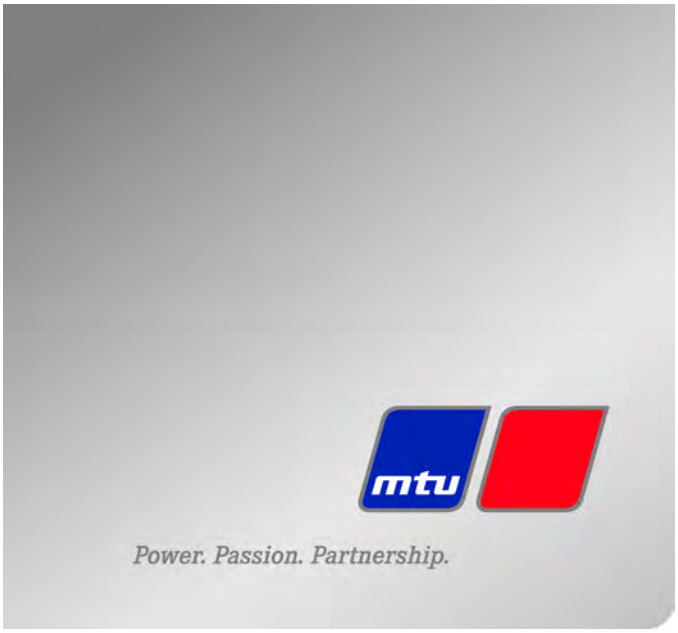
Operating Instructions

Diesel engine

12 V 2000 G25, G25 TB
12 V 2000 G45, G45 TB
12 V 2000 G65, G65 TB
12 V 2000 G85, G85 TB
16 V 2000 G25, G25 TB
16 V 2000 G45, G45 TB
16 V 2000 G65, G65 TB
16 V 2000 G85, G85 TB
18 V 2000 G25, G25 TB
18 V 2000 G45, G45 TB
18 V 2000 G65, G65 TB
18 V 2000 G85, G85 TB
Application group 3A

MS15018/02E



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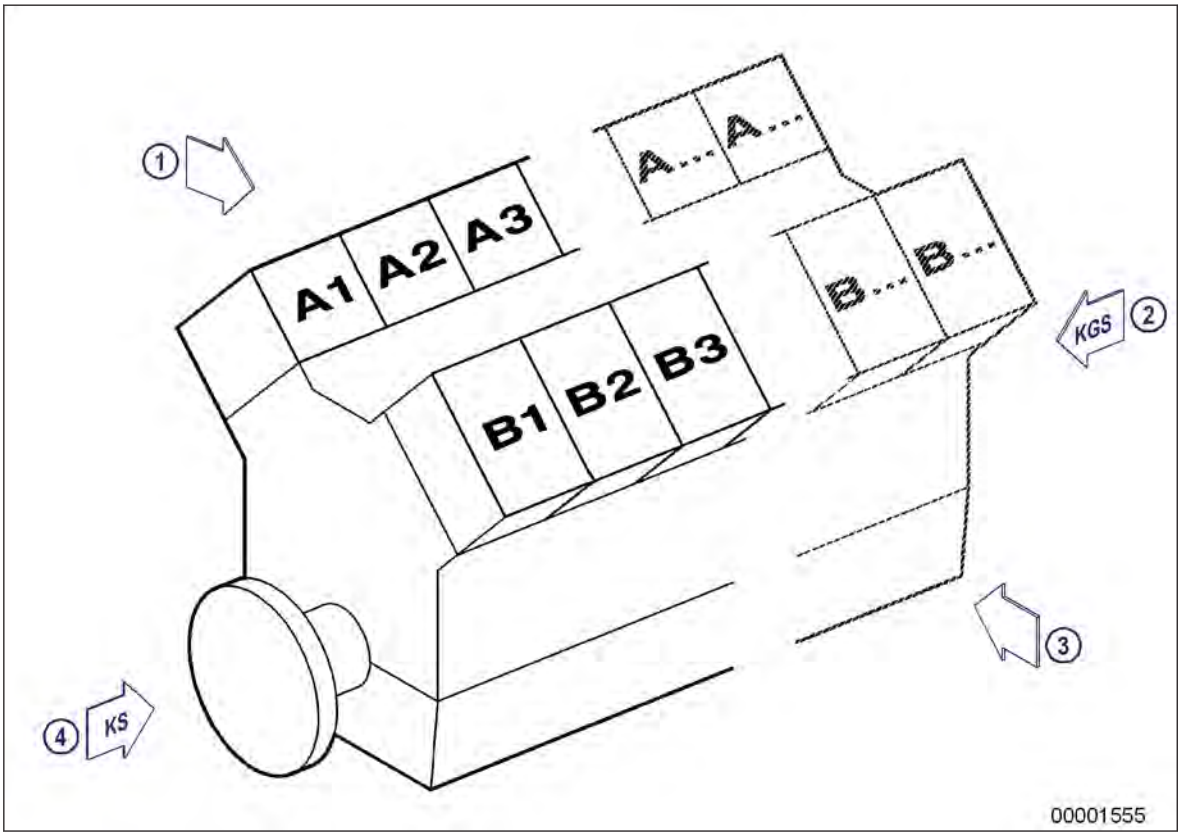
2 General Information

2.1 Engine side and cylinder designations

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

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

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

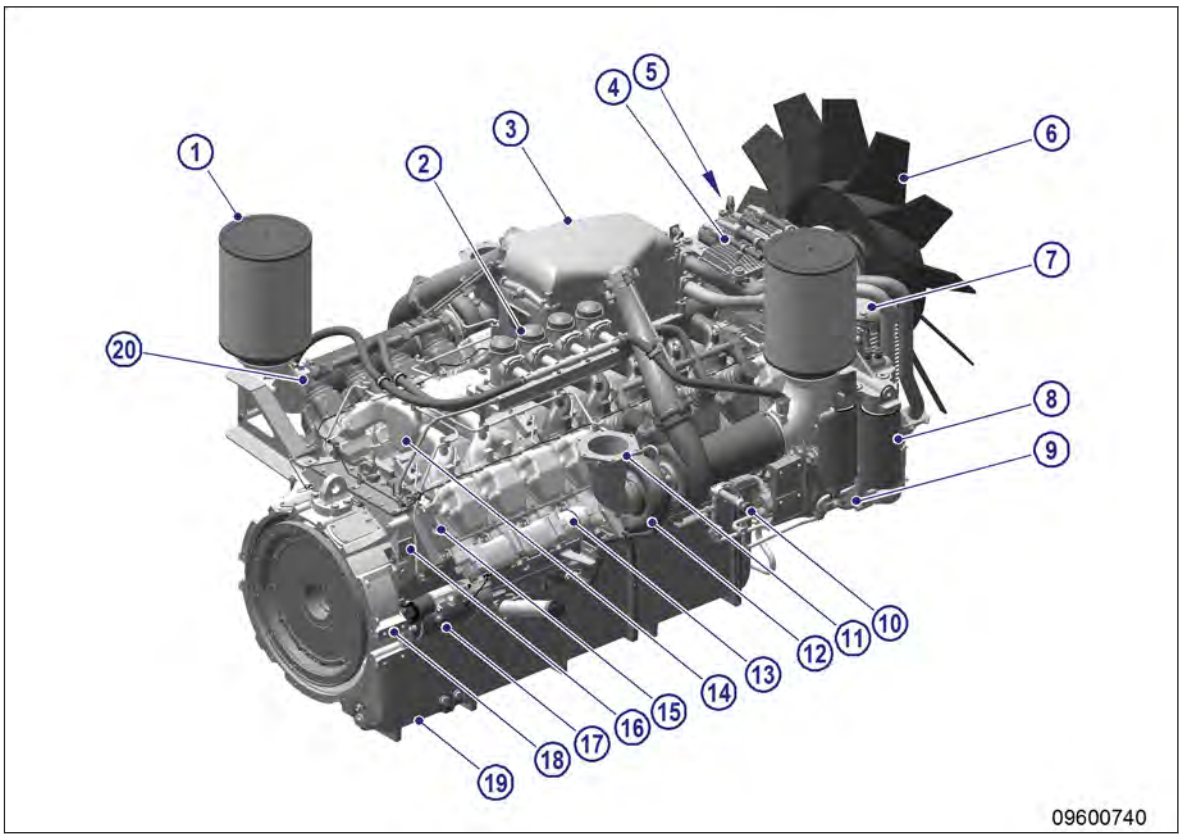


1 Left-hand side of engine
2 Free end
3 Right-hand side of engine
4 Driving end

TIM-ID: 0000002185 - 012

2.2 Engine – Overview

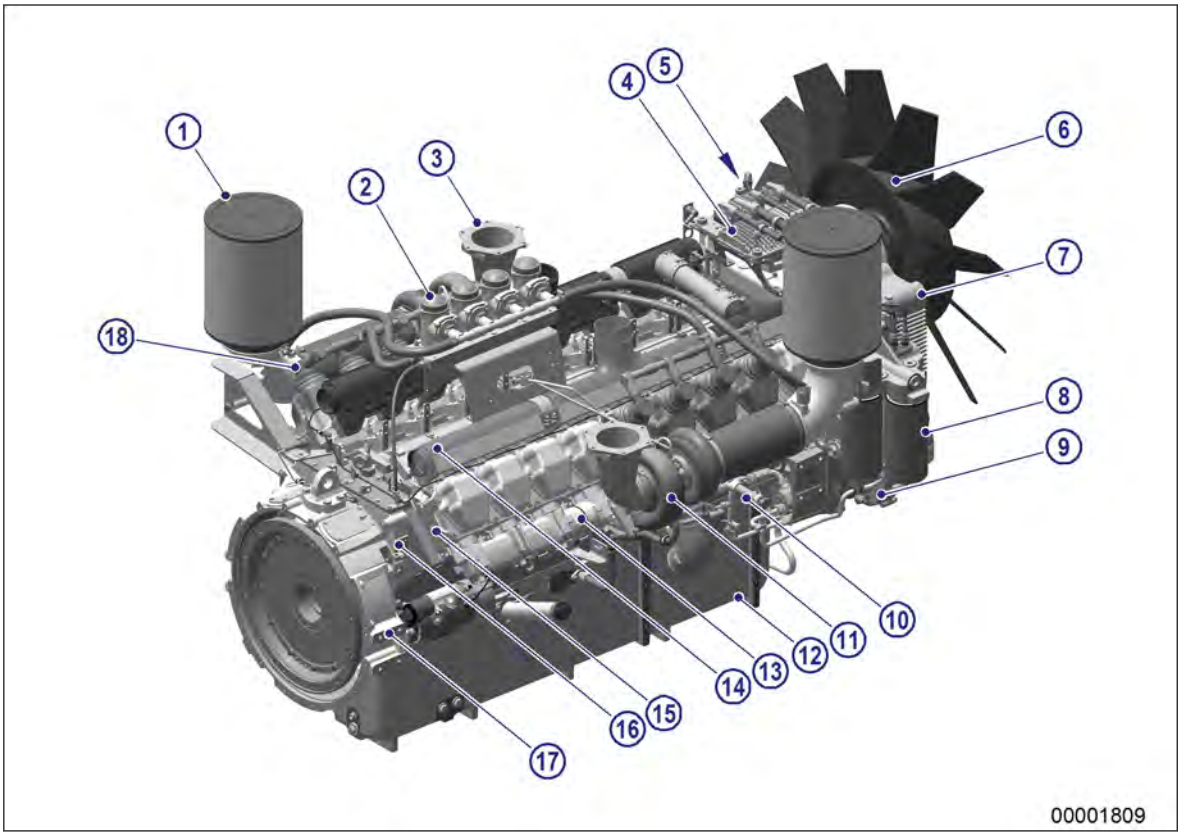
Illustration is applicable to 12/16/18 V 2000 Gxy engines (with water-cooled intercooler TB)



010 Crankcase and add-on components
1 Air filter
2 Oil separator
3 Intercooler
4 Engine governor
5 Fuel filter
6 Fan drive
7 Oil heat exchanger
8 Oil filter
9 Coolant pump
10 Fuel priming pump
11 Air outlet
12 Exhaust turbocharger
13 Exhaust elbow
14 Charge-air manifold
15 Cylinder head
16 Flywheel housing
17 Starter
18 Mounting
19 Oil pan
20 Crankcase breather

TIM-ID: 0000009973 - 004

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



1 Air filter	7 Oil heat exchanger	13 Exhaust elbow
2 Oil separator	8 Oil filter	14 Charge-air manifold
3 Air outlet	9 Coolant pump	15 Cylinder head
4 Engine governor	10 Fuel priming pump	16 Flywheel housing
5 Fuel filter	11 Exhaust turbocharger	17 Mounting
6 Fan drive	12 Oil pan	18 Crankcase breather

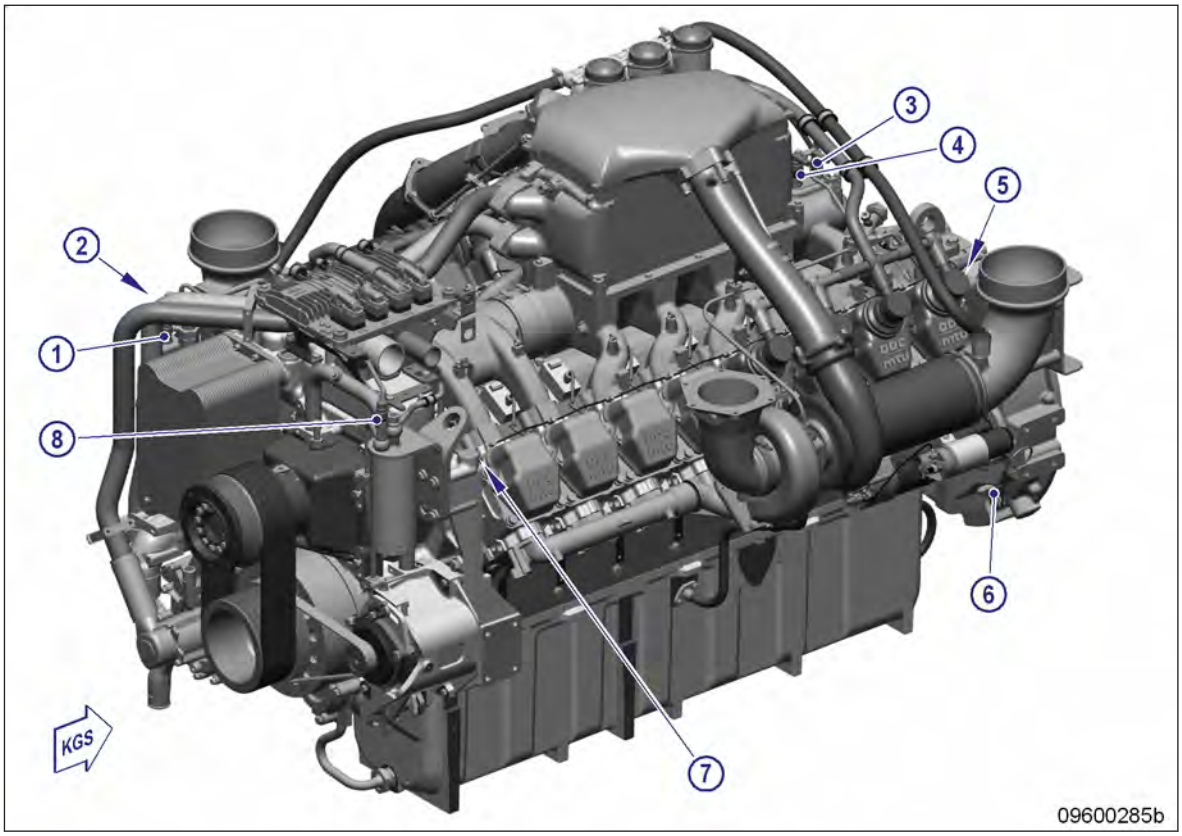
Engine model designation

Key to the engine model designations 12/16/18V 2000 Gxy	
12/16/18	Number of cylinders
V	Cylinder arrangement: V-engine
2000	Series
G	Application
X	Application segment (2, 4, 6, 8)
y	Design index (0,1, 2,...)

TIM-ID: 0000009973 - 004

2.3 Sensors and actuators – Overview

Engines with water-cooled intercooler TB

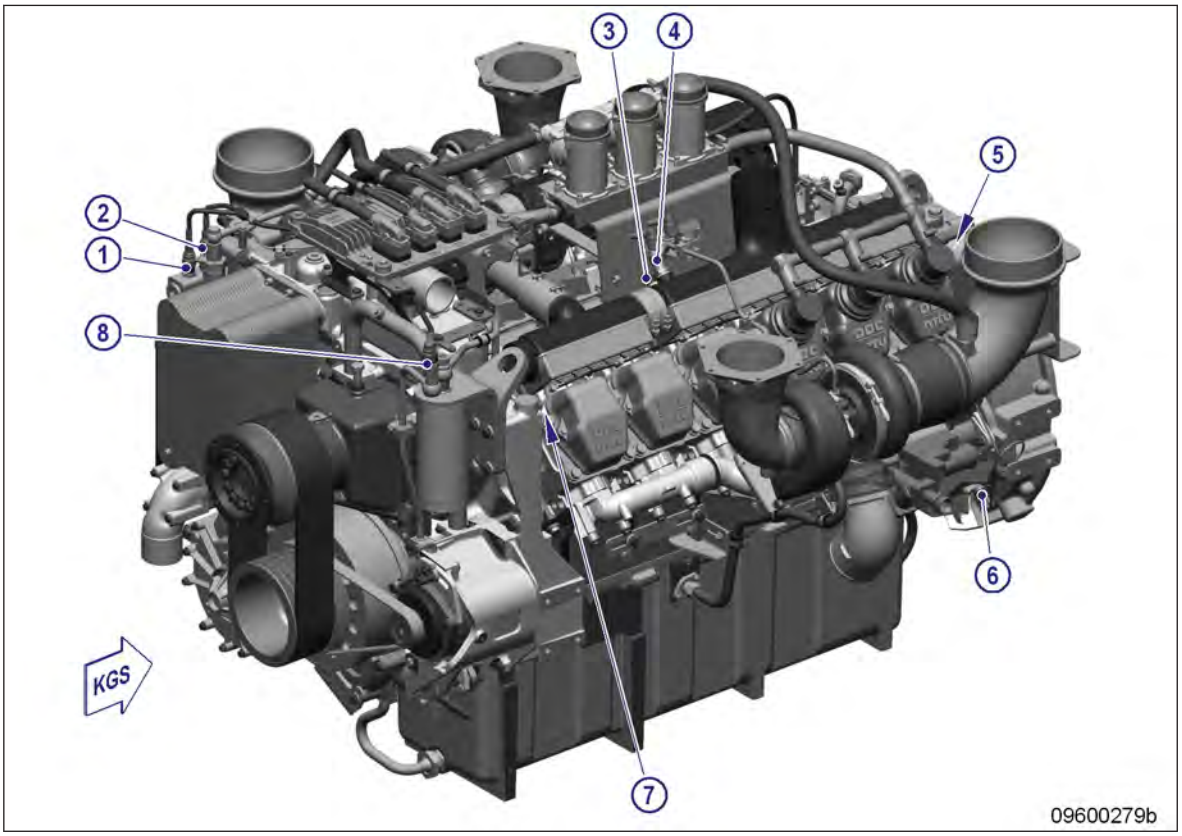


Item	Name	Monitoring of
1	B7	Lube oil temperature
2	B5	Lube oil pressure
3	B9	Charge-air coolant temperature
4	B10	Charge-air pressure
5	B1	Camshaft speed
6	B13	Crankshaft speed
7	B6	Coolant temperature
8	B33	Fuel temperature

The coolant level sensor F33 is located in the coolant expansion tank at the cooler

TIM-ID: 0000022704 - 003

Engine with air-cooled intercooler TD



Item	Name	Monitoring of
1	B7	Lube oil temperature
2	B5	Lube oil pressure
3	B9	Charge-air coolant temperature
4	B10	Charge-air pressure
5	B1	Camshaft speed
6	B13	Crankshaft speed
7	B6	Coolant temperature
8	B33	Fuel temperature

The coolant level sensor F33 is located in the coolant expansion tank at the cooler

TIM-ID: 0000022704 - 003

3 Technical Data

3.1 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 G65	18V 2000 G65
Application group			3A	3A	3A	3A
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	16	18
Rated engine speed	A	rpm	1500	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	452	515	655	720

GENERAL CONDITIONS (for maximum power)

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

MODEL RELATED DATA (basic design)

Number of cylinders			12	12	16	18
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

TIM-ID: 0000010804 - 001

Number of cylinders			12	12	16	18
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	16	18
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	31.84	35.82
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	16	18
Charge air pressure before cylinder - DL	R	bar abs	2.3	2.5	2.5	2.4

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	12	16	18
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	16	18
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	100	100	100
Lube-oil temperature before engine, shutdown	L	°C	105	105	105	105

TIM-ID: 0000010804 - 001

Number of cylinders			12	12	16	18
Lube-oil operating pressure before engine, from	R	bar	6.2	6.2	5.5	6.0
Lube-oil operating pressure before engine, to	R	bar	7.5	7.5	6.5	8.0
Lube-oil pressure before engine, alarm	R	bar	4.4	4.4	4.4	4.4
Lube-oil pressure before engine, shut-down	L	bar	3.9	3.9	3.9	3.9

FUEL SYSTEM

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

TIM-ID: 0000010804 - 001

WEIGHTS / MAIN DIMENSIONS

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

ACOUSTICS

Number of cylinders			12	12	16	18
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	119	119	116	116
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	114	115	119	119

TIM-ID: 0000010804 - 001

3.2 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 G65-TB	18V 2000 G65-TB
Application group			3A	3A	3A	3A
Intake air temperature		°C	25	25	25	25
Charge-air coolant temperature		°C	55	55	55	55
Raw water inlet temperature		°C	-	-	-	-
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	16	18
Rated engine speed	A	rpm	1500	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	452	515	655	720

GENERAL CONDITIONS (for maximum power)

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

MODEL RELATED DATA (basic design)

Number of cylinders			12	12	16	18
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

TIM-ID: 0000010846 - 001

Number of cylinders			12	12	16	18
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	16	18
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	31.84	35.82
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	16	18
Charge air pressure before cylinder - DL	R	bar abs	2.3	2.5	2.5	2.4

COOLANT SYSTEM (HT circuit)

Number of cylinders			12	12	16	18
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

COOLANT SYSTEM (LT circuit)

Number of cylinders			12	12	16	18
Coolant temperature before intercooler (at engine inlet from cooling equipment)	A	°C	55	55	55	55
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

TIM-ID: 0000010846 - 001

LUBE-OIL SYSTEM

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

FUEL SYSTEM

Number of cylinders			12	12	16	18
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	16	18
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	16	18
Engine coolant capacity, engine side (without cooling equipment)	R	liters	110	110	130	140
Charge-air coolant, engine side	R	liters	20	20	20	20
Total engine oil capacity at initial filling (standard oil system) (Option: max. operating inclinations)	R	liters	77	77	102	130
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	99	114

TIM-ID: 0000010846 - 001

Number of cylinders			12	12	16	18
Oil pan capacity at dipstick mark "min." (standard oil system) (Option: max. operating inclinations)	L	liters	50	50	69	87
Oil pan capacity at dipstick mark "max." (standard oil system) (Option: max. operating inclinations)	L	liters	67	67	92	110

WEIGHTS / MAIN DIMENSIONS

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

ACOUSTICS

Number of cylinders			12	12	16	18
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	119	119	116	116
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	114	115	119	119

TIM-ID: 0000010846 - 001

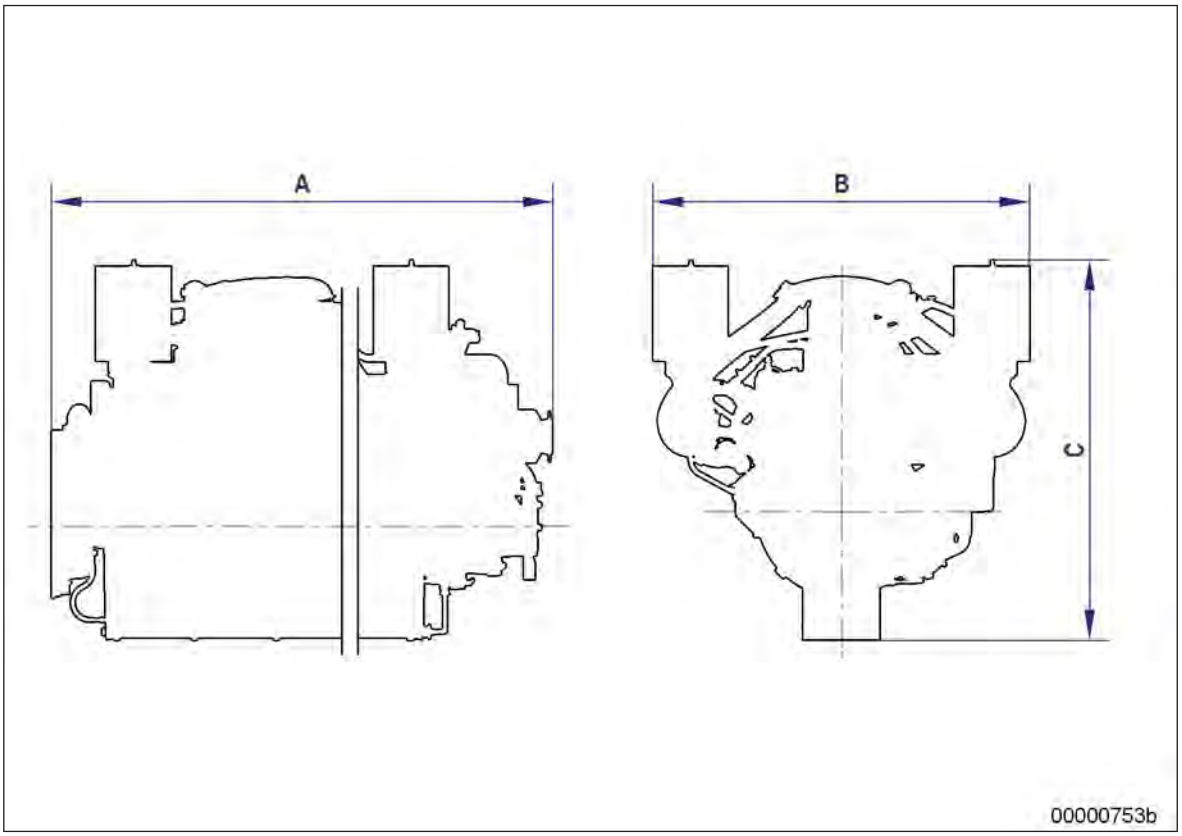
3.3 Firing order

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

TIM-ID: 0000002793 - 002

3.4 Engine – Main dimensions



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

TIM-ID: 0000010030 - 003

4 Operation

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

Preconditions

☑ Engine is stopped and starting disabled.

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

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

Item	Action
Engine	Depreserve (→ MTU Preservation and Represervation Specifications A001070/..).
Lube oil system	Check engine oil level (→ Page 109);
Fuel prefilter	Fill with fuel (→ Page 99).
Fuel prefilter, pressure gauge	Align adjustable pointer with position of pressure indicator (→ Page 97).
Fuel system	Vent (→ Page 94).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 113). Change charge-air coolant (→ Page 121).
Coolant circuit	Check engine coolant level (→ Page 112); Check charge-air coolant level (→ Page 122).
Coolant circuit	Heat engine coolant with coolant preheating unit.
Engine governor	Check plug-in connections (→ Page 135).
Monitoring system	Carry out lamp test (see manufacturer's documentation).
Engine/generator control system	Switch ON; select operating mode, e.g. MANUAL, AUTOMATIC OPERATION.

TIM-ID: 0000002190 - 002

4.2 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 109);
Cooling system	Check engine coolant level (→ Page 112); Check charge-air coolant level (→ Page 122).
Cooling system	Preheat coolant with preheating unit.
Fuel prefilter	Drain (→ Page 98).
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.

TIM-ID: 0000002677 - 001

4.3 Engine – Starting in manual mode (test run)

Preconditions

☑ Generator (if fitted) is not connected to network.

☑ External start interlock is not active.

DANGER

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

WARNING

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

Preparation

Item	Action
Operating mode switch (if fitted)	Change to manual mode.
Preheating pump (if fitted)	Switch on.

Starting the engine

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	If coolant temperature is • > 40 °C (with preheating system), or • > 5 °C (without preheating system): Press start button. • Automatic starting sequence is performed; • Engine speed display instrument indicates increasing speed; • After the starting sequence is completed, engine is running at rated speed.

Connecting the generator (if fitted) to network, engine warm-up procedure to reach operating temperature

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	Close the generator circuit breaker.
Engine	Apply full load only after engine has reached operating temperature (coolant temperature approx. 75 °C).

TIM-ID: 0000002226 - 004

4.4 Safety system – Override

NOTICE

Safety functions and engine shutdown alarms will be disregarded.
Severe material damage!
- Initiate emergency start only in emergency situations.

NOTICE

Inadmissible operating status.
Severe damage to property!
- Use override function only in hazardous situations to ensure full capability in the event of engine faults.

Preparation

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

Safety system – Override

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	Activate pushbutton for Override input of the ECU. • Certain shutdown criteria and/or starting prerequisites are ignored.
Switchgear cabinet, control panel etc. (depending on manufacturer)	Actuate start button, for further starting sequence, refer to engine start (→ Page 32).
Control and display panels	During operation, check the displayed operational data (speed, temperature, pressures). Constantly monitor plant limit values.

TIM-ID: 0000000984 - 003

4.5 Operational checks

DANGER

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

WARNING

Engine noise above 85 dB (A).
Risk of damage to hearing!
- 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 97).
Exhaust system	Check exhaust color (→ Page 64).
Intercooler	Check condensate drain(s) for water discharge and obstruction (→ Page 104).
Air filter	Check signal ring position of service indicator (→ Page 107). Replace air filter (→ Page 105), if the signal ring is completely visible in the red area of the service indicator control window.
Coolant pump	Check relief bore (→ Page 117).
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.

TIM-ID: 0000010120 - 001

4.6 Engine - Stopping in manual mode (test run)

Preconditions

☑ Generator (if fitted) is not connected to network

☑ Engine in manual mode

NOTICE

Stopping the engine when it is running at full load subjects it to extreme thermal and mechanical stresses.
Overheating of and, therefore, damage to components is possible!
- Before shutting down the engine, allow it to idle until the engine temperatures decrease and constant levels are indicated.

Preparing a generator drive (only if generator circuit breaker is provided)

Item	Action
Engine	After the generator breaker (if provided) has been opened, allow the engine to cool down by running it idle for approx. 5 minutes.

Preparing a pump drive (diesel-mechanical/diesel-electric)

Item	Action
Engine	Allow the engine to cool down by running it at reduced speed for approx. 5 minutes. Observe the natural frequencies (plant-specific values) of the engine!

Stopping the engine

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	Press stop button. • Automatic stopping sequence is performed; • Engine at a standstill.

After stopping the engine

Item	Action
Coolant circulation pump	Operate pump for a sufficient period of time after the engine is stopped.

TIM-ID: 0000002285 - 004

4.7 Engine - Emergency stop

NOTICE

An emergency stop causes extreme stress to the engine plant.
Risk of overheating, damage to components!
- Initiate emergency stop only in emergency situations.

Emergency stop from LOP

Item	Action
Emergency stop pushbutton	Press pushbutton. • Engine is stopped by disconnecting the power supply to the ECU; • signalization (e.g. by horn, flashing lamp) is released.

After emergency stop from LOP

Item	Action
Switchgear cabinet, control panel etc. (depending on manufacturer)	Press pushbutton for alarm acknowledgement. • Audible and visual alarm signaling stops.

TIM-ID: 0000002305 - 003

4.8 After stopping the engine – Engine remains ready for operation

After stopping the engine

Item	Action
Engine/generator/pump control	Select operating mode, e.g. MANUAL, AUTOMATIC OPERATION.

TIM-ID: 0000000983 - 003

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

Preconditions

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

After stopping the engine

Item	Action
Coolant circuit	Drain engine coolant (→ Page 114); Drain charge-air coolant (→ Page 120) if: • freezing temperatures are to be expected and the engine is to remain out of service for an extended period and if no antifreeze has been added to the coolant; • the engine room is not heated; • the coolant is not kept at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50 % and engine-room temperature is below -40 °C.
Engine/generator/pump control	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 (→ Preservation and Represervation Specifications A001070/..).

TIM-ID: 0000002706 - 003

5 Maintenance

5.1 Maintenance task reference table [QL1]

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

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

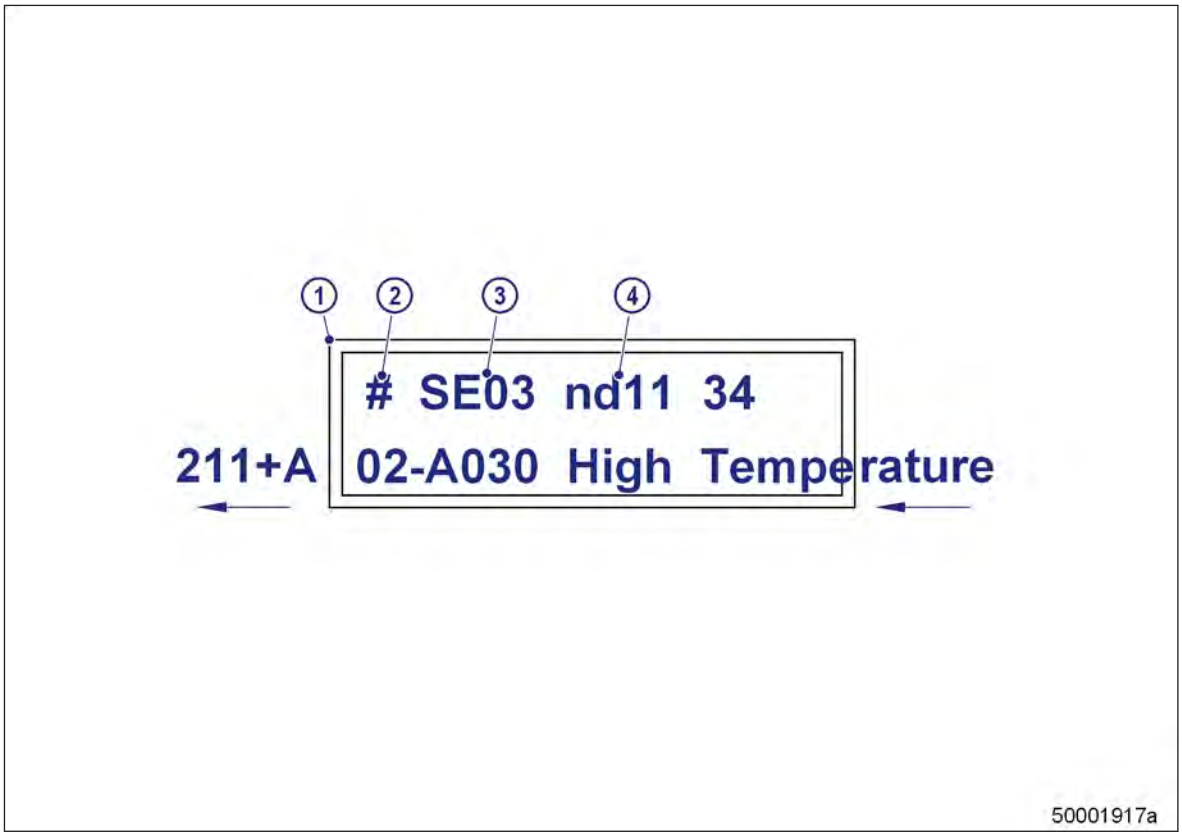
Task	Maintenance tasks	
W0500	Check engine oil level.	(→ Page 109)
W0501	Visually inspect engine for leaks and general condition.	(→ Page 34)
W0502	Check intercooler drain.	(→ Page 34)
W0503	Check signal ring position of service indicator on air filter.	(→ Page 34)
W0505	Check relief bores of water pump(s).	(→ Page 34)
W0506	Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 34)
W0507	Drain water and contaminants from fuel prefilter.	(→ Page 34)
W0508	Check reading on differential pressure gage of fuel prefilter.	(→ Page 34)
W0534	Carry out test run, minimum duration: until steady-state temperature is reached, no less than 1/3 load (monthly).	(→ Page 69)
W1001	Replace fuel filter or fuel filter element.	(→ Page 96)
W1002	Check valve clearance.	(→ Page 77)
W1003	Check belt condition and tension, replace if necessary.	(→ Page 125)
W1005	Replace air filter.	(→ Page 105)
W1006	Replace fuel injectors.	(→ Page 85)
W1007	Replace fuel injection pump(s).	(→ Page 82)
W1008	Replace engine oil filter when changing engine oil, or when the time limit (years) is reached, at the latest.	(→ Page 111)
W1010	Coolant cooler: Check exterior of cooler elements for dirt.	(→ Page 123)
W1011	Perform endoscopic examination.	(→ Page 70)
W1056	Replace fuel pressure maintaining valve.	(→ Page 93)
W1178	Replace pressure pipe neck in cylinder head.	(→ Page 89)

TIM-ID: 0000037729 - 002

6 Troubleshooting

6.1 Fault indication on SAM display – Genset applications

SAM fault messages



1 2-line LC display
2 Time indicator for alarms
3 Fault type
4 Node number

The structure of the display is as follows:

- First line
  - Time indicator for alarms (e.g. #)
  - Type of fault (e.g. SE03)
  - Node number at which the fault occurred (e.g. nd11)
- Second line (option)
  - Running text, providing more information about the fault currently displayed

Time indicator for alarms	Meaning
#	Alarm is no longer active, does not appear on next power-up.
A	Alarm is active.
B	Alarm was active during the last hour.
C	Alarm was active during the last four hours.
D	Alarm was active during the last four to twelve hours.
E	Alarm was active more than twelve hours ago.

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

TIM-ID: 0000008508 - 003

Fault type – fault message text

SE no.	Error message text
0	Sensor Temperatur 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	Temperatur Compensation Error
9	I/O-Module Slot2 Defect
10	I/O-Module Slot3 Defect
11	I/O-Module Slot4 Defect
12	Serial Conection 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.

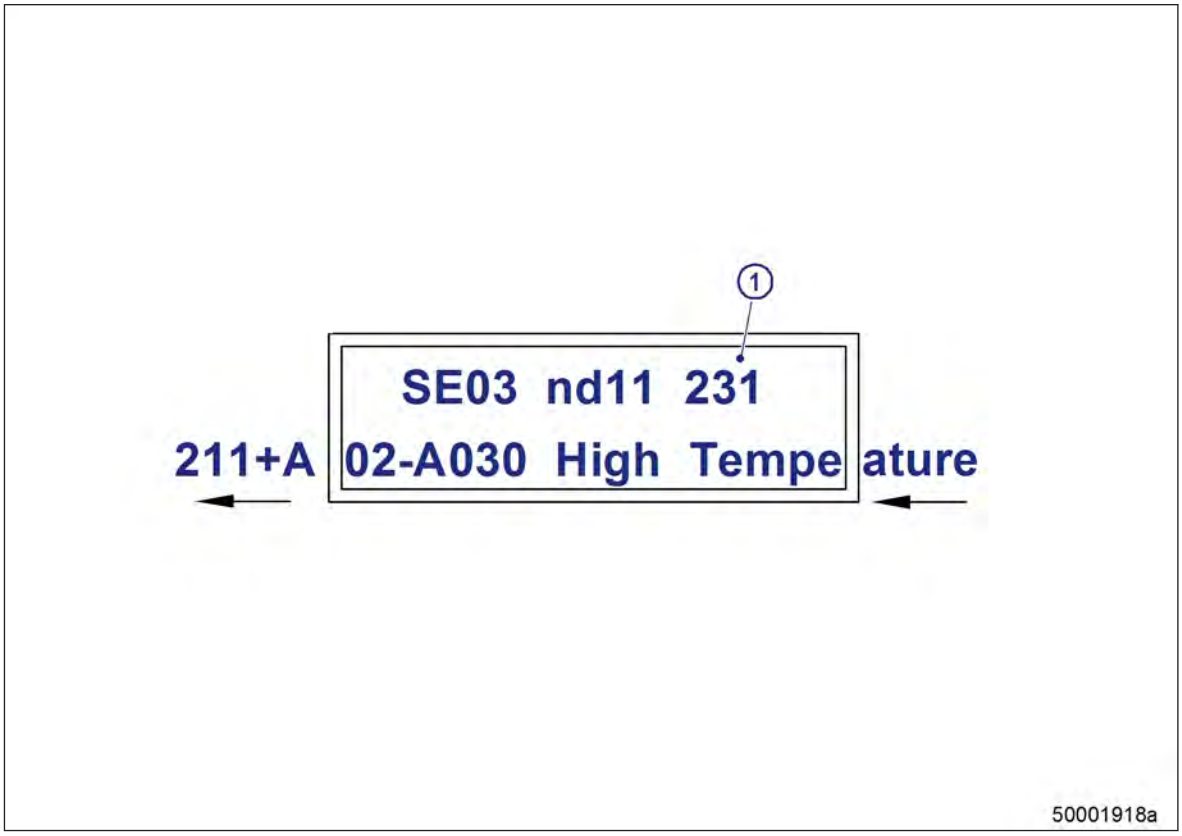
Red alarm:

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 signaled.

Fault and alarm messages

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

TIM-ID: 0000008508 - 003



The fault code (1) comprises three digits.

Fault messages can also be caused by faulty sensors/actuators. Contact Service to have sensors/actuators checked and replaced as necessary if the troubleshooting measures listed 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.	Full 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

TIM-ID: 0000008508 - 003

Fault code no.	Full 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
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

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
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 wiring, 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 wiring, 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
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

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
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	Oil priming 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
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

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
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 ECU 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 node on CAN bus 1 has failed (alarm configuration parameter, see PR 2.8008.100 for explanation).	Test devices connected to CAN, test wiring.	2.0500.680
181	AL CAN2 Node Lost	Connection to a node on CAN bus 2 has failed (alarm configuration 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

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
183	AL CAN No PU-Data	The selected CAN mode initializes communication by means of the PU data module. 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 indicated a warning. Causes are e.g. missing associate 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 indicated a warning. Causes are e.g. missing associate 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 wire break.	Check sensor and wiring (B6), replace as necessary.	1.8004.570
202	SD T-Fuel	SD alarm configuration, fuel temperature sensor faulty, short circuit or wire break.	Check sensor and wiring (B33), replace as necessary.	1.8004.572

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
203	SD T-Charge Air	SD alarm configuration, charge-air temperature sensor faulty, short circuit or wire break.	Check sensor and wiring (B9), replace as necessary.	1.8004.571
205	SD T-Coolant Intercooler	SD alarm configuration, coolant temperature sensor of intercooler faulty, short circuit or wire break.	Check sensor and wiring (B26), replace as necessary.	1.8004.574
208	SD P-Charge Air	SD alarm configuration, charge-air pressure sensor faulty, short circuit or wire break.	Check sensor and wiring (B10), replace as necessary.	1.8004.566
211	SD P-Lube Oil	SD alarm configuration, lube-oil pressure sensor faulty, short circuit or wire break.	Check sensor and wiring (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 wire break.	Check sensor and wiring (B48), replace as necessary.	1.8004.567
216	SD T-Lube Oil	SD alarm configuration, lube-oil temperature sensor faulty, short circuit or wire break.	Check sensor and wiring (B7), replace as necessary.	1.8004.575
219	SD T-Intake Air	SD alarm configuration, intake air temperature sensor faulty, short circuit or wire break.	Check sensor and wiring (B3), replace as necessary.	1.8004.573
220	SD Level Coolant Water	SD alarm configuration, coolant level sensor faulty, short circuit or wire break.	Check sensor and wiring (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 wire break.	Check sensor and wiring (F57), replace as necessary. Fault is rectified when electronics are switched back on.	1.8004.583

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
229	AL Stop Camshaft Sensor Defect	Engine stop due to camshaft sensor fault (and a previous crankshaft sensor fault in the same operating cycle). Alarm configuration parameter, see PR 2.8008.100 for explanation.	Check connector and wiring to sensor B1, replace as necessary. Fault is rectified when engine is restarted. If camshaft and crankshaft sensor are both faulty, check connector and wiring 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 wiring damage, engine remains operational.	Check sensor and wiring (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 wiring damage, engine remains operational.	Check sensor and wiring (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 wiring damage.	Check sensor and wiring (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 wiring damage.	Check speed setting transmitter and wiring, 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 wiring damage	Check wiring, replace as necessary. Fault is rectified when engine is restarted.	2.8006.588

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
270	SD Frequency Input	SD alarm configuration, frequency input faulty, short circuit or wiring damage.	Contact Service.	2.8006.590
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

TIM-ID: 0000008508 - 003

Fault code no.	Full 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

TIM-ID: 0000008508 - 003

Fault code no.	Full 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	Wiring fault in injector wiring cylinder A1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.520

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
322	AL Wiring Cylinder A2	Wiring fault in injector wiring cylinder A2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.526

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
328	AL Wiring Cylinder A8	Wiring fault in injector wiring cylinder A8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder A10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.532

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
334	AL Wiring Cylinder B4	Wiring fault in injector wiring cylinder B4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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	Wiring fault in injector wiring cylinder B9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, rectify injector solenoid valve short circuit (positive to negative) (e.g. by exchanging injectors). Fault rectification: When engine is restarted.	1.8004.538

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
340	AL Wiring Cylinder B10	Wiring fault in injector wiring cylinder B10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring to cylinder A1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.544

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
346	AL Open Load Cylinder A6	Disruption fault in injector wiring cylinder A6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.545
347	AL Open Load Cylinder A7	Disruption fault in injector wiring cylinder A7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder A10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B1. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.550

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
352	AL Open Load Cylinder B2	Disruption fault in injector wiring cylinder B2. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B3. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.552
354	AL Open Load Cylinder B4	Disruption fault in injector wiring cylinder B4. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B5. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B6. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B7. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.556

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
358	AL Open Load Cylinder B8	Disruption fault in injector wiring cylinder B8. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B9. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, 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 wiring cylinder B10. Result: Misfiring (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check injector wiring, exclude disruption in solenoid valve (e.g. by injector replacement). Fault rectification: After each working cycle.	1.8004.559
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. wiring 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. wiring 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. wiring fault).	1.8004.560

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
365	AL Stop MV-Wiring Ground	Injector wiring fault. Engine stop configurable (alarm configuration parameter, see PR 2.8008.100 for explanation). Possible causes: 1. Short circuit of injector positive connection to ground of one or more injectors. 2. Short circuit of injector negative connection to ground of one or more injectors.	Check wiring, replace wiring harness as necessary.	1.8004.561
381	AL Wiring TOP 1	Short circuit or wire break at transistor output 1 plant side (TOP 1, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.638
382	AL Wiring TOP 2	Short circuit or wire break at transistor output 2 plant side (TOP 2, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.639
383	AL Wiring TOP 3	Short circuit or wire break at transistor output 3 plant side (TOP 3, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.640
384	AL Wiring TOP 4	Short circuit or wire break at transistor output 4 plant side (TOP 4, alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	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, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.625
401	AL Open Load Digital Input 2	Line disruption at digital input 2, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.626

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
402	AL Open Load Digital Input 3	Line disruption at digital input 3, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006627
403	AL Open Load Digital Input 4	Line disruption at digital input 4, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.628
404	AL Open Load Digital Input 5	Line disruption at digital input 5, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.629
405	AL Open Load Digital Input 6	Line disruption at digital input 6, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.630
406	AL Open Load Digital Input 7	Line disruption at digital input 7, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.631
407	AL Open Load Digital Input 8	Line disruption at digital input 8, wiring faulty or no resistance via switch, (alarm configuration parameter, see PR 2.8008.100 for explanation).	Check wiring.	2.8006.632
408	AL Open Load Emerg. Stop Input ESI	Line disruption at input for emergency stop, wiring faulty or no resistance via switch	Check wiring.	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

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
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 wiring damage	Check signal transmitter and wiring, 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
463	SD AUX 2	SD alarm configuration, analog input signal for Aux 2 faulty, short circuit or wiring damage.	Check signal transmitter and wiring, 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 wiring damage.	Check pressure transmitter and wiring, replace as necessary.	1.8004.589
468	SD T-AUX 1	Analog input for temperature Aux 1 faulty, short circuit or wiring damage	Check signal transmitter and wiring, replace as necessary.	1.8004.579
469	SD AUX 1	SD alarm configuration, analog input signal for Aux 1 faulty, short circuit or wiring damage.	Check signal transmitter and wiring, replace as necessary.	1.8004.590
470	SD T-ECU	Engine governor defective.	Replace engine governor at next opportunity.	1.8004.587
471	SD Coil Current	SD alarm configuration, HP fuel control block activation, short circuit or wiring damage.	Check sensor and wiring, replace as necessary. Fault is rectified when engine is restarted.	1.8004.592

TIM-ID: 0000008508 - 003

Fault code no.	Full designation	Meaning	Action	Setting parameter no.
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	Initialization error of crash recorder.	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
480	AL Ext. Engine Protection	External engine protection function 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 function (maintenance concept, alarm configuration parameter, see PR 2.8008.100 for explanation).	Contact Service.	2.0555.001

TIM-ID: 0000008508 - 003

6.2 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 133).
Engine/generator control system	Secure seating of assemblies or connectors not provided	Perform visual inspection (see manufacturer's documentation).
Engine Governor	Plug-in connections are loose	Check plug-in connections (→ Page 135).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Probable Cause	Task
Starter	Poor rotation by starter: Battery low or defective	Charge or replace battery (see manufacturer's documentation).
Engine wiring	Defective	Check (→ Page 133).
Fuel system	Not vented	Vent fuel system (→ Page 94).
Engine Governor	Defective	Contact Service.

Engine fires unevenly

Component	Probable Cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 85).
	Injection pump defective	Replace (→ Page 82).
Engine wiring	Defective	Check (→ Page 133).
Fuel system	Not vented	Vent fuel system (→ Page 94).
Engine Governor	Defective	Contact Service.

Engine does not reach nominal speed

Component	Probable Cause	Task
Fuel supply	Fuel prefilter clogged	Replace (→ Page 102).
	Easy-change fuel filter clogged	Replace (→ Page 96).
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 107).
Fuel injection equipment	Injector defective	Replace (→ Page 85).
	Injection pump defective	Replace (→ Page 82).
Engine wiring	Defective	Check (→ Page 133).
Engine	Overloaded	Contact Service.

TIM-ID: 0000002534 - 002

Engine speed not steady

Component	Probable Cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 85).
	Injection pump defective	Replace (→ Page 82).
Speed sensor	Defective	Contact Service.
Fuel system	Not vented	Vent fuel system (→ Page 94).
Engine Governor	Defective	Contact Service.

Charge-air temperature too high

Component	Probable Cause	Task
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 107).
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 107).
Fuel injection equipment	Injector defective	Replace (→ Page 85).
	Injection pump defective	Replace (→ Page 82).
Engine	Overloaded	Contact Service.

Exhaust gas blue

Component	Probable Cause	Task
Engine oil	Too much oil in engine	Drain engine oil (→ Page 110).
	Oil separator of crankcase breather contaminated	Replace (→ Page 74).
Exhaust turbocharger, cylinder head, piston rings, cylinder liner	Defective	Contact Service.

TIM-ID: 0000002534 - 002

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 98).
Intercooler	Leaking	Contact Service.

TIM-ID: 0000002534 - 002

7 Task Description

7.1 Engine

7.1.1 Engine - Barring manually

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

DANGER

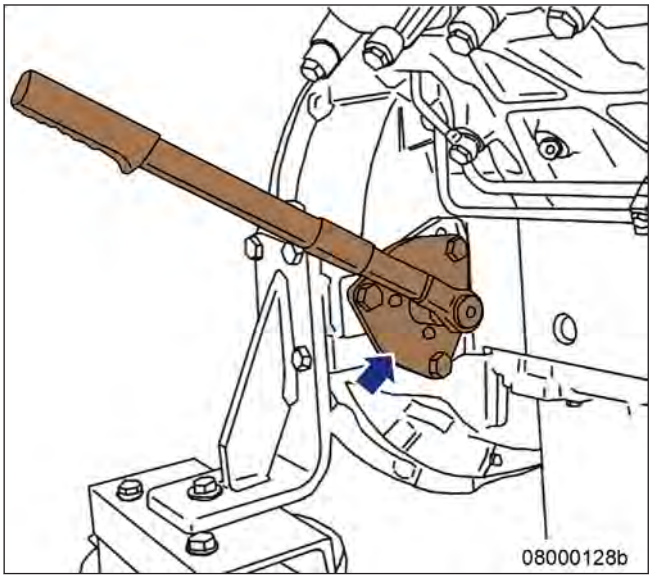
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before cranking the engine, make sure that there are no persons in the engine's danger zone.
- After finishing work on the engine, make sure that all safety devices are put back in place and all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

Engine – Barring manually

1. Remove access cover from flywheel housing.
2. Install barring device (arrow) on flywheel housing.
3. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no resistance.

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

4. For barring device removal, follow reverse sequence of working steps.



TIM-ID: 0000000012 - 003

7.1.2 Engine - Barring with starting system

Preconditions

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

DANGER

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

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.

TIM-ID: 0000000013 - 004

7.1.3 Engine - Test run

DANGER

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

WARNING

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

Engine – Test run

1. Start engine (→ Page 32).
2. Perform test run not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks (→ Page 34).
4. Stop engine (→ Page 35).

TIM-ID: 0000000870 - 008

7.2 Cylinder Liner

7.2.1 Cylinder liner – Endoscopic examination

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

Preparatory steps

1. Remove cylinder head cover (→ Page 80).
2. Remove injector (→ Page 86).

Positioning crankshaft at BDC

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

Cylinder liner – Endoscopic examination

Findings	Action
• Thin carbon coating on circumference of carbon scraper ring • Slight localized additive deposits at top edge • Singular smooth areas at lower edge • Carbon deposits on circumference in clearance between top piston ring and bottom edge of carbon scraper ring • First signs of marks left by top piston ring • Bright mark on entire circumference • Consistent honing pattern without objections • First signs of marks left by lower cooling bores • Running pattern seems darker	No action required
• Dark areas with even or varying degrees of discoloration • Beginning and end of the discoloration are not sharply defined and do not cover the entire stroke area • Dark areas in the upper section of the cooling bore, remaining circumference without objections • Piston rings without objections	Further endoscopic examination required as part of maintenance work
• On the entire circumference, apart from light areas of discoloration (that do not impair operation) clearly darker stripes that start at the top piston ring • Heat discoloration in the direction of stroke and honing pattern damage • Heat discoloration of piston rings	Cylinder liner must be replaced; Service must be contacted

1. Compile endoscopy report using the table.
2. Use technical terms for description of the liner surface (→ Page 72).
3. Depending on findings:
   - do not take any action or
   - carry out a further endoscopic examination as part of maintenance work or
   - contact Service; cylinder liner must be replaced.

TIM-ID: 0000000015 - 014

Final steps

1. Install injector (→ Page 86).
2. Install cylinder head cover (→ Page 80).

TIM-ID: 0000000015 - 014

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

Terms used for endoscopic examination

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

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

TIM-ID: 0000000014 - 015

Evaluation of findings and further measures

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

TIM-ID: 0000000014 - 015

7.3 Crankcase Breather

7.3.1 Crankcase breather - Oil separator element replacement, diaphragm check and replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

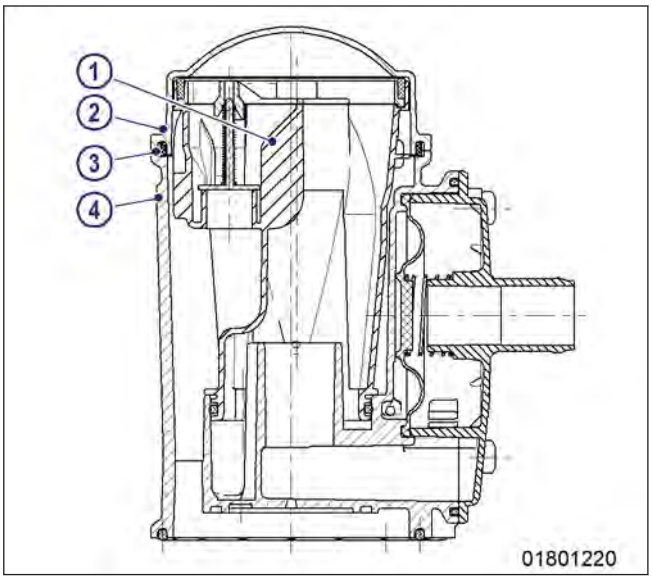
Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Ratchet	F30027340	1
Engine oil		
Filter element	(→ Spare Parts Catalog)	
Diaphragm	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

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

Replacing oil separator element

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. Install cover (2) with new O-ring.



5. Use torque wrench to tighten the screws of cover (2) to the specified torque.

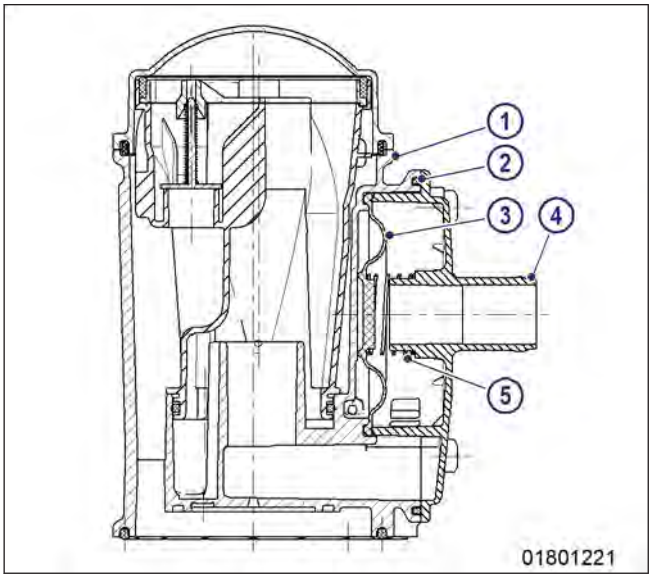
Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	10 Nm –2 Nm

6. Replace further oil separator elements in the same way.

TIM-ID: 0000000017 - 008

Checking diaphragm

1. Remove cover (4).
2. Remove spring (5), gasket (2) and diaphragm (3).
3. Check diaphragm (3) for damage, fit new diaphragm if used one is damaged.
4. Install 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 the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	10 Nm –2 Nm

7. Check diaphragms in further oil separators in the same way.

TIM-ID: 0000000017 - 008

7.3.2 Crankcase breather - Wire mesh cleaning

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Cleaner		
Diesel fuel		
Petroleum jelly		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

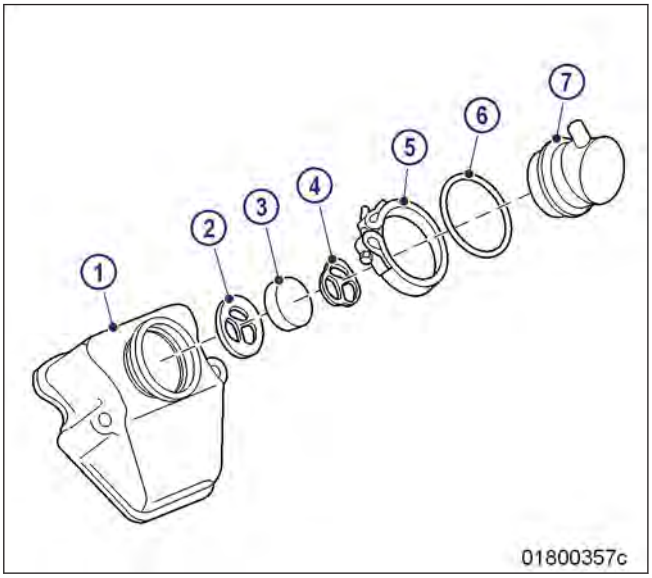
Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

NOTICE

Cleaning agents should not be left to take effect for too long.
Damage to components is possible!
- Observe manufacturer's instructions.

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 remaining components with cleaner.
8. Remove cleaning agent.
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.



TIM-ID: 0000003469 - 002

7.4 Valve Drive

7.4.1 Valve clearance - Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40 °C.

☑ Valves are closed.

Special tools, Material, Spare parts

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

Preparatory steps

1. Remove cylinder head cover (→ Page 80).
2. Install barring device (→ Page 67).
3. Bar engine with barring device in engine direction of rotation until TDC pointer and TDC mark on the flywheel are aligned.

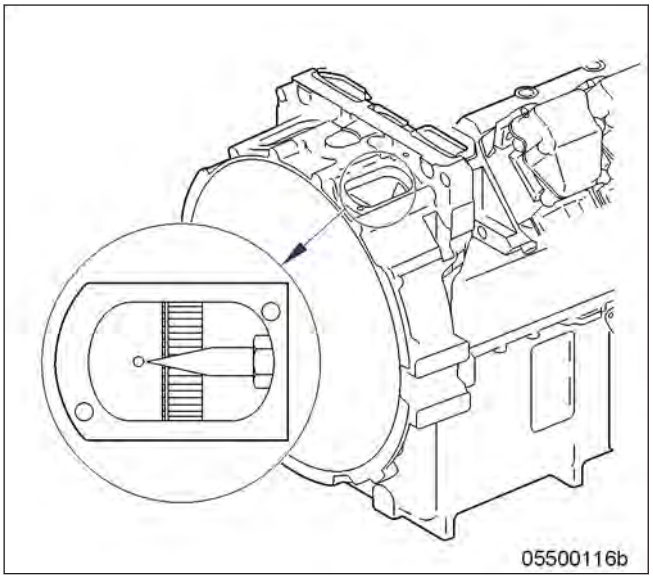
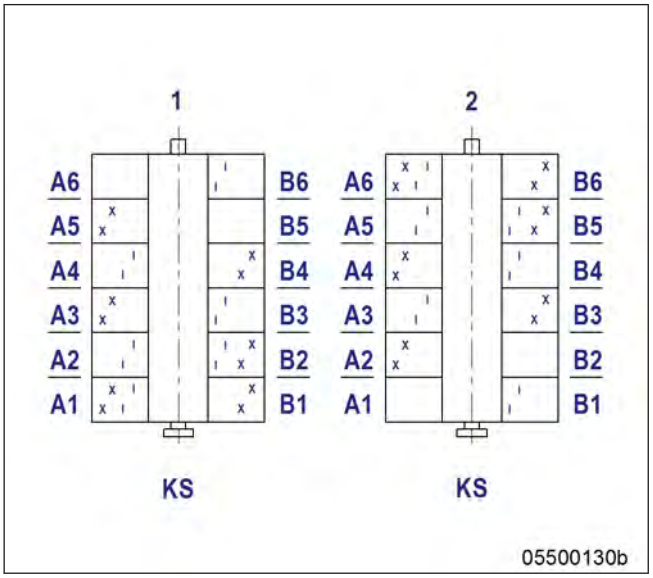


Diagram for 12V engines (two crankshaft positions)



TIM-ID: 0000000018 - 005

Diagram for 16V engines (two crankshaft positions)

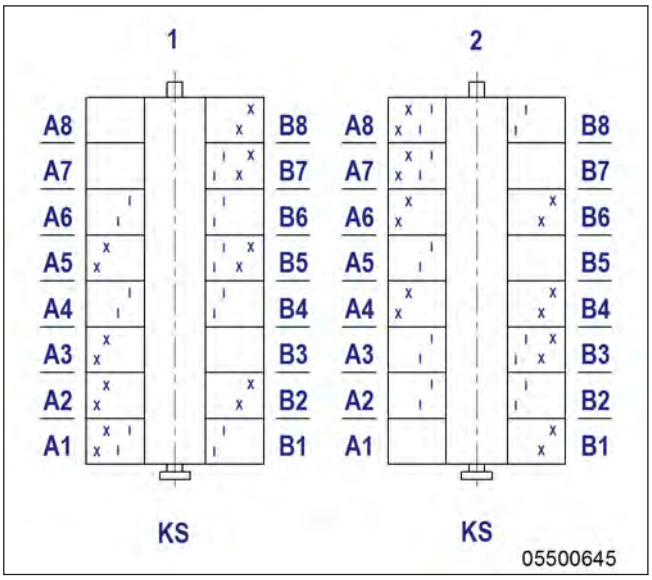
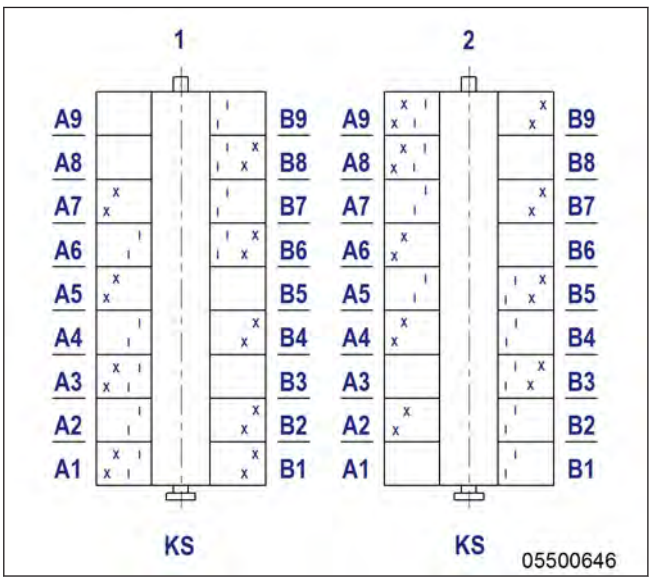


Diagram for 18V engines (two crankshaft positions)

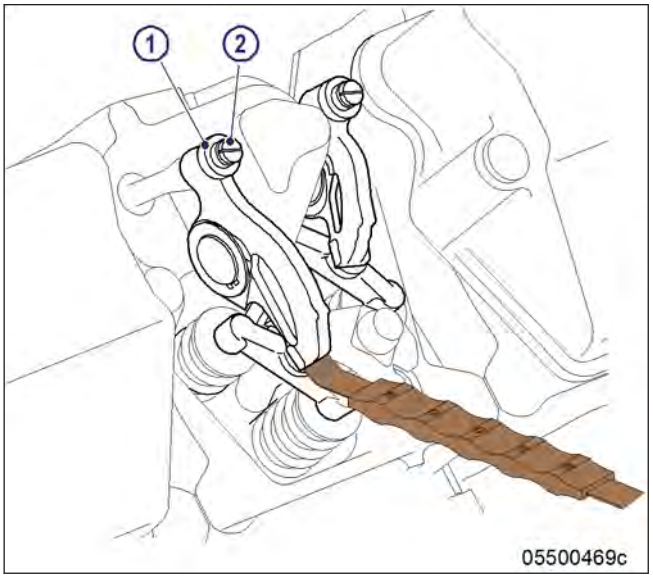


Checking valve clearance at two crankshaft positions

1. Check TDC position of piston in cylinder A1:
   - If the rocker arms are unloaded on cylinder A1, the piston is in firing TDC.
   - If the rocker arms are 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 in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram:
   1 Cylinder A1 is in firing TDC
   2 Cylinder A1 is in overlap TDC
   I Inlet valve
   X Exhaust valve
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

TIM-ID: 0000000018 - 005

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) with torque wrench to the specified tightening torque while holding adjusting screw (2) firmly with screw driver.

Name	Size	Type	Lubricant	Value/Standard
Locknut	M12 x 1	Tightening torque	(Engine oil)	50 Nm

5. Insert feeler gauge between valve bridge and rocker arm to verify that the gauge just passes through the gap.

Result: If not, adjust valve clearance.

Final steps

1. Remove barring device (→ Page 67).
2. Install cylinder head cover (→ Page 80).
3. Install access cover.

TIM-ID: 0000000018 - 005

7.4.2 Cylinder head cover - Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

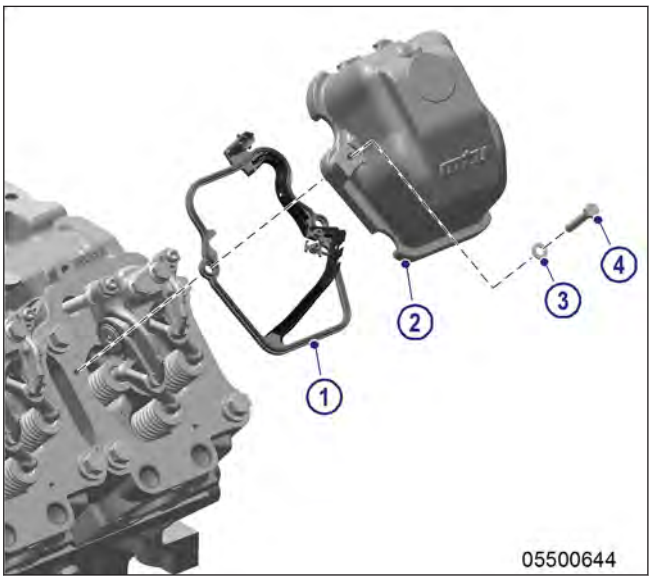
Designation / Use	Part No.	Qty.
Torque wrench, 8-40 Nm	F30043446	1
Ratchet	F30027340	1
Gasket	(→ Spare Parts Catalog)	

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 cylinder head cover (2) with gasket (1) from cylinder head.
2. Clean installation surface.
3. Check condition of gasket (1) in cylinder head cover (1).
4. Replace damaged gasket(s) (1).
5. Install cylinder head cover (2) with screws (4) and washers (3).



Final steps

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

TIM-ID: 0000000019 - 004

7.5 Injection Pump / HP Pump

7.5.1 Injection pump – Replacement

Special tools, Material, Spare parts

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

Injection pump – Replacement

▶ Remove injection pump and install new one (→ Page 82).

TIM-ID: 0000000020 - 004

7.5.2 Injection pump - Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Adapter	F30006234	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot box wrench, 22 mm	F30027425	1
Torque wrench, 0.5-5 Nm	0015384230	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

DANGER

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

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Preparatory steps

1. Close fuel supply line upstream of fuel filter.
2. Drain fuel (→ Page 91).
3. Remove engine governor, if required (→ Page 136).
4. Remove charge-air manifolds and take off seals (only on engines with air-to-air charge-air cooling).

TIM-ID: 0000000021 - 004

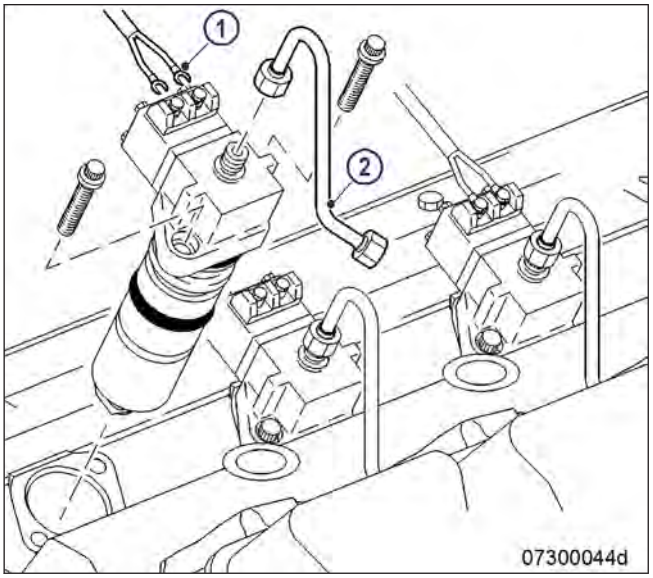
Removing injection pump

1. Mark installation position of injection pump.
2. Disconnect wiring (1) from injection pump.
3. Disconnect fuel line (2).
4. Unscrew securing screws of injection pump by approx. 6 mm.

Result: The preloaded compression spring presses the injection pump out of the crankcase. If not:

- Turn crankshaft with barring device (→ Page 67) .
  Pump cam of camshaft presses the injection pump out of the crankcase. If not:
- 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 rings from injection pump.
8. After removal, seal all openings with suitable covers.



Injection pump – Installation

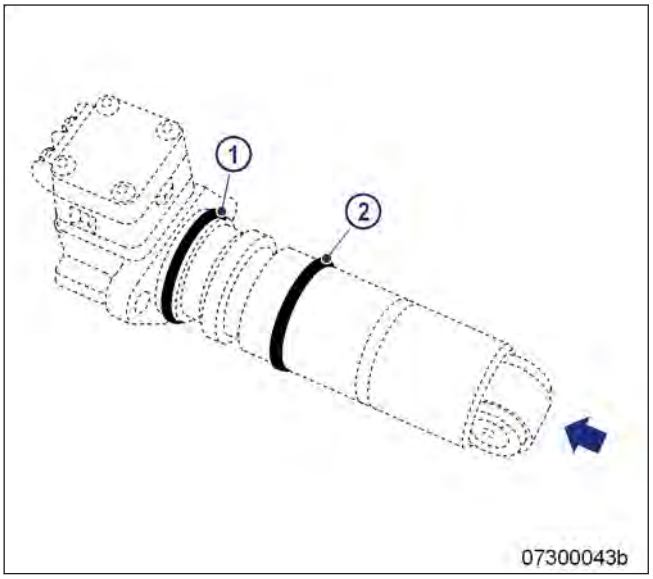
1. Remove all blanking plugs and covers.
2. Clean mating face of injection pump and roller.

Note: Sealing ring (1) Ø47 mm

3. Coat sealing ring (1) with grease and fit onto injection pump.

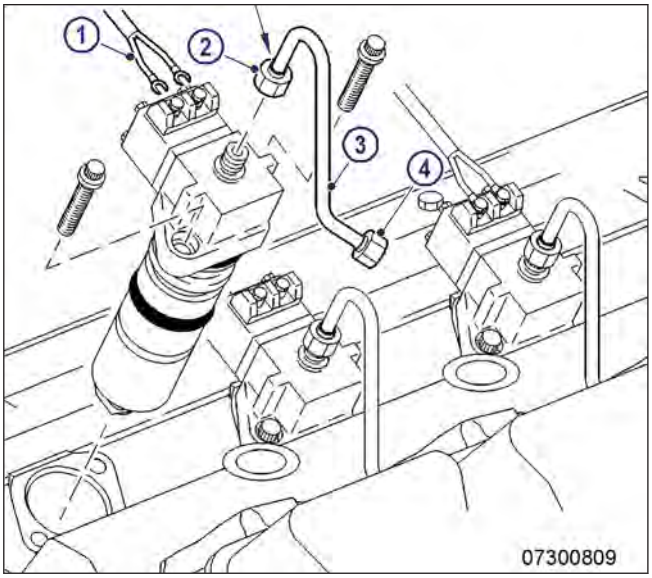
Note: Sealing ring (2) Ø45 mm

4. Coat sealing ring (2) with grease and fit onto injection pump.
5. Coat roller (arrow) with engine oil.
6. Clean sealing face and fuel bores in crankcase.
7. Using barring device (→ Page 67), set pump cam on camshaft to base circle.



TIM-ID: 0000000021 - 004

8. Install injection pump, observing marked installation position.



9. Install securing screws of injection pump and tighten with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10	Tightening torque	(Engine oil)	60 Nm +12 Nm

10. Coat the mating face between union nut and fuel line, ball seal and thread on both ends of the fuel line (3) with engine oil.
11. Install fuel line (3).

Note: Observe the inscription on the union nuts (2, 4).

12. Tighten union nuts (2, 4) marked with “35 +3 Nm” (see arrow) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut	M14	Tightening torque	(Engine oil)	35 Nm +3 Nm

13. Tighten union nuts (2, 4) marked with “30 +3 Nm” (see arrow) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut	M14	Tightening torque	(Engine oil)	30 Nm +3 Nm

14. Install injection pump wiring (1).
15. Use torque wrench to tighten screws to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque	(Engine oil)	1.5 Nm ±0.2 Nm

Final steps

1. Remove barring device (→ Page 67).
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 pipes.
6. Install engine governor (→ Page 136).
7. Open fuel supply line.
8. Vent fuel system (→ Page 94)

TIM-ID: 0000000021 - 004

7.6 Injection Valve / Injector

7.6.1 Injector - Replacement

Special tools, Material, Spare parts

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

Replacing injector

▶ Remove injector and install new injector (→ Page 86).

TIM-ID: 0000000022 - 013

7.6.2 Injector - Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Impact extractor	F30377999	1
Fuel suction device	F30378207	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Adapter	F30006234	1
Plug-in open-end wrench, 19 mm	F30025897	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot box wrench, 22 mm	F30027425	1
Double-head box wrench	F30011450	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

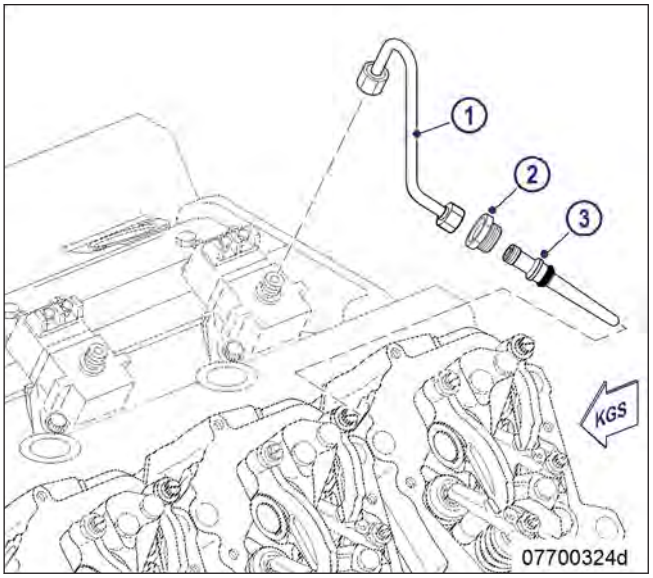
Preparatory steps

1. Close fuel supply line upstream of fuel filter.
2. Drain fuel (→ Page 91).
3. Remove engine governor, if required (→ Page 136).
4. Remove charge-air manifolds and take off seals (only on engines with air-to-air charge-air cooling).
5. Remove cylinder head cover (→ Page 80).

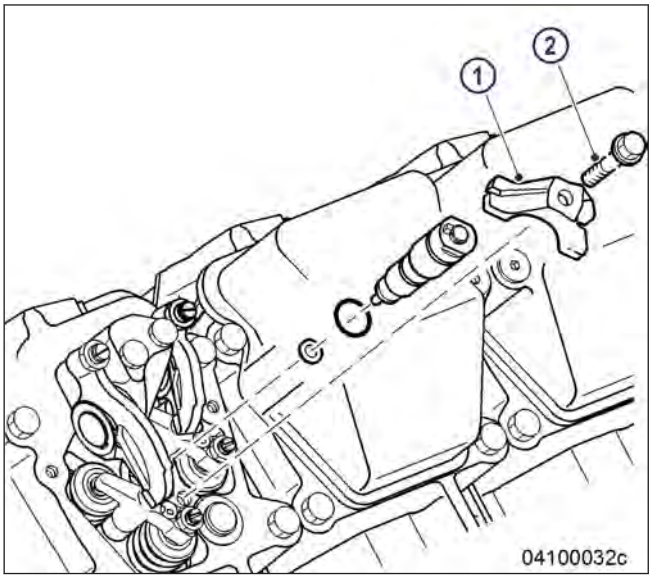
TIM-ID: 0000000023 - 003

Removing injector

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



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



Injector – Installation

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.

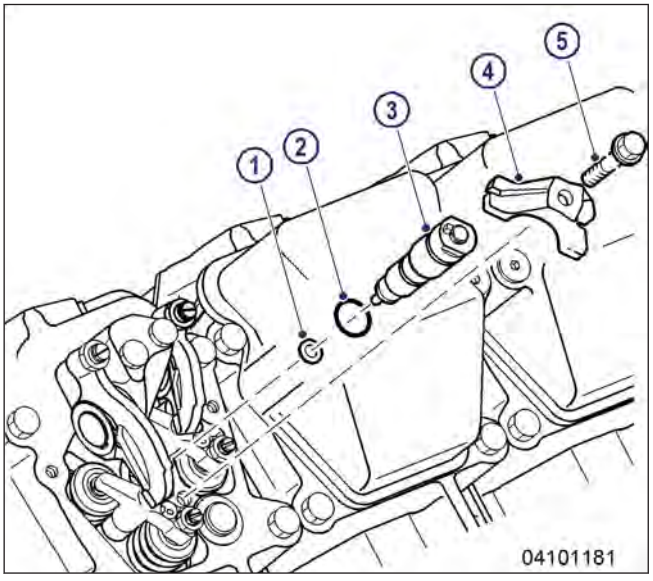
Result:
- The pin is at 11-o'clock position to the transversal axis of the engine.
- Pin is in recess of clamp (4).

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

Result:
- Pin on injector is in the recess in the clamp.
- Forked clamp end is engaged in the cover recess.

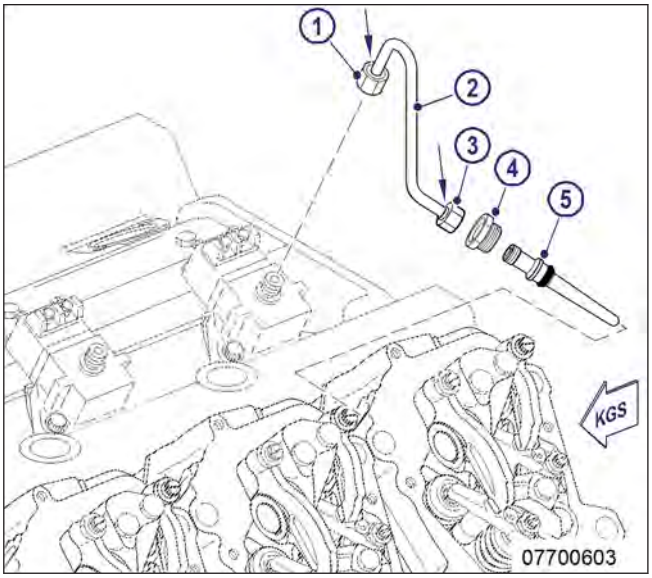
7. Tighten screw (5) of the clamp by hand.

Result: Injector can still be turned.



TIM-ID: 0000000023 - 003

8. Blow out fuel line (2) and pressure pipe neck (5) with compressed air.
9. Coat sealing ring with grease and fit onto pressure pipe neck (5).
10. Coat the tape of the pressure pipe neck (5) with engine oil.
11. Insert pressure pipe neck (5) into cylinder head until the sealing ring is in contact with cylinder head.
12. Fully press in pressure pipe neck (5) by hand.



13. Tighten thrust screw (4) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Thrust screw	M22 x 1.5	Tightening torque	(Engine oil)	40 Nm ±5 Nm

14. Use torque wrench to tighten screw for clamp at injector to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10	Tightening torque	(Engine oil)	50 Nm

15. Coat the mating face between union nut and fuel line, ball seal and thread on both ends of the fuel line (2) with engine oil.
16. Install fuel line (2).

Note: Observe the inscription on the union nuts (1, 3).

17. Tighten union nuts (1, 3) marked with “35 +3 Nm” (see arrows) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut	M14	Tightening torque	(Engine oil)	35 Nm +3 Nm

18. Tighten union nuts (1, 3) marked with “30 +3 Nm” (see arrows) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut	M14	Tightening torque	(Engine oil)	30 Nm +3 Nm

19. Connect leak-off fuel line to cylinder head.

Final steps

1. Install cylinder head cover (→ Page 80).
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 pipes.
6. Install engine governor (→ Page 136).
7. Open fuel supply line.
8. Vent fuel system (→ Page 94)

TIM-ID: 0000000023 - 003

7.7 Fuel System

7.7.1 Fuel injection line – Pressure pipe neck replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Adapter	F30006234	1
Plug-in open-end wrench, 19 mm	F30025897	1
Crowfoot wrench, 19 mm	F30027424	1
Crowfoot box wrench, 22 mm	F30027425	1
Double-head box wrench	F30011450	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
Pressure pipe tube	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

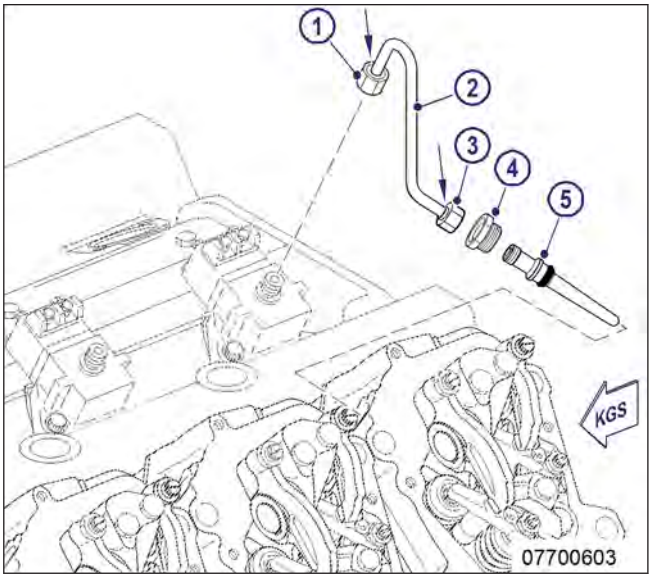
Preparatory steps

1. Close fuel supply line upstream of fuel filter.
2. Drain fuel (→ Page 91).
3. Remove engine governor, if required (→ Page 136).
4. Remove charge-air manifolds and take off seals (only on engines with air-to-air charge-air cooling).

TIM-ID: 0000000024 - 003

Replacing pressure pipe neck

1. Disconnect fuel line (2).
2. Blow out fuel line (2) with compressed air.
3. Remove thrust screw (4).
4. Withdraw pressure pipe neck (5).
5. Coat sealing ring with grease and fit on new pressure pipe neck (5).
6. Coat the tape of the pressure pipe neck (5) with engine oil.
7. Insert pressure pipe neck (5) into cylinder head until the sealing ring is in contact with cylinder head.
8. Fully press in pressure pipe neck (5) by hand.



9. Tighten thrust screw (4) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Thrust screw	M22 x 1.5	Tightening torque	(Engine oil)	40 Nm ±5 Nm

10. Install fuel line (2).

Note: Observe the inscription on the union nuts (1, 3).

11. Tighten union nuts (1, 3) marked with “35 +3 Nm” (see arrows) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut	M14	Tightening torque	(Engine oil)	35 Nm +3 Nm

12. Tighten union nuts (1, 3) marked with “30 +3 Nm” (see arrows) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Union nut	M14	Tightening torque	(Engine oil)	30 Nm +3 Nm

Final steps

1. Clean mating faces on cylinder head and charge-air manifold.
2. Check gaskets for damage and replace them, if required.
3. Coat gaskets with grease and place onto cylinder head.
4. Install charge-air pipes.
5. Install engine governor (→ Page 136).
6. Open fuel supply line.
7. Vent fuel system (→ Page 94)

TIM-ID: 0000000024 - 003

7.7.2 Fuel – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

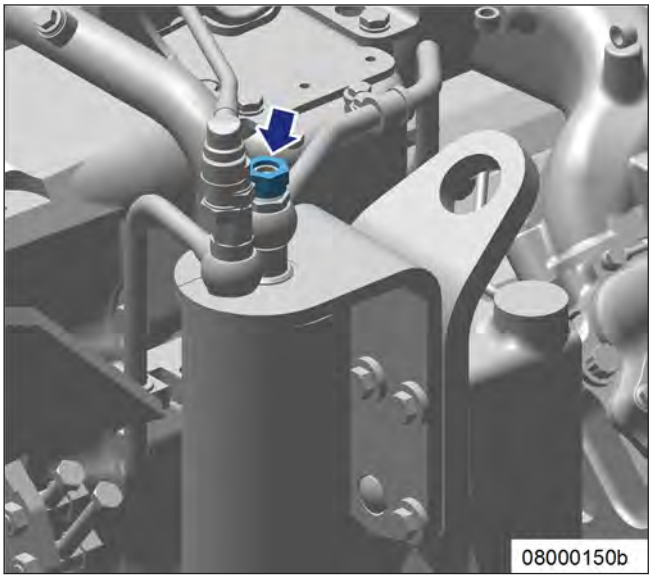
Designation / Use	Part No.	Qty.
Torque wrench, 8-40 Nm	F30043446	1
Box wrench, 17 mm	F30028341	1
Engine oil		

WARNING

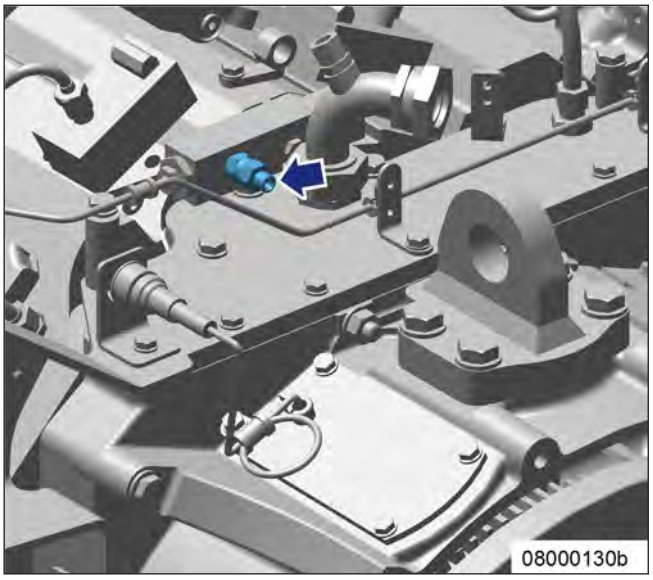
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel – Draining

1. Loosen nut (arrow) on banjo union.



2. Disconnect fuel line on non-return valve (arrow).
3. Remove non-return valve and collet emerging fuel in a suitable container.



TIM-ID: 0000000025 - 003

4. If fuel no longer emerges, install non-return valve and tighten with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Non-return valve		Tightening torque	(Engine oil)	10 Nm +1 Nm

5. Connect fuel line.
6. Tighten nut on banjo union.

TIM-ID: 0000000025 - 003

7.7.3 Fuel pressure maintaining valve - Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

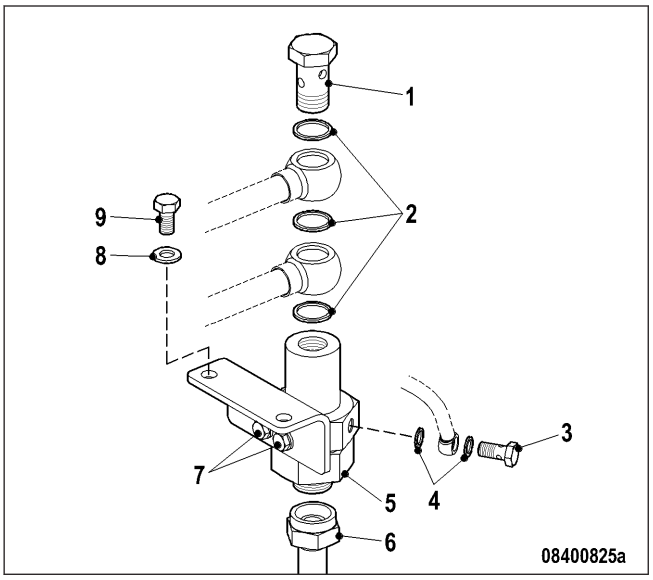
Designation / Use	Part No.	Qty.
Pressure relief valve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open 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.



TIM-ID: 0000000028 - 002

7.7.4 Fuel system - Venting

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

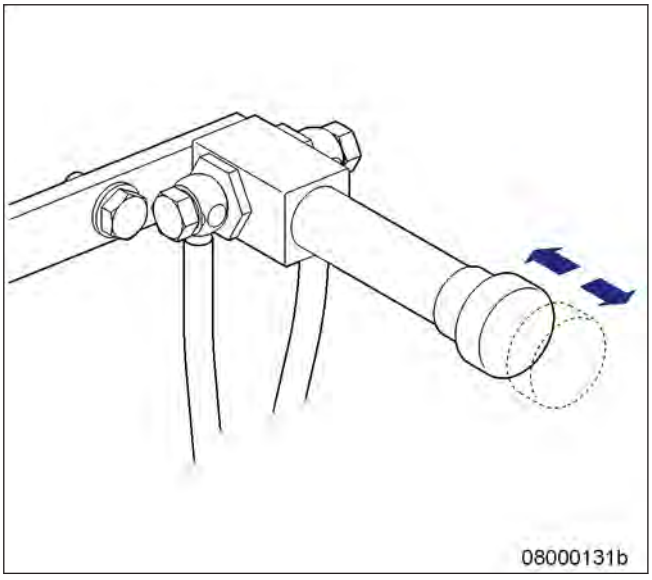
Designation / Use	Part No.	Qty.
Engine oil		

WARNING

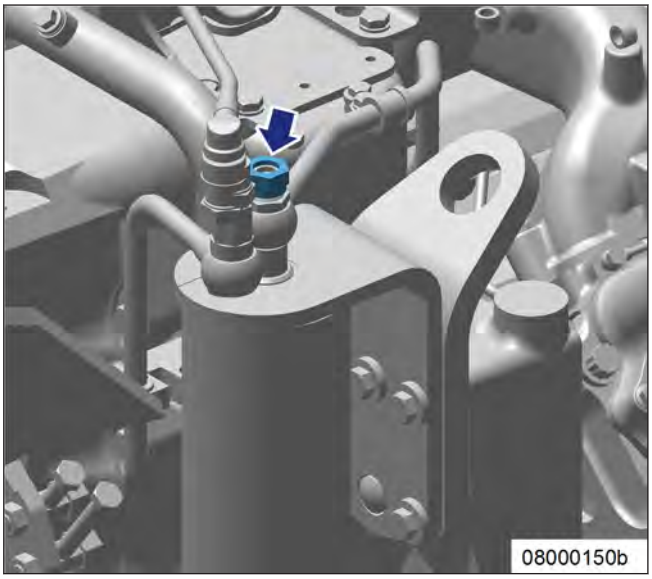
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel system – Venting

1. Unlock fuel priming pump, unscrew handle.

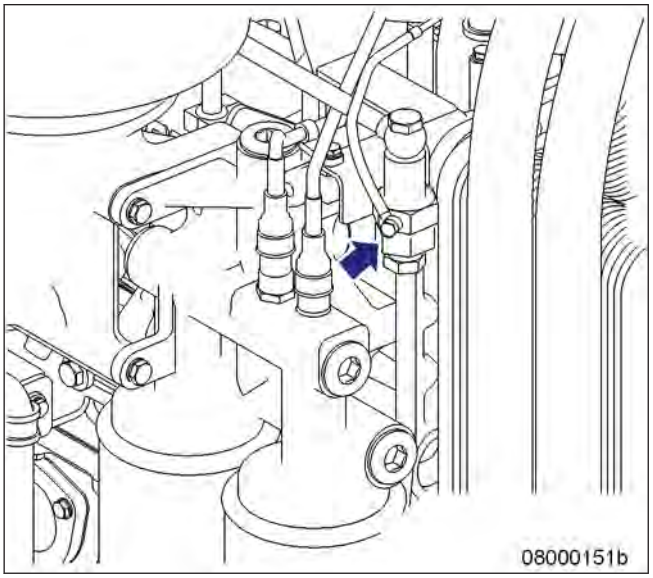


2. Loosen nut (arrow) on banjo union.
3. Operate the pump with the handle until bubble-free fuel emerges.
4. Tighten nut on banjo union.

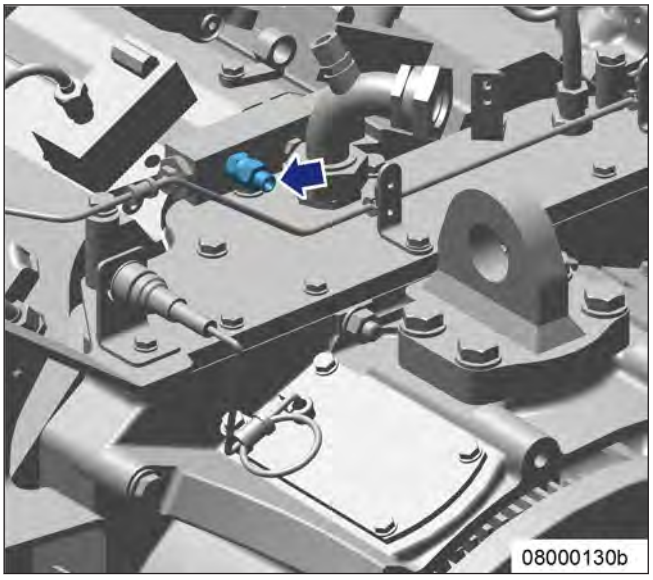


TIM-ID: 0000000026 - 002

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. Use torque wrench to non-return valve to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Non-return valve		Tightening torque	(Engine oil)	10 Nm +1 Nm

12. Tighten union nut of fuel return line.
13. Lock fuel priming pump, screw in handle.

TIM-ID: 0000000026 - 002

7.8 Fuel Filter

7.8.1 Fuel filter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

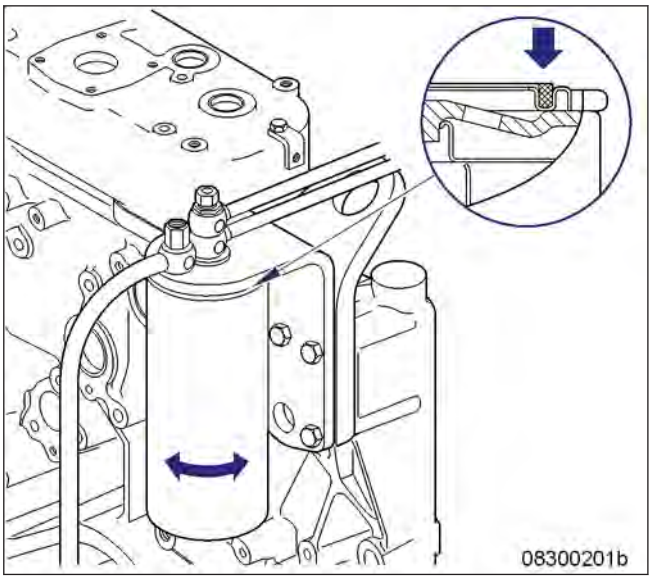
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Diesel fuel		
Easy-change filter	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open 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. Screw on easy-change filter and tighten by hand.
5. Vent fuel system (→ Page 94)



TIM-ID: 0000000027 - 002

7.8.2 Fuel prefilter – Differential pressure check and adjustment of gauge

DANGER

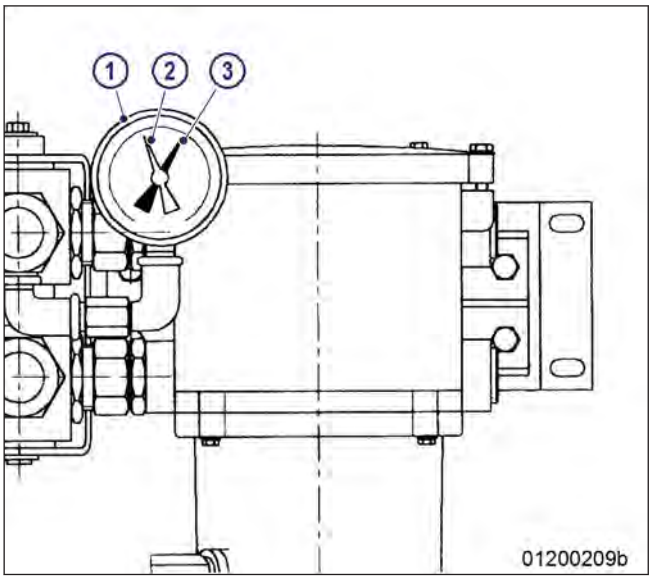
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING

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

Setting adjustable pointer of differential pressure gauge

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



Fuel prefilter – Checking differential pressure

1. With the engine running at full load or rated power, read off pressure at gauge (1).
2. If differential pressure as indicated between position of adjustable pointer (2) and pressure-indicating pointer (3) of pressure gauge is ≥ 0.3 bar, flush filter element of the cut-in filter (→ Page 99).

TIM-ID: 0000004925 - 008

7.8.3 Fuel prefilter - Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

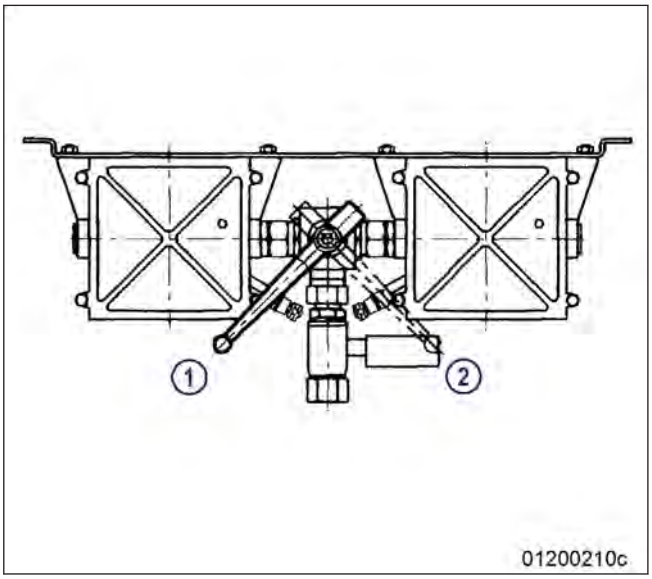
Designation / Use	Part No.	Qty.
Diesel fuel		
Gasket	(→ Spare Parts Catalog)	

WARNING

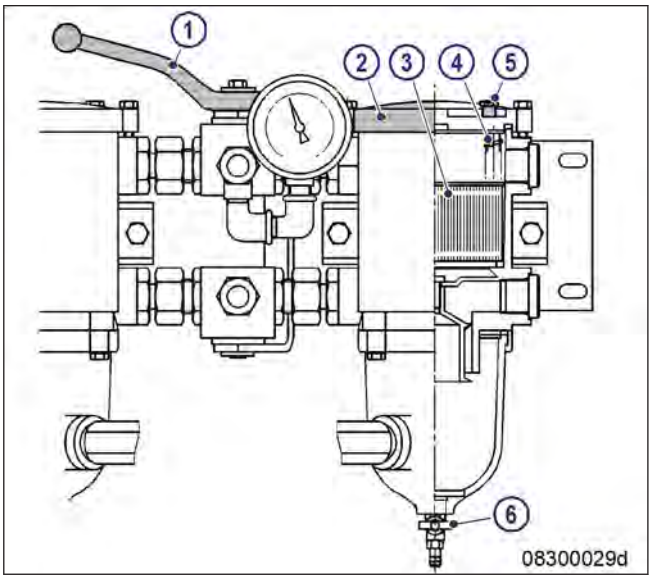
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter – Draining

1. Cut out filter to be drained.
   1 Left filter cut in
   2 Right filter cut in



2. Open threaded vent plug (5) of filter to be drained.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and contaminants from filter until pure fuel emerges.
5. Close drain valve (6).
6. Remove screws for 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 in the cut-out filter again.
11. Close threaded vent plug (5) when fuel emerges.



TIM-ID: 0000004929 - 004

7.8.4 Fuel prefilter – Flushing

Special tools, Material, Spare parts

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

DANGER

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

WARNING

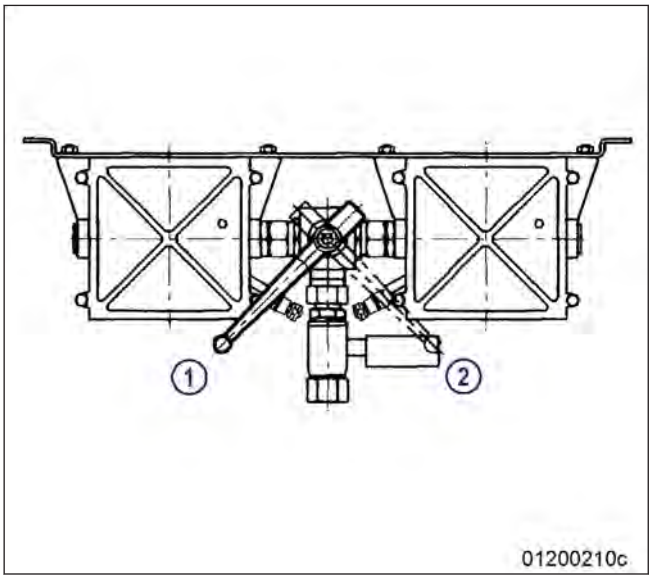
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

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

Fuel prefilter – Flushing

1. Cut out the contaminated filter.
   1 Left filter cut in
   2 Right filter cut in

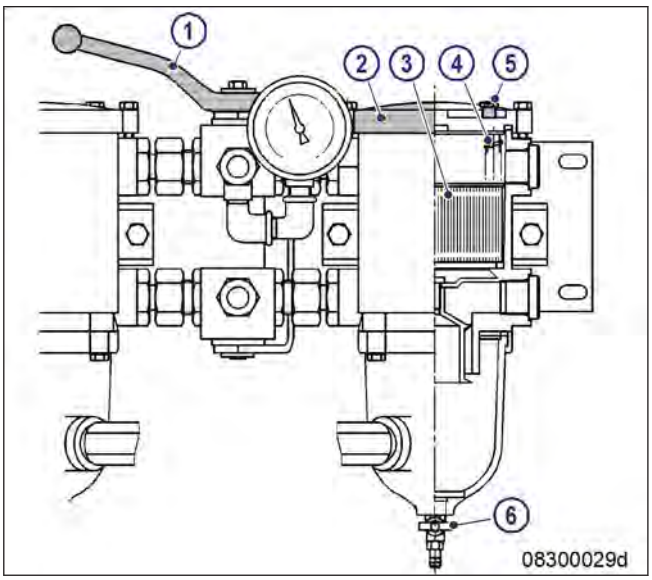


TIM-ID: 0000004937 - 017

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).



Fuel prefilter – Filling with fuel

1. Stop engine (→ Page 35) 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 97).

Result: If flushing did not lead to an improvement of the differential pressure, replace filter element of fuel prefilter (→ Page 102).

TIM-ID: 0000004937 - 017

7.8.5 Fuel prefilter – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

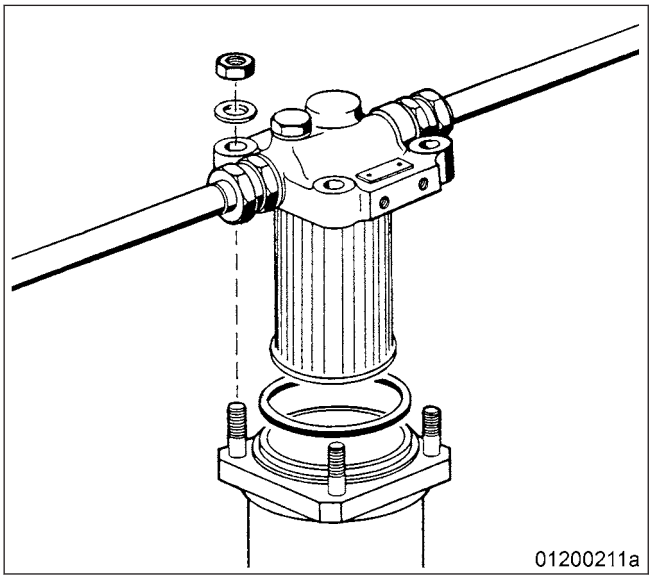
Designation / Use	Part No.	Qty.
Diesel fuel		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Fuel prefilter – Cleaning

1. Close fuel supply.
2. Remove nuts from filter head.
3. Unscrew filter bowl and drain fuel into a suitable container.
4. Remove securing nut for filter element and pull off filter element downwards.
5. Wash filter element in clean fuel using a soft brush.
6. Wash filter bowl with clean fuel.
7. Insert filter element in filter head and secure with nut.
8. Place new sealing ring in filter head groove.
9. Fit cover with seal and tighten nuts crosswise.
10. Open fuel supply.



TIM-ID: 0000004936 - 002

7.8.6 Fuel prefilter - Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

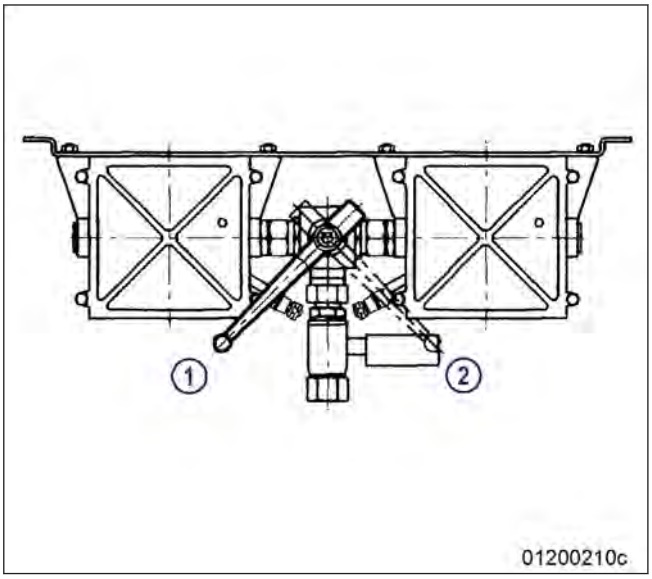
Designation / Use	Part No.	Qty.
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

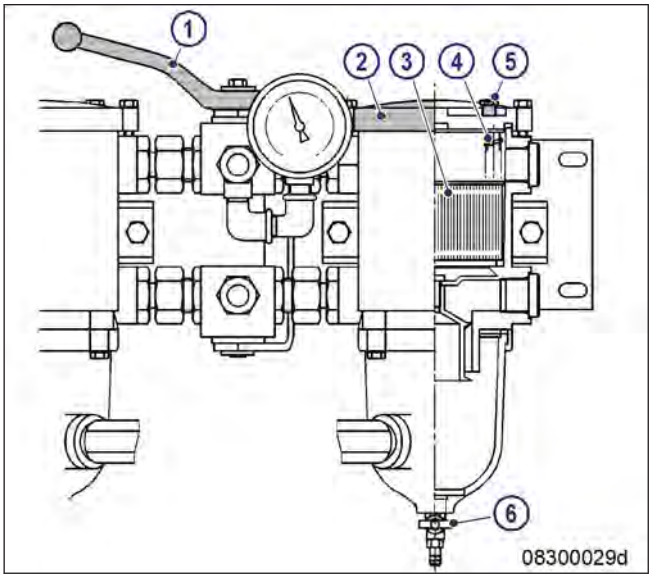
Replacing filter element

1. Cut out filter to be drained.
   - I Left filter cut in
   - II Right filter cut in



TIM-ID: 0000004944 - 005

2. Open threaded vent plug (5) of contaminated filter.
3. Unlock drain valve (6) by pressing toggle and open it.
4. Drain water and dirt from filter.
5. Close drain valve (6).
6. Remove screws securing the cover and take off cover (2).
7. Remove spring housing (4) and filter element (3).
8. Insert new filter element (3) and spring housing (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 in the cut-out filter again.
13. Close threaded vent plug (5) when fuel emerges.
14. Adjust the differential pressure gauge (→ Page 97).



TIM-ID: 0000004944 - 005

7.9 Charge-Air Cooling General, Left-Hand Side

7.9.1 Intercooler - Checking condensate drain for coolant discharge and obstructions

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

WARNING

Compressed air gun ejects a jet of pressurized air.
Risk of injury to eyes and damage to hearing, risk of rupturing internal organs!
- Never direct air jet at people.
- Always wear safety goggles/face mask and ear defenders.

Checking intercooler condensate drain 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 escapes:
3. Clean drain bore(s) and blow out with compressed air.
4. More significant coolant leakage indicates a leaking charge-air cooler. 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 86).
2. Bar engine manually (→ Page 67).
3. Bar engine with the starting system to blow out cylinder chambers (→ Page 68).
4. Install injectors (→ Page 86).

TIM-ID: 0000000030 - 003

7.10 Air Filter

7.10.1 Air filter - Replacement

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Air filter	(→ Spare Parts Catalog)	
Filter insert	(→ Spare Parts Catalog)	
Filter element	(→ Spare Parts Catalog)	

Air filter – Replacement

1. Remove air filter(s) and install new one(s) (→ Page 106).
2. Reset signal ring of service indicator (→ Page 107).

TIM-ID: 0000013385 - 002

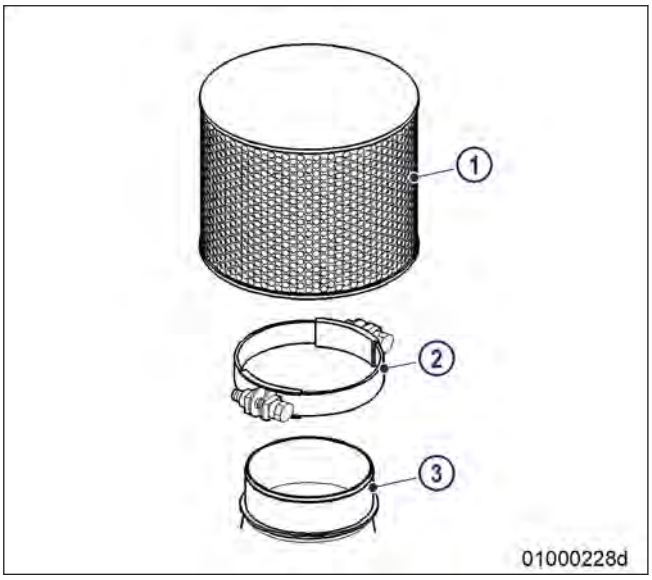
7.10.2 Air filter – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

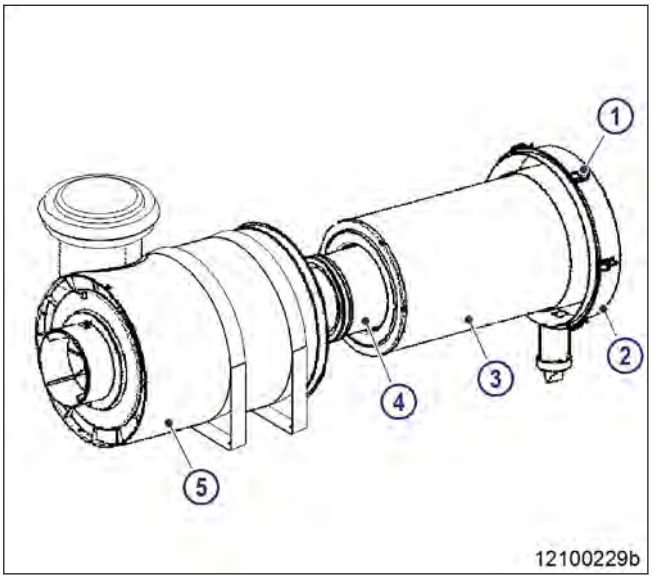
Variant A

1. Loosen clamp (2).
2. Remove air filter (1) and clamp (2) from connecting flange of intake housing (3).
3. Verify that there are no objects in the flange of the intake housing (3) and clean it.
4. Fit air filter (1) and clamp (2) on connecting flange of intake housing (3).
5. Tighten clamp (2).



Variant B

1. Release latches (1).
2. Take off 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.



TIM-ID: 0000013395 - 002

7.11 Air Intake

7.11.1 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 105).
2. After installation of new filter, press reset button (1).

Result: Signal ring returns to initial position.

TIM-ID: 0000000985 - 003

7.12 Starting Equipment

7.12.1 Air starter – Manual operation

DANGER

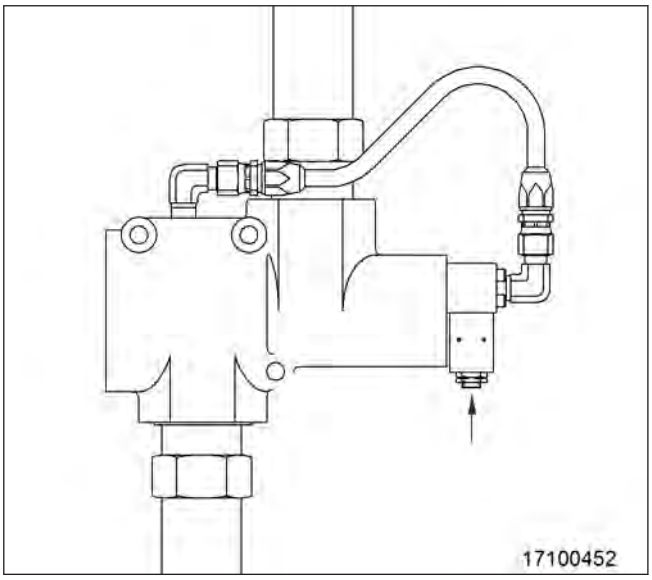
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Before cranking the engine with starter system, make sure that there are no persons in the engine's danger zone.

WARNING

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

Air starter – Manual operation

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



TIM-ID: 0000006076 - 005

7.13 Lube Oil System, Lube Oil Circuit

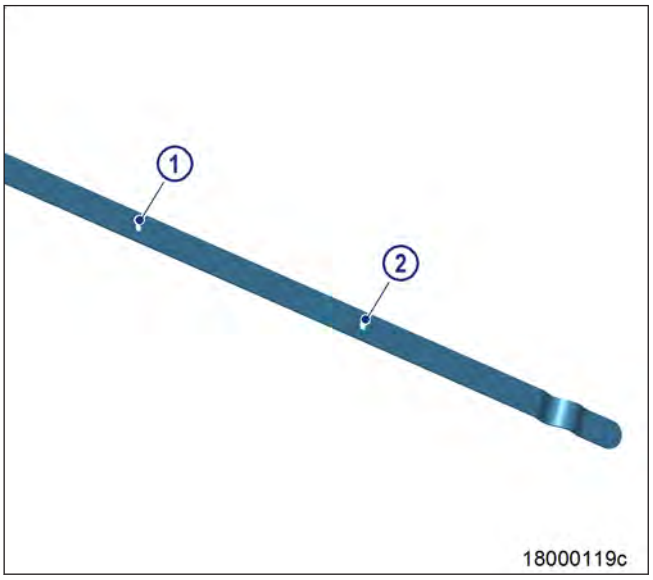
7.13.1 Engine oil – Level check

Preconditions

☑ Engine is stopped and starting disabled.

Oil level check prior to engine start

1. Withdraw oil dipstick from guide tube and wipe it.
2. Insert oil dipstick into guide tube up to the stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between "min." (2) and "max." (1) marks.
4. Top up with oil up to the "max" (1) mark (→ Page 110) if required.
5. Insert oil 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 oil 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 110).
5. Insert oil dipstick into guide tube up to the stop.

TIM-ID: 0000000032 - 003

7.13.2 Engine oil - Change

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

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

WARNING

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

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

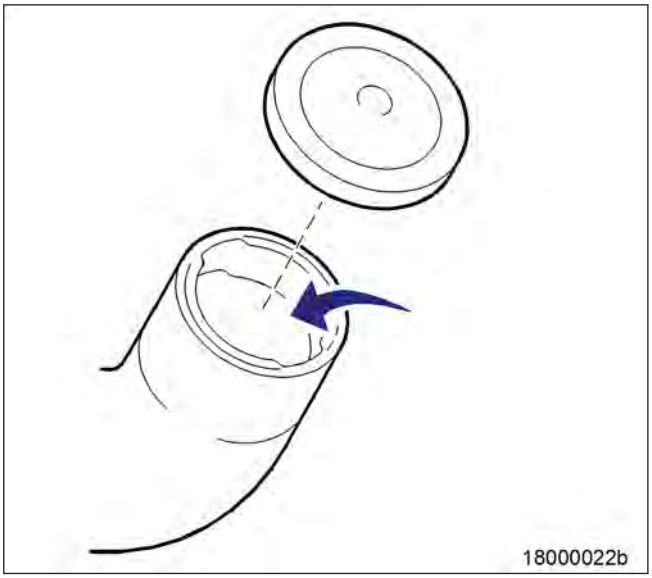
1. Provide a suitable container to collect the oil.
2. Remove drain plug and drain oil.
3. Install drain plug with new sealing ring.
4. Replace engine oil filter (→ Page 111).

Oil change with semirotary hand pump: Oil extraction

1. Provide a suitable container to collect the oil.
2. Extract all oil from oil pan using the semirotary hand pump.
3. Replace engine oil filter (→ Page 111).

Filling with new oil

1. Open cover on filler neck.
2. Pour oil in at filler neck up to "max." mark at oil dipstick.
3. Close cover on filler neck.
4. Check engine oil level (→ Page 109).
5. After oil change and filter replacement, bar engine with starting system (→ Page 68).



TIM-ID: 0000000031 - 006

7.14 Oil Filtration / Cooling

7.14.1 Engine oil filter - Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Oil filter	(→ Spare Parts Catalog)	

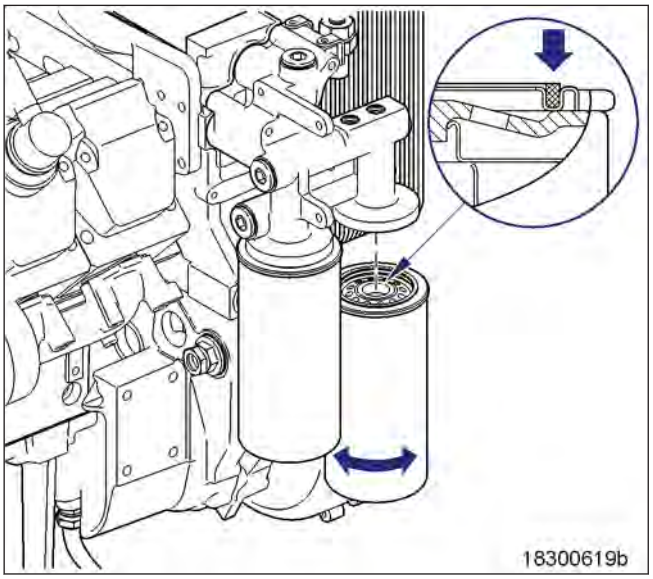
WARNING

Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!

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

Engine oil filter – Replacement

1. Remove oil filter with filter wrench.
2. Clean the sealing face on the adapter.
3. Check condition of the new sealing ring and coat it with oil.
4. Screw on and tighten new engine oil filter by hand.
5. Replace other engine oil filters in the same way.
6. After each oil change and filter replacement, bar engine with starting system (→ Page 68).
7. Check oil level (→ Page 109).



TIM-ID: 0000000033 - 002

7.15 Coolant Circuit, General, High-Temperature Circuit

7.15.1 Engine coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

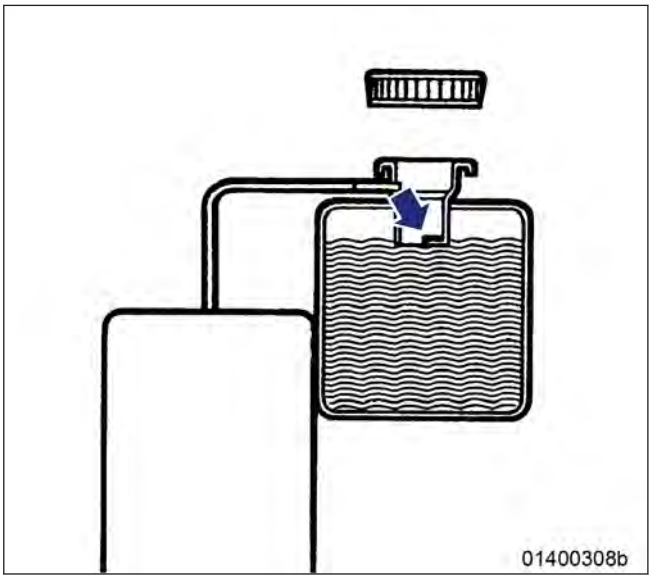
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

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

Checking coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise 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 115).
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 115).

TIM-ID: 0000000037 - 004

7.15.2 Engine coolant - Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine coolant		

Engine coolant – Change

1. Drain engine coolant (→ Page 114).
2. Fill with engine coolant (→ Page 115).

TIM-ID: 0000035998 - 001

7.15.3 Engine coolant - Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

WARNING

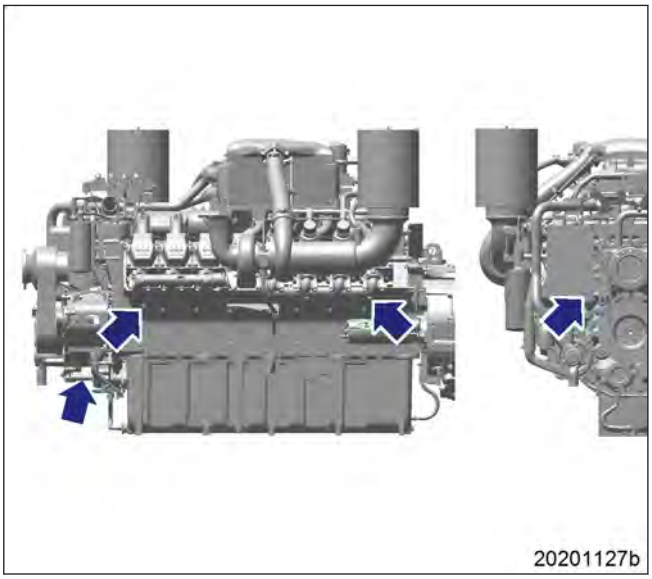
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

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

Engine coolant – Draining

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Draw off precipitated corrosion inhibitor oil from the expansion tank through filler neck.
4. Open drain valves and/or 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.



TIM-ID: 0000000035 - 003

7.15.4 Engine coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

WARNING

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

WARNING

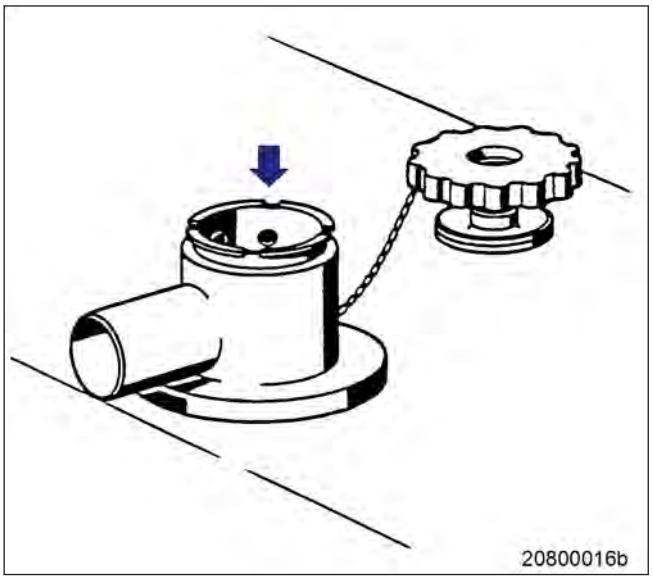
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE

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

Preparatory steps

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise 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, clean sealing faces if required.
3. Fit breather valve and close it.

TIM-ID: 0000000034 - 007

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 112), top up with coolant if required.

TIM-ID: 0000000034 - 007

7.15.5 Coolant pump – Relief bore check

DANGER

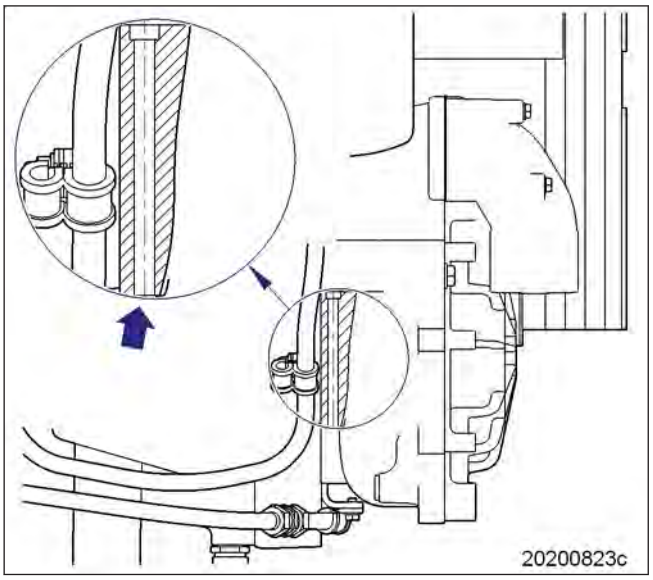
Rotating and moving engine parts.
Risk of crushing, danger of parts of the body being caught or pulled in!
- Only run the engine at low power. Keep away from the engine's danger zone.

WARNING

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

Coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Permissible discharge:
   - Up to 10 drops of coolant per hour
   - Up to 5 drops of oil per hour
3. If discharge exceeds the specified limits, contact Service.
4. If relief bore is dirty:
   a) Stop engine (→ Page 35) and disable engine start.
   b) Clean relief bore with a wire.
   c) Start engine (→ Page 32) and operate it at idle speed for some minutes.
   d) Check relief bore again for oil and coolant discharge.



TIM-ID: 0000000038 - 002

7.16 Low-Temperature Circuit

7.16.1 Charge-air coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

Special tools, Material, Spare parts

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

WARNING

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

WARNING

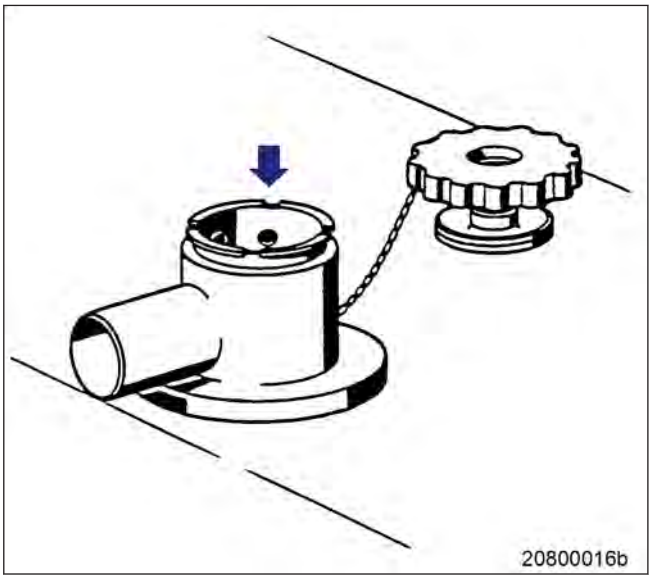
High level of engine noise when the engine is running.
Risk of damage to hearing!
- Wear ear protectors.

NOTICE

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

Preparatory steps

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



TIM-ID: 0000000039 - 005

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, clean sealing faces if required.
4. Fit breather valve and close it.

Final steps

1. Start the engine and operate it at idle speed for some minutes.
2. Check coolant level (→ Page 122).

TIM-ID: 0000000039 - 005

7.16.2 Charge-air coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

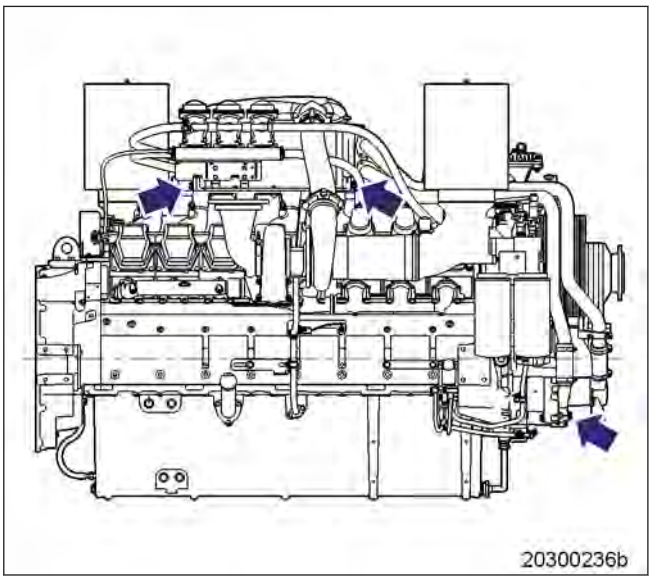
Designation / Use	Part No.	Qty.
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

WARNING

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

Charge-air coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
3. Continue to turn breather valve counter-clockwise and remove.
4. Draw off precipitated corrosion inhibitor oil from the expansion tank through 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.



TIM-ID: 0000000040 - 003

7.16.3 Charge-air coolant - Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Charge-air coolant – Change

1. Drain charge-air coolant (→ Page 120).
2. Fill with charge-air coolant (→ Page 118).

TIM-ID: 0000000041 - 011

7.16.4 Charge-air coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

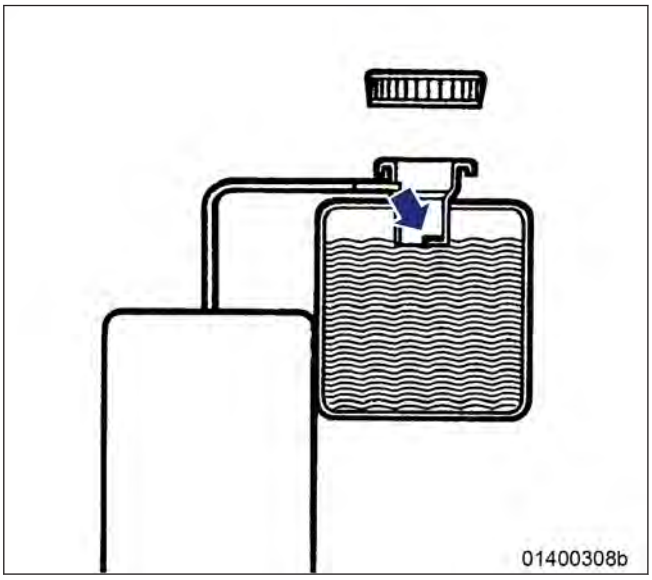
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

WARNING

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

Checking charge-air coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check coolant level (coolant must be visible at marking plate).
4. Top up coolant if necessary (→ Page 118).
5. Check proper condition of breather valve, clean sealing faces if required.
6. Fit breather valve and close it.



Checking charge-air coolant level by means of level sensor:

1. Switch on engine control system and check display (coolant level is automatically monitored by engine control system).
2. Top up coolant if necessary (→ Page 118).

TIM-ID: 0000000042 - 007

7.17 Coolant System

7.17.1 Cooler - Checking cooler elements externally for dirt

Preconditions

☑ Engine is stopped and starting disabled.

Check cooler elements externally for dirt

1. Inspect cooler elements visually for dirt.
2. Clean badly soiled cooler elements (→ Page 124).

TIM-ID: 0000015785 - 001

7.17.2 Cooler – Cleaning cooler elements

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

WARNING

Chemical substances in cleaners.
Risk of irritation and chemical burns!
- Always obey manufacturer's instructions before use!

CAUTION

Excessive reaction time of cleaning agents on components.
Damage to component!
- Observe manufacturer's instructions.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

Unsuitable cleaning tool.
Damage to component!
- Observe manufacturer's instructions.
- Use appropriate cleaning tool.

Cleaning cooler elements

1. Blow out the cooler elements with a jet of compressed air working against the direction of the cooling air parallel to the cooling fins.
2. If cooler elements are badly soiled, treat cooling fins with a hot, grease-dissolving alkaline cleaning agent before cleaning.

TIM-ID: 0000015784 - 001

7.18 Battery-Charging Generator

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

Preconditions

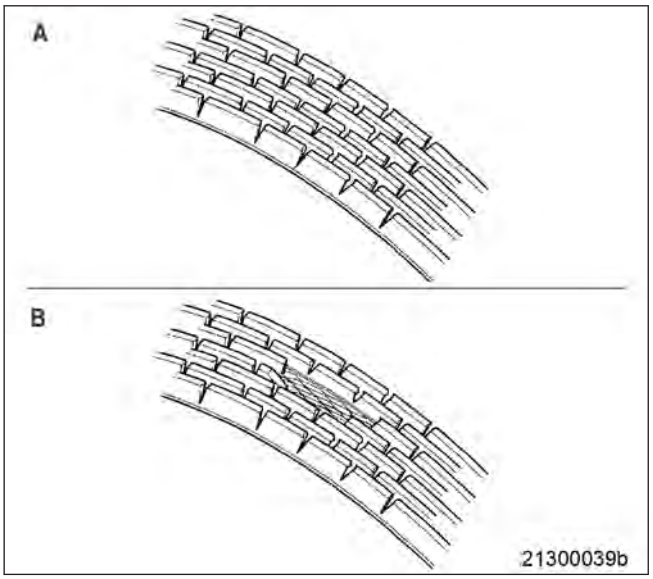
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Pre-tension gauge	Y20097429	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Engine oil		

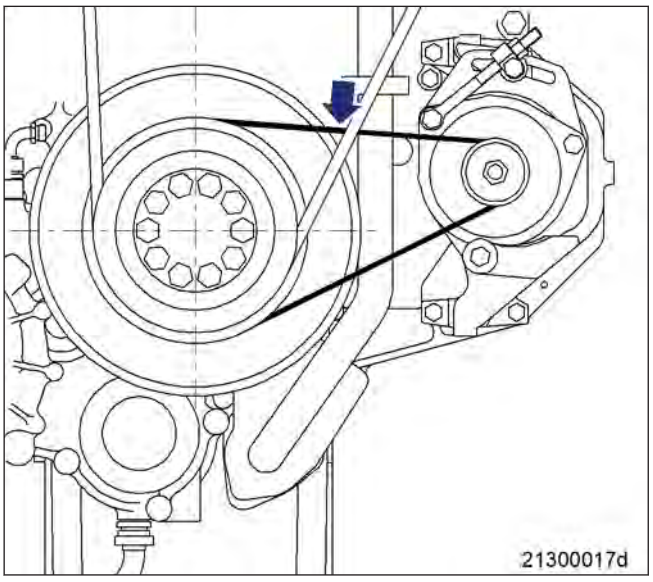
Drive belt – Condition check

1. Remove protective cover.
2. Check condition of drive belt visually.
3. Replace drive belt (→ Page 127):
   - If belt is oily;
   - If belt shows signs of overheating;
   - If ribs are broken around the entire circumference (A);
   - If rib material is broken off in some places (B).
4. Install protective cover.



Drive belt – Tension check

1. Remove protective cover.
2. Position pretension gauge on drive belt midway between belt pulleys.
3. Actuate pushbutton to press the tester uniformly on the drive belt surface until the spring disengages.
4. Do not press any further, otherwise the display value will be falsified.
5. Take off tension tester without changing the position of the display arm.
6. Read off measured value at the intersection of display arm and "KG" scale.
7. If the measured value deviates from the specified setting, readjust belt tension.



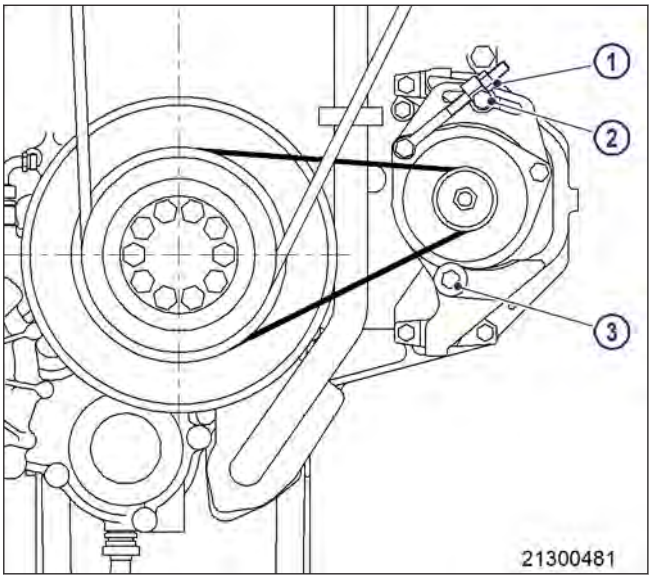
TIM-ID: 0000000043 - 003

8. Install protective cover.

Setting (new drive belt)	450 N - 50 N
Setting (used drive belt)	350 N - 50 N

Drive belt – Tension adjustment

1. Release screws (2, 3).
2. Tension drive belt with tensioning nut (1) and check belt tension.



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

Name	Size	Type	Lubricant	Value/Standard
Screw	M18	Tightening torque	(Engine oil)	40 Nm +4 Nm

4. Tighten screw (3).
5. Check drive belt tension.
6. Install protective cover.

TIM-ID: 0000000043 - 003

7.18.2 Battery-charging generator drive - Drive belt replacement

Preconditions

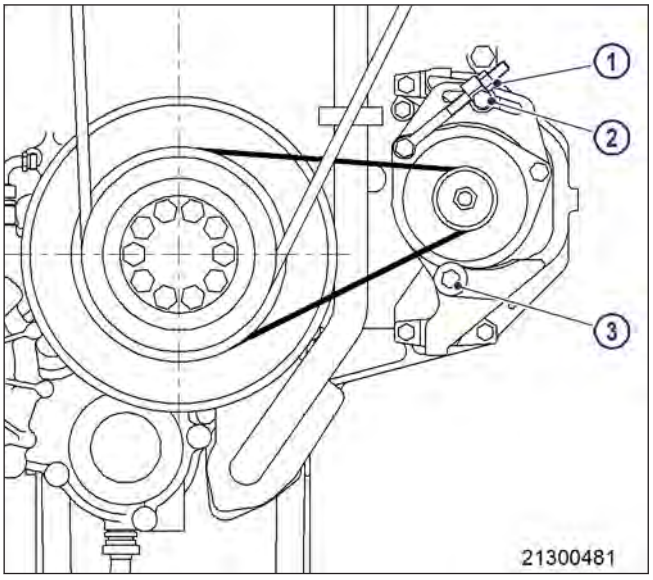
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Engine oil		
Drive belt	(→ Spare Parts Catalog)	

Battery-charging generator drive – Drive belt replacement

1. Remove protective cover.
2. Remove drive belt for fan drive (→ Page 131).
3. Release securing screws (2, 3).
4. Release tensioning screw (1) until the drive 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 125).



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

Name	Size	Type	Lubricant	Value/Standard
Screw	M18	Tightening torque	(Engine oil)	40 Nm + 4 Nm

9. Tighten securing screw (3).
10. Install drive belt for fan drive (→ Page 131).
11. Install protective cover.

TIM-ID: 0000000044 - 003

7.19 Fan Drive

7.19.1 Fan drive - Drive-belt check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Belt tension tester	5505890119/00	1
Torque wrench, 20-100 Nm	F30026582	1
Ratchet	F30027340	1
Engine oil		

Preparatory steps

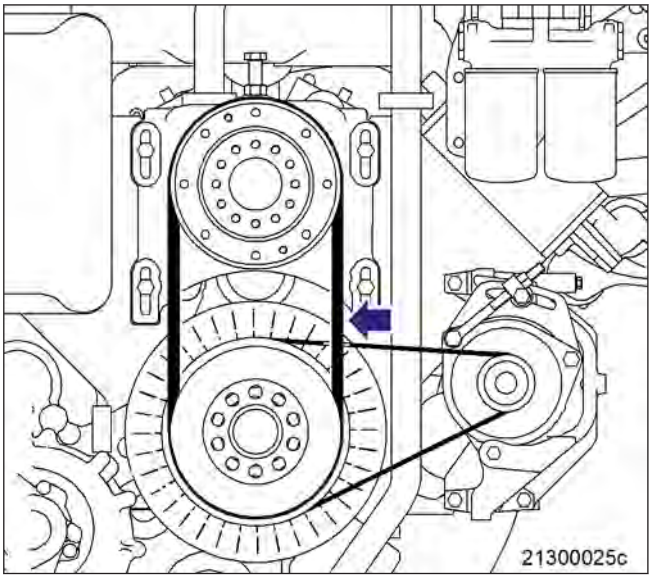
1. Remove screws from protective cover.
2. Remove protective cover.

Drive belt – Condition check

1. Check condition of drive belt visually.
2. Replace drive belt (→ Page 131):
   - If belt is oily;
   - If belt shows signs of overheating;
   - If belt is cracked;
   - If belt is worn;
   - If cracks are found: .

Drive belt – Tension check, variant A

1. Place belt-tension tester onto drive midway between the belt pulleys (arrow).
2. Press button uniformly against drive belt surface until spring disengagement can be heard and felt.
3. Do not press any further, otherwise the display value will be falsified.
4. Take off belt-tension tester without changing the position of the indication arm.
5. Read off measured value at the intersection of indication arm and "KG" scale.



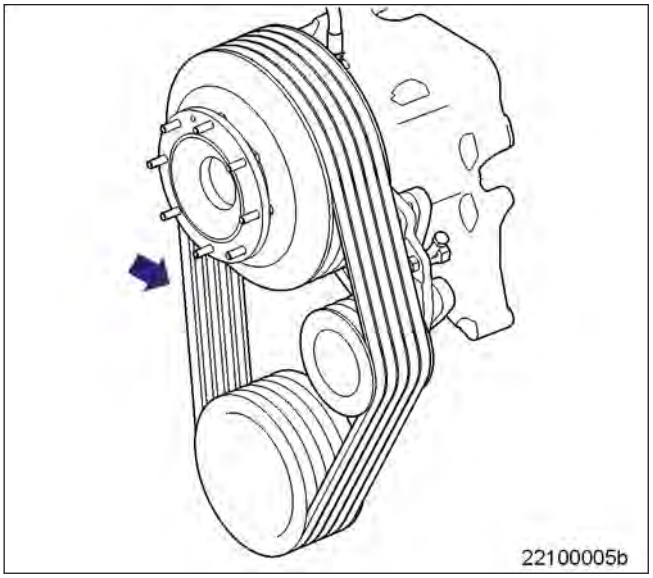
TIM-ID: 0000000045 - 003

6. If the measured value deviates from the specified setting, readjust belt tension.

Setting (new drive belt)	660 N
Setting (used drive belt)	510 N

Drive belt – Tension check, variant B

1. Place belt-tension tester onto drive midway between the belt pulleys (arrow).
2. Press button uniformly against drive belt surface until spring disengagement can be heard and felt.
3. Do not press any further, otherwise the display value will be falsified.
4. Take off belt-tension tester without changing the position of the indication arm.
5. Read off measured value at the intersection of indication arm and "KG" scale.

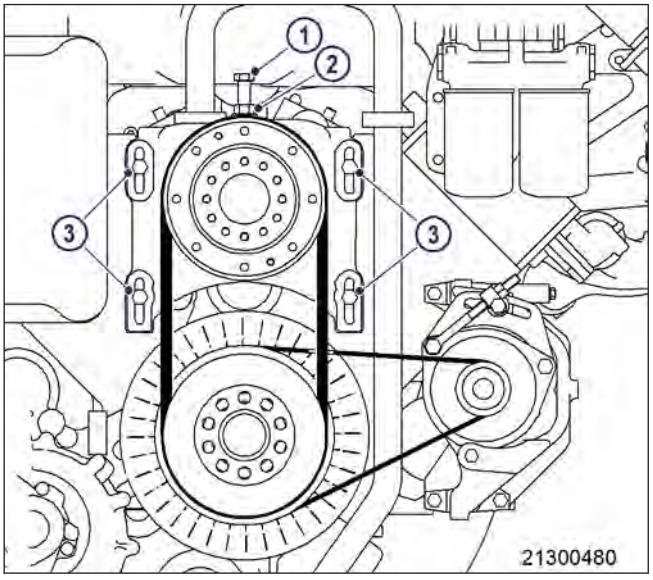


6. If the measured value deviates from the specified setting, readjust belt tension.

Setting (new drive belt)	670 N - 50 N
Setting (used drive belt)	570 N - 50 N

Drive belt – Tension adjustment, variant A

1. Release screws (3).
2. Release locknut (2).
3. Screw in screw (1) to tension drive belt.
4. Tighten locknut (2).
5. Check drive belt tension.



6. Use torque wrench to tighten screws (3) to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M18	Tightening torque	(Engine oil)	100 Nm

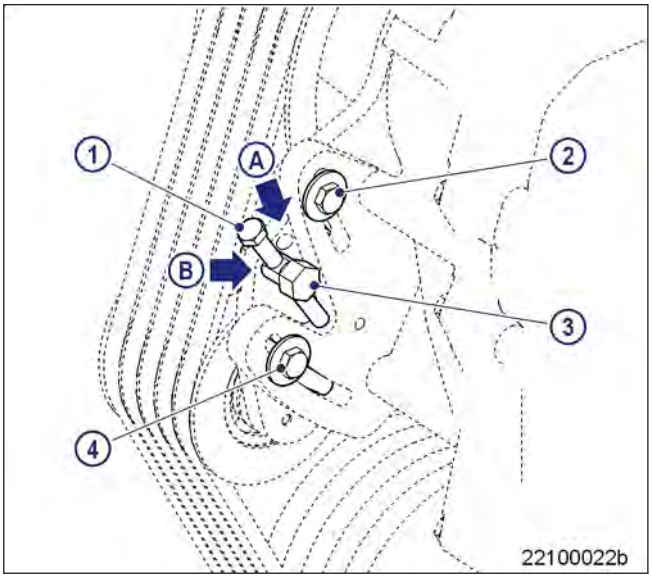
TIM-ID: 0000000045 - 003

Drive belt – Tension adjustment, variant B

1. Release screws (1, 4).

Note: Bolt (3) is in position A for variant 50 Hz, and in position B for variant 60 Hz.

2. Screw in screw (2) to tension drive belt.
3. Check drive belt tension.



4. Tighten screws (1, 4) with torque wrench to the specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M18	Tightening torque	(Engine oil)	69 Nm

5. Check drive belt tension.

Final steps

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

TIM-ID: 0000000045 - 003

7.19.2 Fan drive - Belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

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

Preparatory steps

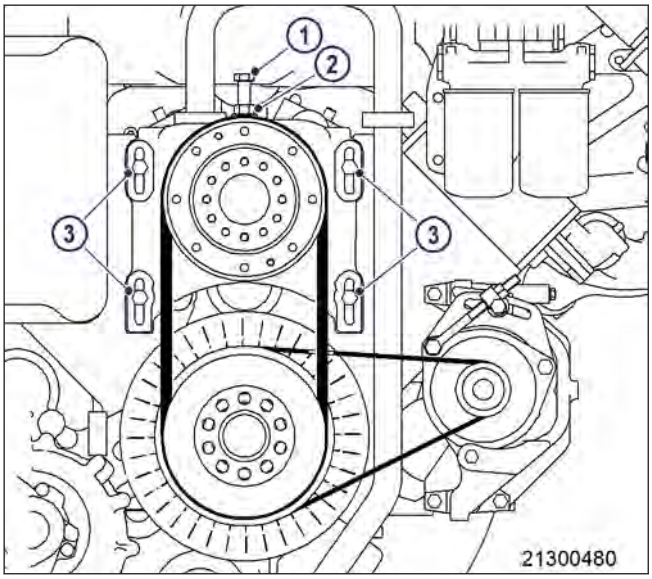
1. Remove protective cover from radiator.
2. Remove fan.

Drive belt replacement, variant A

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

Note: Drive 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 drive tension, the fan bearing pedestal must rest against the gearcase.
7. Adjust and check drive belt tension (→ Page 128).

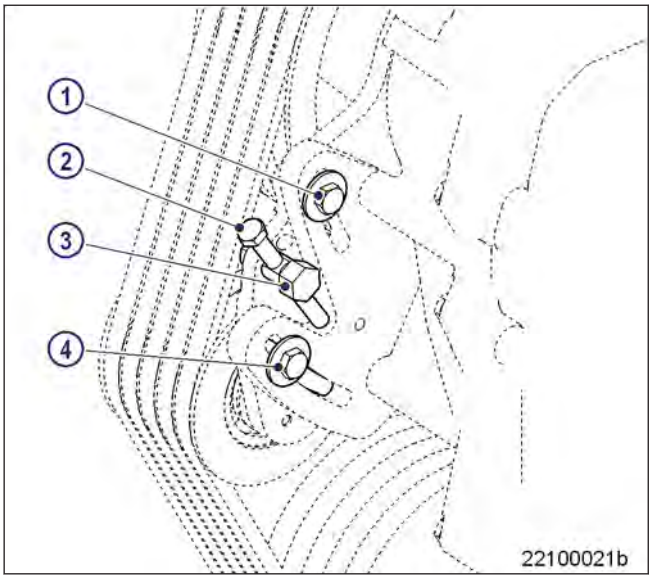


Drive belt replacement, variant B

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

Note: Drive 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 drive tension, the fan bearing pedestal must rest against the gearcase.
6. Adjust and check drive belt tension (→ Page 128).



TIM-ID: 0000000046 - 003

Final steps

1. Install fan.
2. Install protective cover.

TIM-ID: 0000000046 - 003

7.20 Wiring (General) for Engine/Gearbox/Unit

7.20.1 Engine wiring - Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Checking engine wiring

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Check that cable clamps are firm, tighten loose cable clamps.
4. Replace faulty cable clamps.
5. Visually inspect the following electrical line components for damage:
   - Connector housing
   - Contacts
   - Sockets
   - Cables and terminals
   - Plug-in contacts

Result: Contact Service if cable conductors are damaged.

Note: Close male connectors that are not plugged in with the protective cap supplied.

6. Clean dirty connector housings, sockets and contacts using isopropyl alcohol.
7. Ensure that all sensor connectors are securely engaged.

TIM-ID: 0000000029 - 019

7.21 Accessories for (Electronic) Engine Governor / Control System

7.21.1 Engine governor and connectors – Cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Isopropyl alcohol	X00058037	1

Note: Always use test connectors to enter the connectors. Never use test leads for this purpose. Otherwise the contacts could be bent.

Engine governor and connectors – Cleaning

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

Cleaning severely contaminated connectors on the engine governor

Note: Seal unused connectors with the supplied protective cap.

1. Release the latch and pull off 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 lock them.

TIM-ID: 0000000047 - 010

7.21.2 Engine governor plug connections – Check

Preconditions

☑ Engine stopped and starting disabled.

NOTICE

Insertion of unsuitable test probe, e.g. test prod.
The contacts in the plug connection can be bent!
- Carry out check of plug connection only with test connectors.

Checking plug connections at engine governor

1. Check all plug connections for secure seating.
2. Latch loose connectors.

TIM-ID: 0000000048 - 008

7.21.3 ECU 7 engine governor - Removal and installation

Preconditions

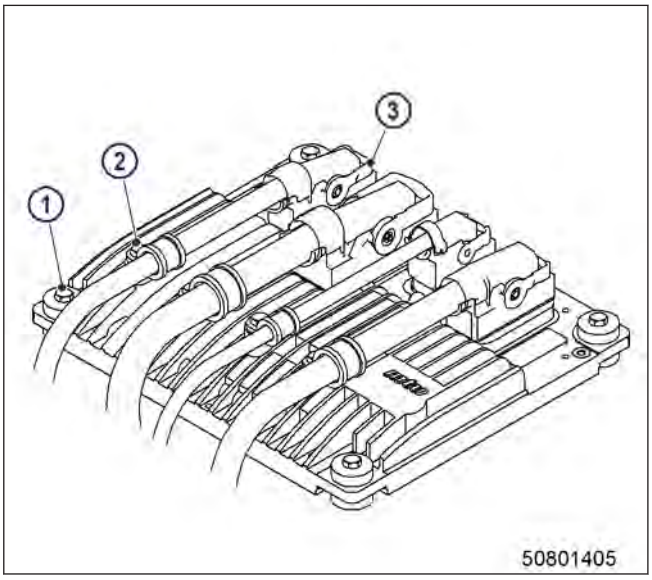
☑ Engine is stopped and starting disabled.

NOTICE

Wrong engine governor installed.
Engine damage!
- When reassembling an engine, make sure that the governor with the data record for the given engine is installed.

Removing engine governor from engine

1. Note or mark assignment of cables and connectors.
2. Remove all screws (2).
3. Undo latches (3) of the connectors.
4. Disconnect all connectors.
5. Remove screws (1).
6. Take off engine governor.



Installing engine governor on engine

1. Install in reverse order. Ensure correct assignment of connectors and sockets in so doing.
2. Check resilient mount before installing.

Result: Replace resilient mount if porous or defective.

TIM-ID: 0000000049 - 007

8 Appendix A

8.1 Abbreviations

Abbreviation	Meaning	Explanation
A/D	Analog/Digital	Transformer: transforms sensor voltages into numeric values
ADEC	Advanced Diesel Engine Controller	Engine management system
AFRS	Air Filter Restriction Sensor	
AGR	Abgasrückführung	Exhaust gas recirculation
AL	Alarm	
ANSI	American National Standards Institute	Association of American standardization organizations
ATL	Abgasturbolader/Abgasturboaufladung	Exhaust turbocharger/exhaust turbocharging
ATS	Air Temperature Sensor	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	Fluids and Lubricants Specifications, MTU Publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
CDC	Calibration Drift Compensation	Setting of drift compensation in engine governor with DiaSys
CEL	Stop 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
CM	Current Measurement	Current measured value
CPS	Coolant Pressure Sensor	Monitors coolant pressure
CR	Common Rail	
CTS	Coolant Temperature Sensor	Monitors coolant temperature
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	Diagnostic lines
DDR	Diagnostic Data Reader	Diagnostic unit
Dia Sys®	Electronic dialog system	
DIN	Deutsches Institut für Normung e. V.	At the same time identifier of German standards (DIN = “Deutsche Industrie-Norm”)
DL	Default Lost	Alarm: Default CAN bus failure
DOC	Diesel Oxidation Catalyst	Oxidation catalyst upstream of the diesel particulate filter
DPF	Dieselpartikelfilter	Diesel particulate filter
DT	Diagnostic Tool	Diagnostic unit
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor

TIM-ID: 0000000858 - 011

Abbreviation	Meaning	Explanation
EDM	Engine Data Module	Memory module for engine data
EEPROM	Electrically Erasable Programmable Read Only Memory	Electrically Erasable Programmable Read Only Memory
EFPA	Electronic Foot Pedal Assembly	Electronic Foot Pedal Assembly
EGR	Exhaust Gas Recirculation	Exhaust gas recirculation
EIL	Engine Ident Label	
EMU	Engine Monitoring Unit	Engine monitoring unit
ESCM	Extreme Site Condition Management	Power reduction in the case of extreme site conditions
ETK	Ersatzteilkatalog	Spare Parts Catalog
EUI	Electronic Unit Injector	Electronic Unit Injector
FO	Frequency Output	
FPS	Fuel Pressure Sensor	Monitors fuel pressure
FRS	Fuel Restriction Sensor	
FTS	Fuel Temperature Sensor	Monitors fuel temperature
FWCP	Fire Water Control Panel	Governor cabinet
GND	Ground	
HD (HP)	High pressure	
HI	High	Alarm: Measured value exceeds 1st maximum limit value
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit value
HT	High Temperature	High temperature
IDM	Interface Data Module	Memory module for interface data
INJ	Injector	
ISO	International Organization for Standardization	International umbrella organization for all national standardization institutes
KGS	Kraftgegenseite	Engine free end in accordance with DIN ISO 1204
KS	Kraftseite	Engine driving end in accordance with DIN ISO 1204
L1	Limit 1	Limit value 1
L2	Limit 2	Limit value 2
LED	Light Emitting Diode	Light emitting diode
LLK	Ladeluftkühlung	Intercooler
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LSG	Maximum-speed governor	
LSU	Lambda Sonde Universal	Universal lambda probe
LT	Low Temperature	Low temperature
MCR	Maximum Continuous Rating	Torque limiting curve
N/A	Not Applicable	
ND	Niederdruck	Low pressure

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Abbre-viation	Meaning	Explanation
NN	Normal Null	Reference surface for height above sea level
NT	Niedertemperatur	
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	Control panel
PIM	Peripheral Interface Module	Peripheral interface module
PWM	Pulse Width Modulation	Modulated signal
P-xyz	Pressure-xyz	Pressure measuring point, xyz specifies the measuring point designation
RL	Redundancy Lost	Alarm: Redundant CAN bus failure
SAE	Society of Automotive Engineers	U.S. standardization organization
SD	Sensor Defect	Alarm: Sensor failure
SEL	Stop EngineLlight	1st function: Warning lamp (stop engine and rectify fault) 2nd function: Read out fault codes
SID	System Identification	
SRS	Synchronous Reference Sensor	OT cylinder 1
SS	Safety System / Security Shutdown	Safety system alarm
TBS	Turbocharger Boost Sensor	Monitors charge-air pressure
TCI	Turbo Compressor Inlet	
TCO	Turbo Compressor Outlet	
TD	Transmitter Deviation	Alarm: Deviation in transmitter values
TPS	Throttle Position Sensor	
TRS	Timing Reference Sensor	
T-xyz	Temperature-xyz	Temperature measuring point, xyz specifies the measuring point designation
U_PDU	Voltage Power Driver Unit	Solenoid valve output stage supply voltage
UDV	Überdruckventil	Pressure relief valve
UT	Unterer Totpunkt	Bottom Dead Center
VNT	Variable Nozzle Turbine	
VSG	Variable-Speed Governor	
VSS	Vehicle Speed Sensor	
WZK	Werkzeugkatalog	Tool Catalog
ZKP	Zuordnung - Kategorie - Parameter	A number assigned to a parameter describing function and allocation

TIM-ID: 0000000858 - 011

8.2 MTU contact persons/service partners

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

Local support

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

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

24h hotline

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

Your contact person in our Customer Assistance Center:

E-mail: info@mtu-online.com

Tel.: +49 7541 9077777

Fax: +49 7541 9077778

Asia/Pacific: +65 6100 2688

North and Latin America: +1 248 560 8000

Spare parts service

Fast, simple and correct identification of spare parts for your drive system or vehicle fleet. The right spare part at the right time at the right place.

With this aim in mind, we can call on a globally networked spares logistics system, a central warehouse at headquarters and on-site stores at our subsidiary companies, agencies and service workshops.

Your contact at Headquarters:

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

Tel.: +49 7541 908555

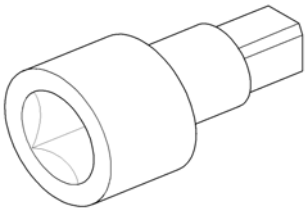
Fax: +49 7541 908121

TIM-ID: 0000000873 - 015

9 Appendix B

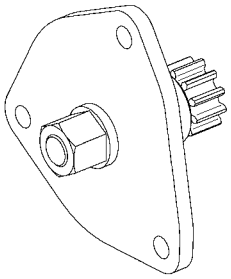
9.1 Special Tools

Adapter



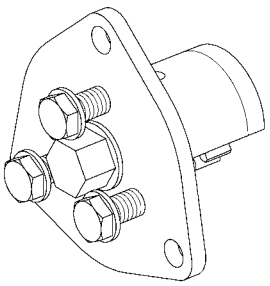
Part No.:	F30006234
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

Barring device for 12V engines



Part No.:	F6558556
Qty.: Used in:	1 7.1.1 Engine – Barring manually (→ Page 67)

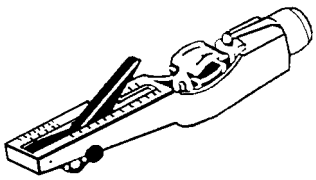
Barring device for 16V, 18V engines



Part No.:	F6558557
Qty.: Used in:	1 7.1.1 Engine – Barring manually (→ Page 67)

DCL-ID: 0000019467 - 004

Belt tension tester



Part No.:	5505890119/00
Qty.: Used in:	1 7.19.1 Fan drive – Drive-belt check and adjustment (→ Page 128)

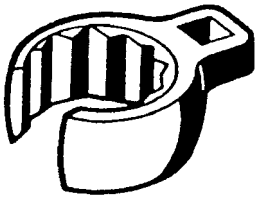
Box wrench, 17 mm

Part No.:	F30028341
Qty.: Used in:	1 7.7.2 Fuel – Draining (→ Page 91)

Crowfoot box wrench, 22 mm

Part No.:	F30027425
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

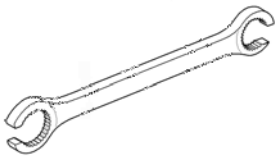
Crowfoot wrench, 19 mm



Part No.:	F30027424
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

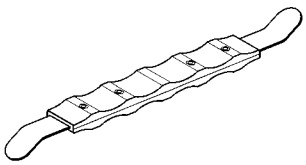
DCL-ID: 0000019467 - 004

Double-head box wrench



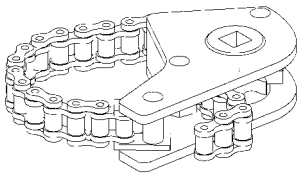
Part No.:	F30011450
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

Feeler gauge



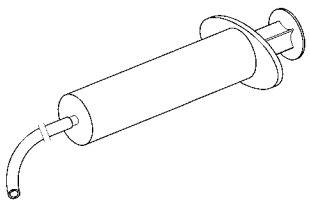
Part No.:	Y4342013
Qty.: Used in:	1 7.4.1 Valve clearance – Check and adjustment (→ Page 77)

Filter wrench



Part No.:	F30379104
Qty.: Used in:	1 7.8.1 Fuel filter – Replacement (→ Page 96)
Qty.: Used in:	1 7.14.1 Engine oil filter – Replacement (→ Page 111)

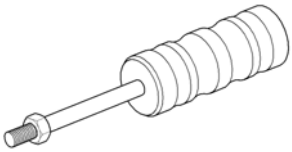
Fuel suction device



Part No.:	F30378207
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)

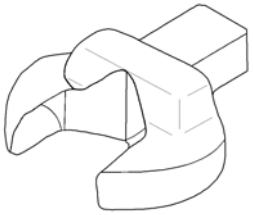
DCL-ID: 0000019467 - 004

Impact extractor



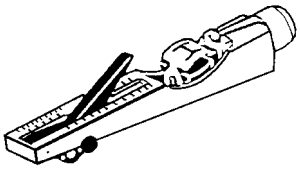
Part No.:	F30377999
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)

Plug-in open-end wrench, 19 mm



Part No.:	F30025897
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

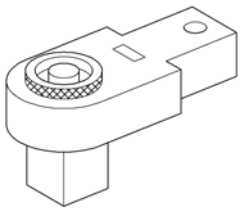
Pre-tension gauge



Part No.:	Y20097429
Qty.: Used in:	1 7.18.1 Battery-charging generator drive – Drive-belt check and adjustment (→ Page 125)

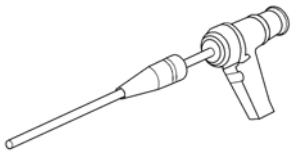
DCL-ID: 0000019467 - 004

Ratchet



Part No.:	F30027340
Qty.: Used in:	1 7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 74)
Qty.: Used in:	1 7.4.1 Valve clearance – Check and adjustment (→ Page 77)
Qty.: Used in:	1 7.4.2 Cylinder head cover – Removal and installation (→ Page 80)
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)
Qty.: Used in:	1 7.18.1 Battery-charging generator drive – Drive-belt check and adjustment (→ Page 125)
Qty.: Used in:	1 7.18.2 Battery-charging generator drive – Drive belt replacement (→ Page 127)
Qty.: Used in:	1 7.19.1 Fan drive – Drive-belt check and adjustment (→ Page 128)

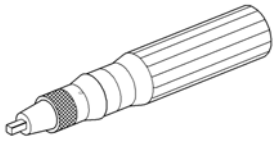
Rigid endoscope



Part No.:	Y20097353
Qty.: Used in:	1 7.2.1 Cylinder liner – Endoscopic examination (→ Page 70)

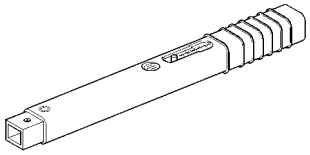
DCL-ID: 0000019467 - 004

Torque wrench, 0.5-5 Nm



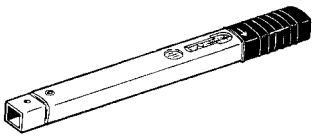
Part No.:	0015384230
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)

Torque wrench, 20-100 Nm



Part No.:	F30026582
Qty.: Used in:	1 7.4.1 Valve clearance – Check and adjustment (→ Page 77)
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)
Qty.: Used in:	1 7.18.1 Battery-charging generator drive – Drive-belt check and adjustment (→ Page 125)
Qty.: Used in:	1 7.18.2 Battery-charging generator drive – Drive belt replacement (→ Page 127)
Qty.: Used in:	1 7.19.1 Fan drive – Drive-belt check and adjustment (→ Page 128)

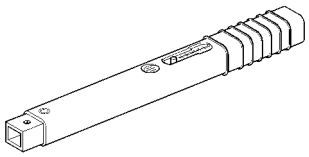
Torque wrench, 6-50 Nm



Part No.:	F30027336
Qty.: Used in:	1 7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 74)

DCL-ID: 0000019467 - 004

Torque wrench, 8-40 Nm



Part No.:	F30043446
Qty.: Used in:	1 7.4.2 Cylinder head cover – Removal and installation (→ Page 80)
Qty.: Used in:	1 7.7.2 Fuel – Draining (→ Page 91)

DCL-ID: 0000019467 - 004

9.2 Consumables

Cleaner	
Part No.:	
Qty.: Used in:	7.3.2 Crankcase breather – Wire mesh cleaning (→ Page 76)

Coolant	
Part No.:	
Qty.: Used in:	7.15.4 Engine coolant – Filling (→ Page 115)
Qty.: Used in:	7.16.1 Charge-air coolant – Filling (→ Page 118)
Qty.: Used in:	7.16.3 Charge-air coolant – Change (→ Page 121)

Diesel fuel	
Part No.:	
Qty.: Used in:	7.3.2 Crankcase breather – Wire mesh cleaning (→ Page 76)
Qty.: Used in:	7.8.1 Fuel filter – Replacement (→ Page 96)
Qty.: Used in:	7.8.3 Fuel prefilter – Draining (→ Page 98)
Qty.: Used in:	7.8.5 Fuel prefilter – Cleaning (→ Page 101)
Qty.: Used in:	7.8.6 Fuel prefilter – Filter element replacement (→ Page 102)

Engine coolant	
Part No.:	
Qty.: Used in:	7.15.2 Engine coolant – Change (→ Page 113)

DCL-ID: 0000019467 - 004

Engine oil	
Part No.:	
Qty.: Used in:	7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 74)
Qty.: Used in:	7.4.1 Valve clearance – Check and adjustment (→ Page 77)
Qty.: Used in:	7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)
Qty.: Used in:	7.7.2 Fuel – Draining (→ Page 91)
Qty.: Used in:	7.7.4 Fuel system – Venting (→ Page 94)
Qty.: Used in:	7.13.2 Engine oil – Change (→ Page 110)
Qty.: Used in:	7.14.1 Engine oil filter – Replacement (→ Page 111)
Qty.: Used in:	7.18.1 Battery-charging generator drive – Drive-belt check and adjustment (→ Page 125)
Qty.: Used in:	7.18.2 Battery-charging generator drive – Drive belt replacement (→ Page 127)
Qty.: Used in:	7.19.1 Fan drive – Drive-belt check and adjustment (→ Page 128)

Fuel	
Part No.:	
Qty.: Used in:	7.8.4 Fuel prefilter – Flushing (→ Page 99)

Grease (Kluthe Hakuform 30-10/Emulgier)	
Part No.:	X00029933
Qty.: Used in:	1 7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	1 7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	1 7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

Isopropyl alcohol	
Part No.:	X00058037
Qty.: Used in:	1 7.20.1 Engine wiring – Check (→ Page 133)
Qty.: Used in:	1 7.21.1 Engine governor and connectors – Cleaning (→ Page 134)

DCL-ID: 0000019467 - 004

Petroleum jelly	
Part No.:	
Qty.: Used in:	7.3.2 Crankcase breather – Wire mesh cleaning (→ Page 76)

DCL-ID: 0000019467 - 004

9.3 Spare Parts

Air filter	
Part No.:	
Qty.: Used in:	7.10.1 Air filter – Replacement (→ Page 105)

Diaphragm	
Part No.:	
Qty.: Used in:	7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 74)

Drive belt	
Part No.:	
Qty.: Used in:	7.18.2 Battery-charging generator drive – Drive belt replacement (→ Page 127)
Qty.: Used in:	7.19.2 Fan drive – Belt replacement (→ Page 131)

Easy-change filter	
Part No.:	
Qty.: Used in:	7.8.1 Fuel filter – Replacement (→ Page 96)

Filter element	
Part No.:	
Qty.: Used in:	7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 74)
Qty.: Used in:	7.8.6 Fuel prefilter – Filter element replacement (→ Page 102)
Qty.: Used in:	7.10.1 Air filter – Replacement (→ Page 105)

Filter insert	
Part No.:	
Qty.: Used in:	7.10.1 Air filter – Replacement (→ Page 105)

DCL-ID: 0000019467 - 004

Gasket	
Part No.:	
Qty.: Used in:	7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 74)
Qty.: Used in:	7.4.2 Cylinder head cover – Removal and installation (→ Page 80)
Qty.: Used in:	7.5.2 Injection pump – Removal and installation (→ Page 82)
Qty.: Used in:	7.6.2 Injector – Removal and installation (→ Page 86)
Qty.: Used in:	7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)
Qty.: Used in:	7.8.3 Fuel prefilter – Draining (→ Page 98)
Qty.: Used in:	7.8.6 Fuel prefilter – Filter element replacement (→ Page 102)

Injection pump	
Part No.:	
Qty.: Used in:	7.5.1 Injection pump – Replacement (→ Page 81)

Injector	
Part No.:	
Qty.: Used in:	7.6.1 Injector – Replacement (→ Page 85)

Oil filter	
Part No.:	
Qty.: Used in:	7.14.1 Engine oil filter – Replacement (→ Page 111)

Pressure pipe tube	
Part No.:	
Qty.: Used in:	7.7.1 Fuel injection line – Pressure pipe neck replacement (→ Page 89)

Pressure relief valve	
Part No.:	
Qty.: Used in:	7.7.3 Fuel pressure maintaining valve – Removal and installation (→ Page 93)

Seal	
Part No.:	
Qty.: Used in:	7.8.4 Fuel prefilter – Flushing (→ Page 99)

DCL-ID: 0000019467 - 004

Sealing ring	
Part No.:	
Qty.: Used in:	7.3.2 Crankcase breather – Wire mesh cleaning (→ Page 76)
Qty.: Used in:	7.5.2 Injection pump – Removal and installation (→ Page 82)
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