Operating Instructions

Diesel engine
12 V 4000 G23, G43, G63, G83
16 V 4000 G23, G43, G63, G83, G83L

M015710/04E

Power. Passion. Partnership.

Table of Contents

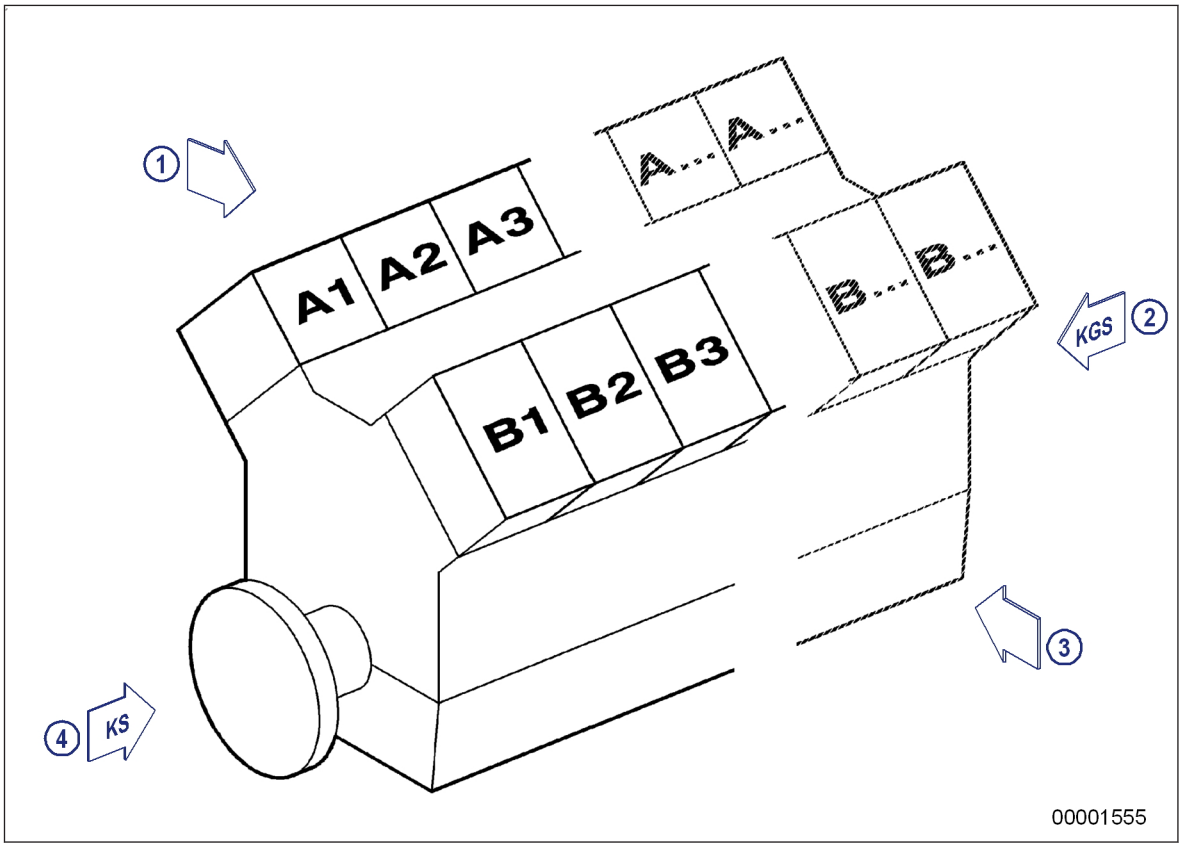
2 General Information

2.1 Engine side and cylinder designations

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

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

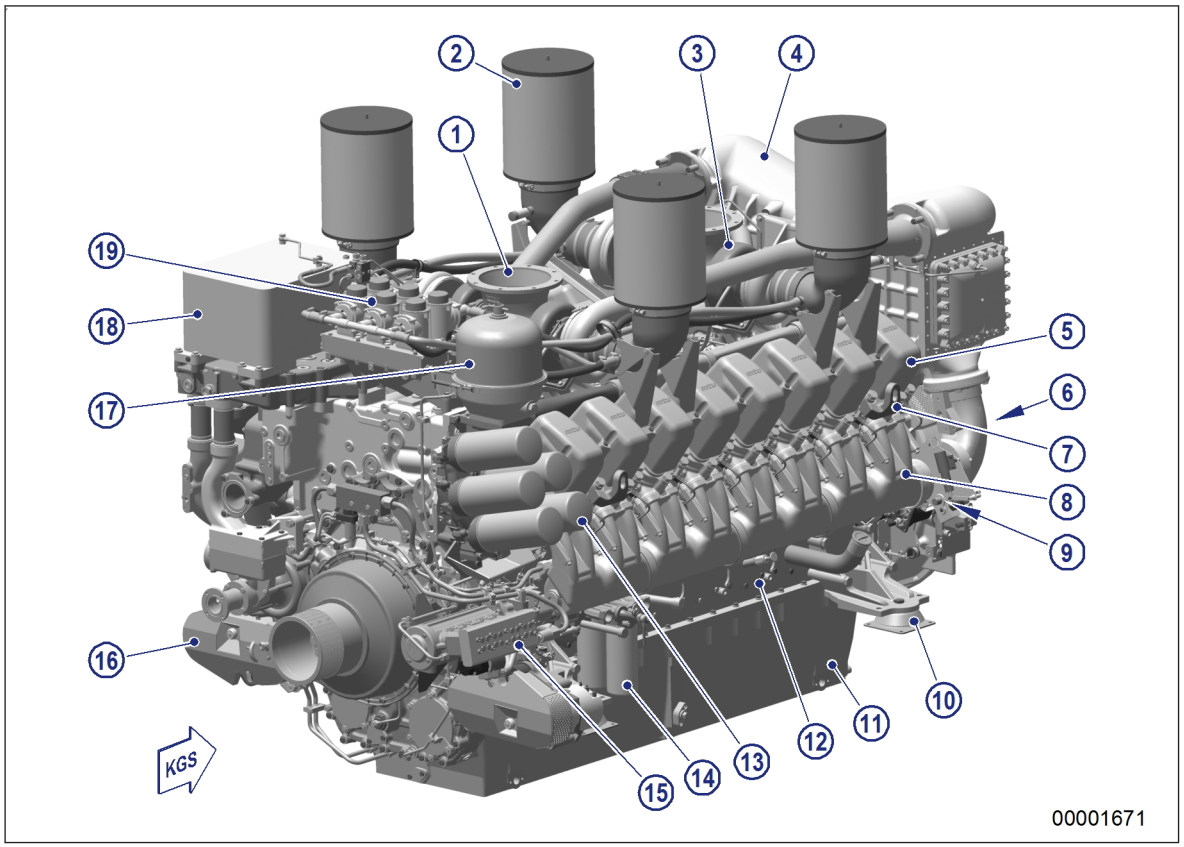
Other components are numbered in the same way, i.e. starting with No. 1 on driving end.



1 Left engine side
2 KGS = Free end
3 Right engine side
4 KS = Driving end

2.2 Engine layout

Illustration applies in the same way to 12 V 4000 Gx3.



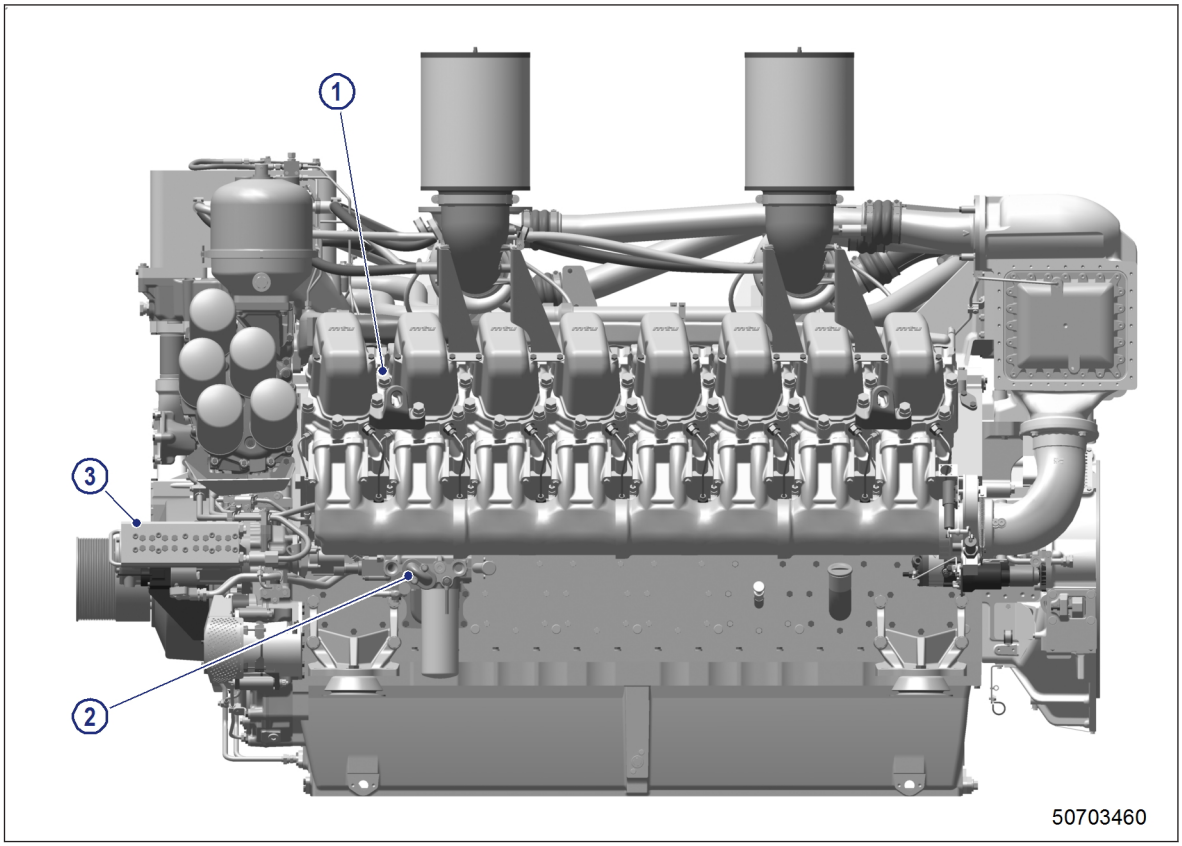
1 Exhaust gas outlet connection
2 Air filter
3 Exhaust turbocharger
4 Intercooler
5 Cylinder head
6 Flywheel
7 Lifting eye
8 Charge-air pipe
9 Starter
10 Engine mounting
11 Oil pan
12 Crankcase
13 Engine oil filter
14 Fuel filter
15 HP fuel pump
16 Battery-charging generator
17 Centrifugal oil filter
18 Oil heat exchanger
19 Crankcase breather

Engine model designation

Key to the engine model designations 12/16V 4000 Gx3(L)	
12/16	Number of cylinders
V	Cylinder arrangement: V engine
4000	Series
G	Application
x	Application segment (2, 4, 6, 8)
3	Design index
L	L (enhanced power / speed)

2.3 Sensors, actuators and injectors – Overview

Illustrations are also valid for 12 V 4000 Gx3 engines.

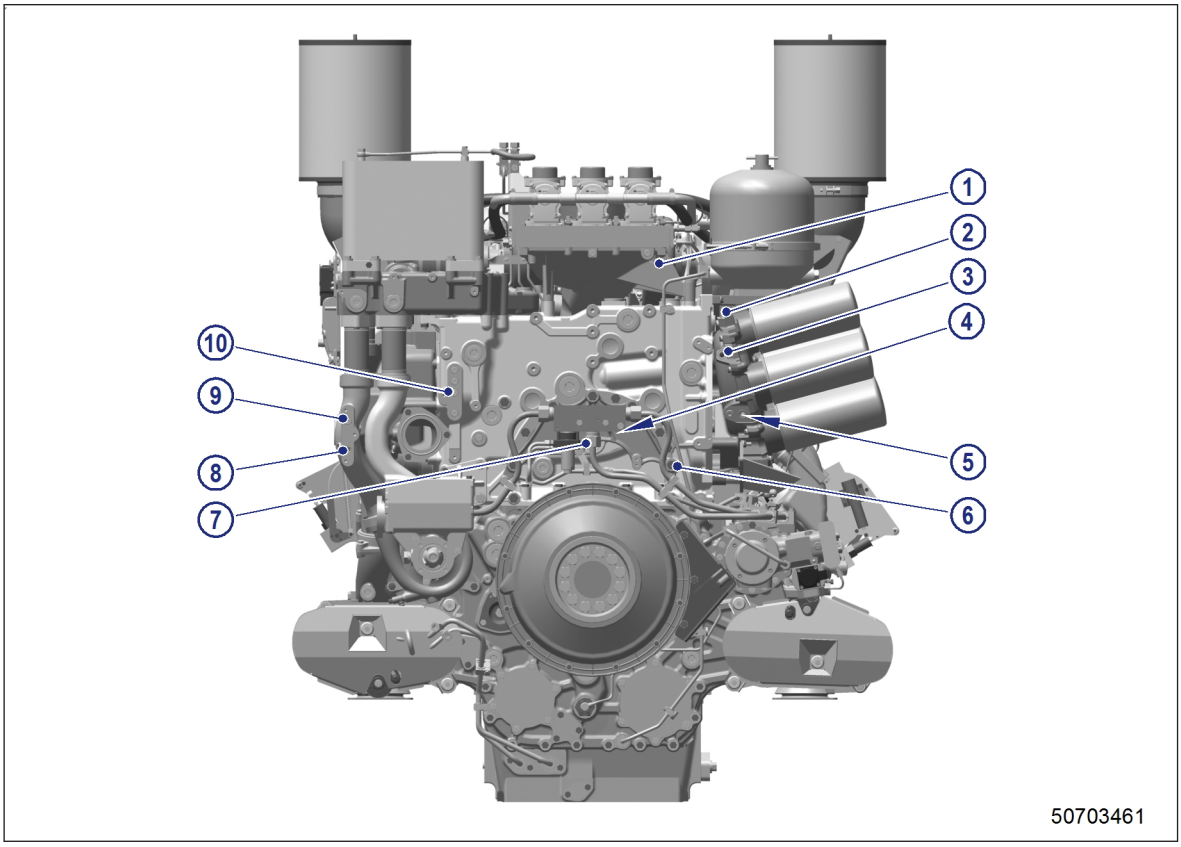


1 Temperature sensors for cylinder exhaust gas B4.1 to B4.8 (engine side A)

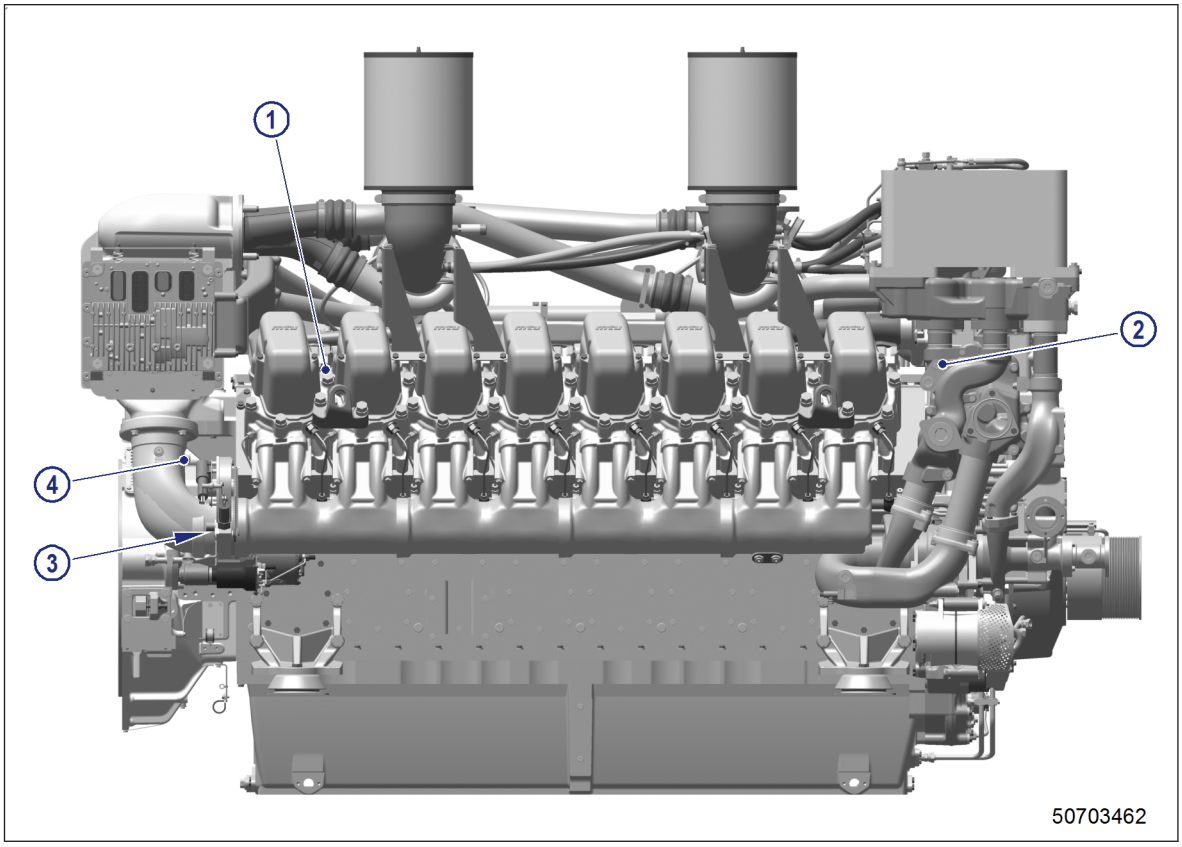
2 Sensor B34 (fuel pressure after filter)

3 M8 (HP fuel pump actuator)

The injectors (Y39.1 to Y39.8, engine side A) are underneath the cylinder head covers of the cylinder. Injector replacement and necessary activities (→ Page 146).

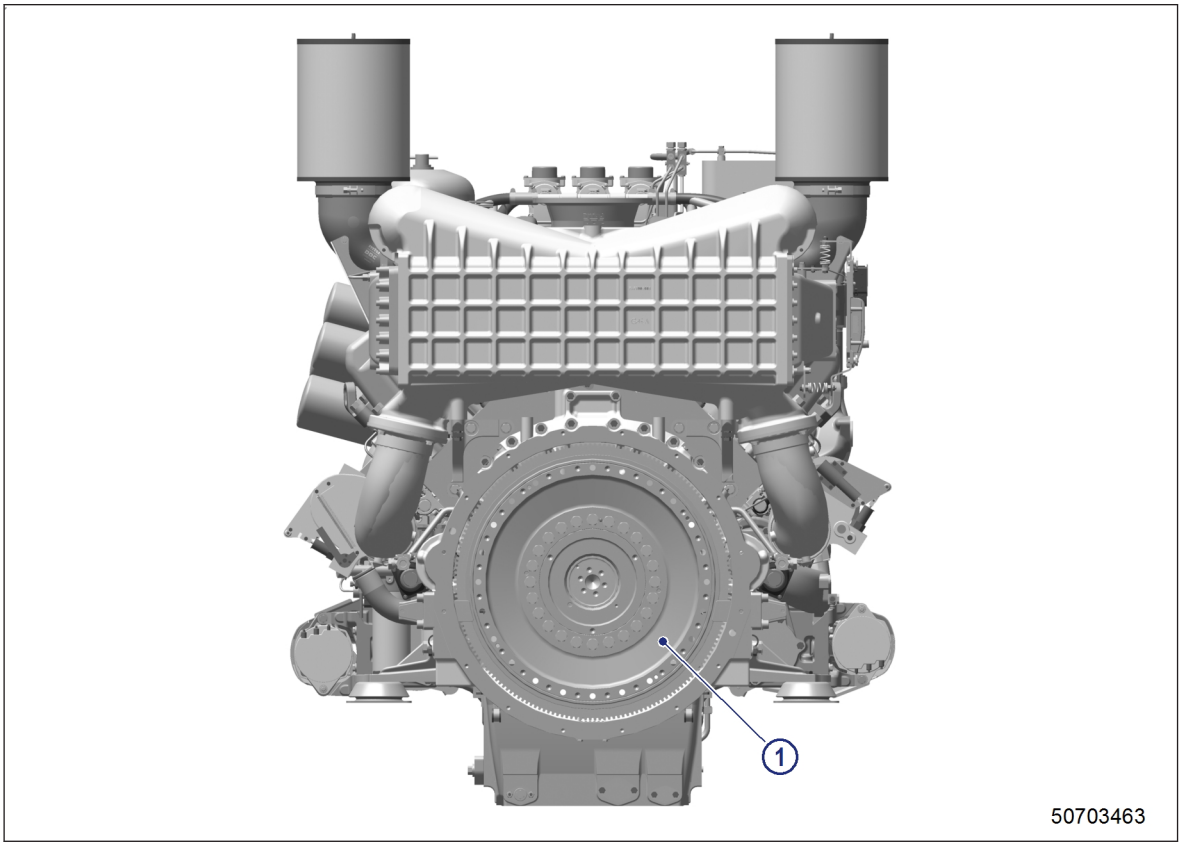


1 B50 (crankcase pressure)
2 B05.3 (lube oil pressure before filter)
3 B05 (lube oil pressure after filter)
4 B33 (fuel temperature in common rail)
5 B07 (lube oil temperature)
6 B01 (camshaft speed)
7 B48 (fuel pressure in common rail)
8 B43 (charge-air coolant pressure)
9 B26 (charge-air coolant temperature)
10 B06 (engine coolant temperature)



1 Temperature sensors for cylinder exhaust gas B4.11 to B4.18 (engine side B)
2 B16 (coolant pressure)
3 B10 (charge-air pressure)
4 B09 (charge-air temperature)

The injectors (Y39.11 to Y39.18, engine side B) are underneath the cylinder head covers of the cylinder. Injector replacement and required procedure (→ Page 146)



1 B13 (crankshaft speed)

3 Technical Data

3.1 16 V 4000 Gx3 engine data: Continuous operation 3A, optimized fuel consumption

Explanation

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

Reference conditions

Engine model			16V 4000G43	16V 4000G63	16V 4000G83
Application group			3A	3A	3A
Intake air temperature		°C	25	25	25
Charge-air coolant temperature		°C	55	55	55
Barometric pressure		mbar	1000	1000	1000
Site altitude above sea level		m	100	100	100

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

Number of cylinders			16	16	16
Rated engine speed	A	rpm	1800	1500	1800
Continuous power as per ISO 3046	A	kW	1560	1635	1710

General conditions (for maximum power)

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

Model related data (basic design)

Number of cylinders			16	16	16
Number of cylinders			16	16	16
Cylinder arrangement: V-angle		Degrees (°)	90	90	90
Bore		mm	170	170	170
Stroke		mm	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3
Compression ratio			16.5	16.5	16.5
Inlet valves per cylinder			2	2	2
Exhaust valves per cylinder			2	2	2

Combustion air / Exhaust gas

Number of cylinders			16	16	16
Charge-air pressure before cylinder - BL	R	bar abs	2.7	2.6	2.9

Coolant system (HT circuit)

Number of cylinders			16	16	16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104
Coolant antifreeze content, max.	L	%	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7

Coolant system (LT circuit)

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

Lube oil system

Number of cylinders			16	16	16
Lube-oil operating temperature before engine, from	R	°C	90	89	88
Lube-oil operating temperature before engine, to	R	°C	96	95	95
Lube-oil temperature before engine, warning	R	°C	97	97	97
Lube-oil temperature before engine, shutdown	L	°C	99	99	99
Lube-oil operating pressure before engine, from	R	bar	4.7	4.2	4.7
Lube-oil operating pressure before engine, to	R	bar	6.5	5.5	6.5

Fuel system

Number of cylinders			16	16	16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5

General operating data

Number of cylinders			16	16	16
Cold start capability: air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32
Firing speed, from	R	rpm	80	80	80
Firing speed, to	R	rpm	120	120	120

Capacities

Number of cylinders			16	16	16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	175	175	175
Charge-air coolant, engine side	R	Liters	50	50	50
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	300	300	300
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	240	240	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	210	210	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	240	240	240

Weights / main dimensions

Number of cylinders			16	16	16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	7700	7700	7700

Acoustics

Number of cylinders			16	16	16
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798)	R	dB(A)	126	124	127
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798)	R	dB(A)	124	124	124

3.2 12 V 4000 Gx3 engine data: Continuous operation, variable 3B, optimized fuel consumption

Explanation

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

Reference conditions

Engine model			12V4000 G23	12V4000 G23R	12V4000 G43	12V4000 G63	12V4000 G83
Application group			3B	3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25	25
Charge-air coolant temperature		°C	55	55	55	55	55
Raw water inlet temperature		°C	-	-	-	-	-
Barometric pressure		mbar	1000	1000	1000	1000	1000
Site altitude above sea level		m	100	100	100	100	100

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

Number of cylinders			12	12	12	12	12
Rated engine speed	A	rpm	1500	1500	1800	1500	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1420	1205	1520	1575	1736

General conditions (for maximum power)

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

Model related data (basic design)

Number of cylinders			12	12	12	12	12
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X	X	X
Uncooled exhaust lines			X	X	X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X	X	X
Combustion method: direct fuel injection			X	X	X	X	X
Cooling method: Treated water			X	X	X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X	X	X
Number of cylinders			12	12	12	12	12
Cylinder arrangement: V-angle		Degrees (°)	90	90	90	90	90
Bore		mm	170	170	170	170	170
Stroke		mm	210	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2	57.2	57.2
Compression ratio			16.5	16.5	16.5	16.5	16.5
Cylinder heads: individual cylinder heads			X	X	X	X	X
Cylinder liners: wet, replaceable			X	X	X	X	X
Inlet valves per cylinder			2	2	2	2	2
Exhaust valves per cylinder			2	2	2	2	2
Standard housing connecting flange (engine main PTO)		SAE	00	00	00	00	00
Flywheel interface		DISC	21	21	21	21	21

Combustion air / Exhaust gas

Number of cylinders			12	12	12	12	12
Charge air pressure before cylinder - DL	R	bar abs	2.6	2.4	2.9	2.9	3.2

Coolant system (HT circuit)

Number of cylinders			12	12	12	12	12
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102	102	102

Number of cylinders			12	12	12	12	12
Coolant temperature after engine, shutdown	L	°C	104	104	104	104	104
Coolant antifreeze content, max.	L	%	50	50	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7	0.7	0.7

Coolant system (LT circuit)

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

Lube oil system

Number of cylinders			12	12	12	12	12
Lube-oil operating temperature before engine, from	R	°C	88	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98	98
Lube-oil temperature before engine, warning	R	°C	99	99	99	99	99
Lube-oil temperature before engine, shutdown	L	°C	101	101	101	101	101
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	5.0	5.0	5.0
Lube-oil operating pressure before engine, to	R	bar	6.0	7.0	7.0	7.0	7.0
Lube-oil operating pressure before engine, warning	R	bar	--	--	--	--	--
Lube-oil operating pressure before engine, shutdown	L	bar	--	--	--	--	--

Fuel system

Number of cylinders			12	12	12	12	12
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5	1.5

General operating data

Number of cylinders			12	12	12	12	12
Cold start capability: air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120	120

Capacities

Number of cylinders			12	12	12	12	12
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	160	160	160	160	160
Charge-air coolant, engine side	R	Liters	40	40	40	40	40
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	260	260	260
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	260	260	260
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	160	160	160	160	160
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	200	200	200	200	200

Weights / main dimensions

Number of cylinders			12	12	12	12	12
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	6200*	6200*	6200*	6200*	6200*

Acoustics

Number of cylinders			12	12	12	12	12
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	124	124	125	125	127
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	120	120	122	121	123

3.3 12 V 4000 Gx3 engine data: Continuous operation, variable 3B, optimized exhaust emissions (TA-Luft)

Explanation

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

Reference conditions

Engine model			12V4000 G23	12V4000 G23R	12V4000 G63
Application group			3B	3B	3B
Intake air temperature		°C	25	25	25
Charge-air coolant temperature		°C	55	55	55
Raw water inlet temperature		°C	-	-	-
Barometric pressure		mbar	1000	1000	1000
Site altitude above sea level		m	100	100	100

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

Number of cylinders			12	12	12
Rated engine speed	A	rpm	1500	1500	1500
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1420	1205	1575

General conditions (for maximum power)

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

Model related data (basic design)

Number of cylinders			12	12	12
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X
Uncooled exhaust lines			X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X
Combustion method: direct fuel injection			X	X	X
Cooling method: Treated water			X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X
Number of cylinders			12	12	12
Cylinder arrangement: V-angle		Degrees (°)	90	90	90
Bore		mm	170	170	170
Stroke		mm	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2
Compression ratio			16.5	16.5	16.5
Cylinder heads: individual cylinder heads			X	X	X
Cylinder liners: wet, replaceable			X	X	X
Inlet valves per cylinder			2	2	2
Exhaust valves per cylinder			2	2	2
Standard housing connecting flange (engine main PTO)		SAE	00	00	00
Flywheel interface		DISC	21	21	21

Combustion air / Exhaust gas

Number of cylinders			12	12	12
Charge air pressure before cylinder - DL	R	bar abs	3.2	2.9	3.5

Coolant system (HT circuit)

Number of cylinders			12	12	12
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104
Coolant antifreeze content, max.	L	%	50	50	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7	0.7	0.7

Coolant system (LT circuit)

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

Lube oil system

Number of cylinders			12	12	12
Lube-oil operating temperature before engine, from	R	°C	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98
Lube-oil temperature before engine, warning	R	°C	99	99	99
Lube-oil temperature before engine, shutdown	L	°C	101	101	101
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	5.0
Lube-oil operating pressure before engine, to	R	bar	7.0	7.0	7.0
Lube-oil operating pressure before engine, warning	R	bar	--	--	--
Lube-oil operating pressure before engine, shut-down	L	bar	--	--	--

Fuel system

Number of cylinders			12	12	12
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5

General operating data

Number of cylinders			12	12	12
Cold start capability: air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32
Firing speed, from	R	rpm	80	80	80
Firing speed, to	R	rpm	120	120	120

Capacities

Number of cylinders			12	12	12
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	160	160	160
Charge-air coolant, engine side	R	Liters	40	40	40
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	260
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	260

Number of cylinders			12	12	12
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	160	160	160
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	200	200	200

Weights / main dimensions

Number of cylinders			12	12	12
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	6200*	6200*	6200*

Acoustics

Number of cylinders			12	12	12
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	126	126	127
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	122	122	122

3.4 16 V 4000 Gx3 engine data: Continuous operation, variable 3B, optimized fuel consumption

Explanation

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

Reference conditions

Engine model			16V 4000G23	16V 4000G43	16V 4000G63	16V 4000G83
Application group			3B	3B	3B	3B
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 to ISO 3046)

Number of cylinders			16	16	16	16
Rated engine speed	A	rpm	1500	1800	1500	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1798	2020	1965	2280

General conditions (for maximum power)

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

Model related data (basic design)

Number of cylinders			16	16	16	16
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X	X
Uncooled exhaust lines			X	X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X	X
Combustion method: direct fuel injection			X	X	X	X
Cooling method: Treated water			X	X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X	X
Number of cylinders			16	16	16	16
Cylinder arrangement: V-angle		Degrees	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3	76.3
Compression ratio			16.5	16.5	16.5	16.5
Cylinder heads: individual cylinder heads			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 housing connecting flange (engine main PTO)		SAE	00	00	00	00
Flywheel interface		DISC	21	21	21	21

Combustion air / Exhaust gas

Number of cylinders			16	16	16	16
Charge air pressure before cylinder - DL	R	bar abs	2.6	2.9	2.8	3.1

Coolant system (HT circuit)

Number of cylinders			16	16	16	16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104	104
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			16	16	16	16
Coolant temperature before intercooler (at engine connection: 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

Lube oil system

Number of cylinders			16	16	16	16
Lube-oil operating temperature before engine, from	R	°C	89	90	89	88
Lube-oil operating temperature before engine, to	R	°C	95	96	95	95
Lube-oil temperature before engine, warning	R	°C	97	97	97	97
Lube-oil temperature before engine, shutdown	L	°C	99	99	99	99
Lube-oil operating pressure before engine, from	R	bar	4.2	4.7	4.2	4.7
Lube-oil operating pressure before engine, to	R	bar	5.5	6.5	5.5	6.5
Lube-oil operating pressure before engine, warning	R	bar	--	--	--	--
Lube-oil operating pressure before engine, shutdown	L	bar	--	--	--	--

Fuel system

Number of cylinders			16	16	16	16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5

General operating data

Number of cylinders			16	16	16	16
Cold start capability: air temperature (w/ o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

Capacities

Number of cylinders			16	16	16	16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	260	260	260	260
Charge-air coolant, engine side	R	Liters	50	50	50	50
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	300	300	300	300
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	240	240	240	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	210	210	210	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	240	240	240	240

Weights / main dimensions

Number of cylinders			16	16	16	16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	7700	7700	7700	7700

Acoustics

Number of cylinders			16	16	16	16
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	125	127	126	129
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	126	125	128	125

3.5 12/16 V 4000 Gx3 engine data: Continuous operation, variable 3B, optimized exhaust emissions (EPA stage 2)

Explanation

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

Reference conditions

Engine model			12V 4000G43	12V 4000G83	16V 4000G43	16V 4000G83
Application group			3B	3B	3B	3B
Intake air temperature		°C	25	25	25	25
Charge-air coolant temperature		°C	45	45	45	45
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 to ISO 3046)

Number of cylinders			12	12	16	16
Rated engine speed	A	rpm	1800	1800	1800	1800
Continuous power ISO 3046 (10% overload capability, design power DIN 6280, ISO 8528)	A	kW	1520	1736	2020	2280

General conditions (for maximum power)

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

Model related data (basic design)

Number of cylinders			12	12	16	16
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X	X
Uncooled exhaust lines			X	X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X	X
Combustion method: direct fuel injection			X	X	X	X
Cooling method: Treated water			X	X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X	X
Number of cylinders			12	12	16	16
Cylinder arrangement: V-angle		Degrees	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	76.3	76.3
Compression ratio			16.5	16.5	16.5	16.5
Cylinder heads: individual cylinder heads			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 housing connecting flange (engine main PTO)		SAE	00	00	00	00
Flywheel interface		DISC	21	21	21	21

Combustion air / Exhaust gas

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

Coolant system (HT circuit)

Number of cylinders			12	12	16	16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104	104
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	16
Coolant temperature before intercooler (at engine connection: from cooling equipment)	A	°C	45	45	45	45
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	16
Lube-oil operating temperature before engine, from	R	°C	88	88	90	88
Lube-oil operating temperature before engine, to	R	°C	98	98	96	94
Lube-oil temperature before engine, warning	R	°C	99	99	97	97
Lube-oil temperature before engine, shutdown	L	°C	101	101	99	99
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	4.7	4.7
Lube-oil operating pressure before engine, to	R	bar	7.0	7.0	6.5	6.5
Lube-oil operating pressure before engine, warning	R	bar	--	--	--	--
Lube-oil operating pressure before engine, shutdown	L	bar	--	--	--	--

Fuel system

Number of cylinders			12	12	16	16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5

General operating data

Number of cylinders			12	12	16	16
Cold start capability: air temperature (w/ o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

Capacities

Number of cylinders			12	12	16	16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	160	160	260	260
Charge-air coolant, engine side	R	Liters	40	40	50	50
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	300	300
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters			240	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	160	160	210	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	200	200	240	240

Weights / main dimensions

Number of cylinders			12	12	16	16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	6200*	6200*	7700	7700

Acoustics

Number of cylinders			12	12	16	16
Exhaust noise, unsilenced - DL (sound power level LW, ISO 6798)	R	dB(A)	125	127	127	129
Engine surface noise with attenuated intake noise filter) - DL (sound power level LW, ISO 6798)	R	dB(A)	122	123	125	125

3.6 12V 4000 Gx3 engine data: Standby operation 3D, optimized fuel consumption

Explanation

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

Reference conditions

Engine model			12V 4000G23	12V 4000G43	12V 4000G63	12V 4000G83
Application group			3D	3D	3D	3D
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 to ISO 3046)

Number of cylinders			12	12	12	12
Rated engine speed	A	rpm	1500	1800	1500	1800
Fuel stop power ISO 3046	A	kW	1575	1736	1750	1910

General conditions (for maximum power)

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

TIM-ID: 0000002873 - 002

Model related data (basic design)

Number of cylinders			12	12	12	12
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X	X
Uncooled exhaust lines			X	X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X	X
Combustion method: direct fuel injection			X	X	X	X
Cooling method: Treated water			X	X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X	X
Number of cylinders			12	12	12	12
Cylinder arrangement: V-angle		Degrees	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	57.2	57.2	57.2	57.2
Compression ratio			16.5	16.5	16.5	16.5
Cylinder heads: individual cylinder heads			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 housing connecting flange (engine main PTO)		SAE	00	00	00	00
Flywheel interface		DISC	21	21	21	21

Combustion air / Exhaust gas

Number of cylinders			12	12	12	12
Charge-air pressure before cylinder - BL	R	bar abs	2.9	3.2	3.2	3.4

Coolant system (HT circuit)

Number of cylinders			12	12	12	12
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104	104
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	12	12
Coolant temperature before intercooler (at engine connection: 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

Lube oil system

Number of cylinders			12	12	12	12
Lube-oil operating temperature before engine, from	R	°C	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	98	98
Lube-oil temperature before engine, warning	R	°C	99	99	99	99
Lube-oil temperature before engine, shutdown	L	°C	101	101	101	101
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	5.0	5.0
Lube-oil operating pressure before engine, to	R	bar	7.0	7.0	7.0	7.0
Lube-oil operating pressure before engine, warning	R	bar	--	--	--	--
Lube-oil operating pressure before engine, shutdown	L	bar	--	--	--	--

Fuel system

Number of cylinders			12	12	12	12
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5

General operating data

Number of cylinders			12	12	12	12
Cold start capability: air temperature (w/ o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

Capacities

Number of cylinders			12	12	12	12
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	160	160	160	160
Charge-air coolant, engine side	R	Liters	40	40	40	40
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	260	260
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters				
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	160	160	160	160
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	200	200	200	200

Weights / main dimensions

Number of cylinders			12	12	12	12
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	6200*	6200*	6200*	6200*

Acoustics

Number of cylinders			12	12	12	12
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798)	R	dB(A)	125	127	126	129
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798)	R	dB(A)	121	123	122	124

3.7 16 V 4000 Gx3 engine data: Standby operation 3D, optimized fuel consumption

Explanation

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

Reference conditions

Engine model			16V 4000G23	16V 4000G43	16V 4000G63	16V 4000G83
Application group			3D	3D	3D	3D
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 to ISO 3046)

Number of cylinders			16	16	16	16
Rated engine speed	A	rpm	1500	1800	1500	1800
Fuel stop power ISO 3046	A	kW	1965	2280	2185	2500

General conditions (for maximum power)

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

TIM-ID: 0000002922 - 002

Model related data (basic design)

Number of cylinders			16	16	16	16
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X	X
Uncooled exhaust lines			X	X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X	X
Combustion method: direct fuel injection			X	X	X	X
Cooling method: Treated water			X	X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X	X
Number of cylinders			16	16	16	16
Cylinder arrangement: V-angle		Degrees	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4.77
Total displacement		Liters	76.3	76.3	76.3	76.3
Compression ratio			16.5	16.5	16.5	16.5
Cylinder heads: individual cylinder heads			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 housing connecting flange (engine main PTO)		SAE	00	00	00	00
Flywheel interface		DISC	21	21	21	21

Combustion air / Exhaust gas

Number of cylinders			16	16	16	16
Charge-air pressure before cylinder - BL	R	bar abs	2.8	3.1	3.1	3.3

Coolant system (HT circuit)

Number of cylinders			16	16	16	16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104	104
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			16	16	16	16
Coolant temperature before intercooler (at engine connection: 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

Lube oil system

Number of cylinders			16	16	16	16
Lube-oil operating temperature before engine, from	R	°C	89	88	88	88
Lube-oil operating temperature before engine, to	R	°C	95	95	94	94
Lube-oil temperature before engine, warning	R	°C	97	97	97	97
Lube-oil temperature before engine, shutdown	L	°C	99	99	99	99
Lube-oil operating pressure before engine, from	R	bar	4.2	4.7	4.2	4.7
Lube-oil operating pressure before engine, to	R	bar	5.5	6.5	5.5	6.5
Lube-oil operating pressure before engine, warning	R	bar	--	--	--	--
Lube-oil operating pressure before engine, shutdown	L	bar	--	--	--	--

Fuel system

Number of cylinders			16	16	16	16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5

General operating data

Number of cylinders			16	16	16	16
Cold start capability: air temperature (w/ o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

Capacities

Number of cylinders			16	16	16	16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	260	260	260	260
Charge-air coolant, engine side	R	Liters	50	50	50	50
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	300	300	300	300
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters	240	240	240	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	210	210	210	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	240	240	240	240

Weights / main dimensions

Number of cylinders			16	16	16	16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	7700	7700	7700	7700

Acoustics

Number of cylinders			16	16	16	16
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798)	R	dB(A)	126	129	128	130
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798)	R	dB(A)	128	125	125	126

3.8 12/16 V 4000 Gx3 engine data: Standby operation 3D, optimized exhaust emissions (EPA stage 2)

Explanation

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

Reference conditions

Engine model			12V 4000G43	12V 4000G83	16V 4000G43	16V 4000G83
Application group			3D	3D	3D	3D
Intake air temperature		°C	25	25	25	25
Charge-air coolant temperature		°C	45	45	45	45
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 to ISO 3046)

Number of cylinders			12	12	16	16
Rated engine speed	A	rpm	1800	1800	1800	1800
Fuel stop power ISO 3046	A	kW	1736	1910	2280	2500

General conditions (for maximum power)

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

TIM-ID: 0000002955 - 002

Model related data (basic design)

Number of cylinders			12	12	16	16
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X	X	X	X
Uncooled exhaust lines			X	X	X	X
Operating method: Four-stroke cycle, diesel, single-action			X	X	X	X
Combustion method: direct fuel injection			X	X	X	X
Cooling method: Treated water			X	X	X	X
Direction of rotation: c.c.w. (facing driving end)			X	X	X	X
Number of cylinders			12	12	16	16
Cylinder arrangement: V-angle		Degrees	90	90	90	90
Bore		mm	170	170	170	170
Stroke		mm	210	210	210	210
Cylinder displacement		Liters	4.77	4.77	4.77	4,77
Total displacement		Liters	57.2	57.2	76,3	76.3
Compression ratio			16.5	16.5	16.5	16.5
Cylinder heads: individual cylinder heads			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 housing connecting flange (engine main PTO)		SAE	00	00	00	00
Flywheel interface		DISC	21	21	21	21

Combustion air / Exhaust gas

Number of cylinders			12	12	16	16
Charge-air pressure before cylinder - BL	R	bar abs	3.2	3.3	3.2	3.3

Coolant system (HT circuit)

Number of cylinders			12	12	16	16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100	100	100	100
Coolant temperature after engine, warning	R	°C	102	102	102	102
Coolant temperature after engine, shutdown	L	°C	104	104	104	104
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	16
Coolant temperature before intercooler (at engine connection: from cooling equipment)	A	°C	45	45	45	45
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	16
Lube-oil operating temperature before engine, from	R	°C	88	88	88	88
Lube-oil operating temperature before engine, to	R	°C	98	98	94	94
Lube-oil temperature before engine, warning	R	°C	99	99	97	97
Lube-oil temperature before engine, shutdown	L	°C	101	101	99	99
Lube-oil operating pressure before engine, from	R	bar	5.0	5.0	4.7	4.7
Lube-oil operating pressure before engine, to	R	bar	7.0	7.0	6.5	6.5
Lube-oil operating pressure before engine, warning	R	bar	--	--	--	--
Lube-oil operating pressure before engine, shutdown	L	bar	--	--	--	--

Fuel system

Number of cylinders			12	12	16	16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1	-0.1	-0.1	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5	1.5	1.5	1.5

General operating data

Number of cylinders			12	12	16	16
Cold start capability: air temperature (w/ o start aid, w/o preheating) - (case A)	R	°C	10	10	10	10
Coolant preheating: preheating temperature (min.)	R	°C	32	32	32	32
Firing speed, from	R	rpm	80	80	80	80
Firing speed, to	R	rpm	120	120	120	120

Capacities

Number of cylinders			12	12	16	16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	160	160	260	260
Charge-air coolant, engine side	R	Liters	40	40	50	50
Engine oil, total, for initial filling (standard oil system) (option: max. operating inclinations)	R	Liters	260	260	300	300
Oil change quantity, max. (standard oil system) (option: max. operating inclinations)	R	Liters			240	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (option: max. operating inclinations)	L	Liters	160	160	210	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (option: max. operating inclinations)	L	Liters	200	200	240	240

Weights / main dimensions

Number of cylinders			12	12	16	16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	6200*	6200*	7700	7700

Acoustics

Number of cylinders			12	12	16	16
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798)	R	dB(A)	127	129	129	130
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798)	R	dB(A)	123	124	125	126

3.9 16 V 4000 G83L engine data: Standby operation 3D, optimized fuel consumption

Explanation

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

Reference conditions

Engine model			16V 4000G83L
Application group			3D
Intake air temperature		°C	25
Charge-air coolant temperature		°C	45
Raw water inlet temperature		°C	-
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

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

Number of cylinders			16
Rated engine speed	A	rpm	1800
Fuel stop power ISO 3046	A	kW	2740

General conditions (for maximum power)

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

Model related data (basic design)

Number of cylinders			16
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X
Uncooled exhaust lines			X
Operating method: Four-stroke cycle, diesel, single-action			X
Combustion method: direct fuel injection			X
Cooling method: Treated water			X
Direction of rotation: c.c.w. (facing driving end)			X
Number of cylinders			16
Cylinder arrangement: V-angle		Degrees (°)	90
Bore		mm	170
Stroke		mm	210
Cylinder displacement		Liters	4.77
Total displacement		Liters	76.3
Compression ratio			16.4
Inlet valves per cylinder			2
Cylinder heads: individual cylinder heads			X
Cylinder liners: wet, replaceable			X
Exhaust valves per cylinder			2
Standard housing connecting flange (engine main PTO)		SAE	00
Flywheel interface (DISC)			21

Combustion air / Exhaust gas

Number of cylinders			16
Charge-air pressure before cylinder - BL	R	bar abs	3.7

Coolant system (HT circuit)

Number of cylinders			16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100
Coolant temperature after engine, warning	R	°C	102
Coolant temperature after engine, shutdown	L	°C	104
Coolant antifreeze content, max.	L	%	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7

Coolant system (LT circuit)

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

Lube oil system

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	88
Lube-oil operating temperature before engine, to	R	°C	94
Lube-oil temperature before engine, warning	R	°C	97
Lube-oil temperature before engine, shutdown	L	°C	99
Lube-oil operating pressure before engine, from	R	bar	4.7
Lube-oil operating pressure before engine, to	R	bar	6.5
Lube-oil operating pressure before engine, warning	R	bar	-
Lube-oil operating pressure before engine, shutdown	L	bar	-

Fuel system

Number of cylinders			16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5

General operating data

Number of cylinders			16
Cold start capability: air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10
Coolant preheating: preheating temperature (min.)	R	°C	32
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

Capacities

Number of cylinders			16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	175
Charge-air coolant, engine side	R	Liters	50
Engine oil capacity, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	300
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	Liters	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (Option: max. operating inclinations)	L	Liters	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (Option: max. operating inclinations)	L	Liters	240

Weights / main dimensions

Number of cylinders			16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	7700

Acoustics

Number of cylinders			16
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798+3)	R	dB(A)	130
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798)	R	dB(A)	126

3.10 16 V 4000 G83L engine data: Standby operation 3D, optimized exhaust emissions (EPA stage 2)

Explanation

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

Reference conditions

Engine model			16V 4000G83L
Application group			3D
Intake air temperature		°C	25
Charge-air coolant temperature		°C	45
Raw water inlet temperature		°C	-
Barometric pressure		mbar	1000
Site altitude above sea level		m	100

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

Number of cylinders			16
Rated engine speed	A	rpm	1800
Fuel stop power ISO 3046	A	kW	2740

General conditions (for maximum power)

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

TIM-ID: 0000039906 - 001

Model related data (basic design)

Number of cylinders			16
Engine with exhaust turbocharging (ETC) and charge-air cooling (CAC)			X
Uncooled exhaust lines			X
Operating method: Four-stroke cycle, diesel, single-action			X
Combustion method: direct fuel injection			X
Cooling method: Treated water			X
Direction of rotation: c.c.w. (facing driving end)			X
Number of cylinders			16
Cylinder arrangement: V-angle		Degrees (°)	90
Bore		mm	170
Stroke		mm	210
Cylinder displacement		Liters	4.77
Total displacement		Liters	76.3
Compression ratio			16.4
Inlet valves per cylinder			2
Cylinder heads: individual cylinder heads			X
Cylinder liners: wet, replaceable			X
Exhaust valves per cylinder			2
Standard housing connecting flange (engine main PTO)		SAE	00
Flywheel interface (DISC)			21

Combustion air / Exhaust gas

Number of cylinders			16
Charge-air pressure before cylinder - BL	R	bar abs	3,7

Coolant system (HT circuit)

Number of cylinders			16
Coolant temperature (at engine connection: outlet to cooling equipment)	A	°C	100
Coolant temperature after engine, warning	R	°C	102
Coolant temperature after engine, shutdown	L	°C	104
Coolant antifreeze content, max.	L	%	50
Pressure loss in off-engine cooling system, max.	L	bar	0.7

Coolant system (LT circuit)

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

Lube oil system

Number of cylinders			16
Lube-oil operating temperature before engine, from	R	°C	88
Lube-oil operating temperature before engine, to	R	°C	94
Lube-oil temperature before engine, warning	R	°C	97
Lube-oil temperature before engine, shutdown	L	°C	99
Lube-oil operating pressure before engine, from	R	bar	4.7
Lube-oil operating pressure before engine, to	R	bar	6.5
Lube-oil operating pressure before engine, warning	R	bar	-
Lube-oil operating pressure before engine, shutdown	L	bar	-

Fuel system

Number of cylinders			16
Fuel pressure at engine inlet connection, min. (when engine is starting)	L	bar	-0.1
Fuel pressure at engine inlet connection, max. (when engine is starting)	L	bar	1.5

General operating data

Number of cylinders			16
Cold start capability: air temperature (w/o start aid, w/o preheating) - (case A)	R	°C	10
Coolant preheating: preheating temperature (min.)	R	°C	32
Firing speed, from	R	rpm	80
Firing speed, to	R	rpm	120

Capacities

Number of cylinders			16
Engine coolant capacity, engine side (without cooling equipment)	R	Liters	175
Charge-air coolant, engine side	R	Liters	50
Engine oil capacity, initial filling (standard oil system) (Option: max. operating inclinations)	R	Liters	300
Oil change quantity, max. (standard oil system) (Option: max. operating inclinations)	R	Liters	240
Oil pan capacity at dipstick mark “min.” (standard oil system) (Option: max. operating inclinations)	L	Liters	210
Oil pan capacity at dipstick mark “max.” (standard oil system) (Option: max. operating inclinations)	L	Liters	240

Weights / main dimensions

Number of cylinders			16
Engine dry weight (basic engine configuration according to scope of delivery specifications)	R	kg	7700

Acoustics

Number of cylinders			16
Exhaust noise, unsilenced - BL (sound power level LW, ISO 6798+3)	R	dB(A)	130
Engine surface noise with attenuated intake noise (filter) - BL (sound power level LW, ISO 6798)	R	dB(A)	126

3.11 Final compression pressure

Final compression pressure

Final compression pressure at 120 rpm	24 bar to 28 bar

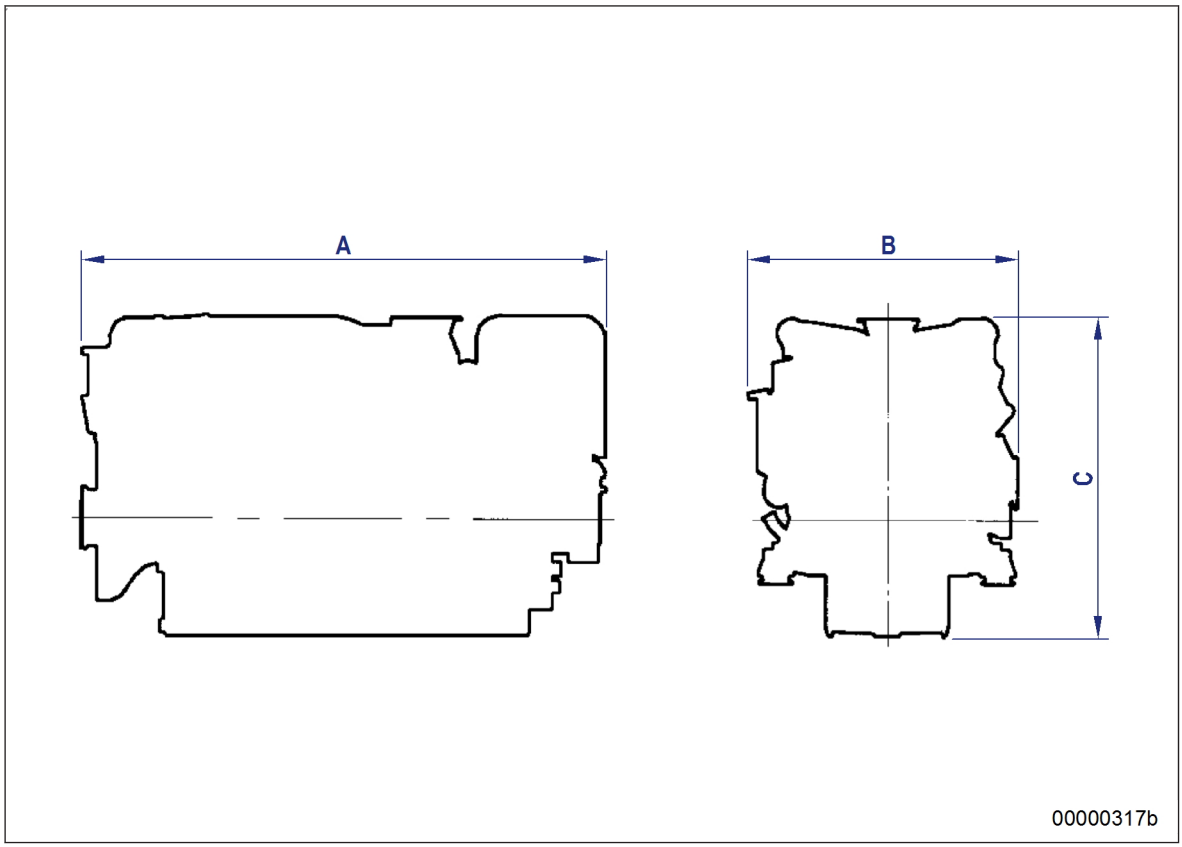
3.12 Firing order

Firing order

Number of cylinders	Firing order
8V	A1-B4-A4-A2-B3-A3-B2-B1
12V	A1-B5-A5-B3-A3-B6-A6-B2-A2-B4-A4-B1
16 V	A1-A7-B4-B6-A4-B8-A2-A8-B3-B5-A3-A5-B2-A6-B1-B7
20 V	A1-B5-A8-B7-A5-B2-A7-B10-A2-B3-A10-B6-A3-B4-A6-B9-A4-B1-A9-B8

3.13 Engine – Main dimensions

Also valid for 12 V and 16 V engines.



Engine model	Length (A)	Width (B)	Height (C)
12 V 4000 Gx3	approx. 2520 mm	approx. 1660 mm	approx. 2160 mm
16 V 4000 Gx3	approx. 2990 mm	approx. 1660 mm	approx. 2160 mm

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 Fluids and Lubricants Specifications A001070/..).
Valve gear	Lubricate valve gear every ≥ 6 months (→ Page 140).
Lube oil system	Check engine oil level (→ Page 169).
Fuel prefilter	Fill with fuel (→ Page 159).
Fuel prefilter, pressure gauge	Align adjustable pointer with position of pressure indicator (→ Page 155).
Coolant circuit	If engine is out of service for more than one year, change engine coolant (→ Page 177). Change charge-air coolant (→ Page 185).
Coolant circuit	Check engine coolant level (→ Page 176); Check charge-air coolant level (→ Page 184).
Coolant circuit	Heat engine coolant with coolant preheating unit.
Engine governor	Check plug-in connections (→ Page 197).
Monitoring system	Carry out lamp test (see manufacturer's documentation).
Engine/generator control system	Switch ON; Select operating mode, e.g. MANUAL OPERATION, AUTOMATIC OPERATION.
HP fuel pump	Only for engines without oil priming pump Fill HP fuel pump with new engine oil (→ Page 145).

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 169);
Cooling system	Check engine coolant level (→ Page 176); Check charge-air coolant level (→ Page 184).
Cooling system	Preheat coolant with preheating unit.
Fuel prefilter	Drain (→ Page 156).
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.

4.3 Start engine in manual mode (testing mode)

Preconditions

☑ Generator (if provided) not connected to network.

☑ External start interlock is not activated.

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

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

Preparation

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

Starting the engine

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

Connect generator to network (if provided), run engine to reach operating temperature)

Item	Task
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).

4.4 Safety system – Override

CAUTION

Safety functions and engine shutdown alarms will be disregarded.
Serious damage to plant!
- Initiate emergency start only in emergency situations.

CAUTION

Inadmissible operational condition.
Major material damage!
- Use override function only in hazardous situations to ensure full capability in case of engine malfunctions.

Preparation

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

Bypassing the 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 69).
Control and display panels	During operation, check the displayed operational data (speed, temperature, pressures). Constantly monitor plant limit values.

4.5 Starting the engine in emergency situations (override mode)

CAUTION

Safety functions and engine shutdown alarms will be disregarded.
Serious damage to plant!
- Initiate emergency start only in emergency situations.

Preparation

Item	Task
Operating mode switch	Set to emergency mode.

Starting the engine in emergency situations

Item	Task
Control cabinet	Actuate switch/button for ECU override input.
Control cabinet	• Automatic starting procedure is performed; any safety functions and alarms leading to engine shutdown are disregarded; • Tachometer indicates increasing crankshaft speed; • Engine is running at rated speed when the starting sequence is completed.

Connecting the generator (if fitted) to mains

Item	Task
Control cabinet	If generator is not connected to mains: Close generator circuit breaker.
Engine	Operate engine at rated power.

4.6 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	Measure
Control and display panels	Check readings of operational data (speed, temperature, pressures).
Engine oil	Check engine oil level (→ Page 169)
Engine under load Engine at nominal speed	Check engine/plant and piping for leaks, repair leaky pipes with the engine stopped (exhaust lines and turbocharger turbine housings may be red-hot. If the maximum exhaust temperatures are not exceeded, no restrictions in engine operation are required) Check for abnormal running noises and vibration.
Fuel prefilter	Check reading on differential pressure gauge to ensure that maximum permissible value is not exceeded (→ Page 155).
Exhaust system	Check exhaust color (→ Page 79).
Intercooler	Check condensate drain(s) for water discharge and obstruction (→ Page 161).
Air filter	Check signal ring position of contamination indicator (→ Page 165). Replace air filter (→ Page 162) if the signal ring is completely visible in the contamination indicator control window.
Engine coolant pump	Check relief bore (→ Page 182).
Charge-air coolant pump	Check relief bore (→ Page 190).
Compressed-air system (if installed)	Check operating pressure on pressure gauge; Always fill compressed-air tank to max. pressure; Drain condensate from compressed-air tank, pressure drop must not exceed 1 bar.

4.7 Stop engine in manual mode (testing mode)

Preconditions

☑ Generator (if provided) not connected to network.

☑ Engine is running in manual mode.

CAUTION

Stopping the engine when it is running at full load causes extreme stress to the engine.
Risk of overheating, damage to components!
- Before stopping the engine, operate it at idle speed until operating temperatures decrease and stable values are indicated.

Preparing the generator drive (only with generator breaker)

Item	Task
Engine	After opening the generator breaker (if provided), allow to cool down off-load for approx. 5 minutes.

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

Item	Task
Engine	Allow to cool down for approx. 5 minutes at reduced engine speed. Observe natural resonance of engine (installation-dependent)!

Stopping the engine

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

After stopping the engine

Item	Task
Coolant pump	Allow to run on for sufficient time after stopping.

4.8 Emergency stop

CAUTION

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

Emergency stop from LOP

Item	Task
EMERGENCY STOP button	Press. • Engine is stopped by switching off power supply to ECU; • Signalization (e.g. by horn, flashing lamp) is released.

After emergency stop from LOP

Item	Task
Switching cabinet, control panel etc. (depending on manufacturer)	Press button for alarm acknowledgement. • Audible and visual signalization stops.

4.9 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.

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

Preconditions

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

After stopping the engine

Item	Task
Cooling system	Drain engine coolant (→ Page 178); Drain charge-air coolant (→ Page 186) if: • freezing temperatures are expected and the engine is to remain out of service for an extended period and coolant has no antifreeze additive; • the engine room is not heated; • the coolant is not maintained at a suitable temperature; • the antifreeze concentration is insufficient for the engine-room temperature; • antifreeze concentration is 50 % and engine-room temperature is below -40°C.
Engine/generator/pump controller	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, preserve engine (→ MTU-Preservation and Represervation Specifications A001070/..).

4.11 Plant cleaning

Preconditions

☑ Engine is stopped and starting disabled.

☑ Operating voltage is not present.

Special tools, Material, Spare parts

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

WARNING

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

WARNING

Water jet.
Risk of injury and scalding!
- Do not direct water jet at persons.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

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

NOTICE

Dry with compressed air.
Damage to component!
- Never aim compressed air directly at electronic components.

Plant cleaning

1. Carry out plant cleaning only in areas where an appropriate oil separator is provided (environmental protection).
2. Prior to putting the cleaning unit into operation, read the Operating Instructions of the water/steam jet unit carefully and observe the safety precautions.
3. During external cleaning of the plant with water/steam-jet units, the pressure of the high-pressure jet (cleaning jet) must not exceed 50 bar. A minimum distance between spray nozzle and plant of 1 m must be observed. The temperature of the cleaning medium must not exceed 80 °C.
4. For external cleaning with high-pressure jet, use a flat-mouth nozzle only.
5. Carry out external cleaning as follows:
   a) Seal all openings in a suitable fashion.
   b) Remove coarse dirt.
   c) Spray on cleaner sparingly and leave it for 1 to 5 minutes.
   d) Use the high-pressure jet to remove the loosened dirt.

Note: Never aim compressed air directly at electronic components.
   e) Dry engine.

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	Option	Maintenance tasks	
W0500		Check engine oil level.	(→ Page 169)
W0501		Visually inspect engine for leaks and general condition.	(→ Page 72)
W0502	X	Check intercooler drain(s).	(→ Page 161)
W0503		Check signal ring position of service indicator on air filter.	(→ Page 165)
W0505		Check relief bores of water pump(s).	(→ Page 182)
W0506		Check engine for abnormal running noises, exhaust color and vibrations.	(→ Page 72)
W0507	X	Drain water and contaminants from fuel prefilter.	(→ Page 72)
W0508	X	Check reading on differential pressure gage of fuel prefilter.	(→ Page 72)
W0534		Carry out test run, minimum duration: until steady-state temperature is reached, no less than 1/3 load (monthly).	(→ Page 133)
W1001		Replace fuel filter or fuel filter element.	(→ Page 153)
W1005		Replace air filter.	(→ Page 162)
W1006		Replace fuel injectors.	(→ Page 146)
W1008		Replace engine oil filter when changing engine oil, or when the interval (years) is reached, at the latest.	(→ Page 171)
W1009	X	Check layer thickness of the oil residue, clean out and replace filter sleeve.	(→ Page 174)
W1011		Perform endoscopic examination.	(→ Page 134)
W1046		Crankcase breather: Replace filter or filter element.	(→ Page 138)
W1207		Check and adjust valve clearance. Attention!First adjustment after 1,000 operating hours.	(→ Page 141)
W1241		Check condition of belt drive and replace if necessary; adjust belt tension.	(→ Page 191)
W1463		Check general condition of engine mounting (visual inspection).	(→ Page 194)
W1714	X	Check and clean oil indicator filter.	(→ Page 172)

Table 1: Maintenance task reference table [QL1]

6 Troubleshooting

6.1 Troubleshooting

Engine does not turn when starter is actuated

Component	Probable cause	Task
Battery	Low or defective	Charge or replace (see manufacturer's documentation).
	Cable connections defective	Check if cable connections are properly secured (see manufacturer's documentation).
Starter (electric)	Engine wiring or starter defective	Check cable connections for secure seating, Contact Service.
Starter (compressed air)	Cabling on starting valve or starter defective	Check cable connections for secure seating, Contact Service.
Engine wiring	Defective	Check (→ Page 195).
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 connections (→ Page 197).
Engine	Running gear blocked (engine cannot be barred manually)	Contact Service.

Engine turns but does not fire

Component	Probable cause	Task
Starter (electric)	Poor rotation by starter: Battery low or defective	Charge or replace battery (see manufacturer's documentation).
Starter (compressed air)	Poor rotation by starter: Air pressure too low	Check compressed air system.
Engine wiring	Defective	Check (→ Page 195).
Fuel system	Not vented	Vent fuel system (→ Page 152).
Engine Governor	Defective	Contact Service.

Engine fires unevenly

Component	Probable cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 146).
Engine wiring	Defective	Check (→ Page 195).
Fuel system	Not vented	Vent fuel system (→ Page 152).
Engine Governor	Defective	Contact Service.

Engine does not reach nominal speed

Component	Probable cause	Task
Fuel supply	Fuel prefilter clogged	Replace (→ Page 159).
	Easy-change fuel filter clogged	Replace (→ Page 153).
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 165).
Fuel injection equipment	Injector defective	Replace (→ Page 146).
Engine wiring	Defective	Check (→ Page 195).
Engine	Overloaded	Contact Service.

Engine speed not steady

Component	Probable cause	Task
Fuel injection equipment	Injector defective	Replace (→ Page 146).
Speed sensor	Defective	Contact Service.
Fuel system	Not vented	Vent fuel system (→ Page 152).
Engine Governor	Defective	Contact Service.

Charge-air temperature too high

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

Charge air pressure too low

Component	Probable cause	Task
Air supply	Air filter clogged	Check signal ring position of service indicator (→ Page 165).
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 165).
Fuel injection equipment	Injector defective	Replace (→ Page 146).
Engine	Overloaded	Contact Service.

Exhaust gas blue

Component	Probable cause	Task
Engine oil	Too much engine oil in the engine	Drain engine oil (→ Page 167).
	Oil separator of crankcase breather contaminated	Replace (→ Page 138).
Exhaust turbocharger, cylinder head, piston rings, cylinder liner	Defective	Contact Service.

Exhaust gas white

Component	Probable cause	Task
Engine	Not at operating temperature	Run engine to reach operating temperature.
Fuel system	Water in fuel	Check fuel system on fuel prefilter. Drain fuel prefilter (→ Page 156).
Intercooler	Leaking	Contact Service.

6.2 Engine governor ADEC (ECU 7) for Series 4000 genset engines – Fault messages

003 – HI T-Fuel

ZKP-Number: 2.0122.931

Limit value 1

Cause	Corrective action
Fuel temperature too high.	▶ Contact Service.

004 – SS T-Fuel

ZKP-Number: 2.0122.932

Limit value 2

Cause	Corrective action
Fuel temperature too high; Engine stop.	▶ Contact Service.

005 – HI T-Charge Air

ZKP-Number: 2.0121.931

Limit value 1

Cause	Corrective action
Charge-air temperature too high.	1. Reduce power. 2. Check intercooler.

006 – SS T-Charge Air

ZKP-Number: 2.0121.932

Limit value 2

Cause	Corrective action
Charge-air temperature too high Engine stop.	1. Reduce power. 2. Check intercooler.

009 – HI T-Coolant Intercooler

ZKP-Number: 2.0124.931

Limit value 1

Cause	Corrective action
Coolant temperature in intercooler too high.	▶ Reduce power.

010 – SS T-Coolant Intercooler

ZKP-Number: 2.0124.932

Limit value 2

Cause	Corrective action
Coolant temperature in intercooler too high;Engine stop.	▶ Reduce power.

015 – LO P-Lube Oil

ZKP-Number: 2.0100.921

Limit value 1

Cause	Corrective action
Lube oil pressure too low.	▶ Check oil level, top up as necessary (→ Page 169).

016 – SS P-Lube Oil

ZKP-Number: 2.0100.922

Limit value 2

Cause	Corrective action
Lube oil pressure too low;Automatic engine shutdown.	▶ Engine must not be started (risk of engine failure), contact Service.

019 – HI T-Exhaust A

ZKP-Number: 2.0126.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (A-side) too high.	1. Check wiring (→ Page 195). 2. Contact Service.

020 – SS T-Exhaust A

ZKP-Number: 2.0126.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (A-side) too high;Engine stop.	1. Check wiring (→ Page 195). 2. Contact Service.

021 – HI T-Exhaust B

ZKP-Number: 2.0127.931

Limit value 1

Cause	Corrective action
Exhaust gas temperature (B-side) too high.	1. Check wiring (→ Page 195). 2. Contact Service.

022 – SS T-Exhaust B

ZKP-Number: 2.0127.932

Limit value 2

Cause	Corrective action
Exhaust gas temperature (B-side) too high;Engine stop.	1. Check wiring (→ Page 195). 2. Contact Service.

023 – LO Coolant Level

ZKP-Number: 2.0152.921

Limit value 1

Cause	Corrective action
Coolant level too low.	▶ Check coolant level in expansion tank(→ Page 176) .

025 – HI P-Diff. Lube Oil

ZKP-Number: 2.0154.931

Limit value 1

Cause	Corrective action
Oil filter differential pressure too high.	▶ Replace oil filter (→ Page 171).

026 – SS P-Diff. Lube Oil

ZKP-Number: 2.0154.932

Limit value 2

Cause	Corrective action
Oil filter differential pressure too high.	▶ Replace oil filter (→ Page 171).

027 – HI Level Leakage Fuel

ZKP-Number: 2.0151.931

Limit value 1

Cause	Corrective action
Leak-fuel level too high.	1. Check fuel system. 2. Contact Service.

029 – HI ETC 2 Idle Speed too High

ZKP-Number: 1.8004.206

Cause	Corrective action
Idle speed of ETC 2 too high.	▶ Contact Service.

030 – SS Engine Overspeed

ZKP-Number: 2.2510.932

Limit value 2

Cause	Corrective action
Reduced fuel injection.	1. Acknowledge alarm. 2. Attempt to restart engine.

031 – HI ETC 1 Overspeed

ZKP-Number: 2.3011.931

Limit value 1

Cause	Corrective action
Speed of primary turbocharger too high.	▶ Contact Service.

032 – SS ETC 1 Overspeed

ZKP-Number: 2.3012.932

Limit value 2

Cause	Corrective action
Speed of primary turbocharger too high.	1. Automatic power reduction by engine control system. 2. Check air filters (→ Page 163).

33 – HI P-Diff-Fuel

ZKP-Number: 20.114.931

Limit value 1

Cause	Corrective action
Fuel filter differential pressure too high.	▶ Replace fuel filter (→ Page 153).

34 – SS P-Diff-Fuel

ZKP-Number: 20.114.932

Limit value 2

Cause	Corrective action
Fuel filter differential pressure too high.	▶ Replace fuel filter (→ Page 153).

036 – HI ETC 2 Overspeed

ZKP-Number: 2.3013.931

Limit value 1

Cause	Corrective action
Speed of first secondary turbocharger too high.	1. Reduce power. 2. Contact Service.

037 – SS ETC 2 Overspeed

ZKP-Number: 2.3013.912

Limit value 2

Cause	Corrective action
Speed of first secondary turbocharger too high.	1. Reduce power. 2. Contact Service.

038 – AL ETC Speed Deviation

ZKP-Number: 1.8004.205

Cause	Corrective action
Synchro fault between primary turbocharger and one of the secondary turbochargers.	1. Reduce power. 2. Contact Service.

039 – AL ETC 2 Cutin Failure

ZKP-Number: 1.8004.204

Cause	Corrective action
Cut-in of turbocharger ETC 2 failed.	1. Reduce power. 2. Contact Service.

044 – LO Coolant Level Intercooler

ZKP-Number: 2.0153.921

Limit value 1

Cause	Corrective action
Intercooler coolant level too low.	▶ Check coolant level (→ Page 184).

051 – HI T-Lube Oil

ZKP-Number: 2.0125.931

Limit value 1

Cause	Corrective action
Lube oil temperature too high.	▶ Reduce power.

052 – SS T-Lube Oil

ZKP-Number: 2.0125.932

Limit value 2

Cause	Corrective action
Lube oil temperature too high. Engine stop.	1. Reduce power. 2. Check engine oil level (→ Page 169).

057 – LO P-Coolant

ZKP-Number: 2.0101.921

Limit value 1

Cause	Corrective action
Coolant pressure too low.	▶ Check coolant circuit.

058 – SS P-Coolant

ZKP-Number: 2.0101.922

Limit value 2

Cause	Corrective action
Coolant pressure too low; Engine stop or reduced fuel injection.	1. Automatic engine shutdown. 2. Check coolant level (→ Page 176).

59 – SS T-Coolant L3

ZKP-Number: 20.120.933

Limit value 3

Cause	Corrective action
Coolant temperature too high/ low	1. Allow engine to cool down. 2. Check engine coolant cooler, clean if dirty. 3. Contact Service.

60 – SS T-Coolant L4

ZKP-Number: 20.120.934

Limit value 4

Cause	Corrective action
Coolant temperature too high/ low	1. Allow engine to cool down. 2. Check engine coolant cooler, clean if dirty. 3. Contact Service.

063 – HI P-Crankcase

ZKP-Number: 2.0106.931

Limit value 1

Cause	Corrective action
Crankcase pressure too high.	1. Reduce power. 2. Replace oil separator element (→ Page 138).

064 – SS P-Crankcase

ZKP-Number: 2.0106.932

Limit value 2

Cause	Corrective action
Crankcase pressure too high; Automatic engine shutdown.	▶ Engine must not be started (risk of engine failure), contact Service.

065 – LO P-Fuel

ZKP-Number: 2.0102.921

Limit value 1

Cause	Corrective action
Fuel supply pressure too low.	1. Check fuel lines for leakage. 2. Clean fuel prefilter (→ Page 154). 3. Flush fuel prefilter (→ Page 157). 4. Replace filter element of fuel prefilter (→ Page 159). 5. Replace fuel filter (→ Page 153).

066 – SS P-Fuel

ZKP-Number: 2.0102.922

Limit value 2

Cause	Corrective action
Fuel supply pressure too low;Engine stop.	1. Check fuel lines for leakage. 2. Clean fuel prefilter (→ Page 154). 3. Flush fuel prefilter (→ Page 157). 4. Replace filter element of fuel prefilter (→ Page 159). 5. Replace fuel filter (→ Page 153).

067 – HI T-Coolant

ZKP-Number: 2.0120.931

Limit value 1

Cause	Corrective action
Coolant temperature too high.	▶ Reduce power.

068 – SS T-Coolant

ZKP-Number: 2.0120.932

Limit value 2

Cause	Corrective action
Coolant temperature too high; Engine stop.	1. Allow engine to cool down. 2. Check engine coolant cooler, clean if dirty. 3. Restart engine (→ Page 69). 4. Contact Service.

081 – AL Rail Leakage

ZKP-Number: 1.8004.046

Cause	Corrective action
Pressure gradient in rail is too low during starting or too high during stopping; HP system leaky, air in system.	▶ Contact Service.

082 – HI P-Fuel (Common Rail)

ZKP-Number: 2.0104.931

Cause	Corrective action
Rail pressure > set value; Speed-sensitive fuel limiter reduction, start of injection moved towards late; Suction restrictor of HP fuel block jamming or HP fuel control block wiring faulty.	▶ Contact Service.

083 – LO P-Fuel (Common Rail)

ZKP-Number: 2.0104.921

Cause	Corrective action
Rail pressure < set value; Speed-sensitive fuel limiter reduction; Suction restrictor of HP fuel control block faulty or leakage in HP fuel system.	▶ Contact Service.

085 – HI T-Umblasen

ZKP-Number: 2.0128.931

Limit value 1

Cause	Corrective action
Recirculation temperature too high.	▶ Reduce power.

086 – SS T-Umblasen

ZKP-Number: 2.0128.932

Limit value 2

Cause	Corrective action
Recirculation temperature too high.	▶ Reduce power.

089 – SS Engine Speed too Low

ZKP-Number: 2.2500.030

Cause	Corrective action
Engine speed too low.	▶ Check for additional messages.

090 – SS Idle Speed Not Reached

ZKP-Number: 2.1090.925

Cause	Corrective action
Idling speed was not attained.	▶ Contact Service.

091 – SS Release Speed Not Reached

ZKP-Number: 2.1090.924

Cause	Corrective action
Runup speed was not attained.	▶ Contact Service.

092 – SS Starter Speed Not Reached

ZKP-Number: 2.1090.923

Cause	Corrective action
Starter speed was not attained; Termination of starting sequence; Starter rotates too slowly or does not rotate at all.	▶ Contact Service.

093 – SS T-Preheat

ZKP-Number: 2.1090.922

Limit value 2

Cause	Corrective action
Preheating temperature too low; coolant temperature too low for engine start; engine start interlock active.	▶ Check preheater.

094 – LO T-Preheat

ZKP-Number: 2.1090.921

Limit value 1

Cause	Corrective action
Preheating temperature too low; coolant temperature too low for engine start.	▶ Check preheater.

095 – AL Prelubrication Fault

ZKP-Number: 2.1090.920

Cause	Corrective action
Oil priming fault.	▶ Check oil priming system.

102 – AL Fuel Cons. Counter Defect

ZKP-Number: 1.8004.624

Cause	Corrective action
Consumption meter faulty.	▶ Contact Service.

104 – AL Eng Hours Counter Defect

ZKP-Number: 1.8004.623

Cause	Corrective action
Hour meter faulty.	▶ Contact Service.

118 – LO ECU Power Supply Voltage

ZKP-Number: 2.0140.921

Limit value 1

Cause	Corrective action
Supply voltage too low.	1. Check ECU supply voltage. 2. Contact Service.

119 – LOLO ECU Power Supply Voltage

ZKP-Number: 2.0140.922

Limit value 2

Cause	Corrective action
Supply voltage too low.	1. Check ECU supply voltage. 2. Contact Service.

120 – HI ECU Power Supply Voltage

ZKP-Number: 2.0140.931

Limit value 1

Cause	Corrective action
Supply voltage too high.	1. Check ECU supply voltage. 2. Contact Service.

121 – HIHI ECU Power Supply Voltage

ZKP-Number: 2.0140.932

Limit value 2

Cause	Corrective action
Supply voltage too high.	1. Check ECU supply voltage. 2. Contact Service.

122 – HI T-ECU

ZKP-Number: 2.0132.921

Limit value 1

Cause	Corrective action
Electronic unit temperature too high.	1. Reduce power. 2. Improve engine room ventilation.

141 – AL Power too high

ZKP-Number: 11.088.007

Cause	Corrective action
Alarm is triggered if the mean value of the power has exceeded the maximum value stipulated by PR1.1088.001 within the last 24 hours.	▶ Reduce power.

142 – AL MCR exceeded 1 hour

ZKP-Number: 1.1088.006

Cause	Corrective action
the alarm is triggered if the MCR has been exceeded for more than 1 hour within the last 12 hours.	▶ Reduce power.

176 – AL LifeData not available

ZKP-Number: 2.4000.004

Cause	Corrective action
No (appropriate) LifeData backup system available, ECU reset after expiration of time-out period.	▶ Contact Service.

177 – AL LifeData restore incomplete

ZKP-Number: 2.4000.006

Cause	Corrective action
this error message is generated if a CRC is faulty during a data upload to ADEC (indicated for each individual module).	▶ Contact Service.

180 – AL CAN1 Node Lost

ZKP-Number: 2.0500.680

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

181 – AL CAN2 Node Lost

ZKP-Number: 2.0500.681

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

182 – AL CAN Wrong Parameters

ZKP-Number: 2.0500.682

Cause	Corrective action
Incorrect parameter values entered in data record.	▶ Contact Service.

183 – AL CAN No PU-Data

ZKP-Number: 2.0500.683

Cause	Corrective action
The selected CAN mode initializes communication by means of the PU data module. However, the necessary PU data module is not present or is invalid.	▶ Contact Service.

184 – AL CAN PU-Data Flash Error

ZKP-Number: 2.0500.684

Cause	Corrective action
A programming error occurred when attempting to copy a received PU data module into the Flash module.	▶ Contact Service.

186 – AL CAN1 Bus Off

ZKP-Number: 2.0500.686

Cause	Corrective action
CAN controller 1 is in "Bus-Off" status.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

187 – AL CAN1 Error Passive

ZKP-Number: 2.0500.687

Cause	Corrective action
CAN controller 1 has indicated a warning.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

188 – AL CAN2 Bus Off

ZKP-Number: 2.0500.688

Cause	Corrective action
CAN controller 2 is in "Bus-Off" status. => automatic changeover to CAN 1.Short circuit, massive interference or Baud rate incompatibility.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

189 – AL CAN2 Error Passive

ZKP-Number: 2.0500.689

Cause	Corrective action
CAN controller 2 has indicated a warning.	1. Check CAN bus for short circuit, rectify short circuit as necessary. 2. Check shielding, improve shielding as necessary. 3. Contact Service.

190 – AL EMU Parameter Not Supported

ZKP-Number: 2.0500.690

Cause	Corrective action
EMU parameters are not supported.	▶ Contact Service.

201 – SD T-Coolant

ZKP-Number: 1.8004.570

Cause	Corrective action
Coolant temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B6), replace as necessary. Error cleared after restarting the engine.

202 – SD T-Fuel

ZKP-Number: 1.8004.572

Cause	Corrective action
Fuel temperature sensor faulty; short circuit or wire break.	▶ Check sensor and wiring (B33), replace as necessary. Error cleared after restarting the engine.

203 – SD T-Charge Air

ZKP-Number: 1.8004.571

Cause	Corrective action
Charge-air temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B9), replace as necessary. Error cleared after restarting the engine.

204 – SD Level Lube Oil

ZKP-Number: 1.8004.602

Cause	Corrective action
Lube oil level sensor defective; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

205 – SD T-Coolant Intercooler

ZKP-Number: 1.8004.574

Cause	Corrective action
Intercooler coolant temperature sensor faulty; short circuit or wire break.	▶ Check sensor and wiring (B26), replace as necessary. Error cleared after restarting the engine.

206 – SD T-Exhaust A

ZKP-Number: 1.8004.576

Cause	Corrective action
Exhaust temperature sensor on A-side faulty; short circuit or wire break.	▶ Check sensor and cabling (B4.21), replace if necessary. Error cleared after restarting the engine.

207 – SD T-Exhaust B

ZKP-Number: 18.004.577

Cause	Corrective action
Exhaust temperature sensor on B-side faulty. short circuit or wire break.	▶ Check sensor and cabling (B4.22), replace as necessary.

208 – SD P-Charge Air

ZKP-Number: 1.8004.566

Cause	Corrective action
Charge-air pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B10), replace as necessary. Error cleared after restarting the engine.

211 – SD P-Lube Oil

ZKP-Number: 1.8004.563

Cause	Corrective action
Lube oil pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B5), replace as necessary. Error cleared after restarting the engine.

212 – SD P-Coolant

ZKP-Number: 1.8004.564

Cause	Corrective action
Coolant pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B16), replace as necessary. Error cleared after restarting the engine.

213 – SD P-Coolant Intercooler

ZKP-Number: 1.8004.569

Cause	Corrective action
Intercooler coolant pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B43), replace as necessary. Error cleared after restarting the engine.

214 – SD P-Crankcase

ZKP-Number: 1.8004.568

Cause	Corrective action
Crankcase pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B50), replace as necessary. Error cleared after restarting the engine.

215 – SD P-HD

ZKP-Number: 1.8004.567

Cause	Corrective action
Rail pressure sensor faulty; High-pressure regulator in emergency mode ==> Short circuit or wire break.	▶ Check sensor and cabling (B48), replace as necessary. Error cleared after restarting the engine.

216 – SD T-Lube Oil

ZKP-Number: 1.8004.575

Cause	Corrective action
Lube oil temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B7), replace as necessary. Error cleared after restarting the engine.

219 – SD T-Intake Air

ZKP-Number: 1.8004.573

Cause	Corrective action
Intake air temperature sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B3), replace as necessary. Error cleared after restarting the engine.

220 – SD Level Coolant Water

ZKP-Number: 1.8004.584

Cause	Corrective action
Coolant level sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (F33), replace as necessary. Error cleared after restarting the engine.

221 – SD P-Diff Lube Oil

ZKP-Number: 1.8004.585

Cause	Corrective action
Lube oil pressure differential sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (F25), replace as necessary. Error cleared after restarting the engine.

222 – SD Level Leakage Fuel

ZKP-Number: 1.8004.582

Cause	Corrective action
Leak-off fuel level sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (F46), replace as necessary. Error cleared after restarting the engine.

223 – SD Level Coolant Intercooler

ZKP-Number: 1.8004.583

Cause	Corrective action
Sensor for intercooler coolant level faulty; short circuit or wire break.	▶ Check sensor and cabling (F57), replace as necessary. Error cleared after restarting the engine.

227 – SD P-Lube Oil before Filter

ZKP-Number: 1.8004.620

Cause	Corrective action
Sensor for lube oil pressure before filter faulty; short circuit or wire break.	▶ Check sensor and cabling (B5.3), replace as necessary. Error cleared after restarting the engine.

228 – SD P-Fuel before Filter

ZKP-Number: 18.004.595

Cause	Corrective action
Fuel pressure sensor faulty. short circuit or wire break.	▶ Check sensor and cabling (B5.3), replace as necessary.

229 – AL Stop Camshaft Sensor Defect

ZKP-Number: 1.8004.562

Cause	Corrective action
Engine stop due to camshaft sensor fault (and a previous crankshaft sensor fault in the same operating cycle).	▶ Check sensor and cabling to connector B1, replace as necessary. Error cleared after restarting the engine.

230 – SD Crankshaft Speed

ZKP-Number: 1.8004.498

Cause	Corrective action
Crankshaft sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B13), replace as necessary. Error cleared after restarting the engine.

231 – SD Crankshaft Speed

ZKP-Number: 1.8004.499

Cause	Corrective action
Camshaft sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B13), replace as necessary. Error cleared after restarting the engine.

232 – SD Charger 1 Speed

ZKP-Number: 1.3011.128

Cause	Corrective action
Speed sensor of primary turbocharger faulty; short circuit or wire break.	▶ Check sensor and cabling (B44.1), replace as necessary. Error cleared after restarting the engine.

233 – SD Charger 2 Speed

ZKP-Number: 1.3011.129

Cause	Corrective action
Speed sensor of secondary turbocharger faulty; short circuit or wire break.	▶ Check sensor and cabling (B44.2), replace as necessary. Error cleared after restarting the engine.

239 – SD P-Diff Fuel

ZKP-Number: 18.004.598

Cause	Corrective action
Fuel differential pressure sensor faulty. This alarm occurs only in combination with the alarm SD P-Fuel before Filter or SD P-Fuel after Filter.	▶ Check for additional message.

240 – SD P-Fuel

ZKP-Number: 1.8004.565

Cause	Corrective action
Fuel pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B34), replace as necessary. Error cleared after restarting the engine.

241 – SD T-Umblasen

ZKP-Number: 1.8004.581

Cause	Corrective action
Recirculation sensor faulty; short circuit or wire break.	▶ Check sensor and cabling (B49), replace as necessary. Error cleared after restarting the engine.

242 – SD T-Coolant (R)

ZKP-Number: 1.8004.622

Cause	Corrective action
Redundant coolant pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

244 – SD P-Lube Oil (R)

ZKP-Number: 1.8004.621

Cause	Corrective action
Redundant lube oil pressure sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

245 – SD ECU Power Supply Voltage

ZKP-Number: 2.8006.589

Cause	Corrective action
Internal ECU fault; Electronics faulty.	▶ Replace Engine Control Unit.

266 – SD Speed Demand

ZKP-Number: 2.8006.586

Cause	Corrective action
Analog speed setting faulty; short circuit or wire break.	1. Check cabling. 2. Check speed demand.

268 – SD Spinning Value

ZKP-Number: 28.006.591

Cause	Corrective action
Analog wheel slip signal faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

269 – SD Loadp.Analog filt.

ZKP-Number: 2.8006.588

Cause	Corrective action
Filtered analog signal of load pulse missing; short circuit or wire break.	▶ Check cabling, replace as necessary. Error cleared after restarting the engine.

270 – SD Frequency Input

ZKP-Number: 2.8006.590

Cause	Corrective action
Frequency input faulty; short circuit or wire break.	1. Check cabling. 2. Check speed demand transmitter. 3. Contact Service.

301 – AL Timing Cylinder A1

ZKP-Number: 1.8004.500

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

302 – AL Timing Cylinder A2

ZKP-Number: 1.8004.501

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

303 – AL Timing Cylinder A3

ZKP-Number: 1.8004.502

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

304 – AL Timing Cylinder A4

ZKP-Number: 1.8004.503

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

305 – AL Timing Cylinder A5

ZKP-Number: 1.8004.504

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

306 – AL Timing Cylinder A6

ZKP-Number: 1.8004.505

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

307 – AL Timing Cylinder A7

ZKP-Number: 1.8004.506

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

308 – AL Timing Cylinder A8

ZKP-Number: 1.8004.507

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

309 – AL Timing Cylinder A9

ZKP-Number: 1.8004.508

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

310 – AL Timing Cylinder A10

ZKP-Number: 1.8004.509

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

311 – AL Timing Cylinder B1

ZKP-Number: 1.8004.510

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

312 – AL Timing Cylinder B2

ZKP-Number: 1.8004.511

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

313 – AL Timing Cylinder B3

ZKP-Number: 1.8004.512

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

314 – AL Timing Cylinder B4

ZKP-Number: 1.8004.513

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

315 – AL Timing Cylinder B5

ZKP-Number: 1.8004.514

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

316 – AL Timing Cylinder B6

ZKP-Number: 1.8004.515

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

317 – AL Timing Cylinder B7

ZKP-Number: 1.8004.516

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

318 – AL Timing Cylinder B8

ZKP-Number: 1.8004.517

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

319 – AL Timing Cylinder B9

ZKP-Number: 1.8004.518

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

320 – AL Timing Cylinder B10

ZKP-Number: 1.8004.519

Cause	Corrective action
Time-of-flight measuring fault of injector: Time-of flight measured value extremely low or extremely high.	▶ Replace injector concerned if the fault message appears frequently (→ Page 146).

321 – AL Wiring Cylinder A1

ZKP-Number: 1.8004.520

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

322 – AL Wiring Cylinder A2

ZKP-Number: 1.8004.521

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

323 – AL Wiring Cylinder A3

ZKP-Number: 1.8004.522

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

324 – AL Wiring Cylinder A4

ZKP-Number: 1.8004.523

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

325 – AL Wiring Cylinder A5

ZKP-Number: 1.8004.524

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

326 – AL Wiring Cylinder A6

ZKP-Number: 1.8004.525

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

327 – AL Wiring Cylinder A7

ZKP-Number: 1.8004.526

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

328 – AL Wiring Cylinder A8

ZKP-Number: 1.8004.527

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

329 – AL Wiring Cylinder A9

ZKP-Number: 1.8004.528

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

330 – AL Wiring Cylinder A10

ZKP-Number: 1.8004.529

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

331 – AL Wiring Cylinder B1

ZKP-Number: 1.8004.530

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

332 – AL Wiring Cylinder B2

ZKP-Number: 1.8004.531

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

333 – AL Wiring Cylinder B3

ZKP-Number: 1.8004.532

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

334 – AL Wiring Cylinder B4

ZKP-Number: 1.8004.533

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

335 – AL Wiring Cylinder B5

ZKP-Number: 1.8004.534

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

336 – AL Wiring Cylinder B6

ZKP-Number: 1.8004.535

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

337 – AL Wiring Cylinder B7

ZKP-Number: 1.8004.536

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

338 – AL Wiring Cylinder B8

ZKP-Number: 1.8004.537

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

339 – AL Wiring Cylinder B9

ZKP-Number: 1.8004.538

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

340 – AL Wiring Cylinder B10

ZKP-Number: 1.8004.539

Cause	Corrective action
Short circuit in injector cabling to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

341 – AL Open Load Cylinder A1

ZKP-Number: 1.8004.540

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

342 – AL Open Load Cylinder A2

ZKP-Number: 1.8004.541

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

343 – AL Open Load Cylinder A3

ZKP-Number: 1.8004.542

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

344 – AL Open Load Cylinder A4

ZKP-Number: 1.8004.543

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

345 – AL Open Load Cylinder A5

ZKP-Number: 1.8004.544

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

346 – AL Open Load Cylinder A6

ZKP-Number: 1.8004.545

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

347 – AL Open Load Cylinder A7

ZKP-Number: 1.8004.546

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

348 – AL Open Load Cylinder A8

ZKP-Number: 1.8004.547

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

349 – AL Open Load Cylinder A9

ZKP-Number: 1.8004.548

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

350 – AL Open Load Cylinder A10

ZKP-Number: 1.8004.549

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

351 – AL Open Load Cylinder B1

ZKP-Number: 1.8004.550

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

352 – AL Open Load Cylinder B2

ZKP-Number: 1.8004.551

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

353 – AL Open Load Cylinder B3

ZKP-Number: 1.8004.552

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

354 – AL Open Load Cylinder B4

ZKP-Number: 1.8004.553

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

355 – AL Open Load Cylinder B5

ZKP-Number: 1.8004.554

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

356 – AL Open Load Cylinder B6

ZKP-Number: 1.8004.555

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

357 – AL Open Load Cylinder B7

ZKP-Number: 1.8004.556

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

358 – AL Open Load Cylinder B8

ZKP-Number: 1.8004.557

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

359 – AL Open Load Cylinder B9

ZKP-Number: 1.8004.558

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

360 – AL Open Load Cylinder B10

ZKP-Number: 1.8004.559

Cause	Corrective action
Open circuit in injector wiring to cylinder. Result: Misfiring.	1. Check solenoid valve. 2. Contact Service.

361 – AL Power Stage Low

ZKP-Number: 1.8004.496

Cause	Corrective action
Internal electronic fault (electronics possibly faulty: start ITS).Check additional messages if ITS indicates diagnosis "Electronics OK" (e.g. cabling faulty).	1. Check solenoid valve cabling. 2. Replace Engine Control Unit.

362 – AL Power Stage high

ZKP-Number: 1.8004.497

Cause	Corrective action
Internal electronic fault (electronics possibly faulty: start ITS).Check additional messages if ITS indicates diagnosis "Electronics OK" (e.g. cabling faulty).	1. Check solenoid valve cabling. 2. Replace Engine Control Unit.

363 – AL Stop Power Stage

ZKP-Number: 1.8004.560

Cause	Corrective action
Internal electronic fault (electronics possibly faulty: start ITS).	1. Check cabling. 2. Attempt to restart engine.

365 – AL Stop MV-Wiring Ground

ZKP-Number: 1.8004.561

Cause	Corrective action
Injector cabling fault. If bit "1.1020.021" (power stage failure: Stop engine) is set, engine is additionally stopped in this case. 1. Short circuit of injector + connection of one or more injectors to ground 2. Short circuit of injector – connection of one or more injectors to ground.	1. Check cabling. 2. Attempt to restart engine.

371 – AL Wiring TO 1

ZKP-Number: 1.8004.634

Cause	Corrective action
Short circuit or wire break on transistor output 1 (TO 1).	1. Check charger valve/cabling, repair as necessary. 2. Replace Engine Control Unit.

372 – AL Wiring TO 2

ZKP-Number: 1.8004.635

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

373 – AL Wiring TO 3

ZKP-Number: 1.8004.636

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

374 – AL Wiring TO 4

ZKP-Number: 1.8004.637

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

381 – AL Wiring TOP 1

ZKP-Number: 2.8006.638

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

382 – AL Wiring TOP 2

ZKP-Number: 2.8006.639

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

383 – AL Wiring TOP 3

ZKP-Number: 2.8006.640

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

384 – AL Wiring TOP 4

ZKP-Number: 2.8006.641

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

390 – AL MCR exceeded

ZKP-Number: 1.1085.009

Cause	Corrective action
DBR/MCR function: MCR exceeded.	1. No action required if alarm only applied temporarily. 2. Contact Service if alarm applied constantly.

392 – HI T-Coolant Red

ZKP-Number: 2.0129.931

Limit value 1

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

393 – SS T-Coolant Red

ZKP-Number: 2.0129.932

Limit value 2

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

394 – LO P-Lube Oil Red

ZKP-Number: 2.0112.921

Limit value 1

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

395 – SS P-Lube Oil Red

ZKP-Number: 2.0112.922

Limit value 2

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

396 – TD T-Coolant Sensor Deviation

ZKP-Number: 1.0480.193

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

397 – TD P-Oil Sensor Deviation

ZKP-Number: 1.0480.293

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

400 – AL Open Load Digital Input 1

ZKP-Number: 2.8006.625

Cause	Corrective action
Line disruption on digital input 1; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

401 – AL Open Load Digital Input 2

ZKP-Number: 2.8006.626

Cause	Corrective action
Line disruption on digital input 2; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

402 – AL Open Load Digital Input 3

ZKP-Number: 2.8006.627

Cause	Corrective action
Line disruption on digital input 3; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

403 – AL Open Load Digital Input 4

ZKP-Number: 2.8006.628

Cause	Corrective action
Line disruption on digital input 4; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

404 – AL Open Load Digital Input 5

ZKP-Number: 2.8006.629

Cause	Corrective action
Line disruption on digital input 5; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

405 – AL Open Load Digital Input 6

ZKP-Number: 2.8006.630

Cause	Corrective action
Line disruption on digital input 6; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

406 – AL Open Load Digital Input 7

ZKP-Number: 2.8006.631

Cause	Corrective action
Line disruption on digital input 7; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

407 – AL Open Load Digital Input 8

ZKP-Number: 2.8006.632

Cause	Corrective action
Line disruption on digital input 8; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

408 – AL Open Load Emerg. Stop Input ESI

ZKP-Number: 2.8006.633

Cause	Corrective action
Line disruption on the input for emergency stop; Cabling faulty or no resistance over switch.	1. Check cabling. 2. Check target device input. 3. Contact Service.

410 – LO U-PDU

ZKP-Number: 2.0141.921

Limit value 1

Cause	Corrective action
Injector voltage too low.	1. Check cabling. 2. Check supply. 3. Contact Service.

411 – LOLO U-PDU

ZKP-Number: 2.0141.922

Limit value 2

Cause	Corrective action
Injector voltage too low.	1. Check cabling. 2. Check supply. 3. Contact Service.

412 – HI U-PDU

ZKP-Number: 2.0141.931

Limit value 1

Cause	Corrective action
Injector voltage too high.	1. Check cabling. 2. Check supply. 3. Contact Service.

413 – HIHI U-PDU

ZKP-Number: 2.0141.932

Limit value 2

Cause	Corrective action
Injector voltage too high.	1. Check cabling. 2. Check supply. 3. Contact Service.

414 – HI Level Water Fuel Prefilter

ZKP-Number: 2.0156.931

Limit value 1

Cause	Corrective action
Water level in fuel prefilter too high.	▶ Drain water (→ Page 156).

415 – LO P-Coolant Intercooler

ZKP-Number: 2.0107.921

Limit value 1

Cause	Corrective action
Coolant pressure in intercooler too low.	▶ Top up coolant (→ Page 187).

416 – SS P-Coolant Intercooler

ZKP-Number: 2.0107.922

Limit value 2

Cause	Corrective action
Coolant pressure in intercooler too low; Engine stop.	▶ Top up coolant (→ Page 187).

417 – SD Level Water Fuel Prefilter

ZKP-Number: 1.8004.594

Cause	Corrective action
Sensor for water level in fuel prefilter faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

419 – SD T-Coolant b.Engine

ZKP-Number: 18.004.604

Cause	Corrective action
Coolant inlet temperature sensor faulty. short circuit or wire break.	▶ Check sensor and cabling (B3), replace as necessary.

420 – AL L1 Aux 1

ZKP-Number: 2.0160.921

Limit value 1

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

421 – AL L2 Aux 1

ZKP-Number: 2.0160.922

Limit value 2

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

428 – AL L1 T-Aux 1

ZKP-Number: 2.0130.921

Limit value 1

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

430 – LO P-Coolant before Engine

ZKP-Number: 20.168.921

Limit value 1

Cause	Corrective action
Coolant pressure too low.	▶ Check coolant circuit.

431 – SS P-Coolant before Engine

ZKP-Number: 20.168.922

Limit value 2

Cause	Corrective action
Coolant pressure too low.	▶ Check coolant circuit.

434 – HI T-Coolant before Engine

ZKP-Number: 20.173.931

Limit value 1

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

435 – SS T-Coolant before Engine

ZKP-Number: 20.173.932

Limit value 2

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

440 – AL L1 P-Aux 1

ZKP-Number: 2.0110.921

Limit value 1

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

442 – AL L2 P-Aux 1

ZKP-Number: 2.0110.931

Limit value 2

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

444 – SD U-PDU

ZKP-Number: 1.8004.578

Cause	Corrective action
Injector power stage sensor defect; Internal fault in ECU.	▶ Replace Engine Control Unit.

445 – SD P-Ambient Air

ZKP-Number: 1.8004.580

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

448 – HI P-Charge Air

ZKP-Number: 2.0103.931

Limit value 1

Cause	Corrective action
Charge-air pressure too high.	▶ Contact Service.

449 – SS P-Charge Air

ZKP-Number: 2.0103.932

Limit value 2

Cause	Corrective action
Charge-air pressure too high.	▶ Contact Service.

450 – SD Idle/End-Torque Input [%]

ZKP-Number: 2.8006.592

Cause	Corrective action
Input signal for initial/final torque faulty; short circuit or wire break.	▶ Check signal transmitter and cabling, replace as necessary. Error cleared after restarting the engine.

454 – SS Power Reduction Active

ZKP-Number: 2.7000.011

Cause	Corrective action
Power reduction is active.	1. Note further fault messages. 2. Determine cause of power reduction and rectify fault

455 – AL L1 Aux1 Plant

ZKP-Number: 2.8006.650

Limit value 1

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

456 – AL L2 Aux1 Plant

ZKP-Number: 2.8006.651

Limit value 2

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

460 – HI T-Exhaust EMU

ZKP-Number: 2.8006.652

Limit value 1

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

461 – LO T-Exhaust EMU

ZKP-Number: 2.8006.653

Limit value 1

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

462 – HI T-Coolant EMU

ZKP-Number: 2.8006.654

Limit value 1

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

464 – SD P-AUX 1

ZKP-Number: 1.8004.589

Cause	Corrective action
Analog input signal for Aux 1 pressure faulty; short circuit or wire break.	▶ Check pressure transmitter and cabling, replace as necessary. Error cleared after restarting the engine.

467 – AL L2 T-Aux 1

ZKP-Number: 2.0130.922

Limit value 2

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

468 – SD T-AUX 1

ZKP-Number: 1.8004.579

Cause	Corrective action
Analog input for Aux 1 temperature faulty.	▶ Replace Engine Control Unit.

469 – SD AUX 1

ZKP-Number: 1.8004.590

Cause	Corrective action
Analog input signal for Aux 1 faulty; short circuit or wire break.	▶ Check signal transmitter and cabling, replace as necessary. Error cleared after restarting the engine.

470 – SD T-ECU

ZKP-Number: 1.8004.587

Cause	Corrective action
Temperature sensor for ECU faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

471 – SD Coil Current

ZKP-Number: 1.8004.592

Cause	Corrective action
Control of HP fuel control block faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary. Error cleared after restarting the engine.

472 – AL Stop SD

ZKP-Number: 2.8006.593

Cause	Corrective action
Engine stop, since all shutdown channels have "sensor faulty".	1. Check cabling. 2. Contact Service.

473 – AL Wiring PWM_CM2

ZKP-Number: 1.8004.593

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

474 – AL Wiring FO

ZKP-Number: 2.8006.655

Cause	Corrective action
Cable break or short circuit on channel FO.	1. Check cabling. 2. Contact Service.

475 – AL CR Trigger Engine Stop

ZKP-Number: 1.8010.009

Cause	Corrective action
Tripped by crash recorder triggering due to engine shutdown.	▶ Determine and rectify cause of triggering / engine shutdown.

476 – AL Crash Rec. Init. Error

ZKP-Number: 1.8010.007

Cause	Corrective action
Initialization error of crash recorder.	▶ Check settings with DiaSys.

478 – AL Comb. Alarm Yel (Plant)

ZKP-Number: 2.8006.001

Cause	Corrective action
Combined alarm YELLOW from plant.	▶ Check additional messages.

479 – AL Comb. Alarm Red (Plant)

ZKP-Number: 2.8006.002

Cause	Corrective action
Combined alarm RED from plant.	▶ Check additional messages.

480 – AL Ext. Engine Protection

ZKP-Number: 20.291.921

Cause	Corrective action
External engine protection function active.	▶ Monitoring of plant signal by ECU active (plant side). Check plant signal.

482 – SD T-Exhaust C

ZKP-Number: 18.004.596

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

483 – SD T-Exhaust D

ZKP-Number: 18.004.597

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

484 – HI T-Exhaust C

ZKP-Number: 20.133.931

Limit value 1

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

485 – SS T-Exhaust C

ZKP-Number: 20.133.932

Limit value 2

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

486 – HI T-Exhaust D

ZKP-Number: 20.134.931

Limit value 1

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

487 – SS T-Exhaust D

ZKP-Number: 20.134.932

Limit value 2

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

488 – HI ETC3 Overspeed

ZKP-Number: 23.014.931

Limit value 1

Cause	Corrective action
Speed of second secondary turbocharger too high.	▶ Reduce power.

489 – SS ETC3 Overspeed

ZKP-Number: 23.014.932

Limit value 2

Cause	Corrective action
Speed of second secondary turbocharger too high.	▶ Reduce power.

490 – HI ETC4 Overspeed

ZKP-Number: 23.015.931

Limit value 1

Cause	Corrective action
Speed of the 3rd secondary turbocharger too high.	▶ Reduce power.

491 – SS ETC4 Overspeed

ZKP-Number: 23.015.932

Limit value 2

Cause	Corrective action
Speed of the 3rd secondary turbocharger too high.	▶ Reduce power.

492 – AL ETC4 Cutin Failure

ZKP-Number: 18.004.202

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

493 – AL ETC3 Cutin Failure

ZKP-Number: 18.004.203

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

500 – AL Wiring POM Starter 1

ZKP-Number: 14.500.900

Cause	Corrective action
A cabling fault in connection of starter 1 of CPM has been detected. This may be due to a missing consumer, wire break or a short circuit.	▶ Check connection between POM and starter.

501 – AL Wiring POM Starter 2

ZKP-Number: 14.500.901

Cause	Corrective action
A cabling fault in connection of starter 2 of CPM has been detected. This may be due to a missing consumer, wire break or a short circuit.	▶ Check connection between POM and starter.

502 – AL Open Load POM Alternator

ZKP-Number: 14.500.902

Cause	Corrective action
A line interruption was detected at the battery-charging connection for the POM.	▶ Check connection between POM and battery-charging generator.

503 – AL Battery Not Charging

ZKP-Number: 14.500.903

Cause	Corrective action
Battery is not charged by battery-charging generator.	▶ Check battery-charging generator and cabling.

504 – AL CAN POM Node Lost

ZKP-Number: 14.500.904

Cause	Corrective action
POM missing on CAN bus.	▶ Check connection and POM.

506 – AL Low Starter Voltage

ZKP-Number: 14.500.906

Cause	Corrective action
The battery voltage is too low for the starting process.	▶ Check starter battery and cabling.

507 – AL POM Error

ZKP-Number: 14.500.907

Cause	Corrective action
A general POM fault occurred.	▶ Replace POM.

508 – AL Wrong POM-ID

ZKP-Number: 14.500.908

Cause	Corrective action
POM sends a different ID number than expected.	▶ Check POM wiring harness.

510 – AL Override applied

ZKP-Number: 27.002.010

Cause	Corrective action
Override was activated.	▶ Deactivate Override pushbutton again.

515 – AL Starter Not Engaged

ZKP-Number: 21.090.926

Cause	Corrective action
Starter on CPM / POM could not be engaged. If the number of automatic start attempts from PR 2.1090.134 Number of Start Attempts is used up then start is canceled. Check CPM, starter and cabling.	1. Repeat starting attempt 2. Check CPM, starter and cabling.

519 – Oillevel Calibration Error

ZKP-Number: 10.158.921

Cause	Corrective action
Error when writing the calibration value to flash memory or level sensor defect.	1. Check sensor and cabling, replace as necessary. 2. Contact Service.

521 – SS P-Lube Oil Mid Val

ZKP-Number: 20.480.289

Limit value 1

Cause	Corrective action
Average oil pressure value from three sources is too low.	▶ Check oil level, top up as necessary.

523 – SS T-Coolant Red Mid Val

ZKP-Number: 20.480.189

Limit value 2

Cause	Corrective action
Average coolant temperature value from three sources is too high.	▶ Reduce power.

524 – SS Engine Overspeed Mid Val

ZKP-Number: 20.480.089

Limit value 2

Cause	Corrective action
Average engine overspeed value from three sources is too high.	1. Acknowledge alarm. 2. Attempt to restart engine.

525 – SD P-Lube Oil (R2)

ZKP-Number: 18.004.638

Cause	Corrective action
Redundant lube-oil pressure sensor faulty. short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

526 – SD T-Coolant (R2)

ZKP-Number: 18.004.639

Cause	Corrective action
Redundant coolant pressure sensor faulty. short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

527 – TD EngineSpd. Sensor Deviation

ZKP-Number: 10.480.093

Cause	Corrective action
Maximum deviation of speed sensors	1. Check speed sensor cabling. 2. Check for additional messages. 3. Contact Service.

528 – SD Engine Speed 3rd Sensor

ZKP-Number: 12.500.102

Cause	Corrective action
Redundant crankshaft speed sensor faulty; short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

529 – SS T-Coolant Red2

ZKP-Number: 20.480.195

Limit value 2

Cause	Corrective action
Second redundant coolant temperature too high.	▶ Check coolant circuit.

530 – SS P-Lube Oil Red2

ZKP-Number: 20.480.295

Limit value 2

Cause	Corrective action
Second redundant lube-oil pressure too high.	▶ Check oil level, top up as necessary.

543 – AL Multiple FDH Slaves

ZKP-Number: 20.555.005

Cause	Corrective action
There is more than one device activated as backup medium for FDH.	▶ Contact Service.

544 – AL Configuration Changed

ZKP-Number: 20.555.003

Cause	Corrective action
This fault becomes active in cases in which the system configuration has been changed, e.g. due to replacement of an ECU or a SAM.	▶ Fault remains active until changes are revoked or data have been transferred by active maintenance. Fault is then automatically cleared.

549 – AL Power Cut-Off detected

ZKP-Number: 27.001.952

This is an alarm from the emergency stop counter function.

Cause	Corrective action
ECU operating voltage was switched off while the engine was running. This may lead to overpressure in the HP system which can damage the engine.	▶ Instruct operators to switch off the power supply only after the engine has come to a standstill.

550 – SS Engine Overspeed Red2

ZKP-Number: 20.480.095

Limit value 2

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

551 – SS Engine Overspeed Camshaft

ZKP-Number: 22.510.933

Limit value 2

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

555 – AL Call MTU Field Service

ZKP-Number: 20.555.001

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

576 – AL ESCM Override

ZKP-Number: 11.075.083

Cause	Corrective action
Violation of corrected MCR or DBR/MCR curve. Engine overload!	▶ Reduce power.

577 – SD T-Lube Oil Pan

ZKP-Number: 10.137.900

Cause	Corrective action
Oil pan temperature sensor faulty. Short circuit or wire break.	▶ Check sensor and cabling, replace as necessary.

578 – AL L1 T-Lube Oil Pan

ZKP-Number: 20.137.921

Limit value 1

Cause	Corrective action
L1 T-Lube Oil Pan has violated limit value 1.	▶

579 – AL MD Forced Idle

ZKP-Number: 21.063.511

Cause	Corrective action
MD forced idle demand => node failure (node 3,4 or 5)	▶

580 – AL MD Request Speed Limit

ZKP-Number: 21.063.513

Cause	Corrective action
MD speed limitation demand => node failure (node 3,4 or 5)	▶

581 – AL MD CAN Stop

ZKP-Number: 21.063.515

Cause	Corrective action
MD CAN stop demand => node failure (node 3,4 or 5)	▶

7 Task Description

7.1 Engine

7.1.1 Engine – Barring manually

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

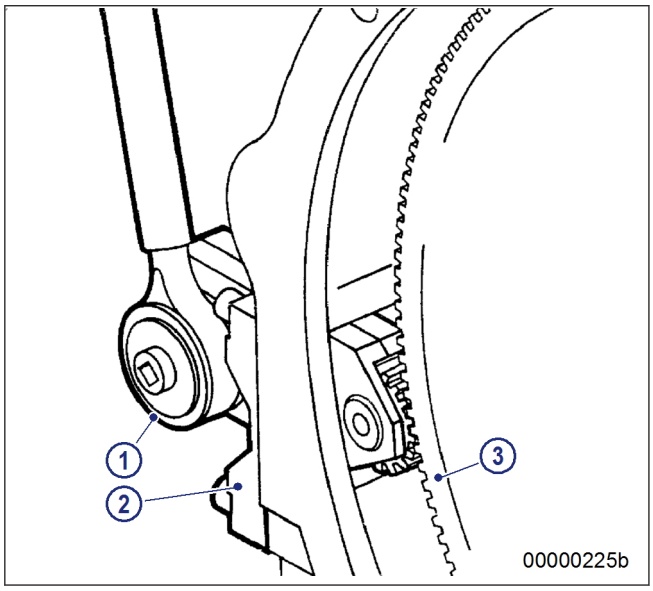
Designation / Use	Part No.	Qty.
Barring device	F6555766	1
Ratchet with extension	F30006212	1

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – Danger to life!
- Before barring the engine, ensure that nobody is in the danger zone.

Engine – Barring manually

1. Remove guard plate.
2. Engage barring device (2) with ring gear (3) and install on flywheel housing.
3. Place ratchet (1) onto barring device (2).
4. Rotate crankshaft in engine direction of rotation. Apart from the normal compression resistance, there should be no further resistance.
5. For barring device removal, follow reverse sequence of working steps.



7.1.2 Engine – Barring with starting system

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, ensure that nobody is in the danger zone.
- After working on the engine, check that all protective devices have been reinstalled and all tools removed from the engine.

Engine – Barring with starting system

1. Release latch of connector X4.
2. Remove connector from engine governor.
3. Bar engine in unloaded condition: Press START button.
4. Let the crankshaft rotate until oil pressure is indicated.
5. Engine start is automatically interrupted when specified starting period has passed. If necessary, re-start the engine after approx. 20 seconds.
6. Connect connector X4 to engine governor and latch in position.

7.1.3 Engine – Test run

DANGER

Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

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

Engine – Test run

1. Start engine (→ Page 69).
2. Perform test run not below 1/3 load and at least until steady-state temperature is reached.
3. Carry out operational checks (→ Page 72).
4. Stop engine (→ Page 73).

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 144).
2. Remove injector (→ Page 147).

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 136).
3. Depending on findings:
   - do not take any action or
   - carry out a further endoscopic examination as part of maintenance work or
   - contact Service; cylinder liner must be replaced.

Final steps

1. Install injector (→ Page 147).
2. Install cylinder head cover (→ Page 144).

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	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.

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Findings	Action
Burn mark	This is caused by a malfunction in the liner / ring tribosystem. Usually they run over the whole ring-travel area (TDC/BDC), starting at the first TDC-ring and becoming more visible from the second TDC-ring 2 onwards and less pronounced from TDC-ring 1. The honing pattern is usually no longer visible and displays a clearly defined (straight) edge to the undisturbed surface. The damaged surface is usually discolored. The circumferential length varies. Liners with burn marks, or heat discoloration, starting in TDC-ring 1 have to be replaced.
Seizure marks, scuffing	Irregular circumference lengths and depths. Can be caused either by the piston skirt or the piston crown. Material deposits on the liner (smear), heavy discoloration. Severe, visible scoring. Replace liner.

Evaluation of findings and further measures

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

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

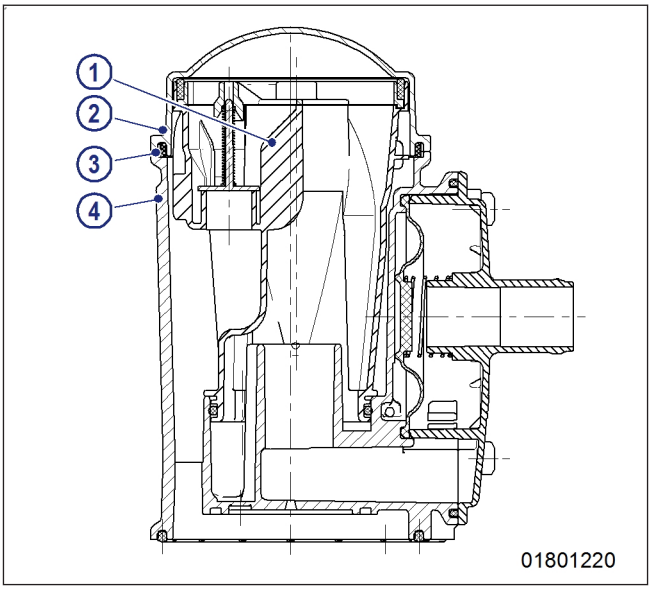
Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Ratchet adapter	F30027340	1
Engine oil		
Filter element	(→ Spare Parts Catalog)	
Diaphragm	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

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.



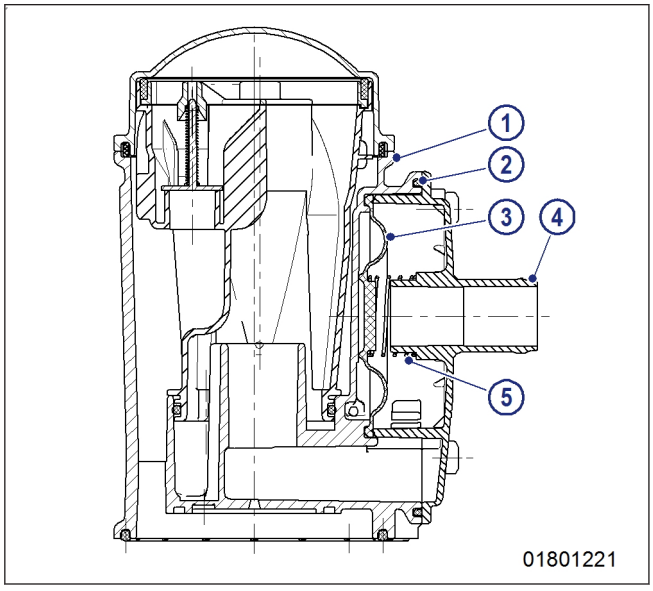
5. Use torque wrench to tighten the screws of cover (2) to the specified torque.

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.

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.

7.4 Valve Drive

7.4.1 Valve gear – Lubrication

Preconditions

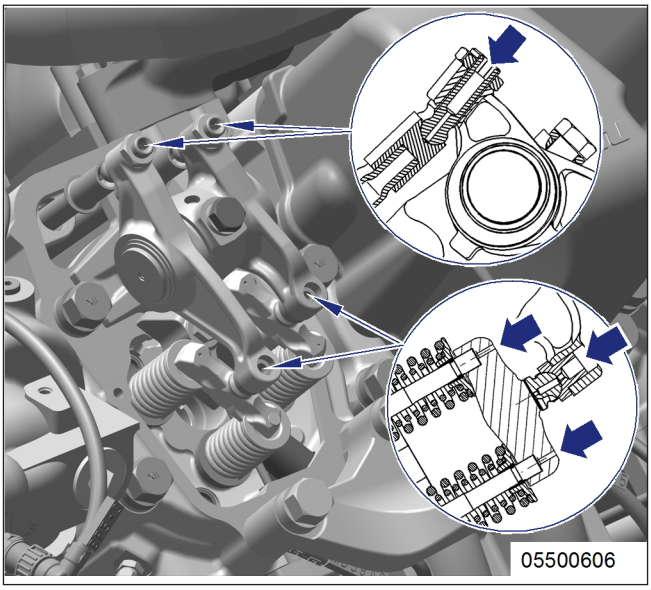
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

Valve gear – Lubrication

1. Remove cylinder head covers (→ Page 144).
2. Fill oil chambers of valve bridges with oil.
3. Fill oil chambers of rocker arms and adjusting screws with oil.
4. Install cylinder head covers (→ Page 144).



7.4.2 Valve clearance – Check and adjustment

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine coolant temperature is max. 40 °C.

☑ Valves are closed.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Feeler gauge	Y20010128	1
Torque wrench, 60-320 Nm	F30047446	1
Ring socket, 24 mm	F30039526	1
Engine oil		

Preparatory steps

1. Remove cylinder head cover (→ Page 144).
2. Install barring device (→ Page 131).

Note: The OT mark (if fitted) on the flywheel must not be used for reference.

3. Rotate crankshaft with barring device in engine direction of rotation until "OT-A1" mark and pointer are aligned.

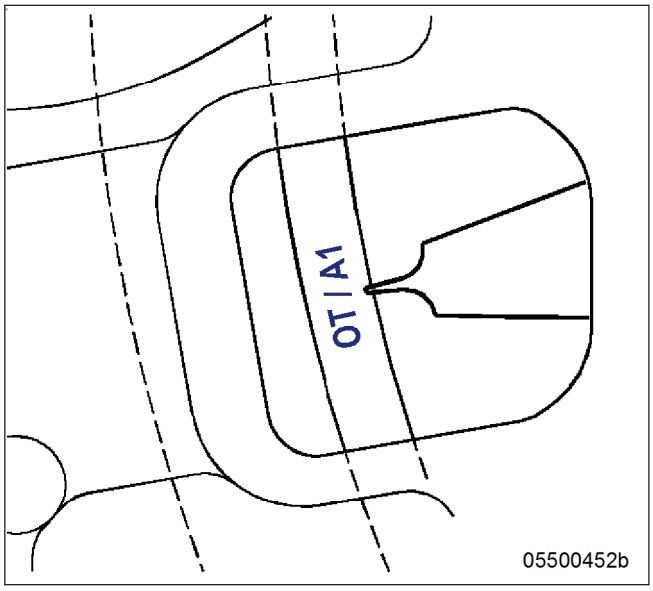


Diagram for 12 V engines (two crankshaft positions)

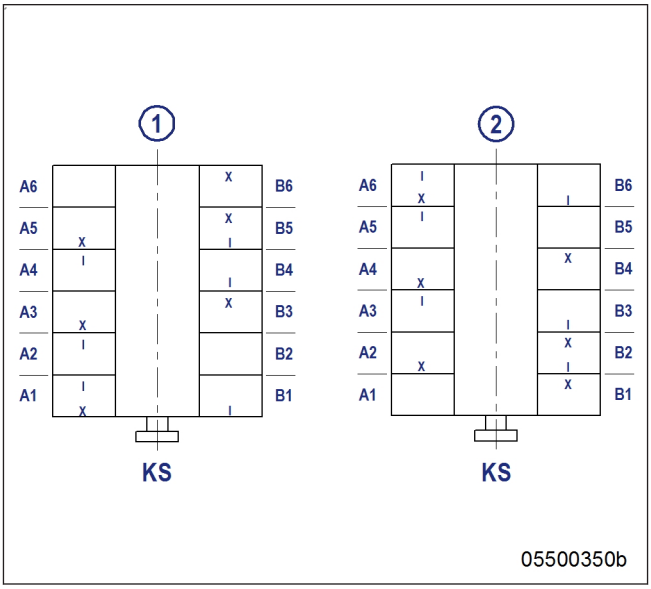
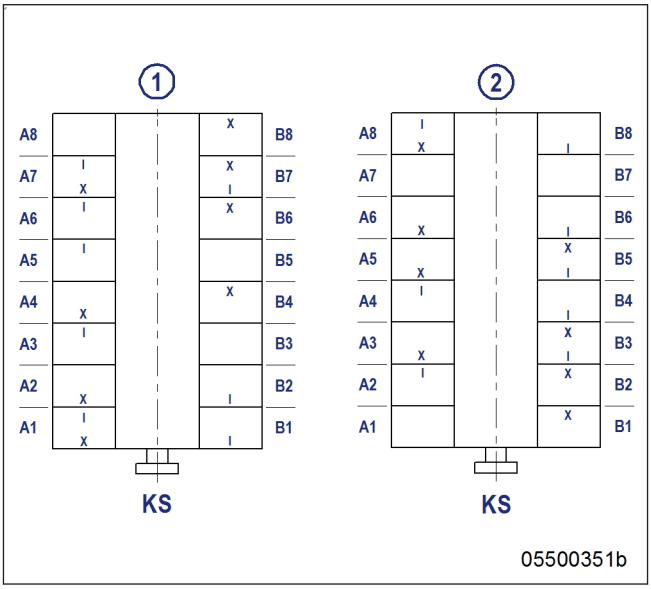


Diagram for 16 V engines (two crankshaft positions)



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 valves (long rocker arm) = 0.2 mm ±0.05 mm
   - Exhaust valves (short rocker arm) = 0.5 mm ±0.05 mm
3. Check all valve clearances in two crankshaft positions (firing TDC and overlap TDC of cylinder A1) as per diagram.
   1 Cylinder A1 is in firing TDC
   2 Cylinder A1 is in overlap TDC
   I Inlet valve
   X Exhaust valve
4. Use feeler gauge to determine the distance between valve bridge and rocker arm.
5. If the deviation from the reference value exceeds 0.1 mm, adjust valve clearance.

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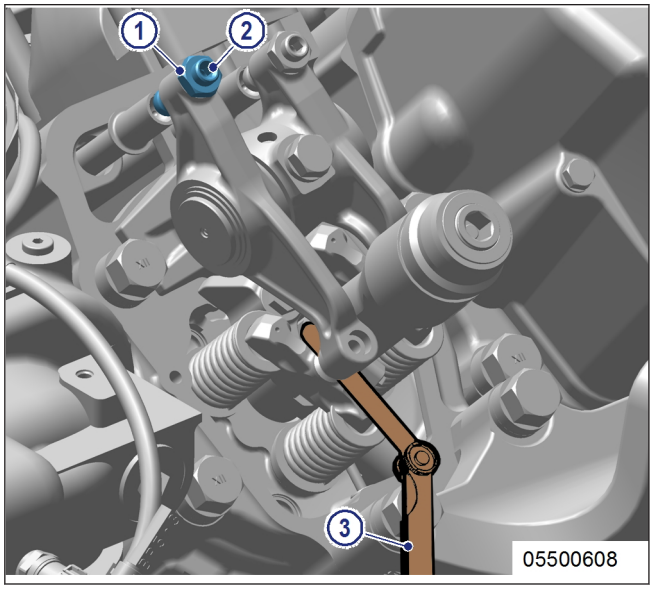
Adjusting valve clearance

1. Release locknut (1).
2. Insert feeler gauge (3) between valve bridge and rocker arm.
3. Using Allen key, set adjusting screw (2) so that the specified valve clearance is provided.
4. Feeler gauge (3) must just pass through gap.



5. Tighten locknut (1) with torque wrench to the specified tightening torque, holding the adjusting screw (2) to prevent it from turning.

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

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

Final steps

1. Remove barring device (→ Page 131).
2. Install cylinder head cover (→ Page 144).

7.4.3 Cylinder head cover – Removal and installation

Preconditions

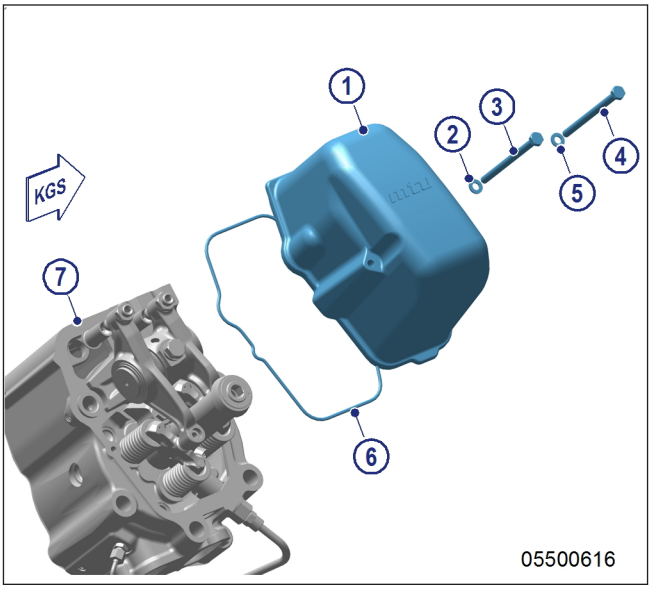
☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	
O-ring	(→ Spare Parts Catalog)	

Removing cylinder head cover

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



Installing cylinder head cover

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

7.5 Injection Pump / HP Pump

7.5.1 HP pump – Filling with engine oil

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Engine oil		

WARNING

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

WARNING

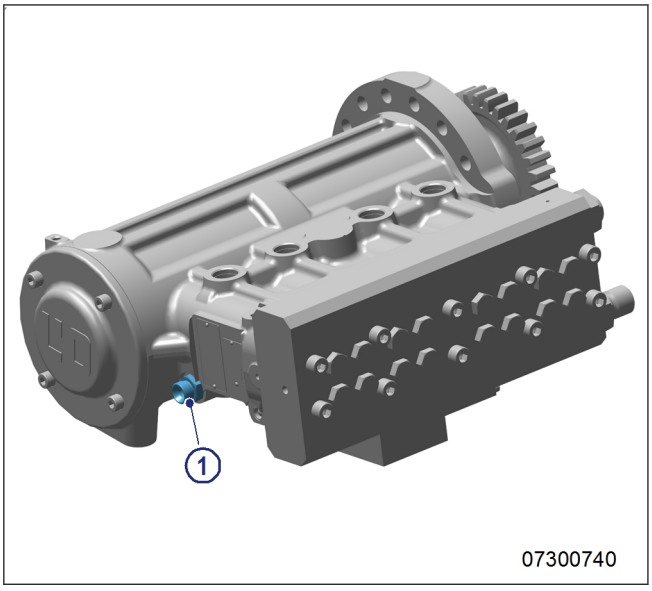
Oils/oil vapors are combustible/explosive.
Risk of fire and explosion!
- Avoid open flames, electric sparks and ignition sources.
- Do not smoke.

CAUTION

Fuel system high-pressure pump not filled with engine oil.
Damage to components, major material damage!
- Make sure that the high-pressure fuel pump is filled with engine oil before installation or initial operation.

Filling HP pump

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



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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 147).

7.6.2 Injector – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Installation/removal tool	F6789889	1
Milling cutter	F30452739	1
Torque wrench, 0.5-5 Nm	0015384230	1
Torque wrench, 10-60 Nm	F30452769	1
Torque wrench, 60-320 Nm	F30452768	1
Assembly paste (Optimoly Paste White T)	40477	1
Grease (Kluthe Hakuform 30-10/Emulgier)	X00029933	1
Engine oil		
O-ring	(→ Spare Parts Catalog)	

WARNING

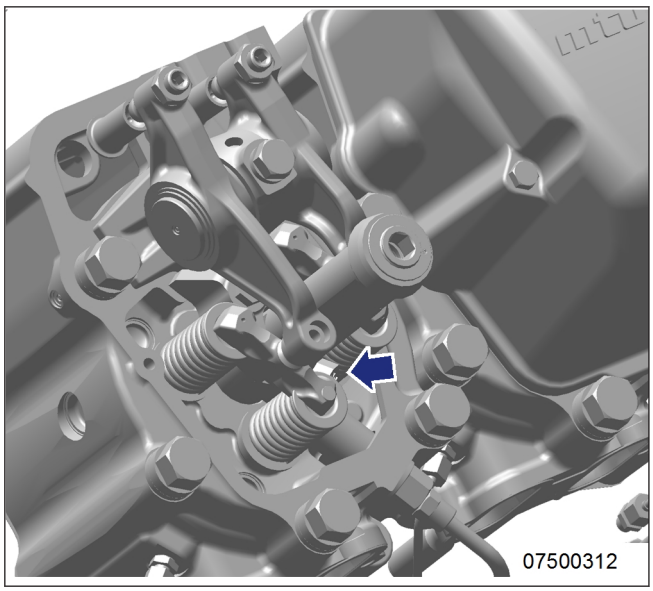
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Preparatory steps

1. Shut off fuel supply to engine.
2. Remove cylinder head cover (→ Page 144).

Removing injector

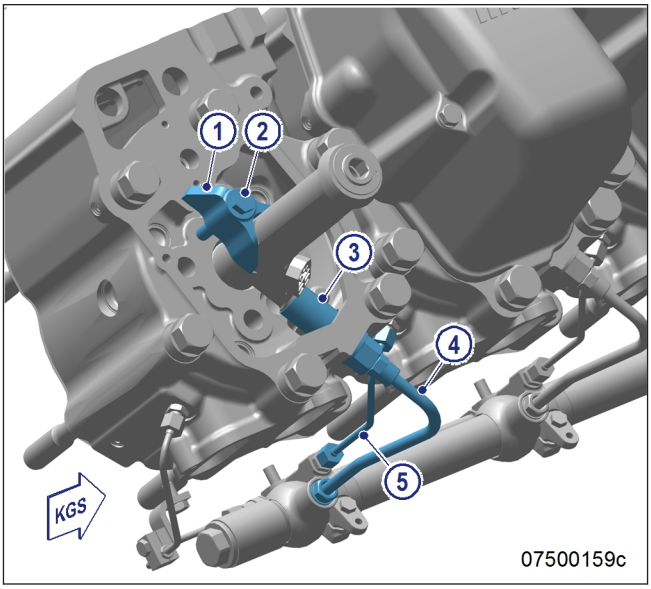
1. Disconnect cable connector on injector.



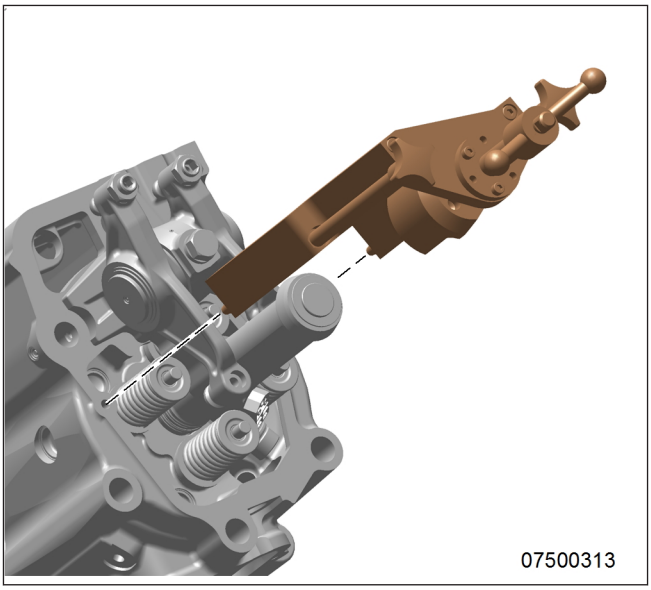
2. Remove HP fuel line (4).
3. Remove return line (5).

Note: The injector accumulator will be emptied when removing the adapter.

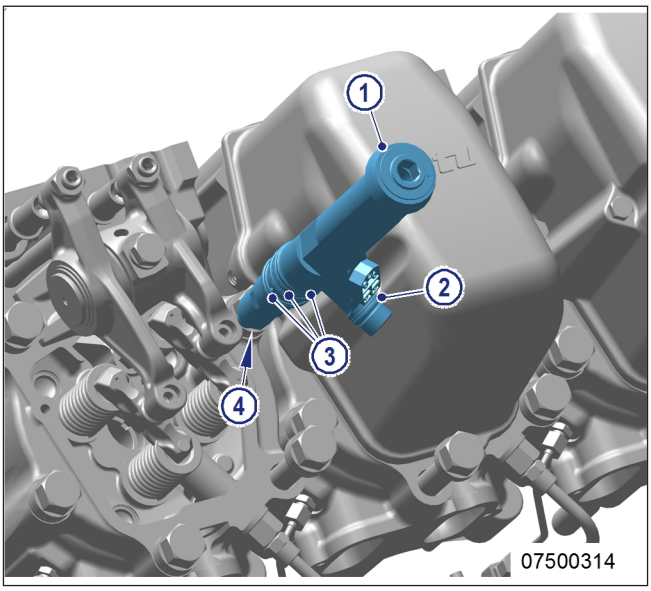
4. Remove adapter (3).
5. Remove screw (2) and take off hold-down clamp (1).



6. Install installation/removal tool on cylinder head.
7. Remove injector with installation/removal tool.
8. Remove installation/removal tool.

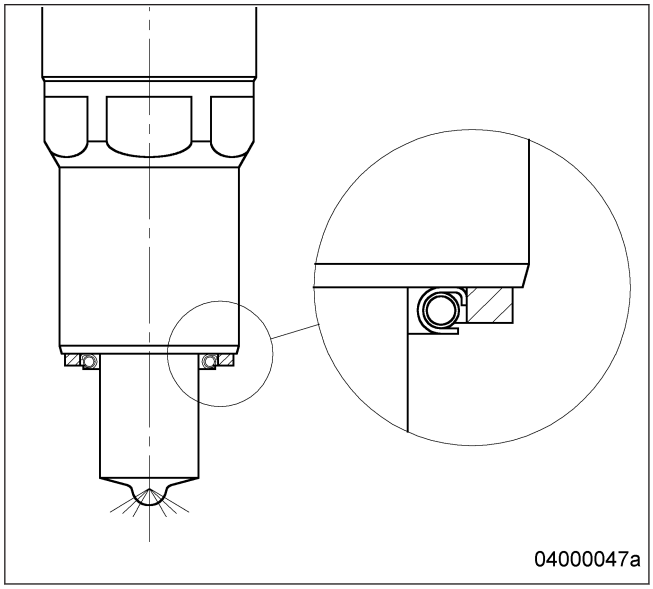


9. Remove sealing ring (4) from injector or use a self-made hook to take it out of the cylinder head.
10. Remove O-rings (3), O-ring (2) and damper ring (1) from injector.
11. Clean all mating and sealing surfaces.
12. Cover all connections and bores, or seal with suitable plugs.

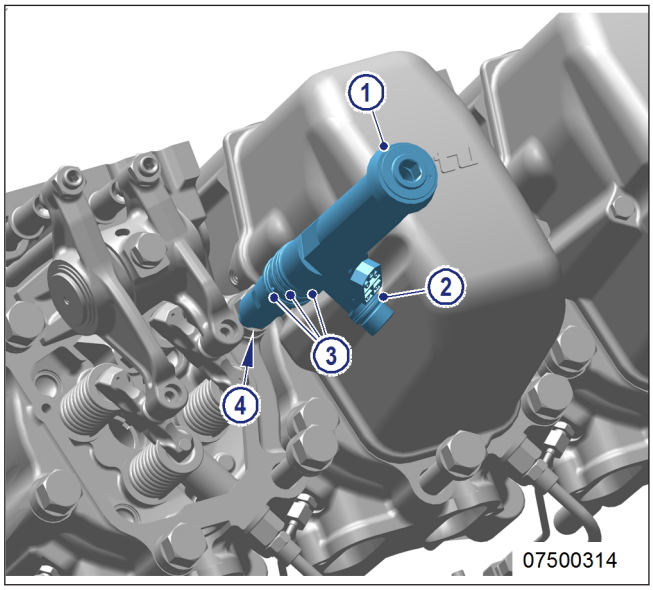


Installing injector

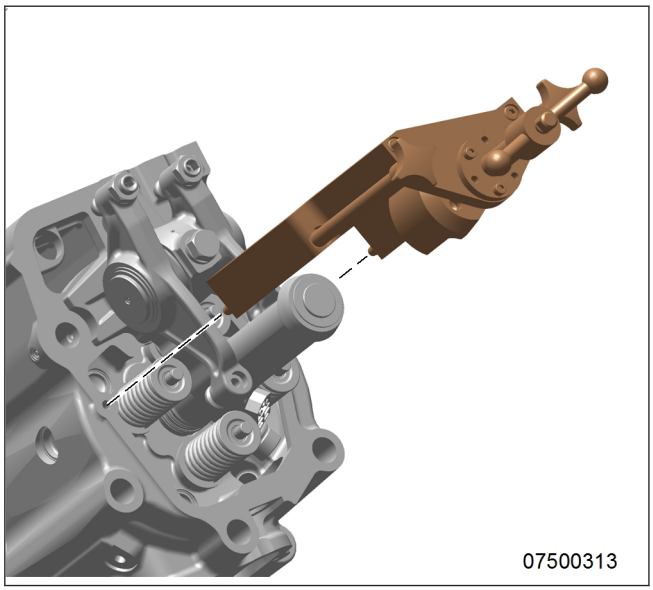
1. Remove plug before installing the injector. (Do not remove the plug from the HP line before installing the adapter.)
2. Coat injector with assembly paste at the seat of the nozzle clamping nut.
3. Fit new sealing ring (included in the scope of supply of the injector) with grease on injector, observe installation position of sealing ring.



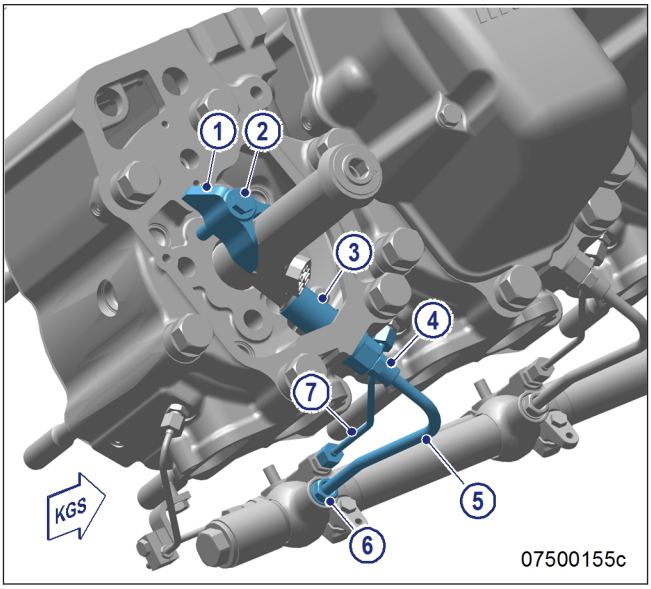
4. Fit new O-rings (3) (included in the scope of supply of the injector), O-ring (2) and damping ring (1) onto the injector and coat with grease.
5. Remove oil carbon from sealing face on cylinder head and protective sleeve with milling cutter.
6. Insert injector into cylinder head, ensuring that the HP line adapter is correctly aligned.



7. Use installation/removal tool to press in injector.
8. Remove installation/removal tool.



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



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

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

Note: Ensure special cleanness.

11. Coat thread and sealing cone of adapter (3) with engine oil.

12. Install adapter (3) and use torque wrench to tighten to the specified initial tightening torque.

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

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

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

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

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

15. Install return line (7).

Note: Ensure special cleanness.

16. Coat thread and sealing cone of HP line (5) with engine oil.

Note: Two HP line versions (single- and double-walled) with different torques as described below.

17. Mount single-walled HP line (5) and use torque wrench to tighten to the specified torque. Tightening sequence:
    1 Rail (6)
    2 Adapter (4)

Name	Size	Type	Lubricant	Value/Standard
Union nut / thrust screw		Tightening torque		30 Nm + 5 Nm

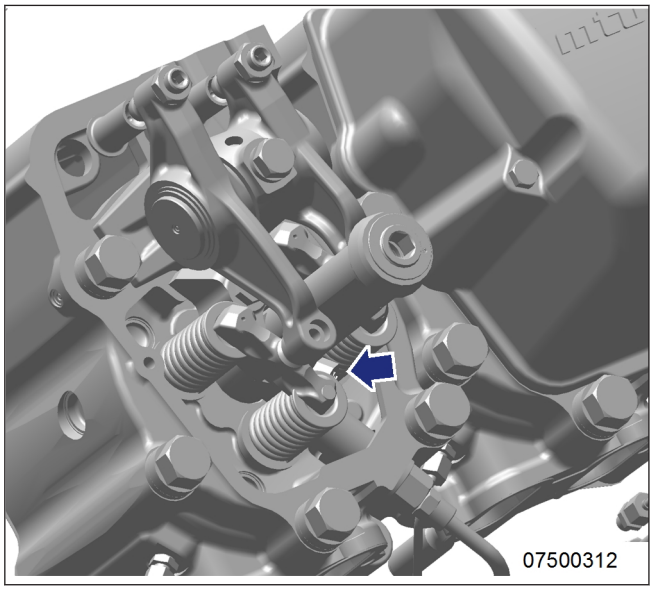
18. Mount double-walled HP line (5) and use torque wrench to tighten to the specified torque. Tightening sequence:
    1 Adapter (4)
    2 Rail (6)

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

19. Fit cable connector onto injector.

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

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



Final steps

1. Install cylinder head cover (→ Page 144).
2. Open fuel supply to engine.

7.7 Fuel System

7.7.1 Fuel system – Venting

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

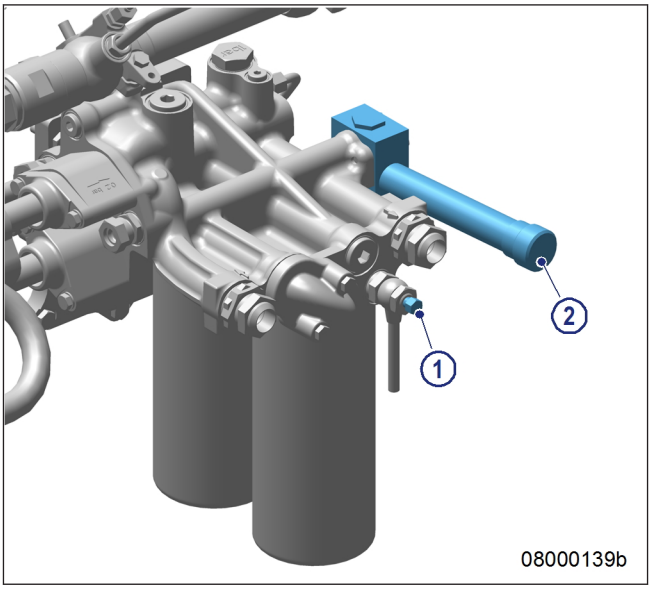
Designation / Use	Part No.	Qty.
Diesel fuel		

WARNING

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

Venting LP fuel system

1. Open vent plug (1).
2. Unlock fuel priming pump (2), screw out handle by turning it counterclockwise.
3. Operate the pump with the handle (2) until bubble-free fuel emerges from the vent plug (1).
4. Close vent plug (1).
5. Screw in handle by turning it clockwise.
6. Verify that fuel priming pump (2) is locked: handle must be tightened.



7.8 Fuel Filter

7.8.1 Fuel filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

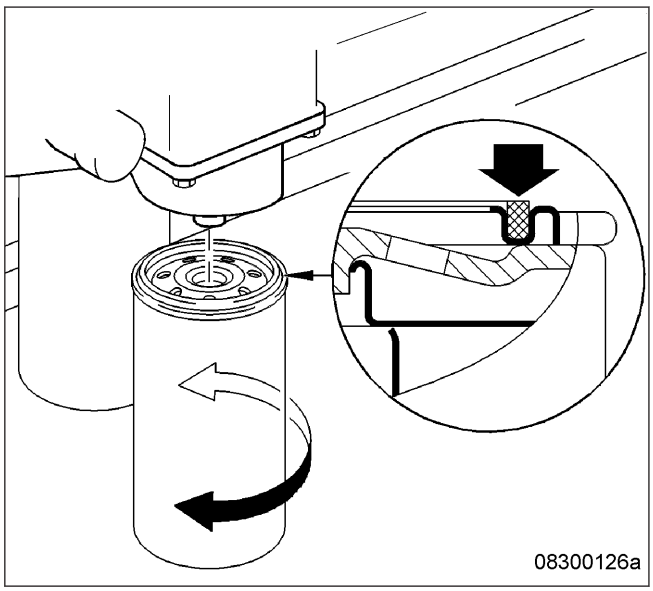
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	1
Engine oil		
Easy-change filter	(→ Spare Parts Catalog)	

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 sealing surface on filter head.
3. Slightly lubricate seal on the easy-change filter (arrow).
4. Screw on the easy-change filter by hand until the seal makes contact and tighten finger-tight.
5. Replace further easy-change filters in the same way.
6. Vent fuel system (→ Page 152).



7.8.2 Fuel prefilter cleaning

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

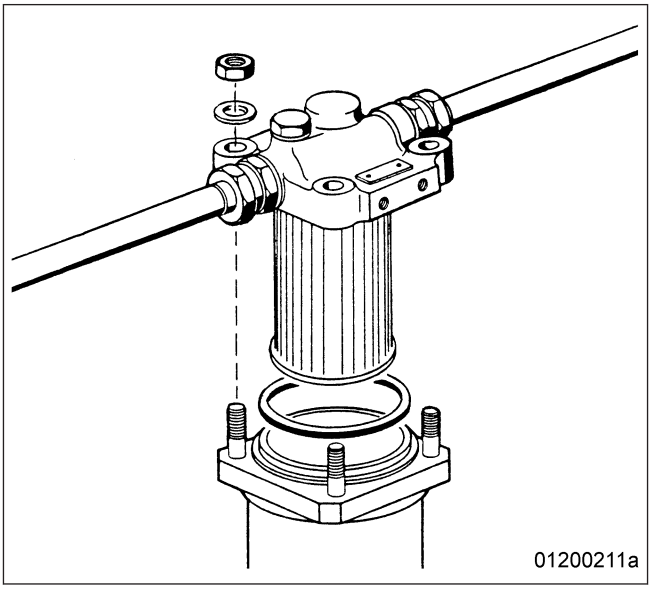
Designation / Use	Part No.	Qty.
Diesel fuel		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

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

Fuel prefilter cleaning

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



7.8.3 Fuel prefilter – Differential pressure gauge check and adjustment

DANGER

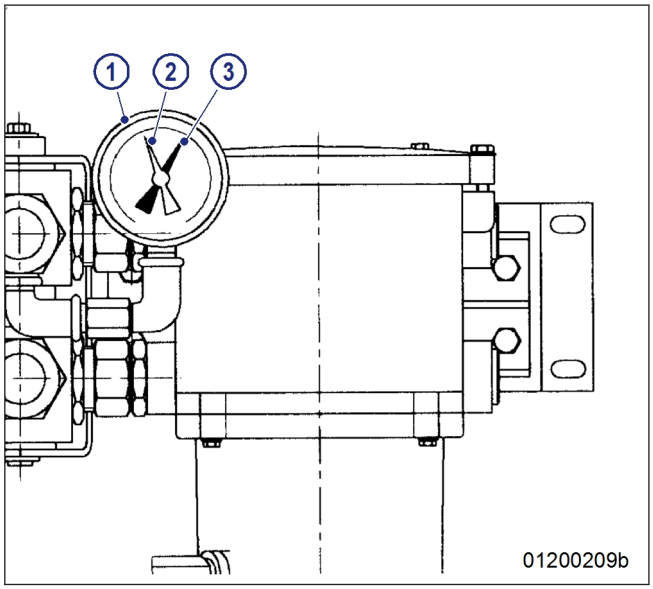
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

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

Adjusting differential pressure gauge

1. When installing the new filter element: align adjustable pointer (2) with pressure-indicating pointer (3) of pressure gauge (1).
2. Check differential pressure.



Checking differential pressure of fuel prefilter

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 157).

7.8.4 Fuel prefilter – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

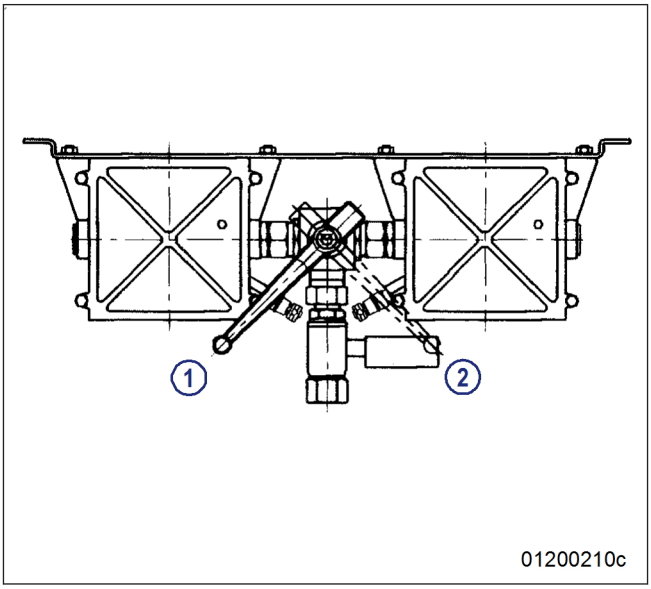
Designation / Use	Part No.	Qty.
Diesel fuel		
Gasket	(→ Spare Parts Catalog)	

WARNING

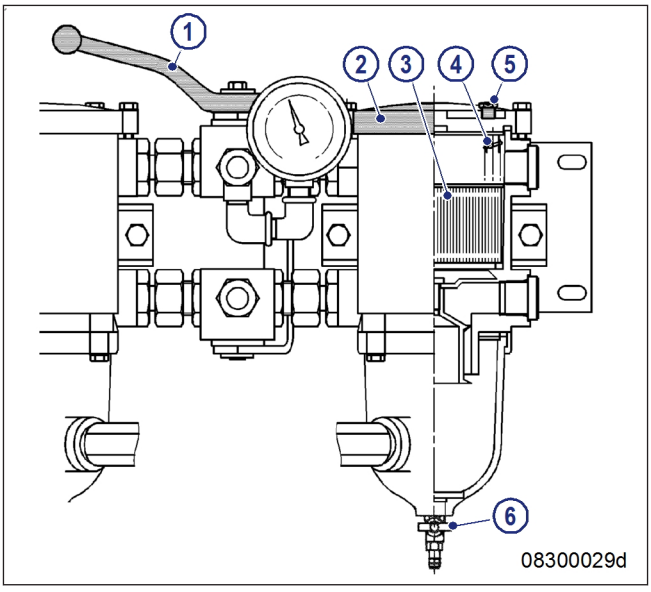
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

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.



7.8.5 Fuel prefilter – Flushing

Special tools, Material, Spare parts

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

DANGER

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

WARNING

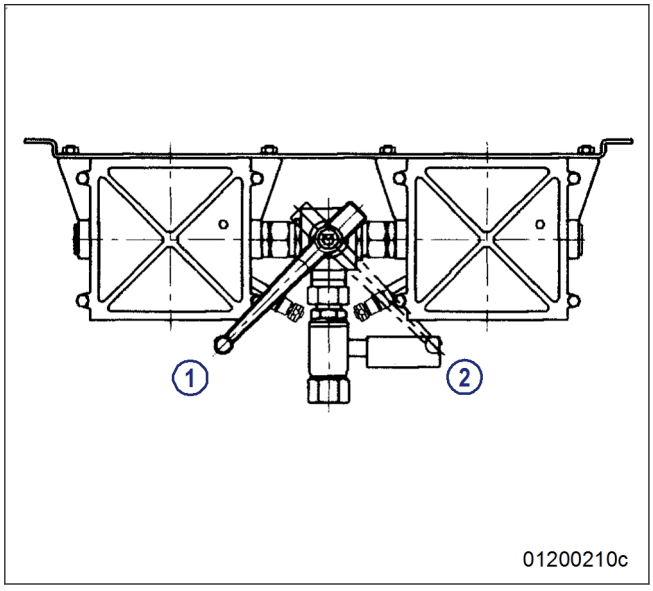
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

WARNING

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

Fuel prefilter – Flushing

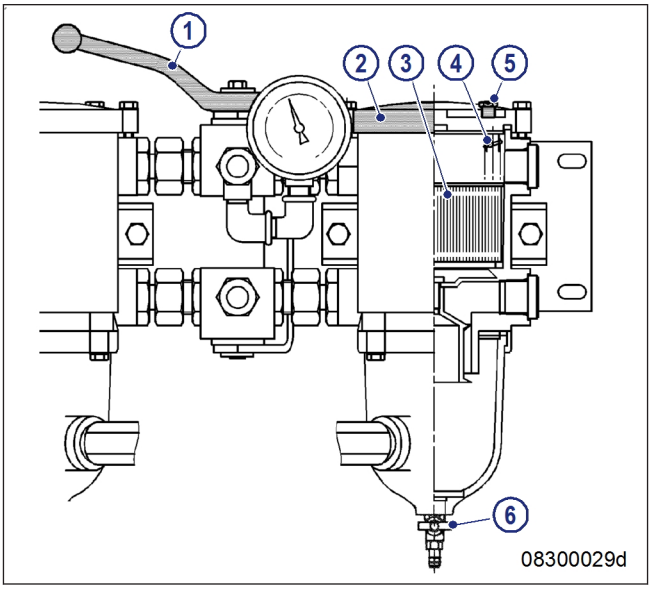
1. Cut out clogged filter.
   - I Left filter cut in
   - II Right filter cut in



2. Open threaded vent plug (5) of filter to be flushed.
3. Unlock drain valve (6) by pressing valve 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 threaded vent plug (5) and drain valve (6).



Fuel prefilter – Topping up with fuel

1. Stop engine (→ Page 73) and disable engine start.
2. Remove screws for 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 155).

Result: If flushing did not lead to an improvement of the differential pressure, replace filter element of fuel prefilter (→ Page 159).

7.8.6 Fuel prefilter – Filter element replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

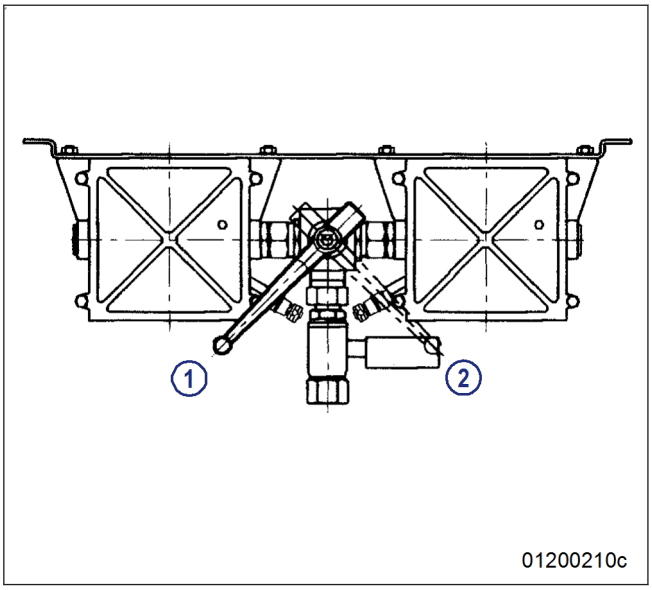
Designation / Use	Part No.	Qty.
Diesel fuel		
Filter element	(→ Spare Parts Catalog)	
Gasket	(→ Spare Parts Catalog)	

WARNING

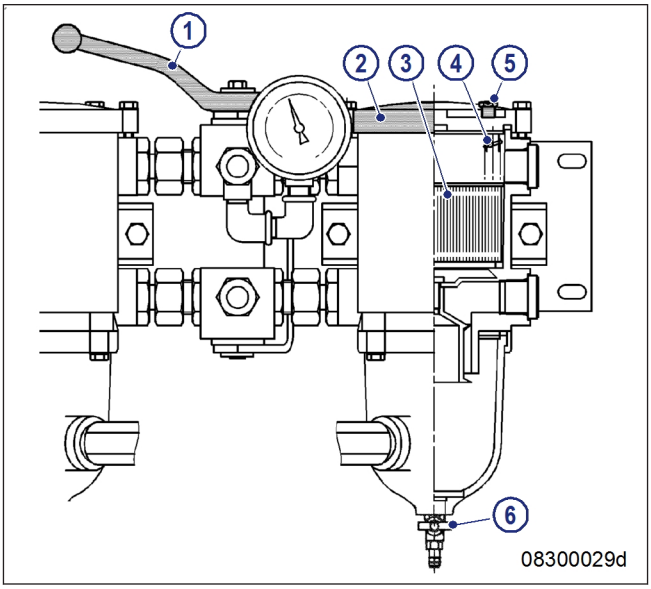
Fuels are combustible.
Risk of fire and explosion!
- Avoid open flames, electrical sparks and ignition sources.
- Do not smoke.

Replacing filter element

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



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 155).



7.9 Charge-Air Cooling

7.9.1 Intercooler – Checking condensate drain for coolant discharge and obstructions

DANGER

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

WARNING

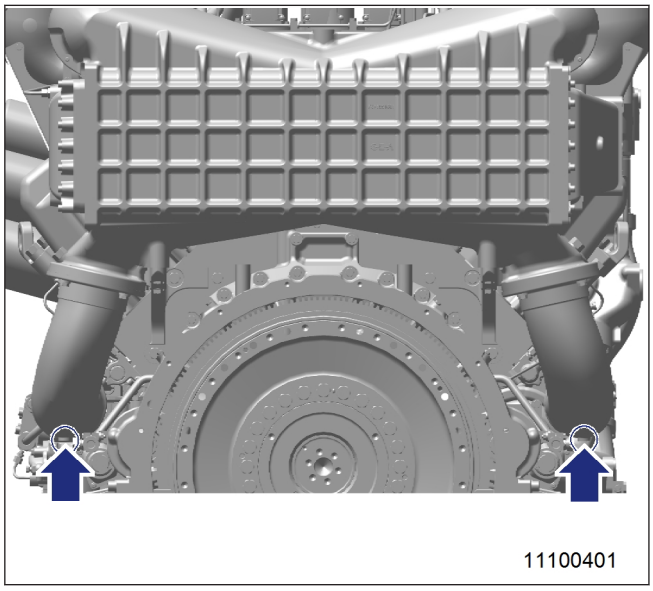
Engine noise above 85 dB (A).
Risk of damage to hearing!
- Wear ear protectors.

WARNING

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

Intercooler – Checking condensate drain for coolant discharge and obstructions

1. With the engine running, verify that air emerges from the condensate drain bore(s) at driving end, left and right engine side. If no air emerges:
   - Clean condensate drain bore(s)
   - Blow out with compressed air
2. If a large amount of coolant is continuously discharged, the intercooler is leaking. Contact Service.



Emergency measures prior to engine start with a leaking intercooler

1. Remove injectors (→ Page 147).
2. Bar engine manually (→ Page 131).
3. Bar engine with starting system to blow out combustion chambers (→ Page 132).
4. Install injectors (→ Page 147).

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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)	

Air filter – Replacement

1. Remove air filter and install new one (→ Page 164).
2. Reset signal ring of service indicator (→ Page 165).

7.10.2 Air filter – Check

Special tools, Material, Spare parts

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

Air filter – Check

1. Check entire circumference of air filter for damage.
2. Fit new air filter if damaged (→ Page 164).

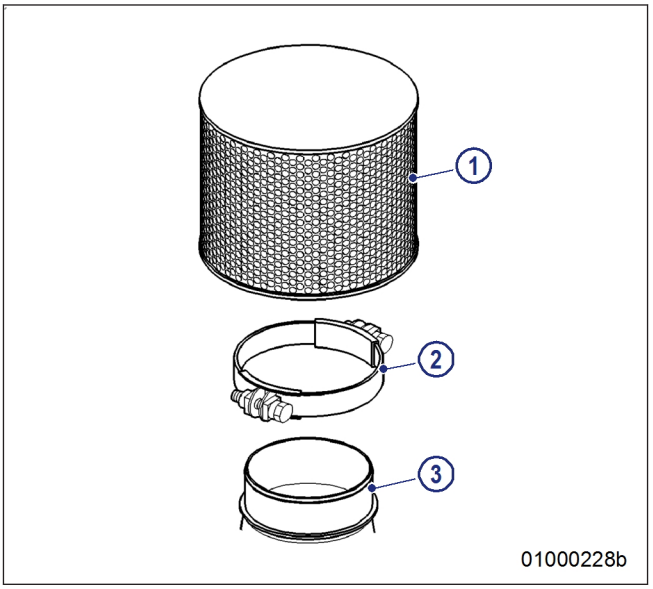
7.10.3 Air filter – Removal and installation

Preconditions

☑ Engine is stopped and starting disabled.

Air filter – Removal and installation

1. Release 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 connecting flange of the intake housing (3) and clean it.
4. Place new air filter (1) with clamp (2) onto intake housing (3).
5. Tighten clamp (2).



7.11 Air Intake

7.11.1 Service indicator – Signal ring position check (optional)

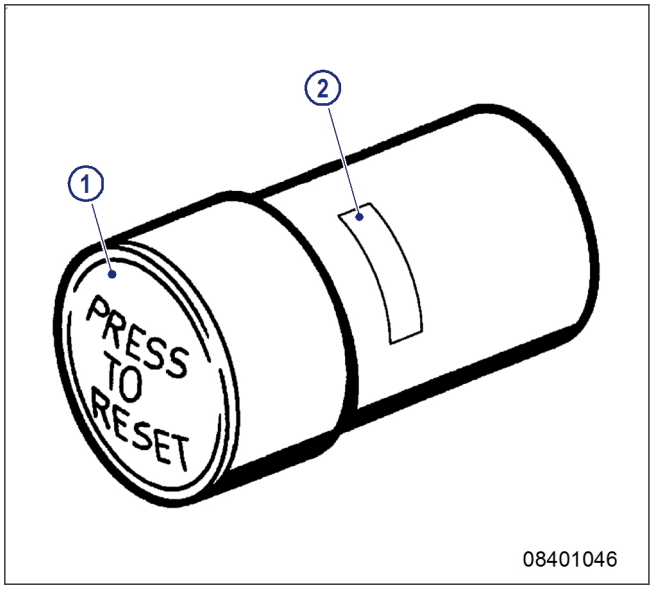
Preconditions

☑ Engine is stopped and starting disabled.

Checking signal ring position

1. If the signal ring is completely visible in the control window (2), replace air filter (→ Page 162).
2. After installation of new filter, press reset button (1).

Result: Engaged piston with signal ring moves back to initial position.



7.12 Starting Equipment

7.12.1 Air starter – Manual operation

DANGER

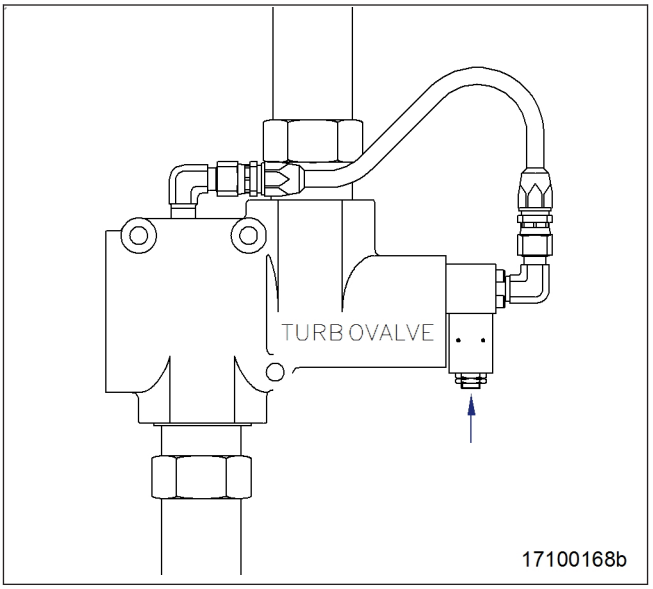
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Before barring or starting the engine, make sure that nobody is in the danger zone.

WARNING

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

Air starter – Manual operation

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



7.13 Lube Oil System, Lube Oil Circuit

7.13.1 Engine oil – Change

Preconditions

☑ Engine is stopped and starting disabled.

☑ Engine is at operating temperature.

☑ MTU fluids and lubricants specifications (A001061/..) are available.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 40-200 Nm	F30027337	1
Ratchet adapter	F30027341	1
Engine oil		
Sealing ring	(→ Spare Parts Catalog)	

WARNING

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

Version without semirotary hand pump: Drain the engine oil through the drain plug(s) on the oil pan.

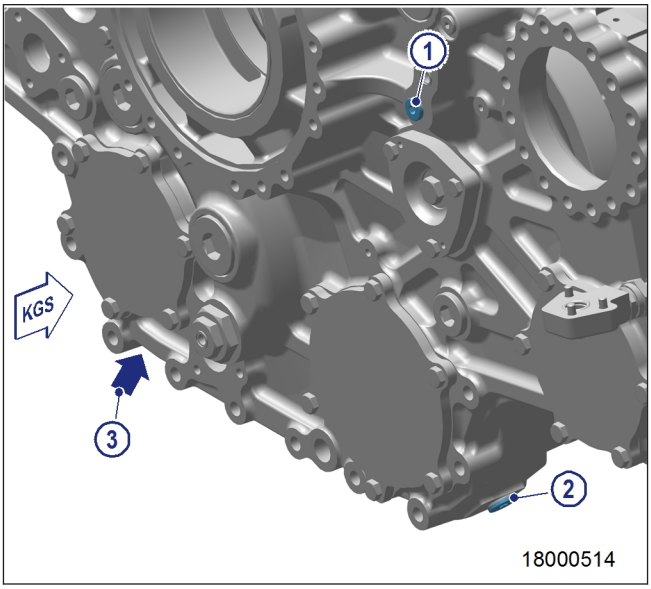
1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug(s) and drain engine oil.
3. Install drain plug(s) with new sealing ring.

Version with semirotary hand pump: Extracting the engine oil

1. Provide a suitable container in which to collect the engine oil.
2. Extract all engine oil from oil pan using the semirotary hand pump.

Draining residual oil from equipment carrier (only with unscheduled engine oil change)

1. Provide a suitable container in which to collect the engine oil.
2. Remove drain plug (1) and drain engine oil from engine oil heat exchanger and from engine oil filter.
3. Remove drain plugs (2) and (3) and drain engine oil.
4. Replace engine oil filter (→ Page 171).
5. Install drain plug(s) with new sealing ring.

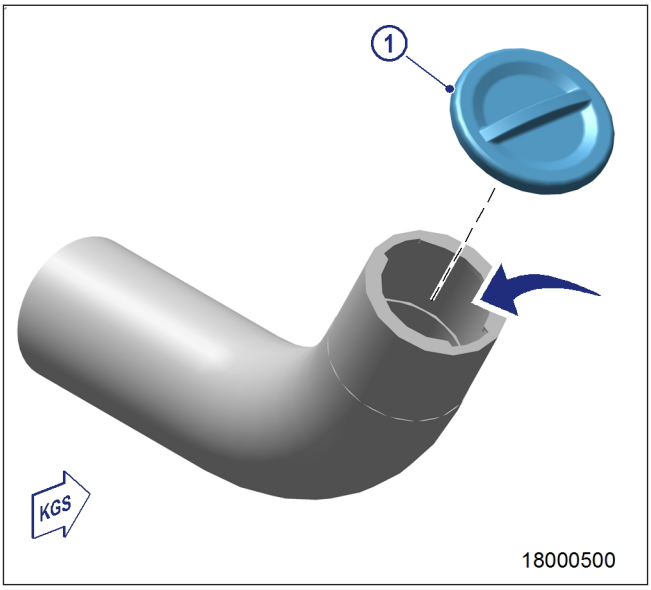


6. Tighten drain (2) and (3) with torque wrench to specified tightening torque.

Name	Size	Type	Lubricant	Value/Standard
Screw	M26 x 1.5	Tightening torque	(Engine oil)	100 Nm +10 Nm

Filling with new engine oil

1. Open cover on filler neck.
2. Pour engine oil through the filler neck up to the "max." mark on the oil dipstick.
3. Close cover on filler neck.
4. Check engine oil level (→ Page 169).



7.13.2 Engine oil – Level check

Preconditions

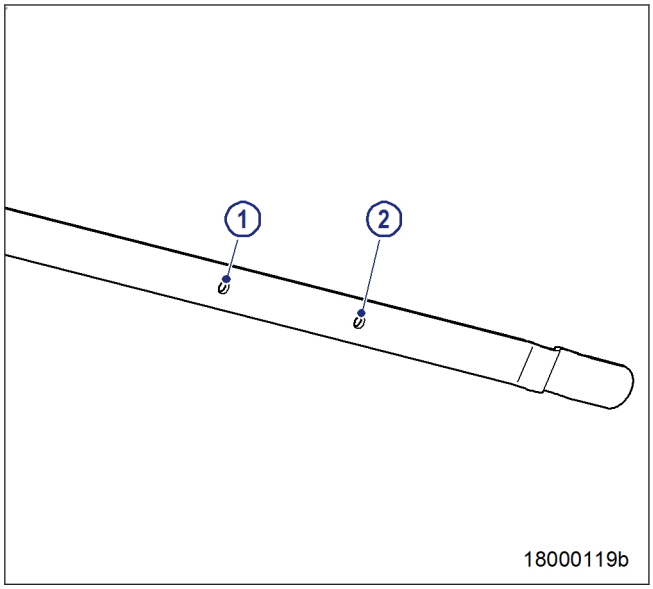
☑ Engine is stopped and starting disabled.

Checking oil level prior to engine start

1. Withdraw oil dipstick from guide tube and wipe it.
2. Insert oil dipstick into guide tube up to stop, withdraw after approx. 10 seconds and check oil level.

Note: After extended standstill, the oil level may exceed the mark (1) by up to 2 cm. This can be caused by oil flowing from e.g. oil filter or heat exchanger back to the oil pan.

3. The oil level must reach mark (1) or exceed mark (1) by up to 2 cm.
4. Top up with oil to mark (1) as necessary (→ Page 167).
5. Insert oil dipstick into guide tube up to the stop.



Checking oil level 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 stop, withdraw after approx. 10 seconds and check oil level.
3. Oil level must be between marks (1) and (2).
4. Top up with oil to mark (1) as necessary (→ Page 167).
5. Insert oil dipstick into guide tube up to the stop.

7.13.3 Engine oil – Sample extraction and analysis

Preconditions

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

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER

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

WARNING

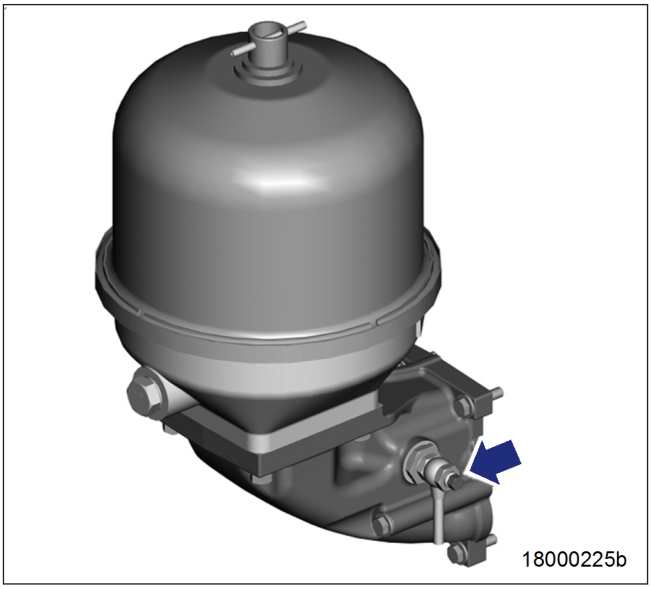
Hot oil.
Oil can contain combustion residues which are harmful to health.
Risk of injury and poisoning!
- Wear protective clothing, gloves, and goggles / safety mask.
- Avoid contact with skin.
- Do not inhale oil vapor.

WARNING

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

Engine oil – Sample extraction and analysis

1. With the engine running at operating temperature, open screw on centrifugal oil filter carrier by 1 to 2 rotations.
2. Drain approx. 2 liters engine oil to flush out the oil sludge.
3. Drain approx. 1 liter engine oil into a clean container.
4. Close screw.
5. Using the equipment and chemicals of the MTU test kit, examine oil for:
   - Dispersion capability (spot test);
   - Water content;
   - Dilution by fuel.



TIM-ID: 0000000932 - 004

7.14 Oil Filtration / Cooling

7.14.1 Engine oil filter – Replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

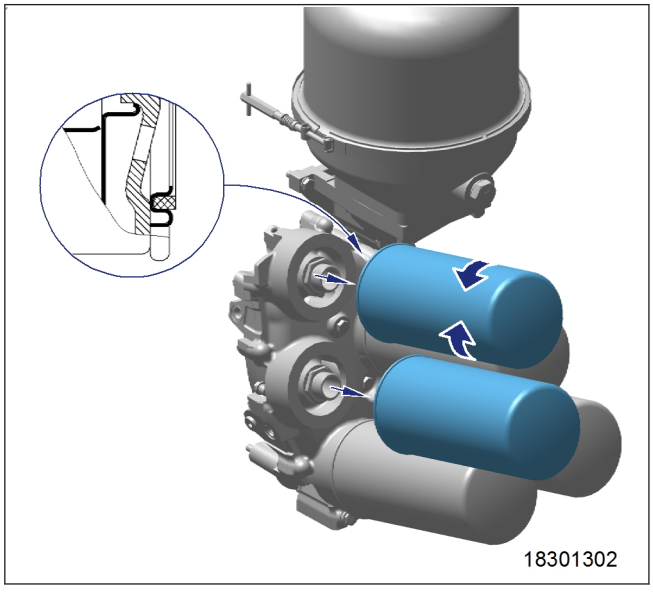
Designation / Use	Part No.	Qty.
Filter wrench	F30379104	
Engine oil		
Oil filter	(→ Spare Parts Catalog)	

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. Unscrew engine oil filter with filter wrench.
2. Clean sealing face on connecting piece.
3. Check sealing ring of new engine oil filter and apply a thin layer of engine oil.
4. Screw on and tighten engine oil filter by hand.
5. Replace other engine oil filters in the same way.
6. Check engine oil level (→ Page 169).
7. After changing engine oil and replacing oil filter(s), bar engine with starting equipment (→ Page 132).



7.14.2 Oil indicator filter – Check

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Cleaner (Snow-White 11-0)	40460	1
Cleaner (Hakupur 312)	30390	1
Engine oil		
Strainer	(→ Spare Parts Catalog)	
Square-section ring	(→ Spare Parts Catalog)	
O-ring	(→ Spare Parts Catalog)	

WARNING

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

WARNING

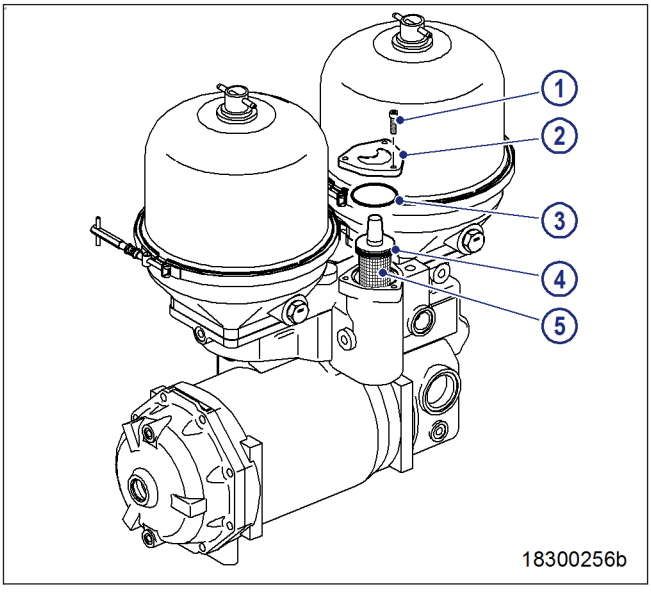
Compressed air
Risk of injury!
- Do not direct compressed-air jet at persons.
- Wear protective goggles / safety mask and ear protectors.

CAUTION

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

Removing strainer

1. Clean oil indicator filter before disassembling it.
2. Remove screws (1).
3. Take off cover (2) with O-ring (3).
4. Remove strainer (5) from housing and allow oil to drip into container.



TIM-ID: 0000036227 - 002

Cleaning strainer

1. Shake coarse contamination out of strainer (5).
2. Clean all metallic parts with cleaner (Snow-White 11-0), then rinse with cleaner (Hakupur 312).
3. Use a soft brush to remove stubborn deposits from strainer if required. Ensure that the mesh is not damaged.
4. Blow out strainer (5) with compressed air from inside.

Checking strainer

Item	Findings	Action
Strainer	Metallic residues	• Clean • Monitor engine operation • Check strainer daily • Contact Service.
Strainer	Damaged	Fit new part
Square-section ring	Damaged	Fit new part
O-ring	Damaged	Fit new part

Installing strainer

1. Coat square-section ring (4) on strainer (5) with engine oil and install strainer (5).
2. Insert strainer into housing.
3. Fill housing with new engine oil.
4. Coat O-ring (3) with engine oil and fit in filter housing.
5. Fit cover (2) and secure with screws (1) and washers.

7.14.3 Centrifugal oil filter – Cleaning and filter sleeve replacement

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Torque wrench, 6-50 Nm	F30027336	1
Cold cleaner (Hakutex 60)	X00056750	1
Filter sleeve	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	
Sealing ring	(→ Spare Parts Catalog)	

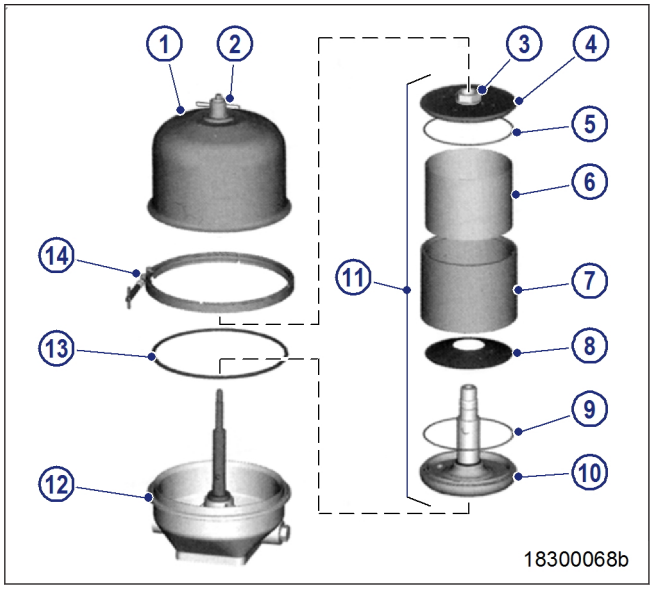
WARNING

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

WARNING

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

Centrifugal oil filter – Cleaning and filter sleeve replacement



1. Remove clamp (14).
2. Release cover screw (2) and take off cover (1).
3. Carefully lift rotor (11), allow oil to drain and remove from housing.
4. Holding the rotor (11) firmly, release rotor cover nut (3).
5. Take off rotor cover (4).
6. Remove filter sleeve (6).
7. Measure thickness of oil residues on filter sleeve (6).
8. If maximum layer thickness of oil residues exceeds 45 mm, shorten maintenance interval.
9. Disassemble rotor tube (7), conical disk (8) and rotor base (10).
10. Wash rotor cover (4), rotor tube (7), conical disk (8) and rotor base (10) with cold cleaner.
11. Blow out with compressed air.
12. Check sealing ring (9), fit new one if necessary.
13. Assemble rotor tube (7), conical disk (8) and rotor base (10) with sealing ring (9).
14. Insert new filter sleeve (6) in rotor tube (7) with the smooth paper surface facing the outer wall.
15. Check sealing ring (5), fit new one if necessary.
16. Mount rotor cover (4) with sealing ring (5).
17. Tighten rotor cover nut (3) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Nut		Tightening torque		35 Nm to 45 Nm

18. Place rotor (11) in housing (12) and check for ease of movement.
19. Check sealing ring (13), fit new one if necessary.
20. Fit sealing ring (13) on housing (12).
21. Fit cover (1).
22. Fit cover screw (2) by hand.
23. Install clamp (14) and tighten with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Clamp		Tightening torque		8 N to 10 Nm

24. Tighten cover nut (2) with torque wrench to the specified torque.

Name	Size	Type	Lubricant	Value/Standard
Screw		Tightening torque		5 Nm to 7 Nm

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

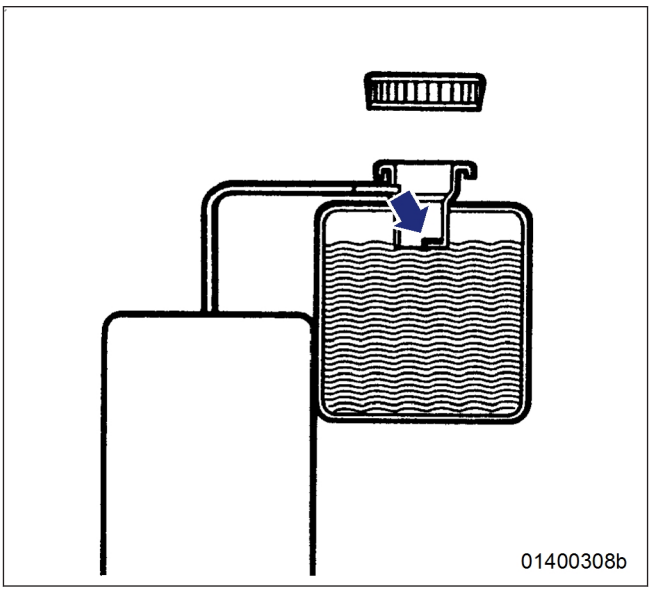
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Checking engine coolant level at filler neck:

1. Turn breather valve on coolant expansion tank counterclockwise to the first stop and allow pressure to escape.
2. Continue to turn breather valve counterclockwise and remove.
3. Check engine coolant level (coolant must be visible at the bottom edge of the filler neck's cast eye).

Checking engine coolant level at remote cooler:

1. Check engine coolant level (coolant must be visible at marker plate).
2. Top up engine coolant if necessary (→ Page 179).
3. Check and clean breather valve.
4. Place breather valve on filler neck and close.



Checking engine coolant level via level sensor:

1. Switch on engine control system and check readings on the display.
2. Top up engine coolant if necessary (→ Page 179).

7.15.2 Engine coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Engine coolant – Change

1. Drain engine coolant (→ Page 178).
2. Fill with engine coolant (→ Page 179).

7.15.3 Engine coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

WARNING

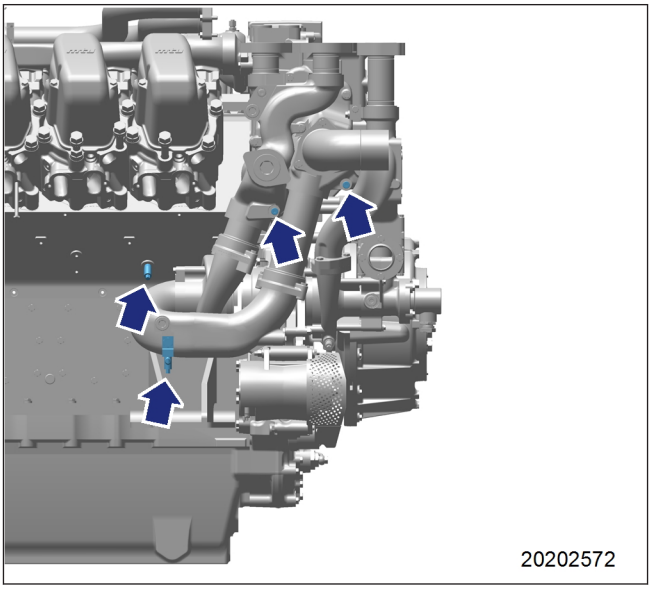
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Preparatory steps

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

Engine coolant – Draining

1. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
2. Continue to turn breather valve counter-clockwise and remove.
3. Draw off separated corrosion inhibitor oil in expansion tank through the filler neck.
4. Open drain valves and/or drain plugs and drain coolant at the following points:
   - Preheating unit
   - Thermostat housing
   - Twin elbow
   - HT coolant pump elbow;
   - Crankcase, left and right sides.
5. Close all open drain points.
6. Place breather valve on filler neck and close.



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

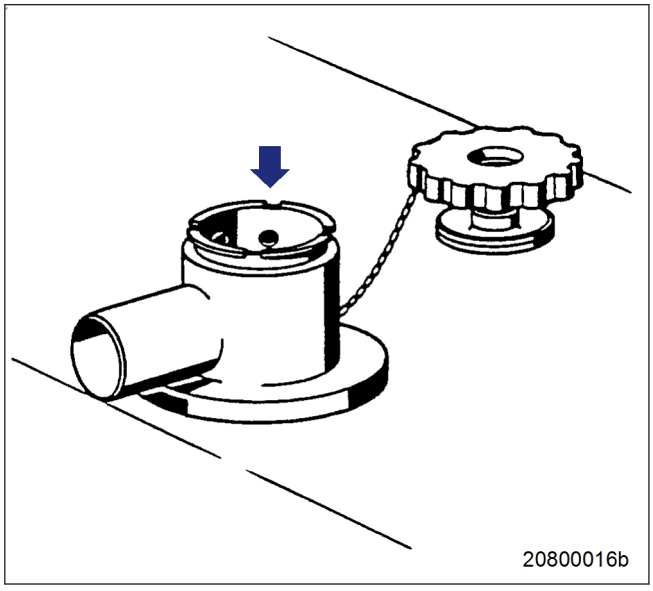
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

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

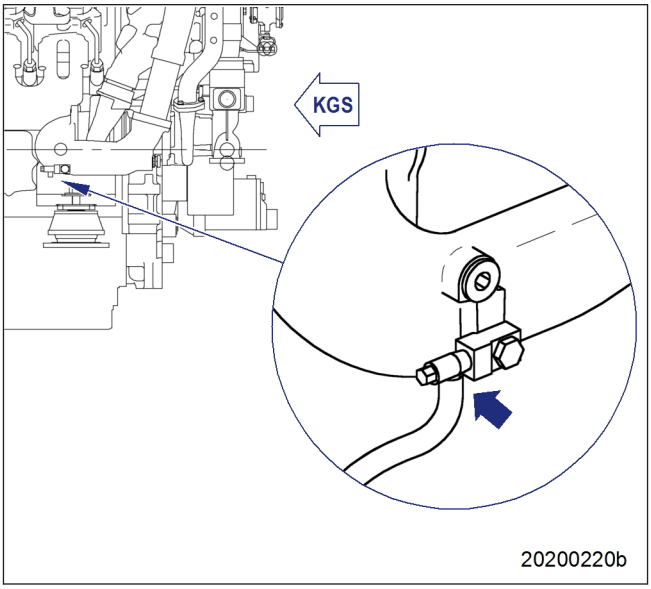
Preparatory steps

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

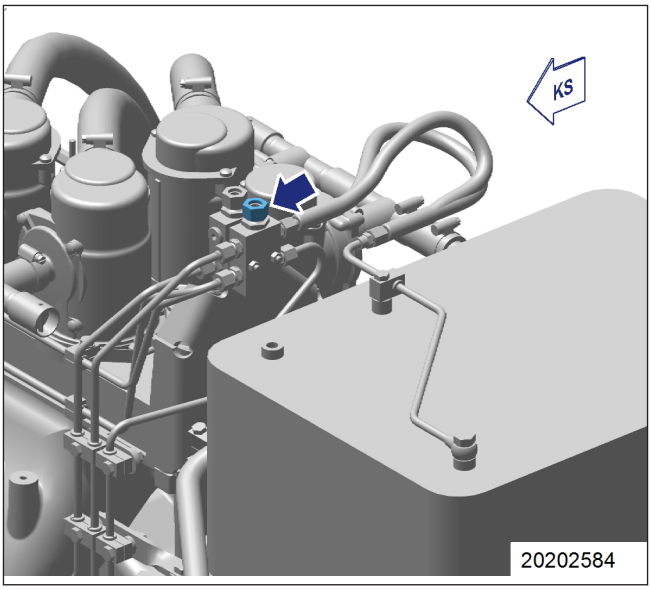


Filling with coolant using a pump

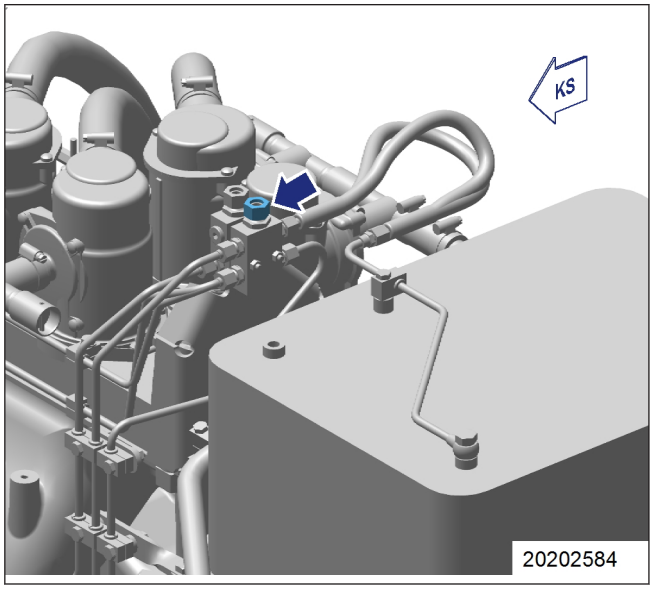
1. Connect appropriate pump with hose to the drain valve of the engine coolant pump (arrow).



2. Undo the vent line union at the distributor piece (arrowed).
3. Open drain valve and pump coolant into engine at 0.5 bar minimum.
4. Tighten the union (arrowed) if coolant leaks out at the loose union.
5. Fill expansion tank until overflow edge is reached.
6. Close drain valve.
7. Check proper condition of breather valve on coolant expansion tank, clean sealing faces if required.
8. Fit breather valve and close it.
9. Start engine (→ Page 69).
10. After 10 seconds of running the engine without load, shut down the engine (→ Page 73).
11. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
12. Continue to turn breather valve counterclockwise and remove.
13. Check coolant level (→ Page 176) and top up engine coolant as required:
    a) Top up coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
    b) Fit breather valve and close it.
14. Repeat the steps from "Start engine" (→ Step 9) until coolant is no longer needed to be topped up.
15. Disconnect pump and hose.



Alternatively: Filling with coolant through filler neck



1. Undo the vent line union at the distributor piece (arrowed).
2. Top up coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
3. Tighten the union (arrowed) if coolant leaks out at the loose union.
4. Check proper condition of breather valve on coolant expansion tank, clean sealing faces if required.
5. Fit breather valve and close it.
6. Start engine (→ Page 69).
7. After 10 seconds of running the engine without load, shut down the engine (→ Page 73).
8. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
9. Turn breather valve counterclockwise and remove.
10. Check coolant level (→ Page 176) and top up with coolant through the filler neck if required:
    a) Top up coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
    b) Fit breather valve and close it.
11. Repeat the steps from "Start engine" (→ Step 6) until coolant is no longer needed to be topped up.

Final steps

1. Start the engine and run it without load for some minutes.
2. Check coolant level (→ Page 176) and top up engine coolant as required.

7.15.5 Engine coolant pump – Relief bore check

DANGER

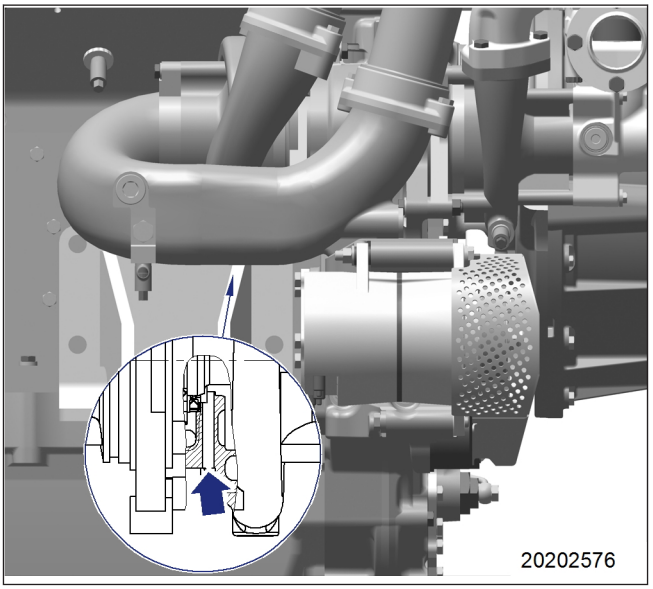
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

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

Engine coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Shut down engine (→ Page 73) and disable engine start, observe general safety instructions “Maintenance and Repair”.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



7.15.6 Engine coolant – Sample extraction and analysis

Preconditions

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

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
MTU test kit	5605892099/00	1

DANGER

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

WARNING

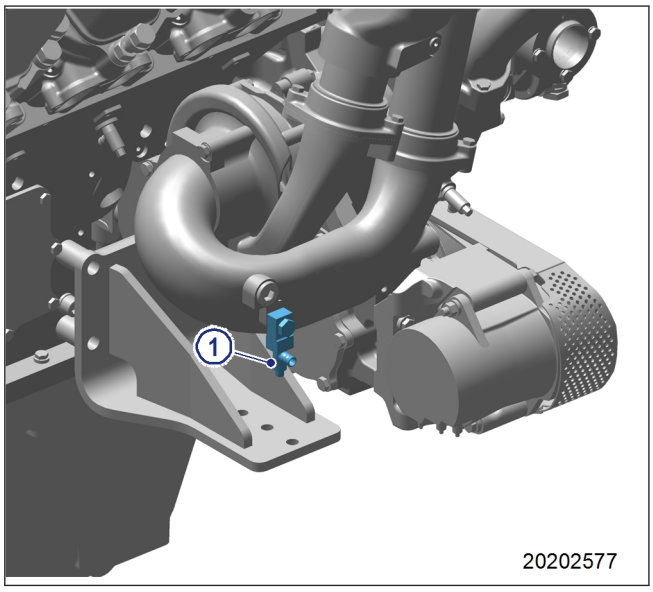
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

WARNING

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

Engine coolant – Sample extraction and analysis

1. With the engine running, open drain valve (1).
2. Flush sample-extraction point by draining approx. 1 liter coolant.
3. Drain approx. 1 liter coolant into a clean container.
4. Close drain valve (1).
5. Using the equipment and chemicals of the MTU test kit, check the coolant for:
   - Antifreeze concentration
   - Corrosion inhibitor concentration
   - pH value.
6. For engine coolant change intervals, (→ MTU Fluids and Lubricants Specifications (A001061/..)).



7.16 Low-Temperature Circuit

7.16.1 Charge-air coolant – Level check

Preconditions

☑ Engine is stopped and starting disabled.

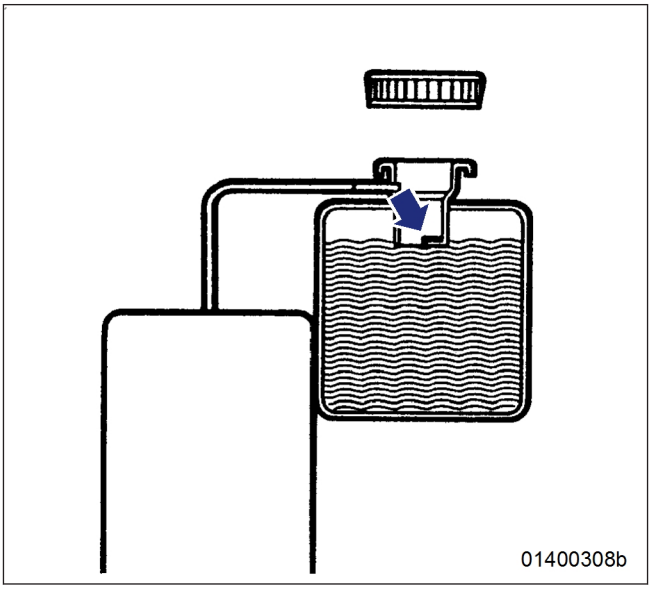
☑ MTU Fluids and Lubricants Specifications (A001061/..) are available.

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 counter-clockwise and remove.
3. Check coolant level (coolant must be visible at marking plate).
4. Top up coolant if necessary (→ Page 187).
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 187).

7.16.2 Charge-air coolant – Change

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

Charge-air coolant – Change

1. Drain charge-air coolant (→ Page 186).
2. Fill with charge-air coolant (→ Page 187).

7.16.3 Charge-air coolant – Draining

Preconditions

☑ Engine is stopped and starting disabled.

Special tools, Material, Spare parts

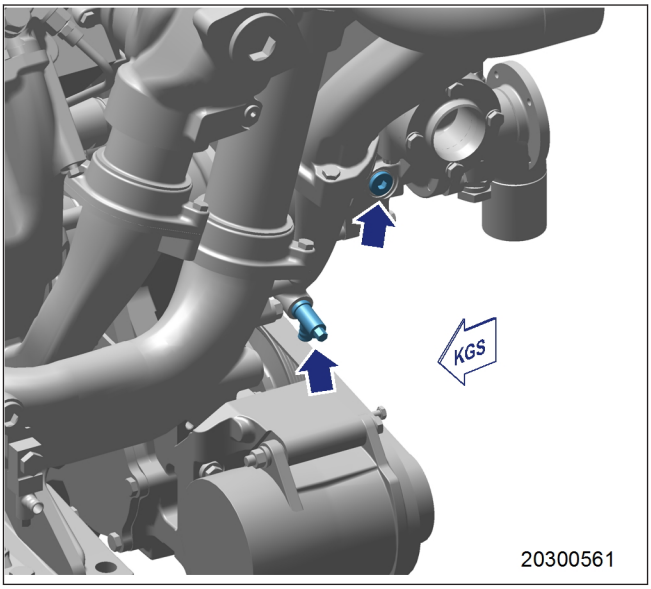
Designation / Use	Part No.	Qty.
Sealing ring	(→ Spare Parts Catalog)	

WARNING

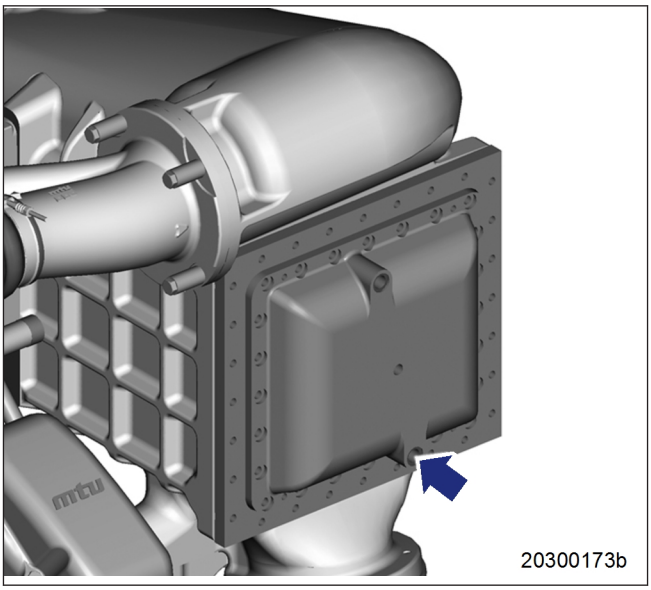
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

Charge-air coolant – Draining

1. Provide an appropriate container to drain the coolant into.
2. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
3. Continue to turn breather valve counter-clockwise and remove.
4. Draw off separated corrosion inhibitor oil in expansion tank through the filler neck.
5. Open drain valves and/or drain plugs and drain coolant at the following points:
   - at the LT coolant pump
   - at the LT thermostat housing.



6. Draining of residual coolant:
   - at the intercooler
7. Close all drain valves and screw in drain plugs with new sealing rings.
8. Place breather valve on filler neck and close.



7.16.4 Charge-air coolant – Filling

Preconditions

☑ Engine is stopped and starting disabled.

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

Special tools, Material, Spare parts

Designation / Use	Part No.	Qty.
Coolant		

WARNING

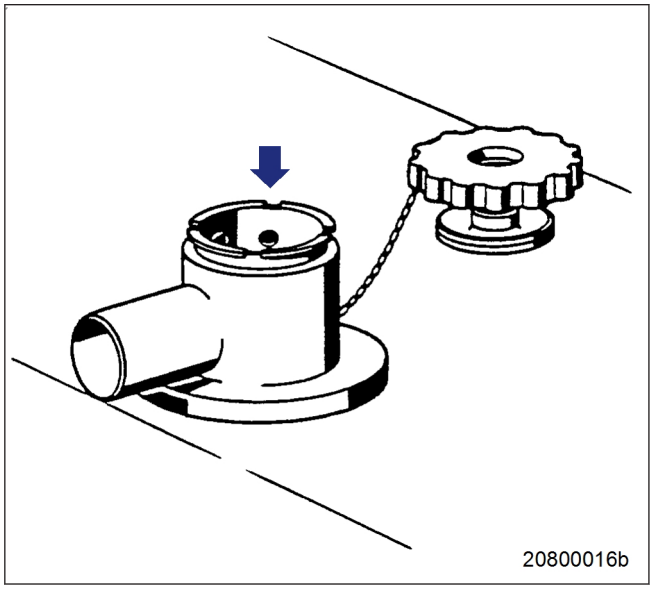
Coolant is hot and under pressure.
Risk of injury and scalding!
- Let the engine cool down.
- Wear protective clothing, gloves, and goggles / safety mask.

CAUTION

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

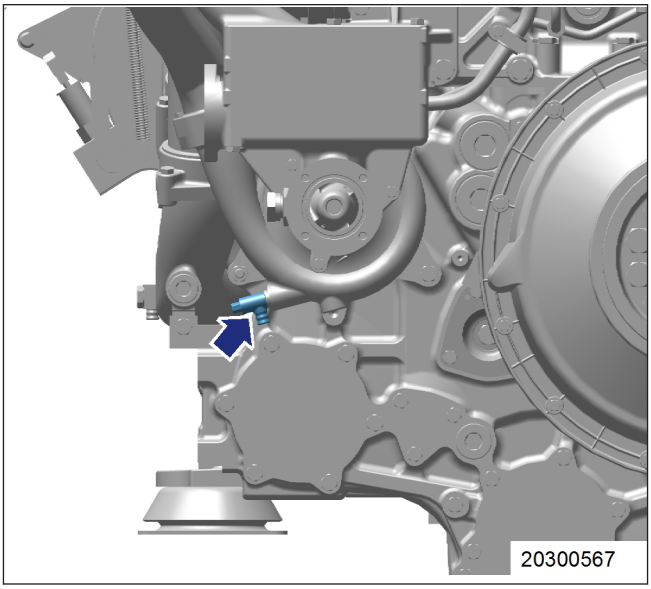
Preparatory steps

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

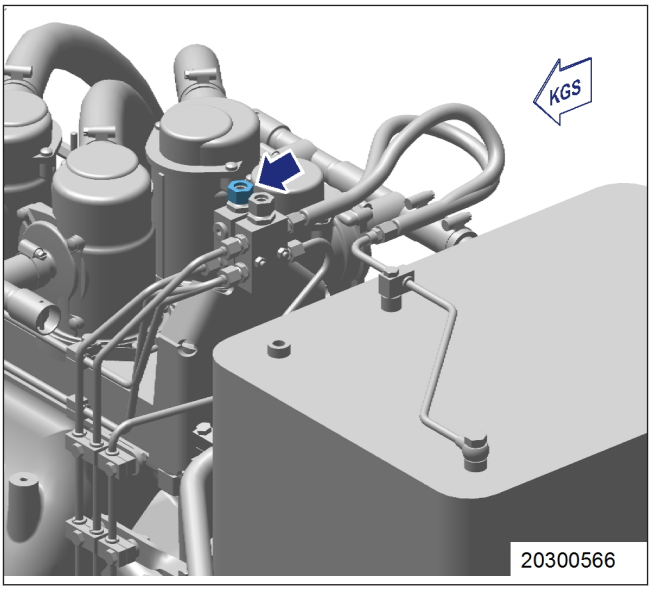


Filling with coolant using a pump

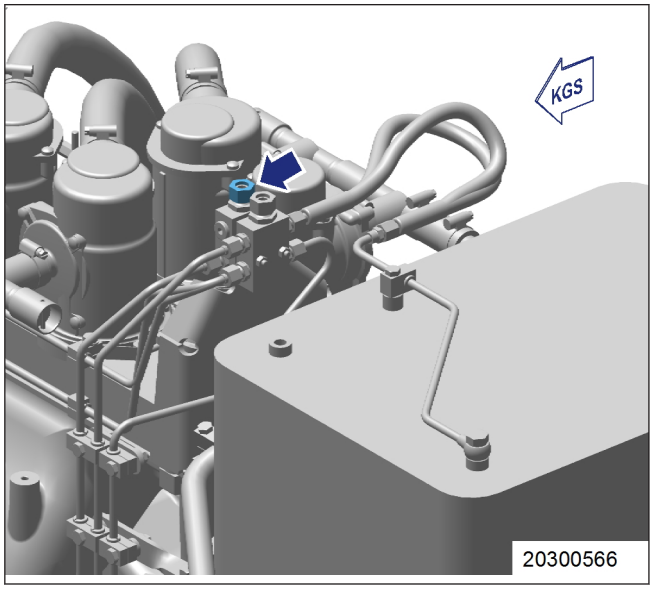
1. Connect a suitable pump with a hose to the drain valve (arrowed).



2. Undo the vent line union at the distributor piece (arrowed).
3. Open drain valve and pump coolant into engine at 0.5 bar minimum.
4. Tighten the union (arrowed) if coolant leaks out at the loose union.
5. Fill expansion tank until overflow edge is reached.
6. Close drain valve.
7. Check proper condition of breather valve and clean sealing faces if required.
8. Place breather valve on filler neck and close.
9. Start engine (→ Page 69).
10. After 10 seconds of running the engine without load, shut down the engine (→ Page 73).
11. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
12. Continue to turn breather valve counterclockwise and remove.
13. Check coolant level (→ Page 184) and top up coolant as required:
    a) Fill in coolant in expansion tank until the coolant level at top edge of filler neck remains constant.
    b) Place breather valve on filler neck and close.
14. Repeat the steps from "Start engine" (→ Step 9) until coolant is no longer needed to be topped up.
15. Disconnect pump and hose.



Alternatively: Filling with coolant through filler neck



1. Undo the vent line union at the distributor piece (arrowed).
2. Top up coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
3. Tighten the union (arrowed) if coolant leaks out at the loose union.
4. Check proper condition of breather valve on coolant expansion tank, clean sealing faces if required.
5. Fit breather valve and close it.
6. Start engine (→ Page 69).
7. After 10 seconds of running the engine without load, shut down the engine (→ Page 73).
8. Turn breather valve of coolant expansion tank counterclockwise until the first stop and allow pressure to escape.
9. Turn breather valve counterclockwise and remove.
10. Check coolant level (→ Page 184) and top up with coolant through the filler neck if required:
    a) Top up coolant in expansion tank via filler neck until coolant level at top edge of filler neck remains constant.
    b) Fit breather valve and close it.
11. Repeat the steps from "Start engine" (→ Step 6) until coolant is no longer needed to be topped up.

Final steps

1. Start the engine and run it without load for some minutes.
2. Check coolant level (→ Page 184) and top up coolant as required.

7.16.5 Charge-air coolant pump – Relief bore check

DANGER

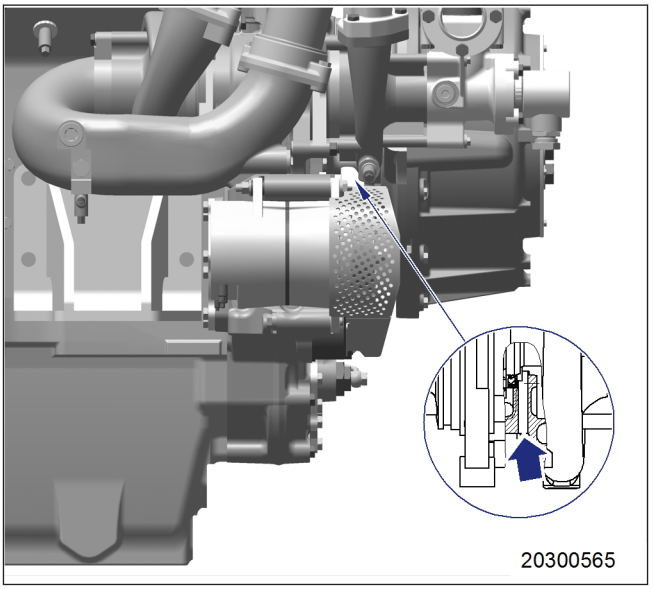
Unguarded rotating and moving engine components.
Risk of serious injury – danger to life!
- Take special care when working on a running engine.

WARNING

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

Charge-air coolant pump – Relief bore check

1. Check relief bore for oil and coolant discharge.
2. Shut down engine (→ Page 73) and disable engine start, observe general safety instructions “Maintenance and Repair”.
3. Clean the relief bore with a wire if it is dirty.
   - Permissible coolant discharge: up to 10 drops per hour;
   - Permissible oil discharge: up to 5 drops per hour.
4. If discharge exceeds the specified limits: Contact Service.



7.17 Belt Drive

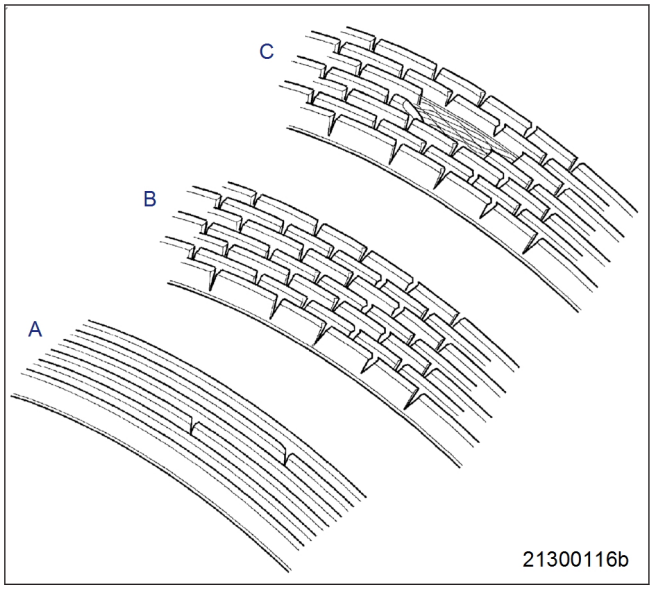
7.17.1 Drive belt – Condition check

Preconditions

☑ Engine is stopped and starting disabled.

☑ Guard is removed.

Drive belt – Condition check



Item	Findings	Action
Drive belt A	Singular cracks	None
Drive belt	Belt is oily, shows signs of over-heating	Replace (→ Page 193)
Drive belt B	Cracks on entire circumference	
Drive belt C	Chunking	

TIM-ID: 0000000920 - 010

7.18 Battery-Charging Generator

7.18.1 Battery-charging generator drive – Drive belt tension adjustment

Preconditions

☑ Engine is stopped and starting disabled.

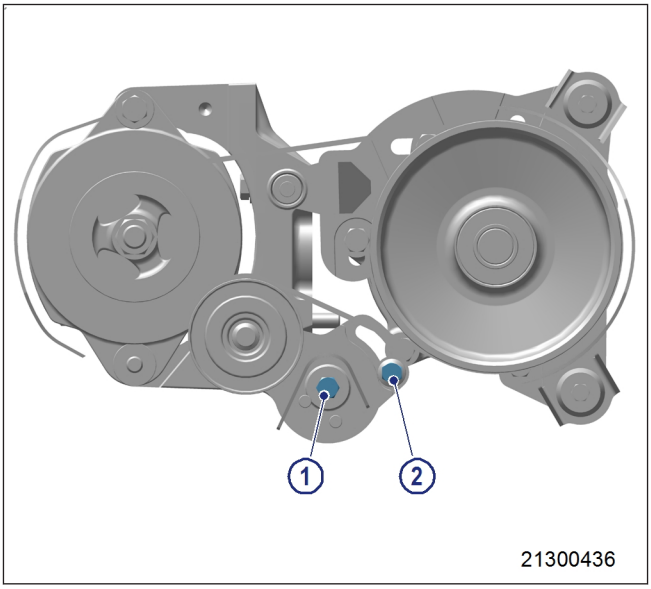
WARNING

Spring/circlip/tensioning roller preload.
Risk of injury!
- Only use specified tool and equipment.

Adjusting belt tension

1. Remove protective cover.
2. Slacken screws (1) and (2) by half a turn.

Result: Belt tensioner moves against the drive belt and tensions it.



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

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		60 Nm +5 Nm

4. Tighten screw (1) to specified tightening torque using a torque wrench.

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		42 Nm

5. Install protective cover.

7.18.2 Battery-charging generator drive – Drive belt replacement

Preconditions

☑ Engine is stopped and starting disabled.

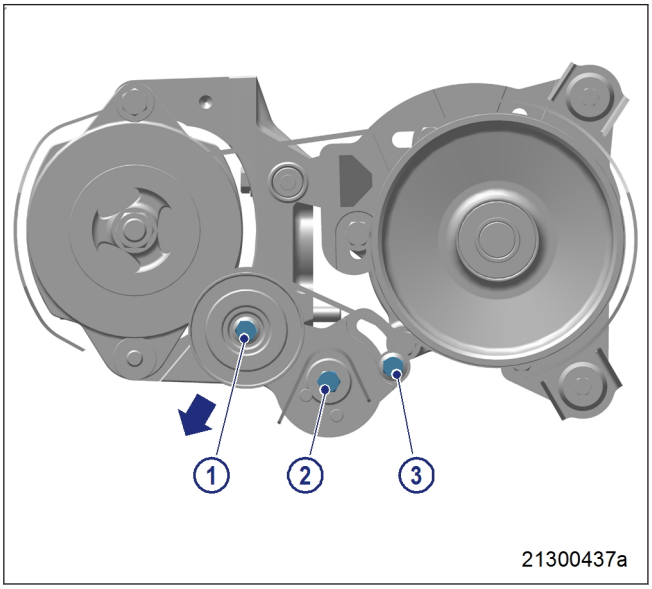
WARNING

Spring/circlip/tensioning roller preload.
Risk of injury!
- Only use specified tool and equipment.

Battery-charging generator drive – Drive belt replacement

1. Remove protective cover.
2. Slacken screws (2) and (3) by half a turn.
3. Mount socket or box wrench on screw (1) and press belt tensioner in direction of arrow as far as the stop.
4. Tighten screw (3).
5. Remove the used drive belt.
6. Fit new drive belt.
7. Slacken screw (3) by half a turn.

Result: Belt tensioner moves against the drive belt and tensions it.



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

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		60 Nm +5 Nm

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

Name	Size	Type	Lubricant	Value/Standard
Screw	M10x1.5	Tightening torque		42 Nm

10. Install protective cover.
11. Readjust belt tension after 30 minutes and again after 8 hours engine runtime (→ Page 192).

7.19 Engine Mounting / Support

7.19.1 Engine mounting – Check

Engine mounting – Check

Item	Findings	Action
Visually inspect mounts.	• Damage • Brittleness • Deformation • Crack formation • Swelling visible	Replace (contact Service).

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

Engine wiring – Check

1. Check securing screws of cable clamps on engine and tighten loose threaded connections.
2. Ensure that cables are fixed in their clamps and cannot swing freely.
3. Check that cable ties are firm, tighten loose cable ties.
4. Replace faulty cable ties.
5. Visually inspect the following electrical line components for damage:
   - connector housings;
   - contacts;
   - sockets;
   - cables and terminals;
   - plug-in contacts.
6. (→ Contact Service) if cable conductors are damaged.

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

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

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 with isopropyl alcohol.
2. Remove dirt from connector and cable surfaces with isopropyl alcohol.
3. Check legibility of cable labels. Clean or replace illegible labels.

Cleaning severely contaminated connectors on 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.

7.21.2 Engine governor – Checking plug-in connections

Preconditions

☑ Engine is stopped and starting disabled.

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

Checking plug-in connections on engine governor

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

7.21.3 ECU 7 engine governor – Removal and installation

Preconditions

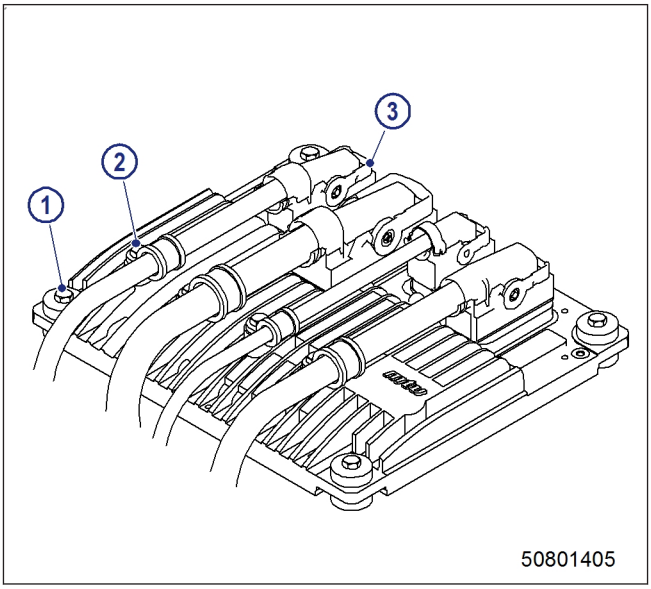
☑ Engine is stopped and starting disabled.

CAUTION

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

Removing Engine Control Unit from engine

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



Installing Engine Control Unit on engine

1. Install in reverse order. In doing so, ensure correct assignment of connectors and sockets.
2. Check rubber mounts before installation.

Result: Replace rubber mounts if they are found porous or defective.

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	
ANSI	American National Standards Institute	Association of American standardization organizations
ATL	Abgasturbolader	Exhust turbocharger (ETC)
ATS	Air Temperature Sensor	
BR	Baureihe	Series
BV	Betriebsstoffvorschrift	MTU Fluids and Lubricants Specifications, publication No. A01061/..
CAN	Controller Area Network	Data bus system, bus standard
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	
CPS	Coolant pressure sensor	
CTS	Coolant temperature sensor	
DDEC	Detroit Diesel Electronic Controls	Engine control system made by Detroit Diesel
DDL	Diagnostic Data Link	
DDR	Diagnostic Data Reader	
DIN	Deutsches Institut für Normung e. V.	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	Diesel particulate filter	
DT	Diagnostic Tool	
ECM	Electronic Control Module	Electronic control unit of the DDEC system
ECU	Engine Control Unit	Engine governor
EDM	Engine Data Module	Memory module for engine data
EEPROM	Electrically Erasable Programmable Read Only Memory	
EFPA	Electronic Foot Pedal Assembly	
EGR	Exhaust Gas Recirculation	

Abbre-viation	Meaning	Explanation
EMU	Engine Monitoring Unit	
ETK	Ersatzteilkatalog	Spare Parts Catalog (SPC)
EUI	Electronic Unit Injector	
FPS	Fuel Pressure Sensor	
FRS	Fuel Differential Pressure Sensor	
FTS	Fuel Temperature Sensor	
FWCP	Fire Water Control Panel	
GND	Ground	
HP	High pressure	
HI	High	Alarm: Measured value exceeds 1st maximum limit
HIHI	High High	Alarm: Measured value exceeds 2nd maximum limit value
HT	High Temperature	
IDM	Interface Data Module	Memory module for interface data
INJ	Injector	
ISO	International Organization for Standardi-zation	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
LED	Light Emitting Diode	
LO	Low	Alarm: Measured value lower than 1st minimum limit value
LOLO	Low Low	Alarm: Measured value lower than 2nd minimum limit value
LSG	Limiting Speed Governor	
N/A	Not Applicable	
LP	Low pressure	
OEM	Original Equipment Manufacturer	
OI	Optimized Idle	
OLS	Oil Level Sensor	
OPS	Oil pressure sensor	
OTS	Oil Temperature Sensor	
OT	Oberer Totpunkt	Top dead center (TDC)
PAN	Panel	Control panel
PIM	Peripheral Interface Module	
PWM	Modulated signal	
P-xyz	Pressure-xyz	Pressure measuring point, xyz specifies the meas-uring 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

Abbre-viation	Meaning	Explanation
SEL	Stop engine light	1st function: Warning lamp (stop engine and rectify fault) 2nd function: Read out fault codes
SID	System Identifier	
SRS	Synchronous Reference Sensor	TDC cylinder 1
SS	Safety System	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
UT	Unterer Totpunkt	Bottom dead center (BDC)
VNT	Variable nozzle turbine	
VSG	Variable-speed governor	
VSS	Vehicle Speed Sensor	
WZK	Werkzeugkatalog	Tool Catalog

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 at Headquarters: Service-support@mtu-online.com

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

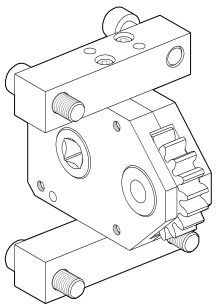
Phone: +49 7541 908555

Fax: +49 7541 908121

9 Appendix B

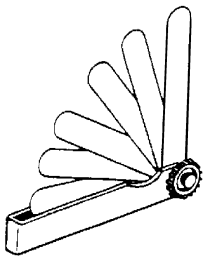
9.1 Special Tools

Barring device



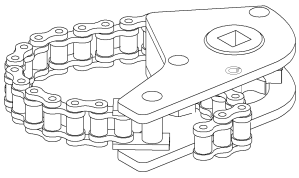
Part No.:	F6555766
Qty.: Used in:	1 7.1.1 Engine – Barring manually (→ Page 131)

Feeler gauge



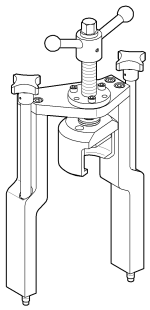
Part No.:	Y20010128
Qty.: Used in:	1 7.4.2 Valve clearance – Check and adjustment (→ Page 141)

Filter wrench



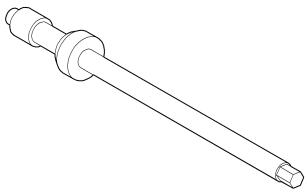
Part No.:	F30379104
Qty.: Used in:	1 7.8.1 Fuel filter – Replacement (→ Page 153)
Qty.: Used in:	 7.14.1 Engine oil filter – Replacement (→ Page 171)

Installation/removal tool



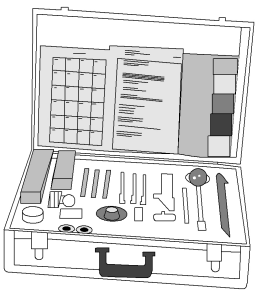
Part No.:	F6789889
Qty.:	1
Used in:	7.6.2 Injector – Removal and installation (→ Page 147)

Milling cutter



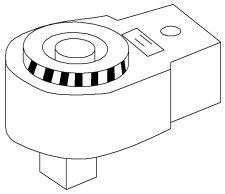
Part No.:	F30452739
Qty.:	1
Used in:	7.6.2 Injector – Removal and installation (→ Page 147)

MTU test kit



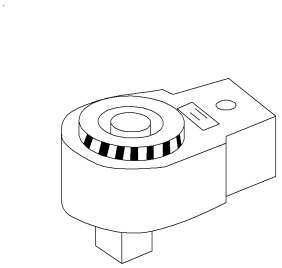
Part No.:	5605892099/00
Qty.:	1
Used in:	7.13.3 Engine oil – Sample extraction and analysis (→ Page 170)
Qty.:	1
Used in:	7.15.6 Engine coolant – Sample extraction and analysis (→ Page 183)

Ratchet adapter



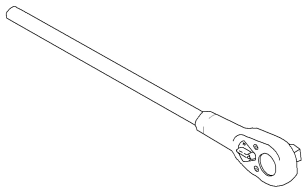
Part No.:	F30027340
Qty.:	1
Used in:	7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 138)

Ratchet adapter



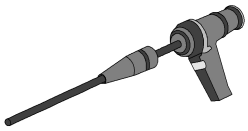
Part No.:	F30027341
Qty.:	1
Used in:	7.13.1 Engine oil – Change (→ Page 167)

Ratchet with extension



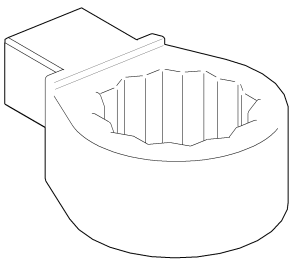
Part No.:	F30006212
Qty.:	1
Used in:	7.1.1 Engine – Barring manually (→ Page 131)

Rigid endoscope



Part No.:	Y20097353
Qty.:	1
Used in:	7.2.1 Cylinder liner – Endoscopic examination (→ Page 134)

Ring socket, 24 mm



Part No.:	F30039526
Qty.:	1
Used in:	7.4.2 Valve clearance – Check and adjustment (→ Page 141)

Steam jet cleaner

Part No.:	-
Qty.:	1
Used in:	4.11 Plant cleaning (→ Page 77)

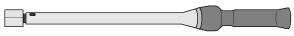
Torque wrench, 0.5-5 Nm

Part No.:	0015384230
Qty.:	1
Used in:	7.6.2 Injector – Removal and installation (→ Page 147)

Torque wrench, 10-60 Nm

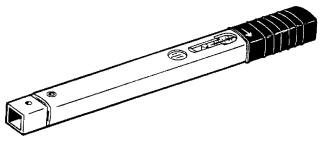
Part No.:	F30510423
Qty.:	1
Used in:	1.4 Crankshaft transport locking device (→ Page 8)

Torque wrench, 10-60 Nm



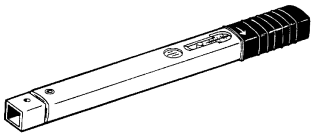
Part No.:	F30452769
Qty.:	1
Used in:	7.6.2 Injector – Removal and installation (→ Page 147)

Torque wrench, 40-200 Nm



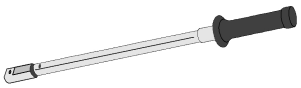
Part No.:	F30027337
Qty.: Used in:	1 7.13.1 Engine oil – Change (→ Page 167)

Torque wrench, 6-50 Nm



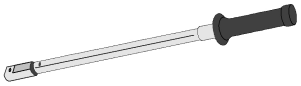
Part No.:	F30027336
Qty.: Used in:	1 7.3.1 Crankcase breather – Oil separator element replacement, diaphragm check and replacement (→ Page 138)
Qty.: Used in:	1 7.14.3 Centrifugal oil filter – Cleaning and filter sleeve replacement (→ Page 174)

Torque wrench, 60-320 Nm



Part No.:	F30047446
Qty.: Used in:	1 7.4.2 Valve clearance – Check and adjustment (→ Page 141)

Torque wrench, 60-320 Nm



Part No.:	F30047446
Qty.: Used in:	1 1.4 Crankshaft transport locking device (→ Page 8)

Torque wrench, 60-320 Nm

Part No.:	F30452768
Qty.:	1
Used in:	7.6.2 Injector – Removal and installation (→ Page 147)

9.2 Index

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