench to tighten union nut on pressure pipe neck to specified torque 35 Nm +3 Nm.



Final steps

1. Install cylinder head cover (→ Page 102).
2. Vent fuel system (→ Page 115).

6.7.2 Fuel pressure maintaining valve – Removal and installation

Preconditions

- Engine is stopped and starting disabled.

Spare parts

Designation / Use	Part No.	Qty.
Pressure relief valve		
Sealing ring		
Sealing ring		



WARNING

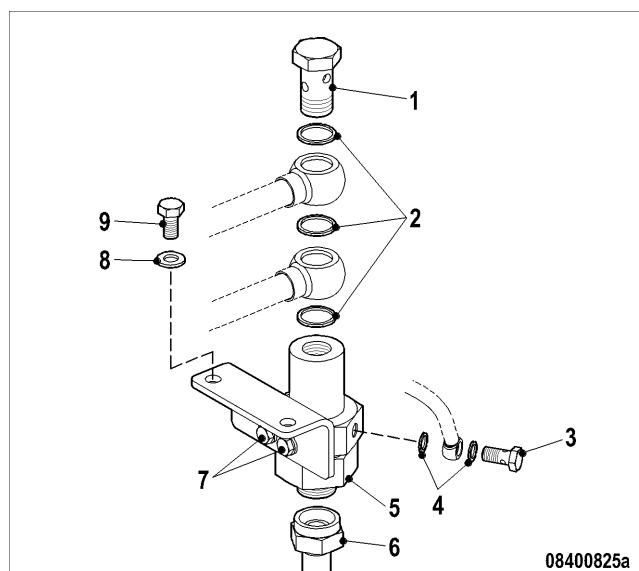
Fuels are combustible.

Risk of fire and explosion!

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

Fuel pressure maintaining valve – Removal and installation

1. Shut off fuel supply.
2. Remove fuel line (6).
3. Remove banjo screws (1) and (3).
4. Remove sealing rings (2) and (4).
5. Remove screws (9) with washer (8).
6. Remove screws (7) and take off holder.
7. Install new pressure relief valve (5) with new sealing rings (2) and (4), following the reverse sequence of working steps.
8. Open fuel supply.



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6.7.3 Fuel – Draining

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Torque wrench, 8 - 40 Nm	F30043446	1
Socket wrench	F30028341	1



WARNING

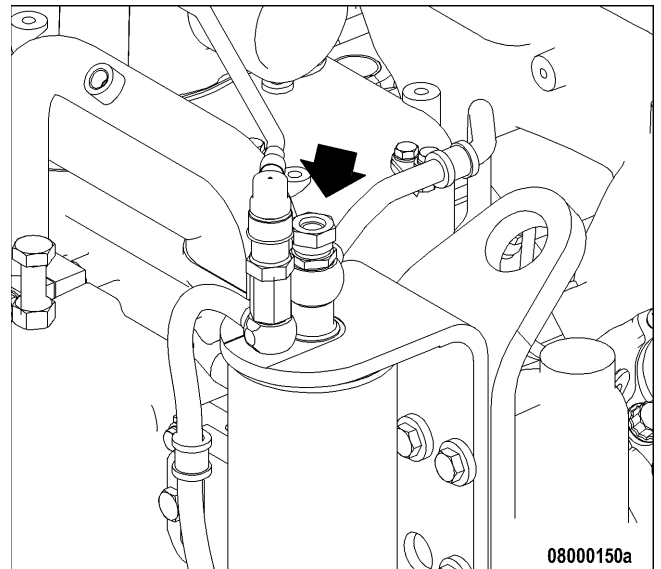
Fuels are combustible.

Risk of fire and explosion!

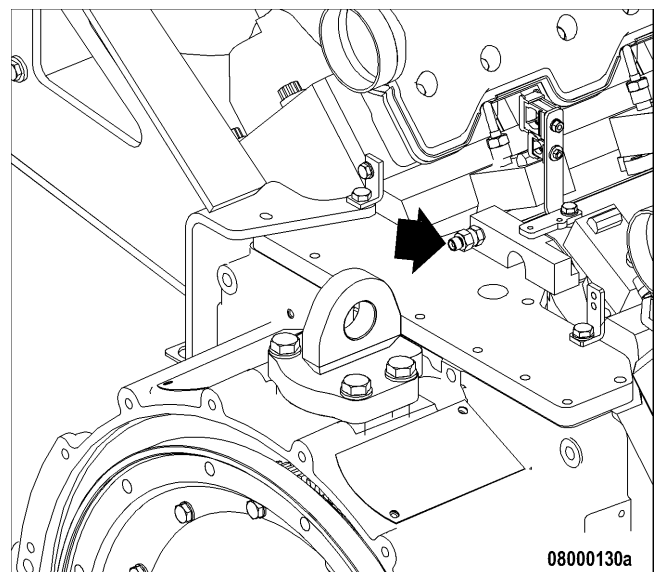
- Avoid naked flames, electrical sparks and ignition sources.
- Do not smoke.

Draining fuel

1. Loosen nut (arrow) on banjo union.



2. Remove fuel line from non-return valve.
3. Unscrew non-return valve on end piece (arrow) and drain fuel into a suitable container.
4. If fuel no longer emerges, install non-return valve and tighten with torque wrench to the specified tightening torque 10 Nm +1 Nm.
5. Install fuel line.
6. Tighten nut on banjo union.



6.7.4 Fuel system – Venting

Preconditions

- Engine is stopped and starting disabled.



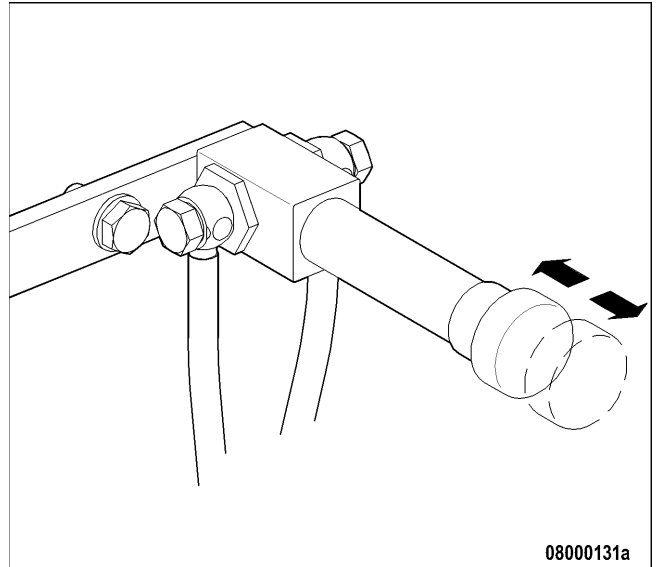
Fuels are combustible.

Risk of fire and explosion!

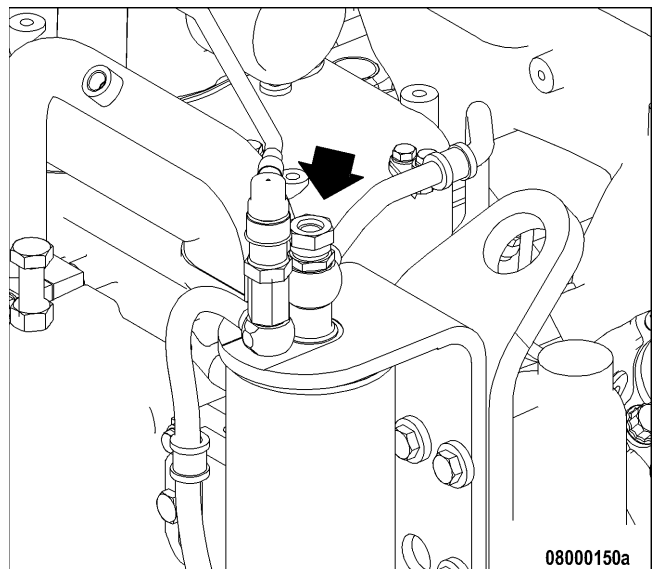
- Avoid naked flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel system – Venting

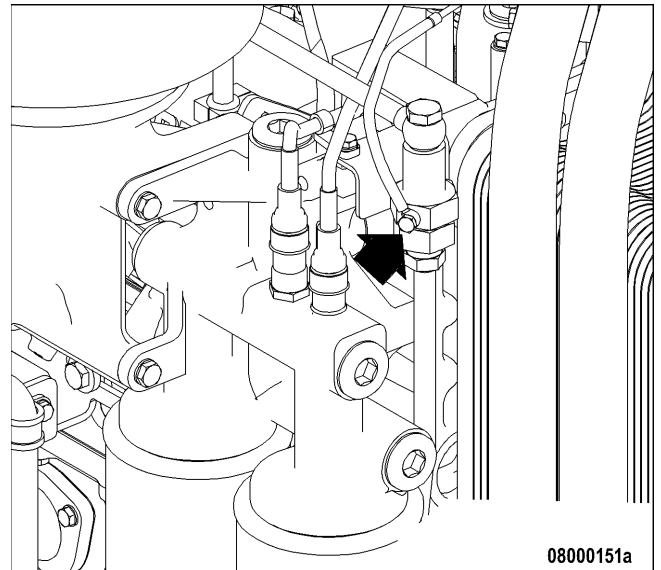
1. Unlock fuel priming pump, unscrew handle.



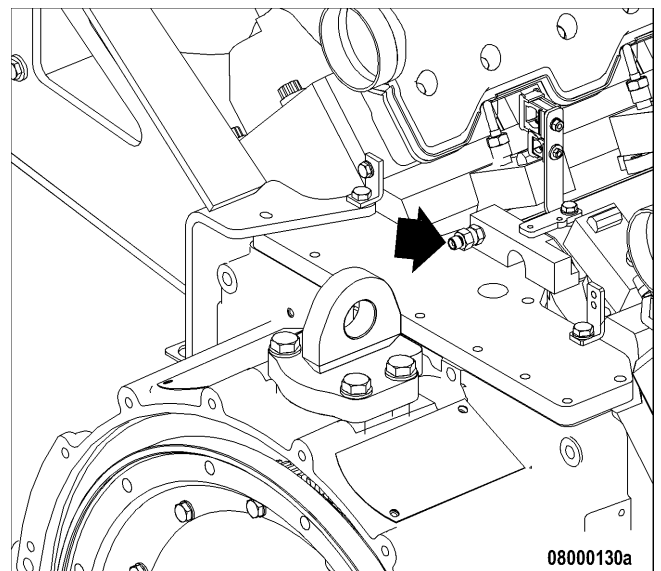
2. Loosen nut (arrow) on banjo union.
3. Operate the pump with the handle until bubble-free fuel emerges.
4. Tighten nut on banjo union.



5. Loosen banjo screw (arrow).
6. Operate the pump with the handle until bubble-free fuel emerges.
7. Tighten banjo screw.



8. Loosen union nut of fuel return line.
9. Loosen non-return valve (arrow).
10. Operate the pump with the handle until bubble-free fuel emerges.
11. Tighten non-return valve.
12. Tighten union nut of fuel return line.
13. Lock fuel priming pump, screw in handle.



6.8 Fuel Filter

6.8.1 Fuel filter – Replacement

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1

Material

Designation / Use	Part No.	Qty.
Diesel fuel		

Spare parts

Designation / Use	Part No.	Qty.
Easy-change filter		



WARNING

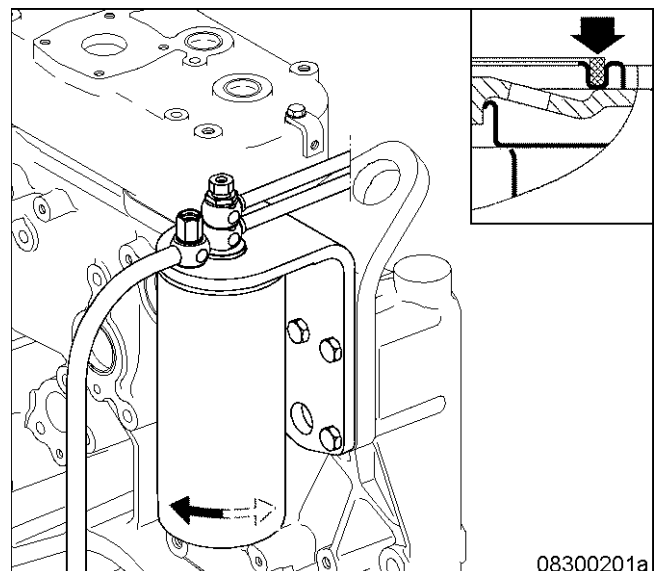
Fuels are combustible.

Risk of fire and explosion!

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

Fuel filter – Replacement

1. Remove easy-change filter using the filter wrench.
2. Clean the sealing surface on the bracket.
3. Fill the new easy-change filter with clean fuel.
4. Install and tighten new filter by hand.
5. Vent fuel system (→ Page 115).



6.8.2 Fuel prefilter cleaning

Preconditions

- Engine is stopped and starting disabled.

Material

Designation / Use	Part No.	Qty.
Diesel fuel		

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		



WARNING

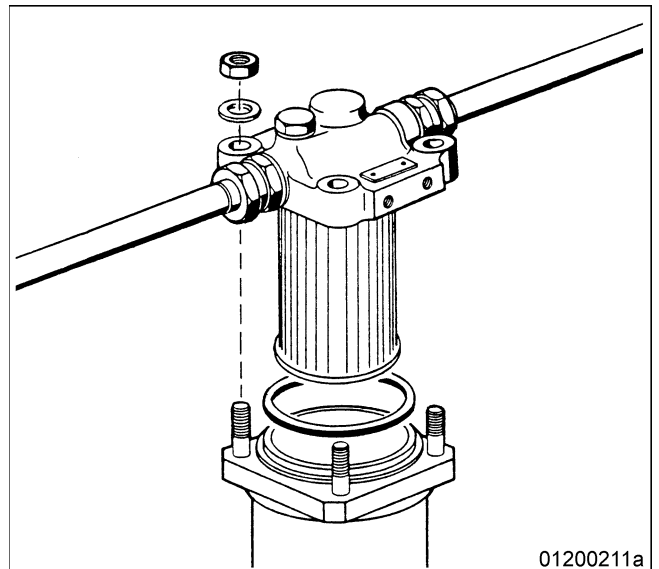
Fuels are combustible.

Risk of fire and explosion!

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

Fuel prefilter cleaning

1. Shut off fuel supply.
2. Remove nuts from filter head.
3. Take off filter housing and drain fuel into appropriate container.
4. Remove filter-element securing nut and remove filter element by pulling it downwards.
5. Wash filter element in clean fuel using a smooth brush.
6. Wash filter housing with clean fuel.
7. Insert filter element into filter housing and secure with nut.
8. Place new sealing ring into groove in filter head.
9. Fit cover with seal and secure it with nuts crosswise.
10. Open fuel supply.



6.8.3 Fuel prefilter – differential pressure check and adjustment of gauge



Unguarded rotating and moving engine components.

Risk of serious injury – danger to life!

- Take special care when working on a running engine.



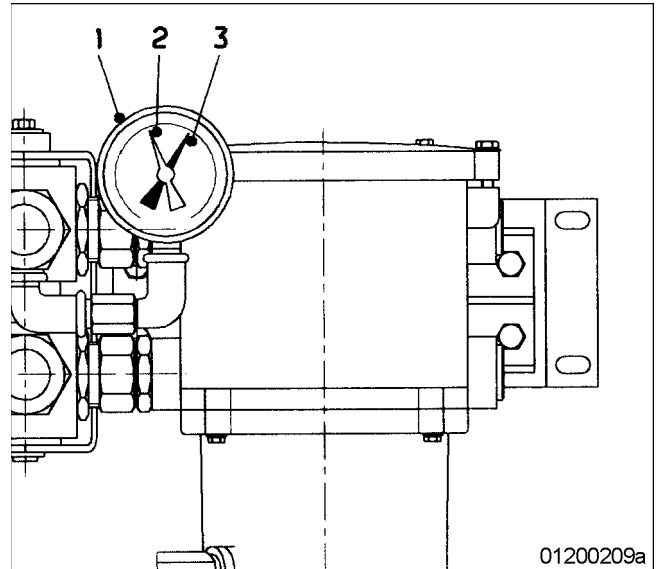
Engine noise above 85 dB (A).

Risk of damage to hearing!

- Wear ear protectors.

Setting adjustable pointer of differential pressure gauge

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



Fuel prefilter – checking differential pressure

1. With the engine running at full load or rated power, read off pressure at gauge (1).
2. If differential pressure as indicated between position of adjustable pointer (2) and pressure-indicating pointer (3) of pressure gauge is ≥ 0.3 bar, flush filter element of the cut-in filter (→ Page 122).

6.8.4 Fuel prefilter – draining

Preconditions

- Engine is stopped and starting disabled.

Material

Designation / Use	Part No.	Qty.
Diesel fuel		

Spare parts

Designation / Use	Part No.	Qty.
Gasket		



WARNING

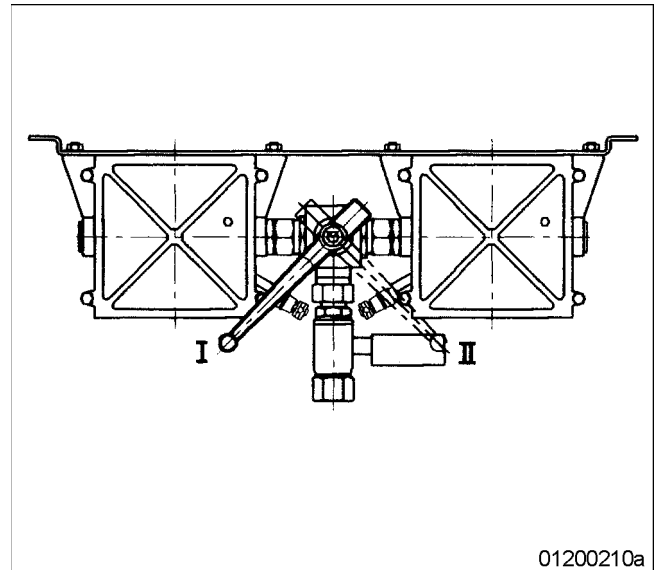
Fuels are combustible.

Risk of fire and explosion!

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

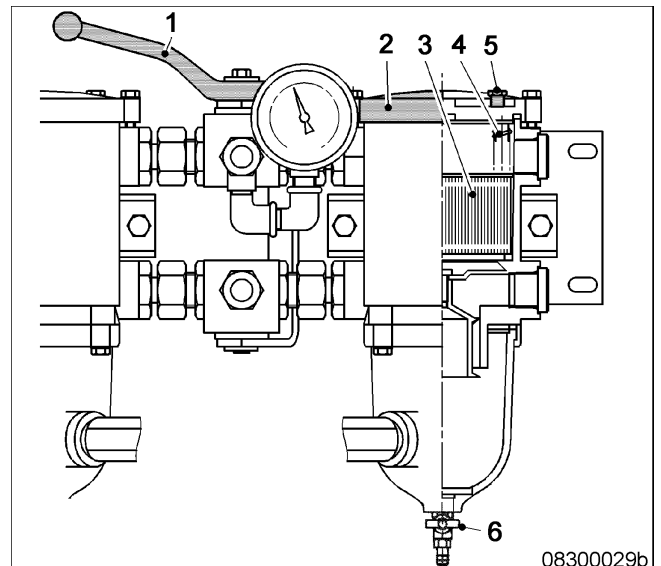
Fuel prefilter – draining

1. Cut out the filter to be drained.



I Left filter cut in
II Right filter cut in

2. Open vent plug (5) of the filter to be drained.
3. Unlock drain cock (6) by pressing toggle and open it.
4. Drain water and contaminants from the filter until pure fuel emerges.
5. Close drain cock (6).
6. Remove screws securing the cover and take off cover (2).
7. Fill filter housing with clean fuel.
8. Place new gasket in cover (2).
9. Fit cover with gasket and secure it with screws.
10. Cut the cut-out filter in again.
11. When fuel emerges from system, close vent plug (5).



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6.8.5 Fuel prefilter – flushing

Material

Designation / Use	Part No.	Qty.
Diesel fuel		

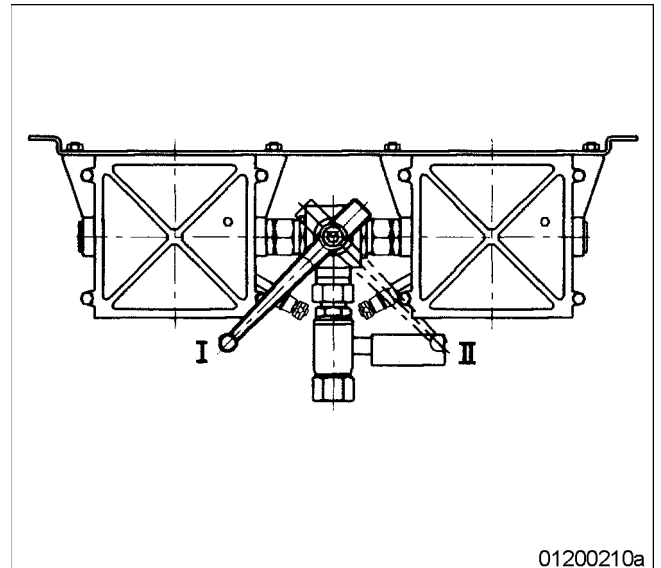
Spare parts

Designation / Use	Part No.	Qty.
Gasket		

 DANGER	Unguarded rotating and moving engine components. Risk of serious injury – danger to life! <ul style="list-style-type: none"> • Take special care when working on a running engine.
 WARNING	Fuels are combustible. Risk of fire and explosion! <ul style="list-style-type: none"> • Avoid naked flames, electrical sparks and ignition sources. • Do not smoke.
 WARNING	Engine noise above 85 dB (A). Risk of damage to hearing! <ul style="list-style-type: none"> • Wear ear protectors.

Fuel prefilter – flushing

1. Cut out the contaminated filter.

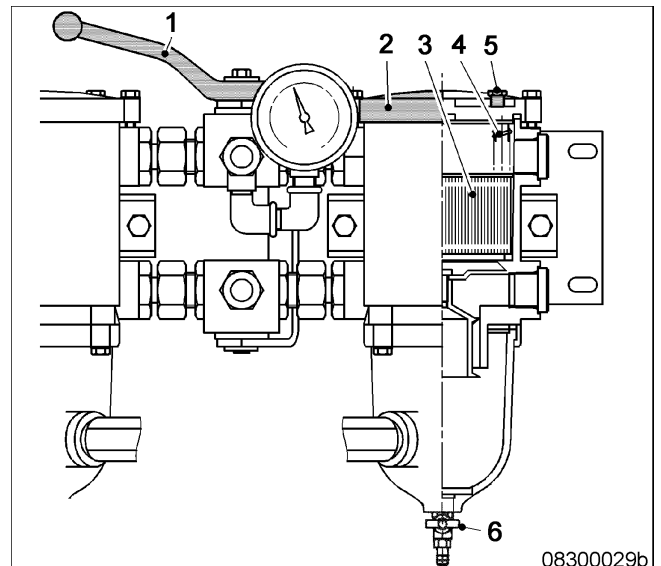


I Left filter cut in
II Right filter cut in

2. Open vent plug (5) of the filter to be flushed.
3. Unlock drain cock (6) by pressing toggle, open it and drain fuel.

Result: Fuel flows from filtered side back to the unfiltered side, flushing the filter deposits downwards out of the filter.

4. Close vent plug (5) and drain cock (6).



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Fuel prefilter – filling fuel

1. Stop engine (→ Page 52) and disable engine start.
2. Remove screws securing the cover and take off cover (2).
3. Fill filter housing with clean fuel.
4. Place new gasket in cover (2).
5. Fit cover with gasket and secure it with screws.
6. Check differential pressure (→ Page 119).

Result: If flushing did not lead to an improvement of the differential pressure, replace filter element (→ Page 124).

6.8.6 Fuel prefilter – filter element replacement

Preconditions

- Engine is stopped and starting disabled.

Material

Designation / Use	Part No.	Qty.
Diesel fuel		

Spare parts

Designation / Use	Part No.	Qty.
Filter element		
Gasket		



WARNING

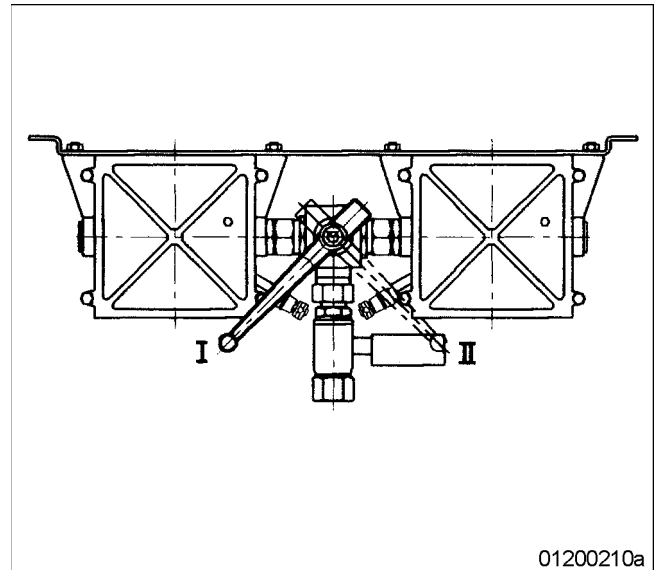
Fuels are combustible.

Risk of fire and explosion!

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

Fuel prefilter – filter element replacement

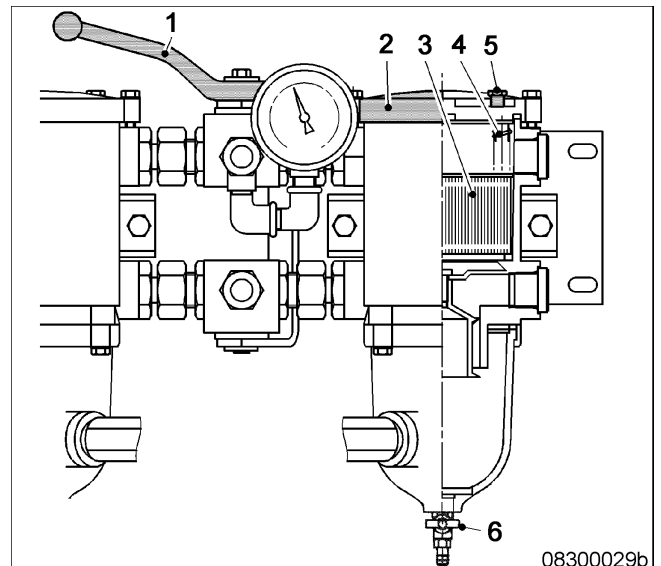
1. Cut out the contaminated filter.



I Left filter cut in
II Right filter cut in

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2. Open vent plug (5) of the contaminated filter.
3. Unlock drain cock (6) by pressing toggle and open it.
4. Drain water and contaminants from the filter.
5. Close drain cock (6).
6. Remove screws securing the cover and take off cover (2).
7. Remove spring (4) and filter element (3).
8. Insert new filter element (3) and spring (4).
9. Fill filter housing with clean fuel.
10. Place new gasket in cover (2).
11. Fit cover with gasket and secure it with screws.
12. Cut the cut-out filter in again.
13. Close vent plug (5) when fuel emerges.
14. Align adjustable pointer of differential pressure gauge with pressure-indicating pointer.
(→ Page 119).



08300029b

6.9 Charge-air Cooling, General, Left-hand Side

6.9.1 Intercooler – Checking condensate drains for coolant discharge and obstructions

Preconditions

- Engine is stopped and starting disabled.

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		



WARNING

Compressed air.

Risk of injury!

- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

Intercooler – Checking condensate drains for coolant discharge and obstructions

1. Remove plug screw(s) from charge-air manifold.
2. Check drain bore(s) for air discharge. If no air emerges:
3. Clean drain bore(s) and blow out with compressed air.
4. If a large amount of coolant is continuously discharged, the intercooler is leaking. Contact Service.
5. Install plug screw(s) with new sealing ring and tighten.

Emergency measures prior to engine start with a leaking intercooler

1. Remove injectors (→ Page 108).
2. Bar engine manually (→ Page 89).
3. Bar engine with starting system to blow out combustion chambers (→ Page 90).
4. Install injectors (→ Page 108).

6.10 Air Filter

6.10.1 Air filter – Replacement

Spare parts

Designation / Use	Part No.	Qty.
Air filter		
Filter insert		
Filter element		

Remove air filter(s) and install new one(s) (→ Page 128).

Reset signal ring of service indicator (→ Page 129).

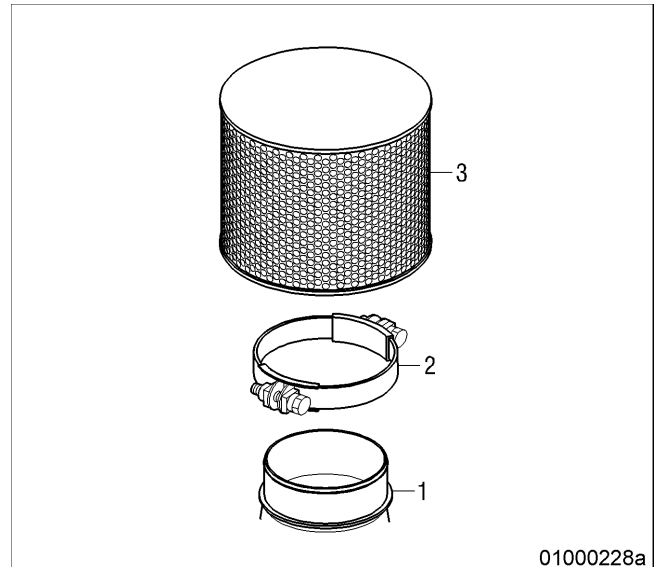
6.10.2 Air filter – Removal and installation

Preconditions

- Engine is stopped and starting disabled.

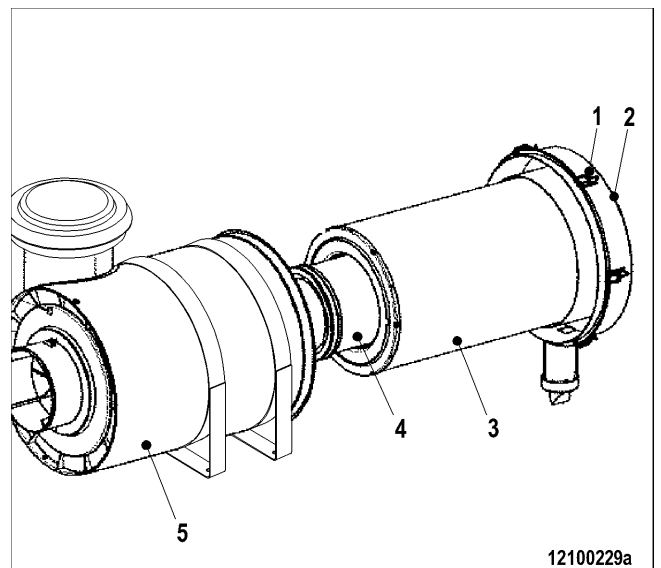
Variant A

1. Release clamp (2).
2. Remove air filter (3) and clamp (2) from flange of intake housing (1).
3. Verify that there are no objects in the flange of the intake housing (1) and clean it.
4. Place new air filter (3) with clamp (2) onto intake housing (1).
5. Tighten clamp (2).



Variant B

1. Release latches (1).
2. Remove cover (2).
3. Remove filter insert (3) and filter element (4).
4. Wipe out filter housing (5) and cover (2) with moist cloth.
5. Insert new filter element (4) and filter insert (3).
6. For installation, follow reverse sequence of working steps.



6.11 Air Intake

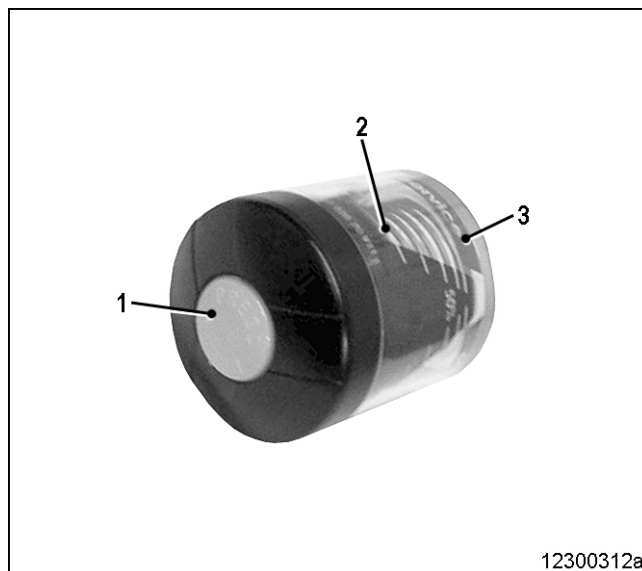
6.11.1 Service indicator – Signal ring position check

Preconditions

- Engine is stopped and starting disabled.

Checking signal ring position

1. Replace air filter, if the signal ring (2) is completely visible in the red area of the service indicator control window (3) (→ Page 127).
2. After installation of new filter, press reset button (1).
Result: Signal ring returns to initial position.



6.12 Starting Equipment

6.12.1 Air starter – manual operation



DANGER

Unguarded rotating and moving engine components.

Risk of serious injury — danger to life!

- Before barring or starting the engine, ensure that nobody is in the danger zone.



WARNING

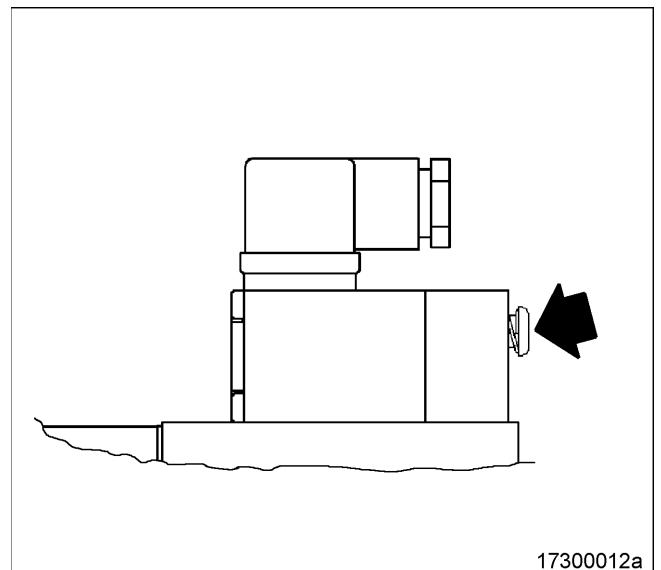
Engine noise above 85 dB (A).

Risk of damage to hearing!

- Wear ear protectors.

Air starter – manual operation

1. Press pushbutton for manual start and hold it.
2. Allow compressed air to enter the air starter until the engine fires evenly.
3. Release pushbutton.



6.13 Lube-oil System, Lube-oil Circuit

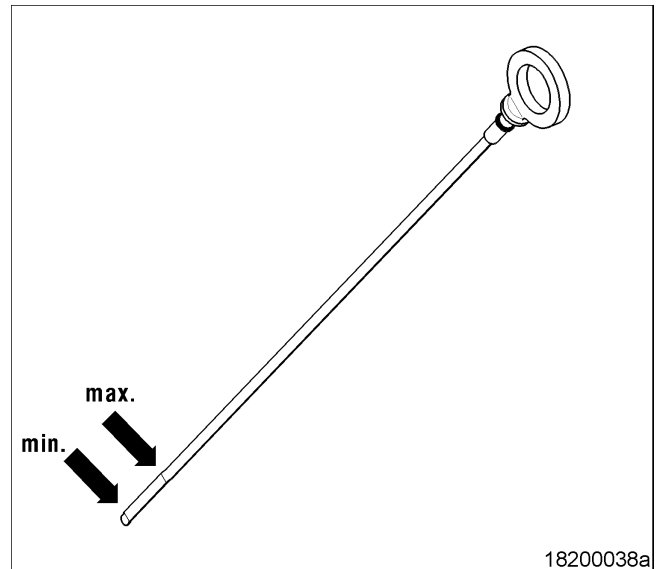
6.13.1 Engine oil – Level check

Preconditions

- Engine is stopped and starting disabled.

Oil level check prior to engine start

1. Withdraw dipstick from guide tube and wipe it.
2. Insert dipstick into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. Top up to "max." if required (→ Page 132).
5. Insert dipstick into guide tube up to the stop.



Oil level check after the engine is stopped

1. 5 minutes after stopping the engine, remove oil dipstick from the guide tube and wipe it.
2. Insert dipstick into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." and "max." marks.
4. Top up to "max." if required (→ Page 132).
5. Insert dipstick into guide tube up to the stop.

6.13.2 Engine oil – Change

Preconditions


- Engine is stopped and starting disabled.
- Engine is at operating temperature.
- MTU Fluids and Lubricants Specifications (A001061/..) are available.

Material

Designation / Use	Part No.	Qty.
Engine oil		

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		

 WARNING	<p>Hot oil. Oil can contain combustion residues which are harmful to health.</p> <p>Risk of injury and poisoning!</p> <ul style="list-style-type: none"> • Wear protective clothing, gloves, and goggles / safety mask. • Avoid contact with skin. • Do not inhale oil vapor.
---	---

Oil change without semirotary hand pump: Draining oil at drain plug on oil pan

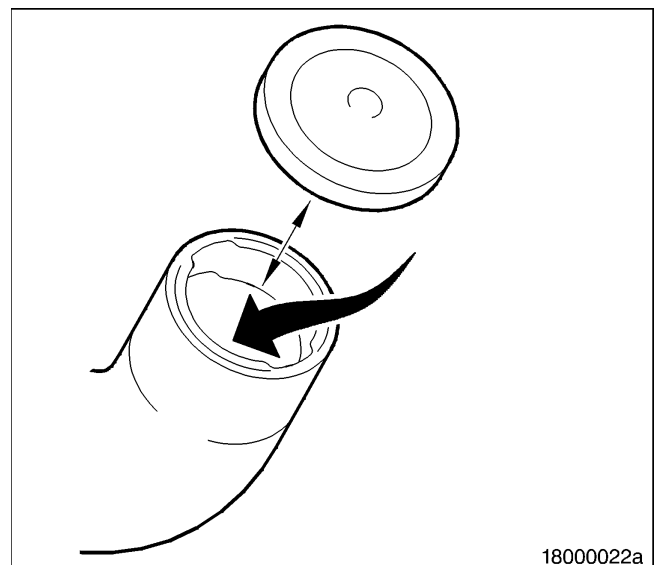
1. Provide a suitable container in which to collect the oil.
2. Remove drain plug and drain oil.
3. Install drain plug with new sealing ring.
4. Replace engine oil filter (→ Page 133).

Oil change using semirotary hand pump: Oil extraction

1. Provide a suitable container in which to collect the oil.
2. Extract all oil from oil pan using the hand pump.
3. Replace engine oil filter (→ Page 133).

Engine oil system filling

1. Open cover of filler neck.
2. Pour oil in at filler neck up to "max." mark at oil dipstick.
3. Close cover of filler neck.
4. Check engine oil level (→ Page 131).
5. After oil change and filter replacement, bar engine with starting system (→ Page 90).



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6.14 Oil Filtration/Cooling

6.14.1 Engine oil filter – Replacement

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1

Material

Designation / Use	Part No.	Qty.
Engine oil		

Spare parts

Designation / Use	Part No.	Qty.
Oil filter		



WARNING

Hot oil.

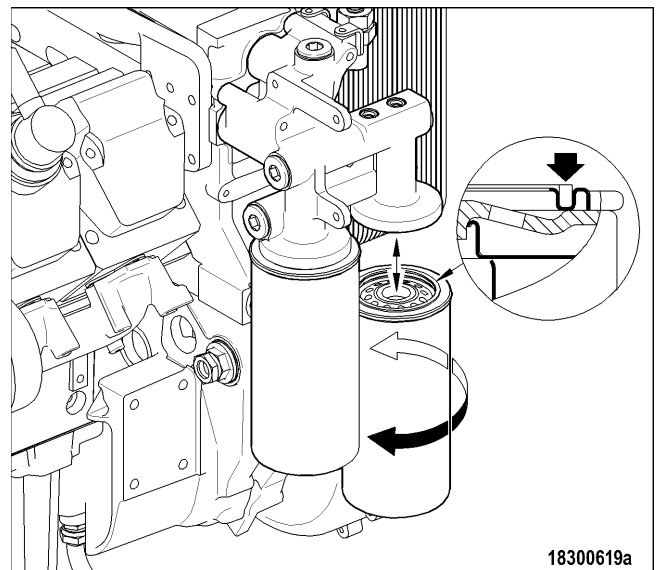
Oil can contain combustion residues which are harmful to health.

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 oil filter using the filter wrench.
2. Clean the sealing surface of the filter head.
3. Check condition of the new sealing ring and coat it with oil.
4. Install and tighten new oil filter by hand.
5. Replace further oil filters in the same way.
6. After each oil change and filter replacement, bar the engine with starting system (→ Page 90).
7. Check oil level (→ Page 131).



6.15 General Cooling Circuit, HT Circuit

6.15.1 Engine coolant filling

Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specification (A001061/..) is available.

Material

Designation / Use	Part No.	Qty.
Engine coolant		



Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.



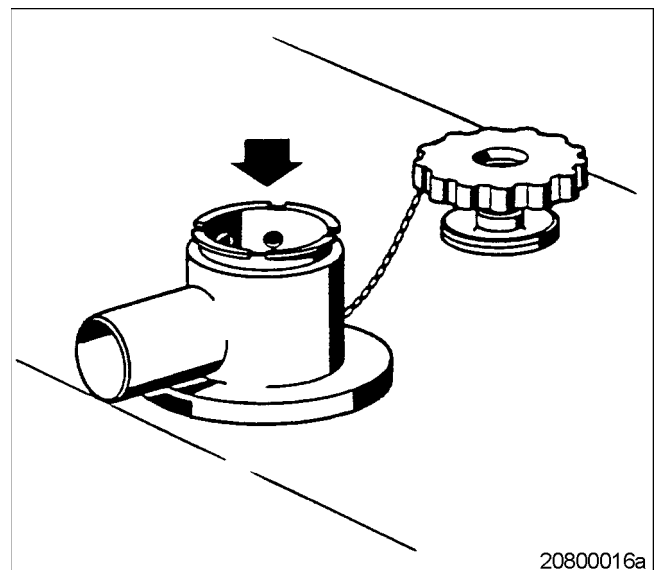
Cold coolant in hot engine can cause thermal stress.

Formation of cracks in components!

- Fill / top up coolant only into cold engine.

Preparatory steps

1. Turn breather valve on coolant expansion tank counterclockwise to first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.



Engine 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 and clean sealing faces, if required.
3. Set breather valve onto filler neck and close it.

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 137) and top up, if required.

6.15.2 Engine coolant – Draining

Preconditions

- Engine is stopped and starting disabled.

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		
Sealing ring		



WARNING

Coolant is hot and under pressure.

Risk of injury and scalding!

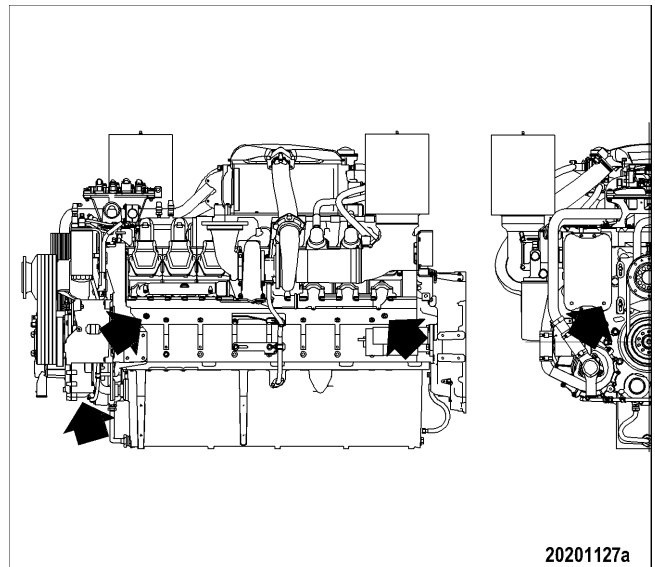
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

1. Provide an appropriate container to drain the coolant into.
2. Switch off preheating unit.

Draining engine coolant

1. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Draw off segregated corrosion inhibitor oil in expansion tank through the filler neck.
4. Open drain valves and drain plugs and drain coolant at the following points:
 - At the preheating unit;
 - At the engine coolant pump;
 - At the crankcase, left and right sides;
 - At oil heat exchanger.
5. Close all open drain points.
6. Place breather valve on filler neck and close.



6.15.3 Engine coolant – Change

Material

Designation / Use	Part No.	Qty.
Engine coolant		

Drain engine coolant (→ Page 135).

Fill engine coolant system (→ Page 134).

6.15.4 Engine coolant – Level check

Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specifications (A001061/..) are available.



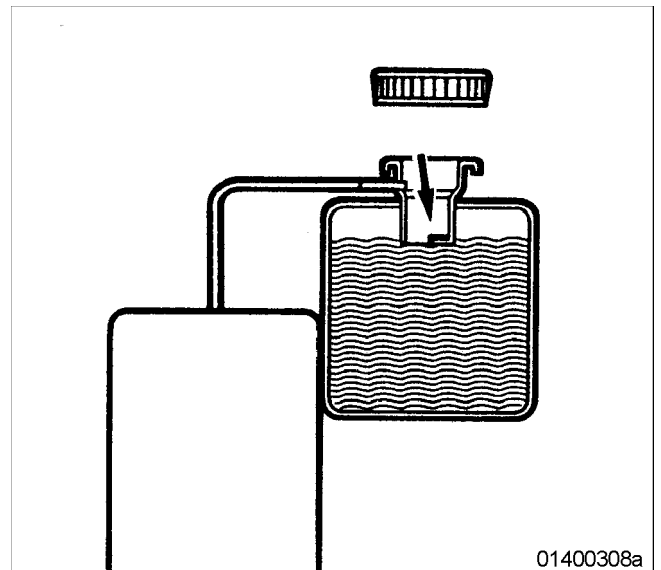
Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Coolant-level check at filler neck:

1. Turn breather valve of filler neck 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 134).
5. Check and clean breather valve.
6. Place breather valve on filler neck and close.



Coolant-level check 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 134).

6.15.5 Coolant pump – Relief bore check



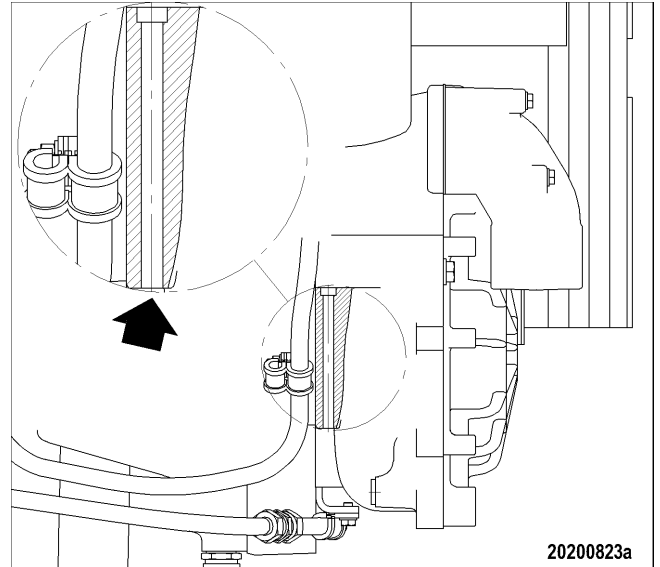
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
 • Take special care when working on a running engine.



Engine noise above 85 dB (A).
Risk of damage to hearing!
 • Wear ear protectors.

Coolant pump – Relief bore check

1. Check relief bore for oil and water discharge.
2. Stop engine (→ Page 52) and disable engine start.
3. Clean the relief bore with a wire if it is dirty.
 - Permissible coolant discharge: Up to 10 drops/hour;
 - Permissible oil discharge: Up to 5 drops/hour;
4. If discharge exceeds the specified limits, contact Service.



6.16 LT Circuit

6.16.1 Charge-air coolant filling

Preconditions


- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specification (A001061/..) is available.


Material

Designation / Use	Part No.	Qty.
Coolant		

Spare parts

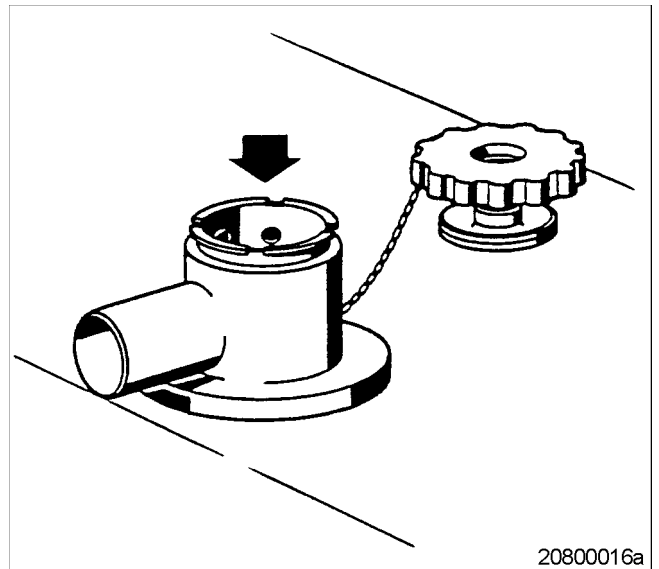
Designation / Use	Part No.	Qty.
Sealing ring		

 WARNING	Engine noise above 85 dB (A). Risk of damage to hearing! <ul style="list-style-type: none"> • Wear ear protectors.
---	---

 CAUTION	Cold coolant in hot engine can cause thermal stress. Formation of cracks in components! <ul style="list-style-type: none"> • Fill / top up coolant only into cold engine.
---	--

Preparatory steps

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



Charge-air coolant filling

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

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 143).

6.16.2 Charge-air coolant – Draining

Preconditions

- Engine is stopped and starting disabled.

Spare parts

Designation / Use	Part No.	Qty.
Sealing ring		
Sealing ring		



WARNING

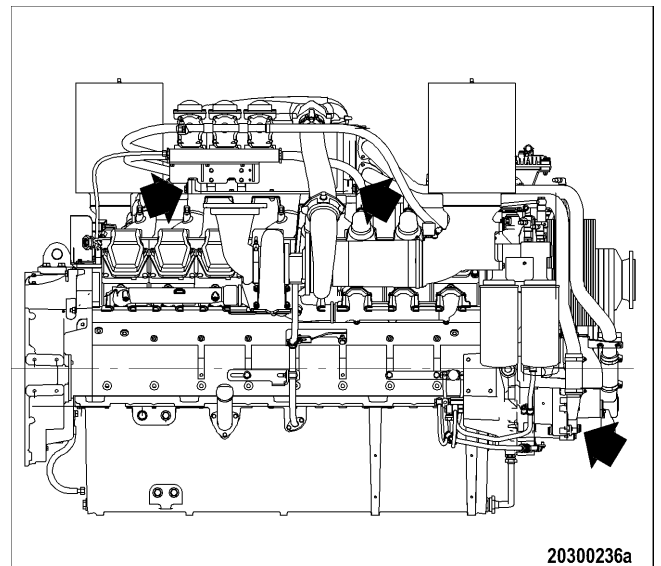
Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Draining charge air coolant

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
3. Continue to turn breather valve counterclockwise and remove.
4. Draw off segregated corrosion inhibitor oil in expansion tank through the filler neck.
5. Open drain plugs and drain coolant at the following points:
 - At the charge-air coolant pump;
 - At the intercooler, engine driving end and free end sides.
6. Screw in drain plugs with new sealing rings.
7. Place breather valve on filler neck and close.



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6.16.3 Charge-air coolant change

Material

Designation / Use	Part No.	Qty.
Coolant		

Drain charge-air coolant system (→ Page 141).

Fill charge-air coolant system (→ Page 139).

6.16.4 Charge-air coolant level check

Preconditions

- Engine is stopped and starting disabled.
- MTU Fluids and Lubricants Specification (A001061/..) is available.



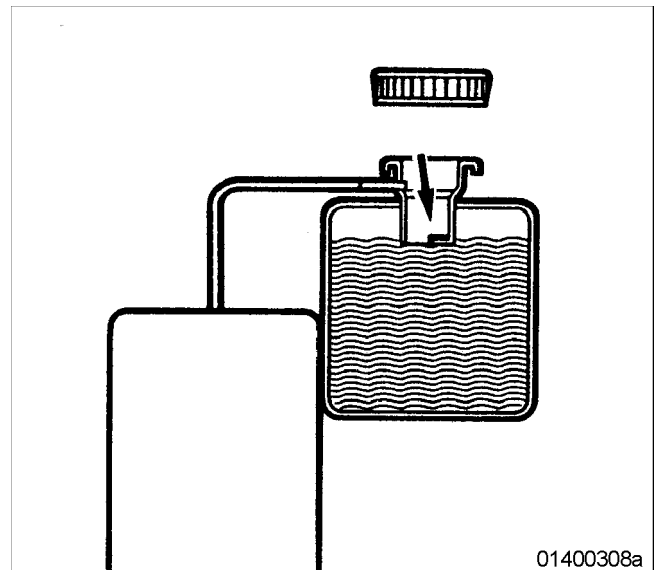
Coolant is hot and under pressure.

Risk of injury and scalding!

- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Charge-air coolant level check at filler neck:

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. Check coolant level (coolant must be visible at marking plate).
4. If required, top up with treated coolant (→ Page 139).
5. Check proper condition of breather valve, clean sealing faces if required.
6. Fit breather valve onto filler neck and close it.



Charge-air coolant level check by means of level sensor:

1. Switch engine control system ON and check display (coolant level is automatically monitored by the engine control system).
2. If required, top up with treated coolant (→ Page 139).

6.17 Battery-charging Generator

6.17.1 Battery-charging generator drive – Drive-belt check and adjustment

Preconditions

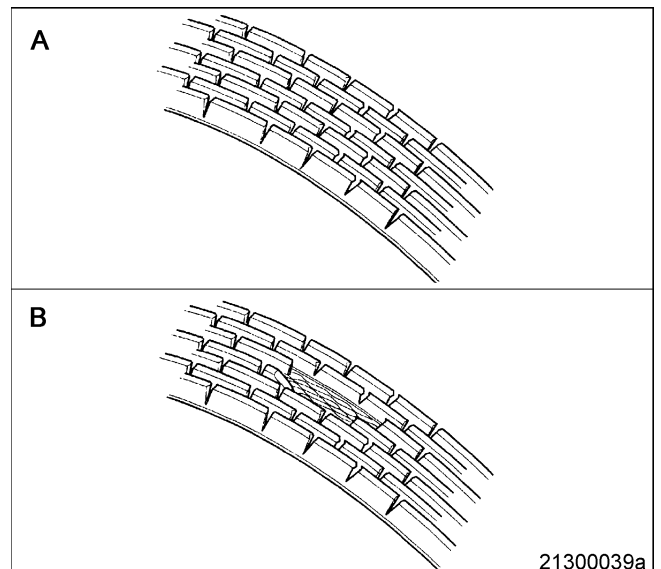
- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Belt tension tester	Y20097429	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1

Checking belt condition

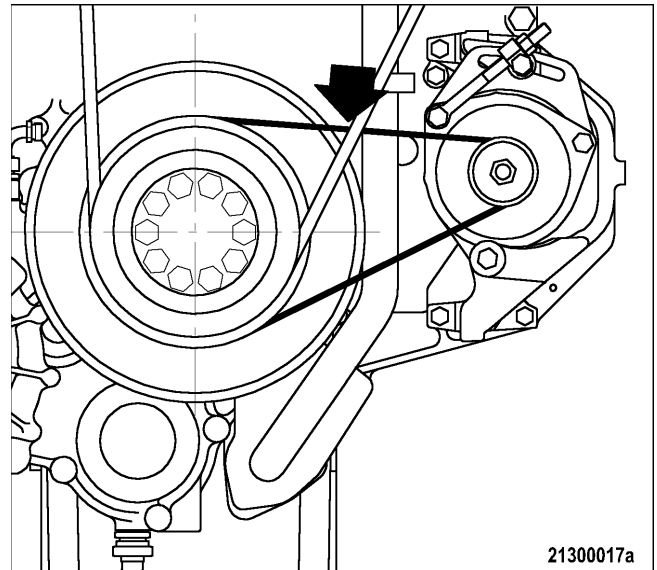
1. Remove guard cover.
2. Check belt for contamination by oil, cracks, wear, and signs of overheating.
3. Replace drive belt:
 - If belt is oily;
 - If belt shows signs of overheating;
 - If ribs are broken around the entire circumference (A);
 - If ribs are broken around the entire circumference and material is broken off in some places (B) (→ Page 146).
4. Install guard cover.



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Checking belt tension

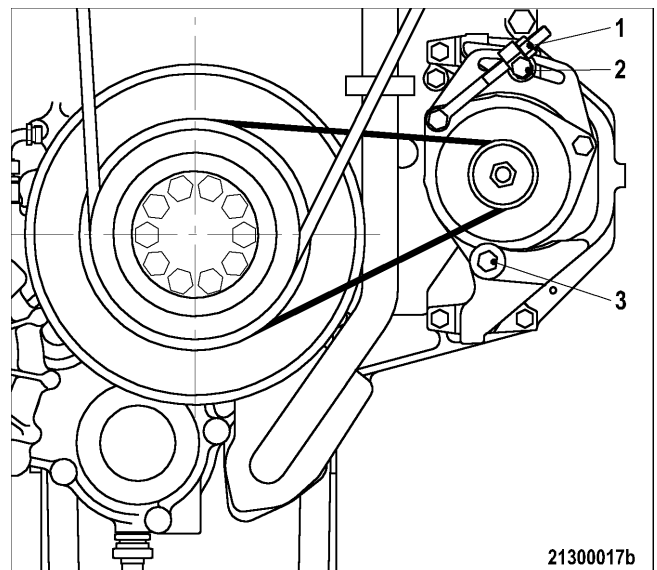
1. Remove guard cover.
2. Place belt-tension tester onto drive belt midway between the belt pulleys.
3. Press button uniformly down on drive-belt surface until spring disengagement can be heard and felt.
4. Do not press any further, otherwise the reading is not exact.
5. Take off belt-tension tester without changing the position of the indication arm.
6. Read off measuring value at the intersection of indication arm and "KG" scale.
7. If the measured value deviates from the specified belt tension, readjust belt tension.
8. Install guard cover.



Setting for new V-belt	Test force: $f = 450 \text{ N} - 50 \text{ N}$
Setting for used V-belt	Test force: $f = 350 \text{ N} - 50 \text{ N}$

Adjusting belt tension

1. Loosen screws (2 and 3).
2. Tension ribbed drive belt with tensioning nut (1) and check belt tension
3. Tighten screw (2) with torque wrench to $40 \text{ Nm} + 4 \text{ Nm}$.
4. Tighten securing screw (3).
5. Check drive belt tension.
6. Install guard cover.



6.17.2 Battery-charging generator drive – Drive belt replacement

Preconditions

- Engine is stopped and starting disabled.

Special tools

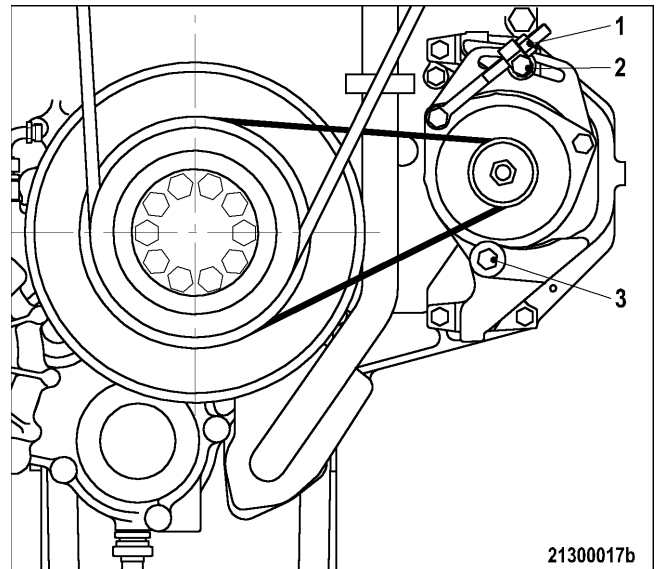
Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1

Spare parts

Designation / Use	Part No.	Qty.
Ribbed belt		

Battery-charging generator drive – Drive belt replacement

1. Remove guard cover.
2. Remove drive belt from ventilator wheel (→ Page 150).
3. Loosen securing screws (2 and 3).
4. Release tensioning screw (1) until the ribbed belt can be removed.
5. Check belt pulleys for cleanliness, remove dirt, if any.
6. Fit new drive belt.
7. Tension drive belt with tensioning nut (1) and check belt tension (→ Page 144).
8. Tighten securing screw (2).
 - Tightening torque: 40 Nm + 4 Nm
9. Tighten securing screw (3).
10. Install ventilator drive belt (→ Page 150).
11. Install guard cover.



6.18 Ventilator Drive

6.18.1 Ventilator drive – Drive-belt check and adjustment

Preconditions

- Engine is stopped and starting disabled.

Special tools

Designation / Use	Part No.	Qty.
Belt-tension tester	Y20097429	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet adapter	F30027340	1

Preparatory steps

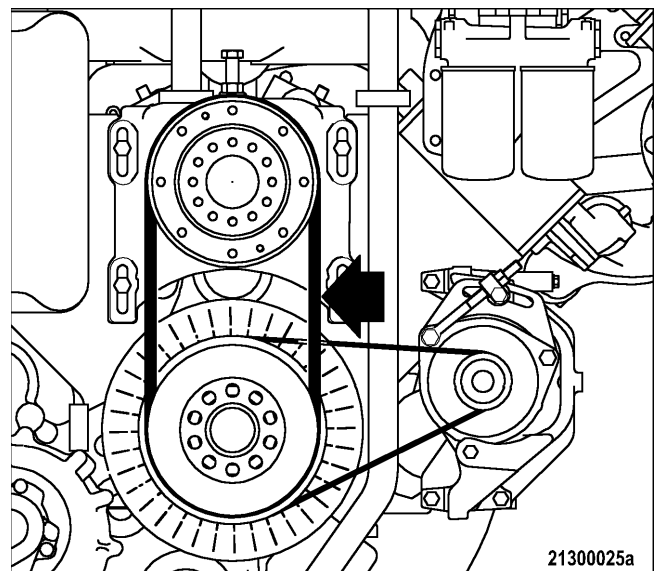
1. Remove screws from guard cover.
2. Remove guard cover.

Checking belt condition

1. Check V-belt for contamination by oil, cracks, wear, chunking and signs of overheating.
2. Replace V-belt:
 - If belt is oily;
 - If belt shows signs of overheating;
 - If belt shows cracks;
 - If belt is worn;
 - If cracks are found: (→ Page 150).

Checking belt tension - variant A

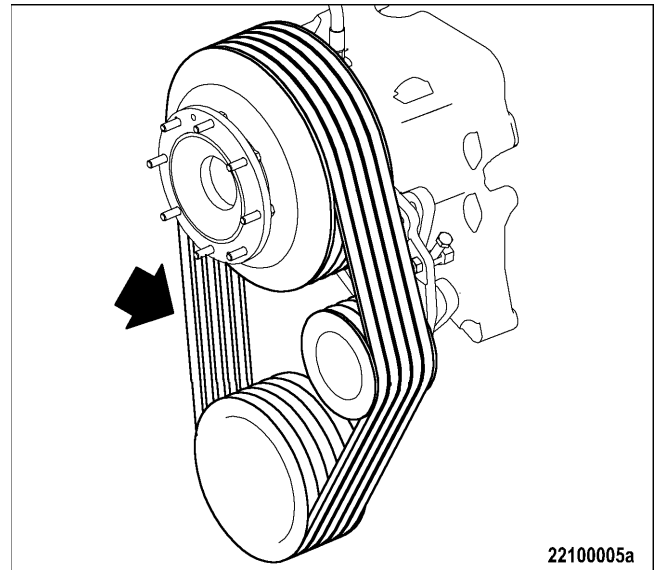
1. Place belt-tension tester onto V-belt midway between the belt pulleys (arrow).
2. Press button uniformly against V-belt surface until spring disengagement can be heard and felt.
3. Take off belt-tension tester without changing the position of the indication arm.
4. Read off measured value at the intersection of indication arm and "KG" scale.
5. If the measured value deviates from the specified belt tension, readjust belt tension.



Setting for new V-belt	Test force: $f = 660\text{N}$
Setting for used V-belt	Test force: $f = 510\text{N}$

Checking belt tension - variant B

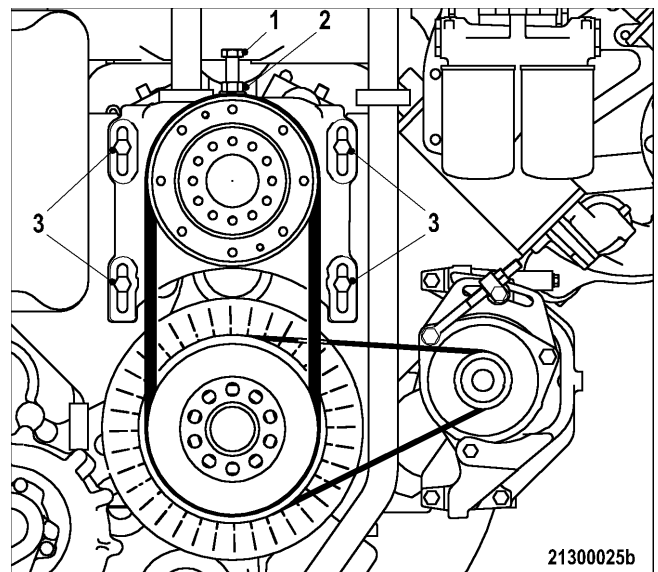
1. Place belt-tension tester onto V-belt midway between the belt pulleys (arrow).
2. Press button uniformly against V-belt surface until spring disengagement can be heard and felt.
3. Take off belt-tension tester without changing the position of the indication arm.
4. Read off measured value at the intersection of indication arm and "KG" scale.
5. If the measured value deviates from the specified belt tension, readjust belt tension.



Setting for new V-belt	Test force: $f = 670\text{N} - 50\text{N}$
Setting for used V-belt	Test force: $f = 570\text{N} - 50\text{N}$

Adjusting belt tension - variant A:

1. Loosen screws (3).
2. Release locknut (2).
3. Screw in screw (1) to set specified belt tension.
4. Tighten locknut.
5. Check V-belt tension.
6. Tighten screws with torque wrench to 100 Nm.

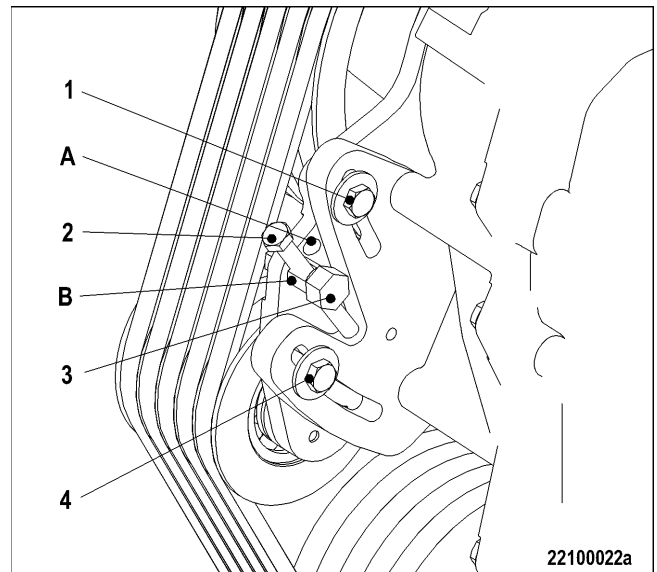


Adjusting belt tension - variant B:

1. Loosen screws (1 and 4).

Note: For the 50 Hz variant, screw (3) must be in position (A); for all other variants in position (B).

2. Screw in screw (2) to tension V-belt.
3. Check V-belt tension.
4. Tighten screws (1 and 4) with torque wrench to 69 ± 7 Nm.
5. Check V-belt tension.

**Final steps**

1. Install guard cover.
2. Fit screws and tighten.

6.18.2 Ventilator drive – Drive belt replacement

Preconditions

- Engine is stopped and starting disabled.

Spare parts

Designation / Use	Part No.	Qty.
V-belt		

Preparatory steps

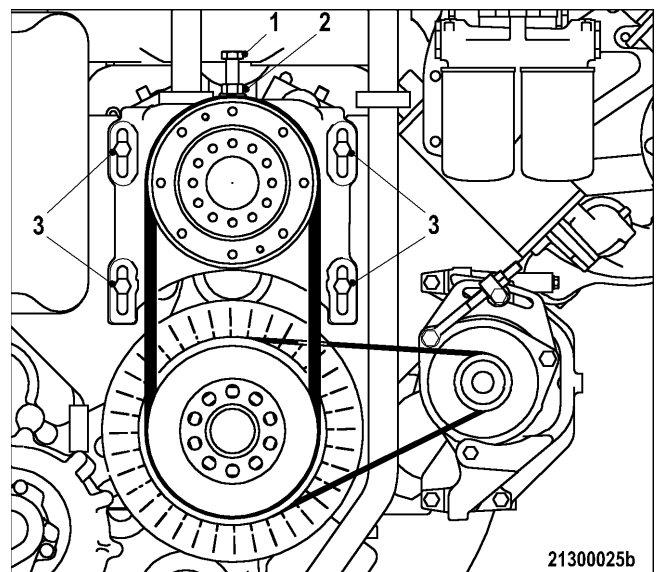
1. Remove guard cover from cooler.
2. Remove ventilator.

Drive belt replacement on 12V/16V engines:

1. Loosen securing screws (3).
2. Release locknut (2).
3. Screw out tensioning screw (1) until V-belts can be removed.
4. Check belt pulley on ventilator bearing pedestal and crankshaft for contamination, clean if necessary.

Note: V-belts must only be fitted in the grooves as a set and without applying any force.

5. Fit new set of drive belts.
6. To check V-belt tension, the ventilator bearing pedestal must rest against the gearcase.
7. Adjust and check V-belt tension (→ Page 147).

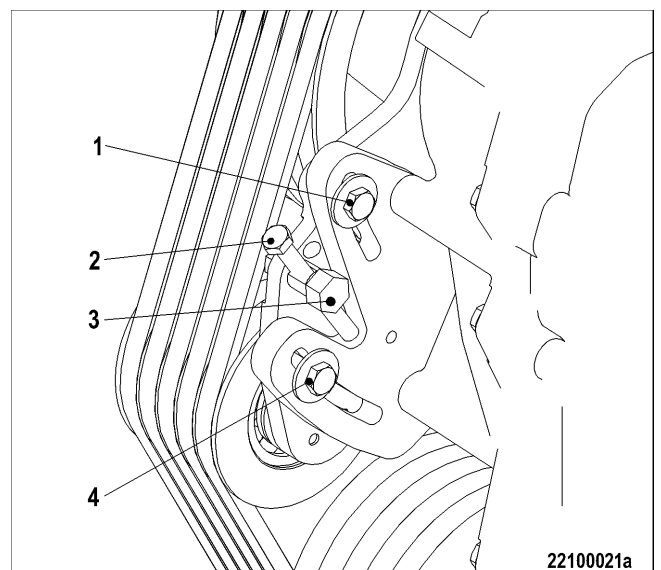


Drive belt replacement on 18V engines:

1. Loosen securing screws (1 and 4).
2. Unscrew tensioning screw (2) with bolt (3) until the V-belts can be removed.
3. Check belt pulley on ventilator bearing pedestal and crankshaft for contamination, clean if necessary.

Note: V-belts must only be fitted in the grooves as a set and without applying any force.

4. Fit new set of drive belts.
5. To check V-belt tension, the ventilator bearing pedestal must rest against the gearcase.
6. Adjust and check V-belt tension (→ Page 147).



Final steps

1. Install ventilator.
2. Install guard cover.

6.19 Cabling, General for Engine / Gearbox / Genset

6.19.1 Engine wiring – Check

Preconditions

- Engine is stopped and starting disabled.

Material

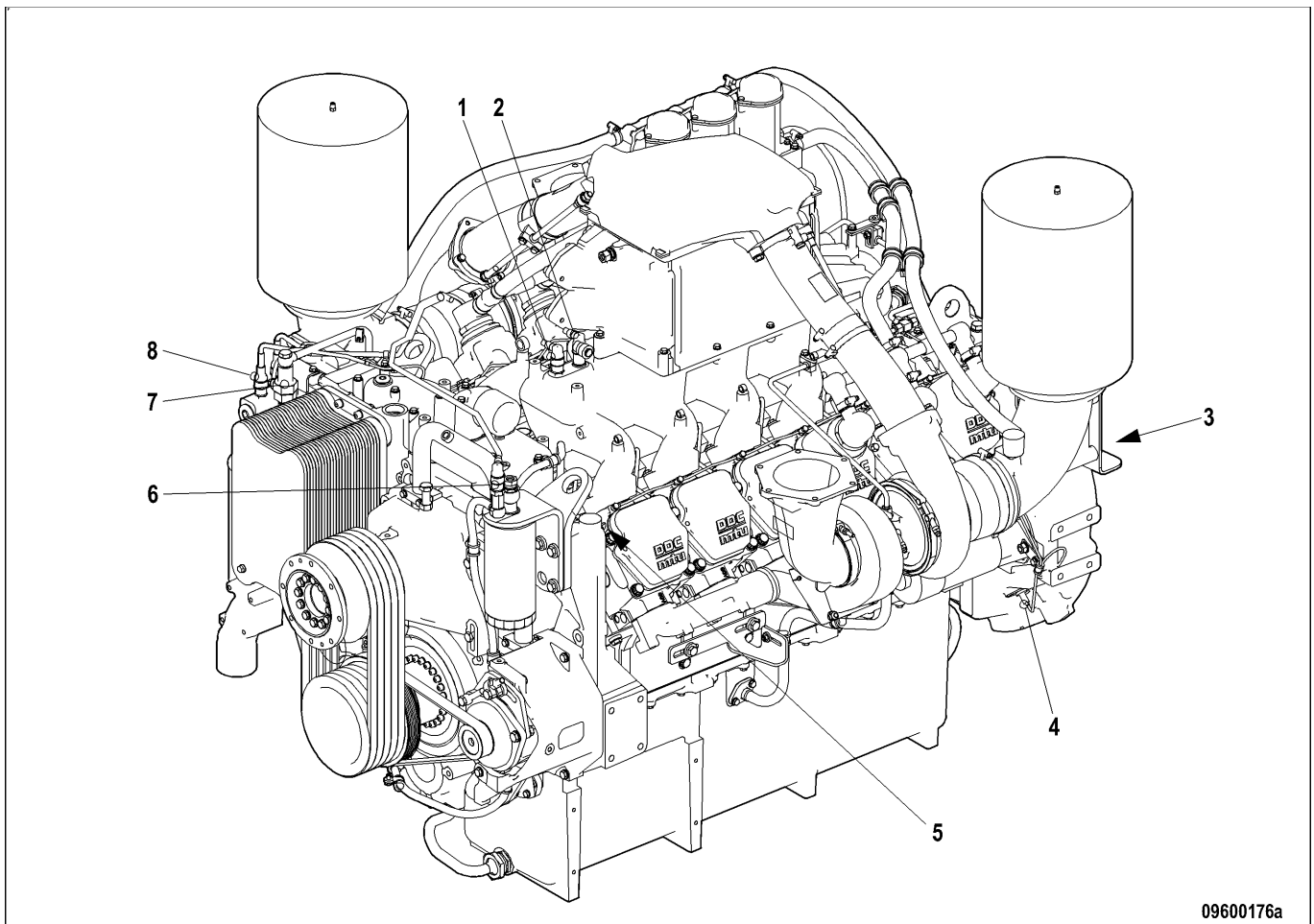
Designation / Use	Part No.	Qty.
Isopropyl alcohol	46181	1

Engine wiring – Check

1. Check securing screws of cable clamps on the engine and tighten loose screw connections.
2. Make certain that cables are securely seated in clamps and cannot move freely.
3. Check cable binders for secure seating, tighten loose cable binders.
4. Replace defective cable binders.
5. Inspect electrical components visually for damage:
 - connector housings;
 - contacts;
 - connector sockets;
 - cables and terminals;
 - plug-in contacts.
6. If conductors are damaged (→Contact Service)
7. Clean dirty connector housings, sockets and contacts with isopropyl alcohol.
8. Make certain that all sensor connectors are securely latched.

6.19.2 Sensors and actuators

Illustration is also valid for 16 V and 18 V engines



09600176a

No.	Designation	Monitoring of
1	B10	Charge-air pressure
2	B9	Charge-air temperature
3	B1	Camshaft speed
4	B13	Crankshaft speed
5	B6	Coolant temperature
6	B33	Fuel temperature
7	B5	Lube oil pressure
8	B7	Lube oil temperature

6.20 Accessories for Engine Governor (Electronic) / Control System

6.20.1 ECU and connectors – Cleaning

Preconditions

- Engine is stopped and starting disabled.

Material

Designation / Use	Part No.	Qty.
Isopropyl alcohol		

ECU and connectors – Cleaning

1. Remove coarse dirt from housing surface using a cloth moistened with isopropyl alcohol.
2. Remove dirt from connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

Cleaning severely contaminated connectors on ECU

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 secure latches.

6.20.2 ECU – Checking plug-in connections

Preconditions

- Engine is stopped and starting disabled.

ECU – Checking plug-in connections

1. Verify that all plug-in connections are securely seated.
2. Secure loose connectors and latch.

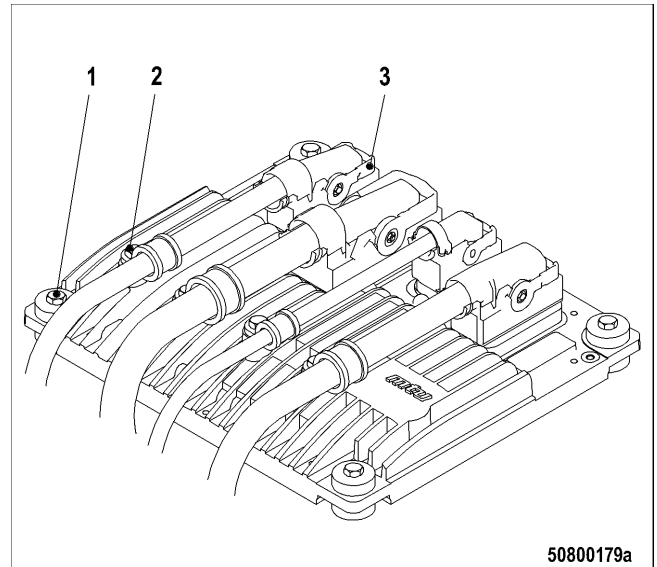
6.20.3 ECU – Removal and installation

Preconditions

- Engine is stopped and starting disabled.

ECU – Removal

1. Note or mark assignment of cables and connectors.
2. Remove all screws (2).
3. Release lock (3) of connectors.
4. Withdraw all connectors.
5. Remove screws (1).
6. Remove ECU.

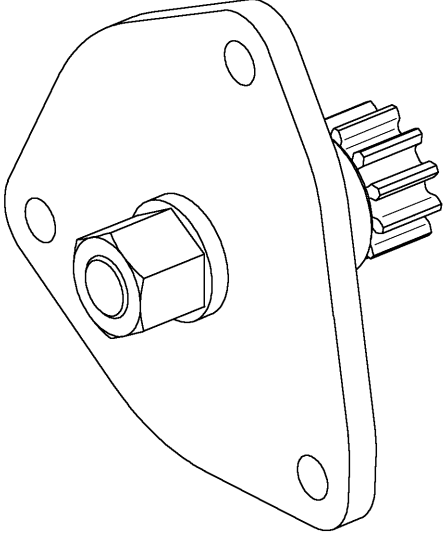
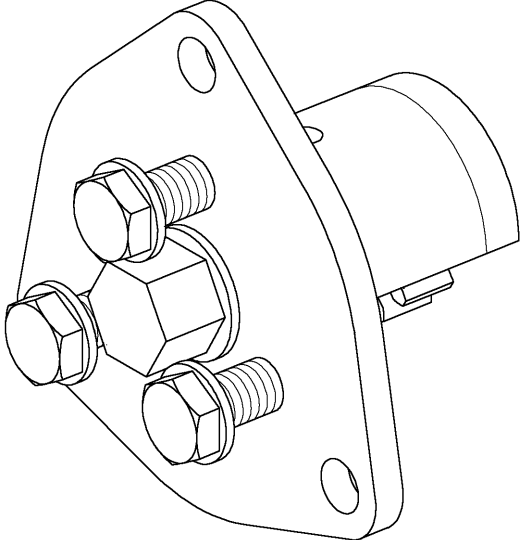



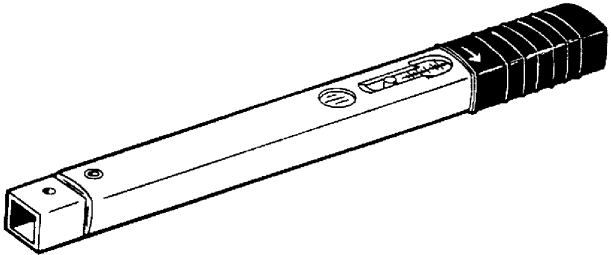
ECU – Installation

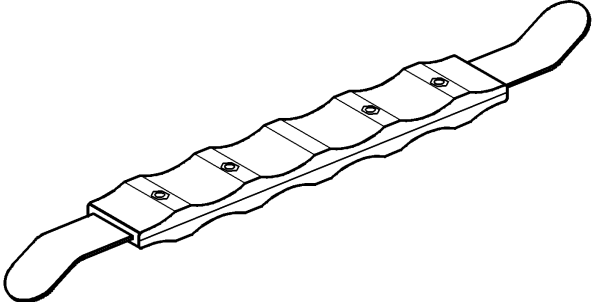
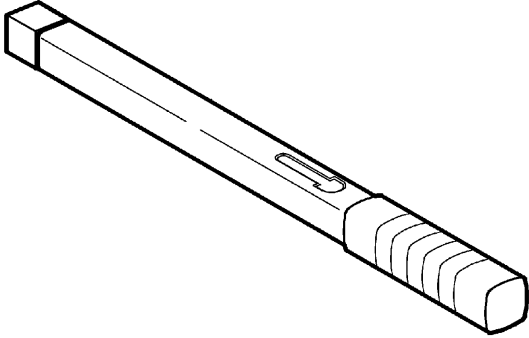
1. For installation follow reverse sequence of working steps. Ensure that connectors are plugged in the correct socket.
2. Check rubber bearing before installation.
Result: If the rubber bearing is porous or defective, fit a new one.

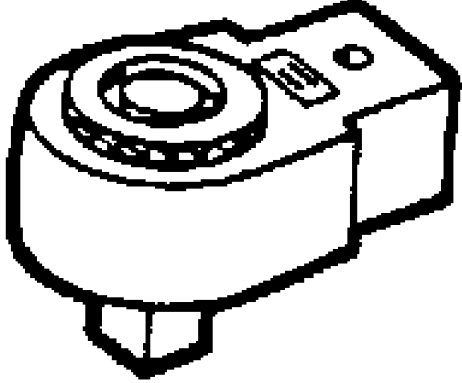
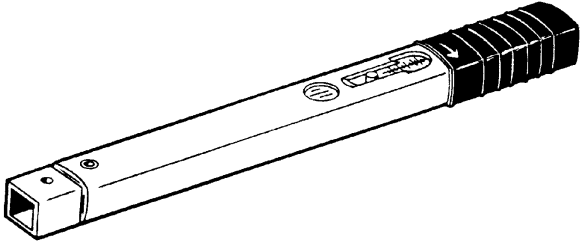
7 Special Tools

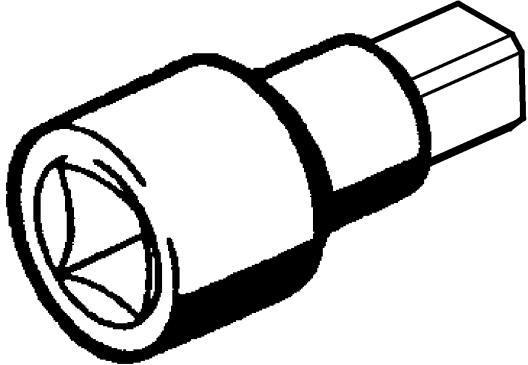
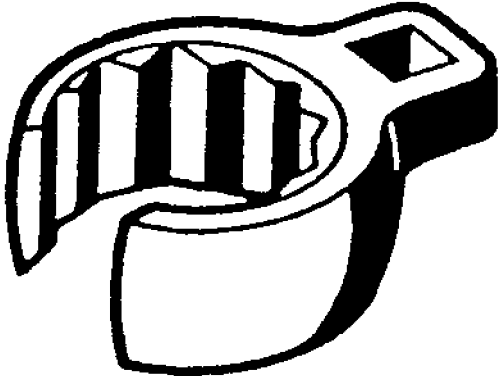
7.1 Special tools

Part No.	Designation / Use	Qty.	
F6558556	Barring tool for 12V engines	1	
F6558557	Barring tool for 16/18V engines	1	

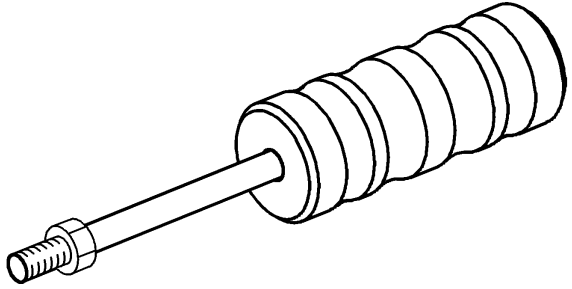
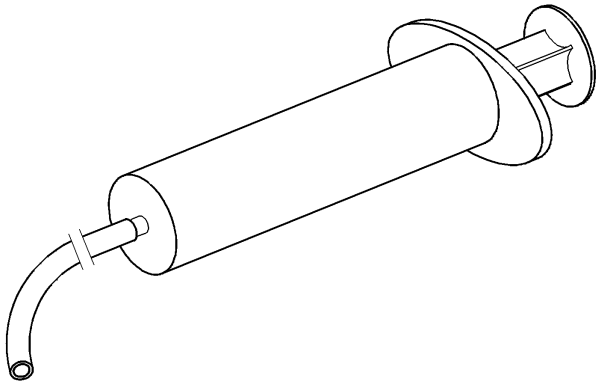
Part No.	Designation / Use	Qty.	
Y20097353	Rigid endoscope	1	
F30027336	Torque wrench 6-50 Nm	1	

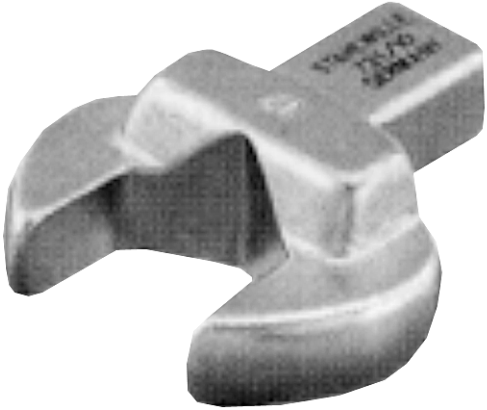

Part No.	Designation / Use	Qty.	
Y4342013	Feeler gauge	1	
F30026582	Torque wrench, 20-100 Nm	1	


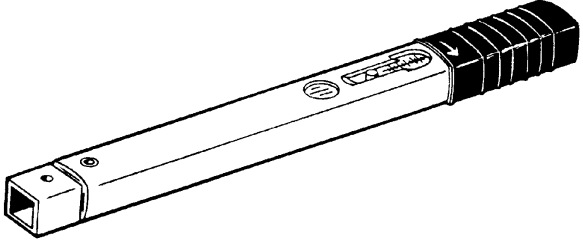
Part No.	Designation / Use	Qty.	
F30027340	Ratchet adapter	1	 A technical drawing of a ratchet adapter. It features a circular ratchet mechanism on top, a central shaft, and a rectangular base with a small protrusion on the side.
F30043446	Torque wrench 8-40 Nm	1	 A technical drawing of a torque wrench. It has a long, slender body with a square drive end on the left and a black, textured handle on the right. A scale is visible on the handle.

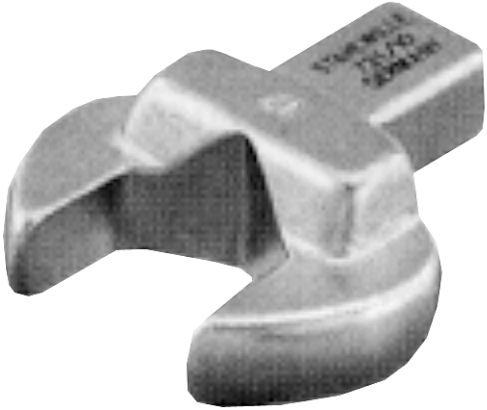
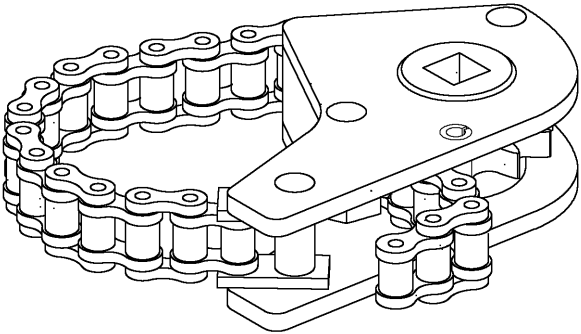
Part No.	Designation / Use	Qty.	
F30006234	Adapter	1	
F30027424	Crowfoot wrench, 19 mm	1	

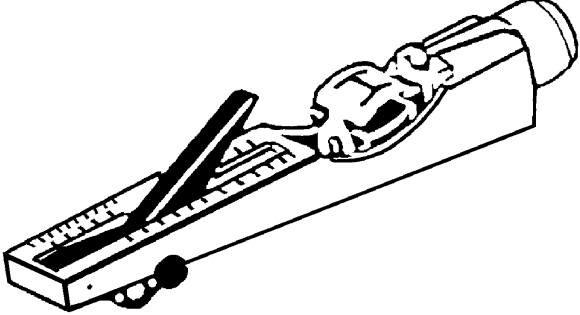
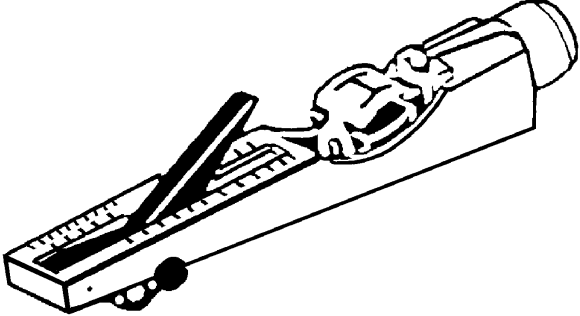
Part No.	Designation / Use	Qty.	
F30027425	Crowfoot wrench, 22 mm	1	
0015384230	Torque wrench, 0.5-5 Nm	1	

Part No.	Designation / Use	Qty.	
F30377999	Impact extractor	1	
F30378207	Fuel suction device	1	

Part No.	Designation / Use	Qty.	
F30025897	Open end socket wrench	1	 An open end socket wrench with a hexagonal head and a curved handle. The head has a flat top surface with some markings, and the handle is a simple curved shape.
F30011450	Double box wrench	1	 A double box wrench with a long, straight handle and two box ends. The handle has a textured grip area in the middle. The box ends are rectangular with rounded corners and a central opening.

Part No.	Designation / Use	Qty.	
F30025897	Socket wrench, 19 mm	1	
F30043446	Torque wrench, 8 - 40 Nm	1	

Part No.	Designation / Use	Qty.	
F30028341	Socket wrench	1	
F30379104	Filter wrench	1	

Part No.	Designation / Use	Qty.	
Y20097429	Belt tension tester	1	
Y20097429	Belt-tension tester	1	

8 Annex

8.1 Manufacturer's documentation

See Manufacturer's documentation.

8.2 MTU contact person/service partner

You will find the MTU contact person/service partner for your region at www.mtu-online.com, worldwide, in the left-hand navigation margin.

8.3 Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital	Transformer: transforms sensor voltages into numeric values
AFRS	Air Filter Restriction Sensor	
ANSI	American National Standards Institute	
ATL	Abgasturbolader	Exhaust turbocharger
ATS	Air Temperature Sensor	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	MTU Fluids and Lubricants Specifications, Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CEL	Check engine light	1st function: Warning lamp (rectify fault as soon as possible) 2nd function: Read out fault codes
CKT	Circuit	
CLS	Coolant level sensor	Monitors coolant level
CPS	Coolant pressure sensor	Monitors coolant pressure
CTS	Coolant temperature sensor	Monitors coolant temperature
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	
DDR	Diagnostic Data Reader	
DIN	Deutsches Institut für Normung e. V.	German Standardization Organization, at the same time identifier of German standards ("Deutsche Industrie-Norm")
DL	Default Lost	Alarm: Default CAN bus failure
DT	Diagnostic Tool	
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Storage module engine data
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	
EGR	Exhaust Gas Recirculation	
EMU	Engine Monitoring Unit	
EUI	Electronic Unit Injector	

Abbreviation	Meaning	Explanation
FPS	Fuel Pressure Sensor	Monitors fuel pressure
FRS	Fuel - Differential Pressure Sensor	
FTS	Fuel Temperature Sensor	Monitors fuel temperature
FWCP	Fire Water Control Panel	
GND	Ground	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit
HT	High Temperature	-
IDM	Interface Data Module	
INJ	Injector	
ISO	International Organization for Standardization	
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
LED	Light Emitting Diode	
LO	Low	Alarm: Measured value lower than 1st minimum limit
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit
LSG	Limiting Speed Governor	
N/A	Not Applicable	
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	Monitors oil level
OPS	Oil Pressure Sensor	Monitors oil pressure
OTS	Oil Temperature Sensor	Monitors oil temperature
OT	Oberer Totpunkt	Top dead center
PAN	Panel	
PIM	Peripheral Interface Module	
PWM	Pulsewidth modulated	
P-xyz	Pressure-xyz	Pressure measuring point xyz
RL	Redundancy Lost	Alarm: Redundant CAN bus failure

Abbreviation	Meaning	Explanation
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop engine light	1st function: Warning lamp (stop engine and rectify fault) 2nd function: Read out fault codes
SID	System Identifier	
SPC	Spare Parts Catalog	
SRS	Synchronous Reference Sensor	TDC cylinder 1
SS	Safety System	Indicated alarm is initiated by the safety system
TBS	Turbocharger Boost Sensor	Monitors charge-air pressure
TC	Tools Catalog	
TCI	Turbo Compressor Inlet	
TCO	Turbo Compressor Outlet	
TD	Transmitter Deviation	Alarm: Sensor-comparison failure
TPS	Throttle Position Sensor	
TRS	Timing Reference Sensor	
T-xyz	Temperature-xyz	Temperature measuring point xyz
UT	Unterer Totpunkt	Bottom dead center
VNT	Variable nozzle turbine	
VSG	Variable Speed Governor	
VSS	Vehicle Speed Sensor	

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