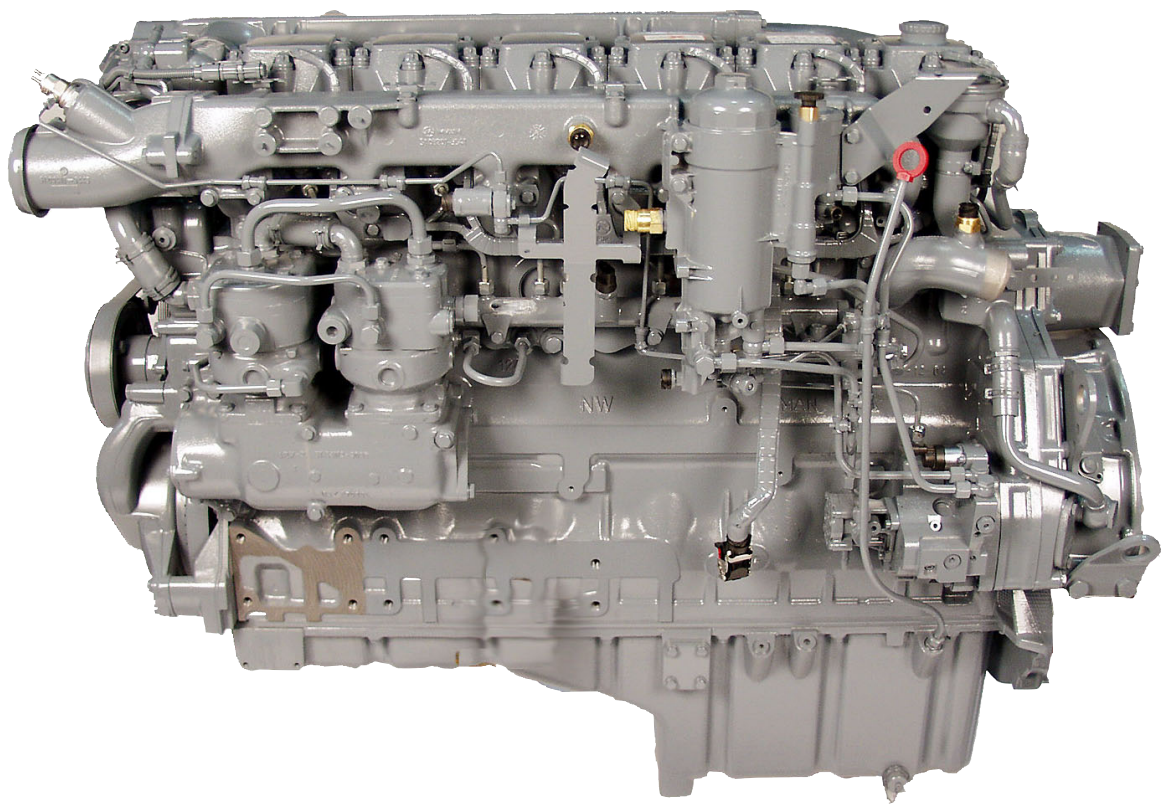


WORKSHOP MANUAL

LIEBHERR

DIESEL-ENGINE

D 846 CR A7



9739306

LIEBHERR

Name	Value	Units
Modul	3	
Voltage (sliding-gear)	24	V
Output	6,6	kW

2.2.15 Air compressor

Name	Value	Units
Flow rate at nominal speed 1900 min ⁻¹ and 10.5 bar	550	l/min
Übersetzungsverhältnis	1:1,15	
Water-cooled	Yes	
Einbautemperatur Lagerinnenring	min. 100 max. 120	°C °C

2.2.16 Turbocharger with Waste-Gate

Name	Value	Units
Waste-Gate opening pressure	2,55	bar
Full stroke	3,5	mm

2.2.17 Assembly tightening torque in accordance with the works' standard

Unless special tightening torques have been prescribed, and with the exception of secondary or fixed connections, screw connections should always be tightened using workshop-approved torque wrenches or precision rotary screw drivers.

The torques once tightened, should not deviate from the specified settings by more than ±15%.

Note**Using the tables**

- ! For connecting elements featuring strengths other than those specified, always apply the tightening torque of the part with the least strength class (e.g. screw with strength class 8.8, nut with strength class 10; tightening torque to comply with the 8.8 column).
- ! If a part featuring a slotted hole is to be screwed to a part featuring a borehole, always tighten from the borehole side out.
- ! The tightening of grooved screws and nuts to slotted holes is not permissible.
- ! When screwing a soft component to a hard component, always screw from the side of the harder component wherever possible.
- ! Always use washers when screwing hexagonal screws and nuts onto light-alloy surfaces.
- ! Ribbed screws and nuts may not be used on light alloys.
- ! Screws featuring washer head or flange head may only be tightened with a ring spanner or socket spanner due to the low height of the spanner's working surface.

Table 1

Assembly-nominal tightening torque M_A for screw connections with flat bearing face

Nominal thread size x pitch	Tensile strengths (screw / nut) in Nm			
	Flat hexagon socket or hexagon head			Washer head or flange head
	8.8/8	10.9/10	12.9/12	10.9/10
M 4	2,5	4	4,5	—
M 5	5	7,5	9	9
M 6	9	13	15	15
M 7	14	20	25	—
M 8	22	30	35	35
M 8x1	23	35	40	40
M 10	45	65	75	75
M 10x1,25	45	65	75	75
M 10x1	50	70	85	85
M 12	75	105	125	115
M 12x1,5	75	110	130	120
M 12x1,25	80	115	135	125
M 14	115	170	200	175
M 14x1,5	125	185	215	190
M 16	180	260	310	280
M 16x1,5	190	280	330	300
M 18	260	370	430	380
M 18x2	270	390	450	400
M 18x1,5	290	410	480	420
M 20	360	520	600	540
M 20x2	380	540	630	560
M 20x1,5	400	570	670	590
M 22	490	700	820	—
M 22x2	510	730	860	740
M 22x1,5	540	770	900	780
M 24	620	890	1040	—
M 24x2	680	960	1130	—
M 24x1,5	740	1030	1220	—

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Note

Using tables 2 and 3

Apply caution when working with screws featuring washer heads with grooved bearing surfaces (e.g. Verbus rib):

- ! When refitting screws and nuts featuring grooved or serrated bearing face (e.g. for repair tasks), always use new screws or nuts on the side which is being tightened
- ! When screwing a soft component to a hard component, always screw from the side of the harder component wherever possible.
- ! When tightening galvanised grooved screws on the screw head, on components made of ductile cast iron (GGG) or from softer materials, the prescribed assembly nominal tightening torque is to be increased approx. 15%.
- ! When tightening components with their surfaces painted, with more than two joint surfaces, pay particular attention to the thickness of the surface coating layer and the type of paint, as the prestressing force could be considerably reduced if several more coatings of paint are applied. If necessary, optimisation of the tightening torque by practical testing during tightening may be required .

Table 2

Assembly-nominal tightening torque M_A for screw connections with grooved or serrated bearing face (washer head or flange head)

Thread sizes x pitch	Prestressing force F_V max. in kN	Tensile strengths (screw / nut) in Nm					
		10.9/10 galvanised (yellow) material group		10.9/10 phosphated (black)		12.9/12 phosphated (black) material group	
	¹⁾	1	2			1	2
M 5	13,6	8	11	²⁾	²⁾		
M 6	16,4	14	19	²⁾	²⁾		
M 8	29,9	33	45	²⁾	²⁾		
M 10	48,3	70	95	²⁾	²⁾		
M 12	81,6					150	170
M 12x1,5	74,7	120	150	²⁾	²⁾		
M 14	112,7					260	320
M 14x1,5	105,8	210	280	²⁾	²⁾		
M 16	154,1					360	425
M 16x1,5	143,7	270	370	²⁾	²⁾		
M 18x2	203,5					520 ³⁾	520 ³⁾
M 18x1,5	219,6					550 ³⁾	550 ³⁾

¹⁾Furthermore, pay attention to the prestressing force as under no circumstances may the values in table 2 be exceeded. A reduction of below $0.5 F_{V \max.}$ in the effective applied prestressing force following final fastening of the threaded union is not permissible and must be optimised via tightening tests.

²⁾Will be determined, or details in the technical documentation.

³⁾Applies for Durlok screws only (serrated washer head).

Table 3

Assembly-nominal tightening torque M_A for grooved screws featuring a tensile strength of 100, phosphated

Nominal thread size x pitch	Tensile strength (screw / nut) in Nm	
	Material group 1	Material group 2 ¹⁾
M 5	10	11
M 6	17	19
M 8	40	45
M 10	85	95
M 12x1,5	150	170
M 14x1,5	260	320
M 16x1,5	360	425
¹⁾ When tightening softer materials, the assembly nominal tightening torques for Ø — M 14 can be increased by 15%, and for Ø — M 16, by 10% as required.		

Material group 1	Harder materials, e.g.	C45, C60, cast steel (GS)
		tempered or hardened materials
		Cast iron (GG) and malleable cast iron (GTS)
		Ductile cast iron (GGG), only for Ø M 12x1,5 ¹⁾
Material group 2	Slightly less hard materials, e.g.	(ductile cast iron (GGG), only for Ø M 14 ¹⁾)
		QSTE340, QSTE420, M 22, ST2K60
	Softer materials, e.g.	ST12, ST13, ST14, STO3Z, STO5Z, STO7Z
		ST37-2, ST280Z
¹⁾ When using galvanised grooved screws (yellow) with a tensile strength of 10.9/10 (table 2), all values apply for material group 1.		

2.2.18 Assembly tightening torques, deviating from the works' standard

Note



All screw connections for which the intended use has not been listed in the following tables, are to be tightened in accordance with "assembly tightening torques in accordance with the works' standard".

! Lightly oil screws before fixing.

! Tolerance in accordance with the works' standard, if not specified, max. ± 15%

Locking screws		
DIN 908	M 14x1,5, M 16x1,5	80 Nm
	M 18x1,5, M 22x1,5	100 Nm
	M 24x1,5, M 26x1,5	120 Nm
	M 30x1,5	150 Nm
DIN 7604	AM 10x1, M 12x1,5	50 Nm
	AM 14x1,5	80 Nm

Crankcase / flywheel housing / aggregate support				
			Initial tightening	Definitive tightening
Crankshaft main bearing cover on crankcase	M 18x2		300 Nm + 30 Nm	90° + 10°
Connecting rod bearing cap	M 14x1,5 (Torx)	10.9	100 Nm + 10 Nm	90° + 10°
Flywheel on crankshaft, 1st angular torque	M 16x1,5	12.9	100 Nm + 10 Nm	90° + 10°
Flywheel on crankshaft, 2nd angular torque	M 16x1,5	12.9		90° + 10°
Diesel engine support on crankcase	M 14	12.9		225 Nm
Thrust washer on flywheel housing	M 8	12.9		40 Nm
Flywheel housing on crankcase	M 10	12.9		75 Nm
Vibration damper on crankshaft	M 16x1,5	10.9		260 Nm
Fastening screws drive hub	M 8x16	8.8		23 Nm
Drive gear high-pressure pump	M 10x35	10.9		65 Nm
Drive gear air compressor	M 10x35	10.9		65 Nm
High-pressure gear wheel	M 18x1,5			100 Nm + 10 Nm
Fastening nut drive gear	M 18x1,5			110 Nm
Fastening screws drive gear	M 10x35	10.9	45 Nm	90°
Fastening screws aggregate support	M 8x28, M 8x90, M8x120	8.8		22 Nm

Cylinder head				
Tightening / retightening of the cylinder head bolts, see "Cylinder head bolts"				
			Initial tightening	Definitive tightening
Lock nut on valve adjuster screw	M 12x1	8.8		45 Nm
Lock nut on retainer (ZBS)	M 10x1	8.8		45 Nm
Fastening screw cylinder head cover	M 8x30	8.8		23 Nm

Cooling system				
			Initial tightening	Definitive tightening
Locking screw coolant pump housing	M 42x1,5			170 Nm
Hose connection	M 26x1,5			100 Nm
Collar screw coolant pump on crankshaft (central screw)	M 12x1,5	10.9	30 Nm	180°
Fastening screw coolant pump	M 12x45	8.8		75 Nm
Fastening screw coolant pump	M 12x65	8.8		75 Nm
Fastening screws thermostat housing	M 8x125	8.8		22 Nm
Fastening screws coolant manifold	M 8x35	8.8		22 Nm

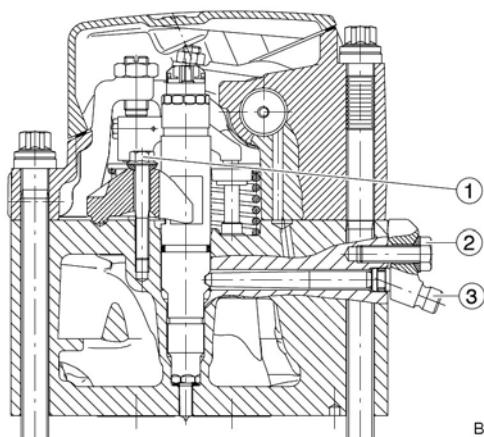
Piston and connecting rod				
			Initial tightening	Definitive tightening
Connecting rod bearing bolts	M 14x1	10.9	100 Nm + 10 Nm	90° + 10°

Lubrication				
			Initial tightening	Definitive tightening
Oil spray nozzle on crankcase	M 14x1,5			70 Nm
Oil pick-up pipe on oil pump	M 8x55	8.8		22 Nm
Fastening screws oil pick-up pipe	M 8x35	8.8		22 Nm
Oil pump on crankcase	M 8	8.8		22 Nm
Pressure limiting valve on oil pump	M 8x55	8.8		22 Nm
Cover on oil pump	M 8	8.8		22 Nm
Oil cooler on oil filter head	M 8	8.8		22 Nm
Oil filter cover				25 Nm + 5 Nm
Fastening screws oil filter module	M 10x35, 10x170	8.8		45 Nm
Oil pressure sensor	M 18x1,5			44 Nm
Pressure sensor	M 18x1,5			45 Nm + 5 Nm
Hose connection	M 26x1,5			80 Nm
Oil sump on crankcase	M 8x40	8.8		22 Nm
Locking screw (oil drain plug) on oil sump	M 26x1,5	10.9		80 Nm
Fastening screw ventilation manifold	M 10x70	8.8		45 Nm
Pipe clamp crankcase breather				9 Nm

Exhaust / suction elbow				
Tightening / retightening of exhaust manifold screws / nuts from the inside out				
			Initial tightening	Definitive tightening
Exhaust manifold on cylinder head	M 10		60 Nm + 5 Nm	90° + 10°
Exhaust manifold on cylinder head	M 10		60 Nm + 5 Nm	90° + 10°
Crossover pipe exhaust pipe on AGR module	M 8x20			30 Nm
Heat flaps exhaust manifold	M 8x12			23 Nm
Hose clip crankcase breather				5,5 Nm
Flame glow plug	M 32x1,5			25 Nm
Fastening screws air induction pipe	M 8	10.9		35 Nm
Fastening screws intercooler manifold	M 10	8.8		45 Nm
Temperature sensor	M 16x1,5			45 Nm
Hose clamps induction pipe				5,5 Nm

Exhaust gas recirculation (EGR module)				
			Initial tightening	Definitive tightening
Fastening screws AGR module	M 10x85	8.8	10 Nm	45 Nm
Induction pipe on cylinder head	M 8	10.9		30 Nm
Crossover pipe exhaust pipe on AGR module	M 8x20			30 Nm
Crossover pipe AGR module on induction pipe	M 8x22	8.8		22 Nm
Fastening screws coolant manifold	M 8x35	8.8		23 Nm
Fastening screws connecting manifold	M 8x20			30 Nm
Fastening screws housing EGR flap	M 8x25	8.8		16 Nm
Fastening screws angle bracket	M 8x30	8.8		16 Nm
Fastening screws crossover pipe	M 8x25	8.8		23 Nm
Fastening screws control cylinder	M 8x40	8.8		10 Nm

Turbocharger with Waste-Gate				
			Initial tightening	Definitive tightening
Turbocharger fastening — collar nut			10 Nm + 5 Nm	90° + 10°
Fastening nuts on the exhaust manifold	M 10			60 Nm + 5 Nm
Fastening nuts on the turbocharger	M 10			60 Nm + 5 Nm
Hose clamps intake manifold	M 6	8.8		9 Nm
Fastening screws oil return pipe	M 8x20	8.8		22 Nm



- 1 Screw hold-down plate of the injector
 2 Screw for adapter to the high-pressure line
 3 High-pressure line

Common Rail				
			Initial tightening	Definitive tightening
Fastening nut drive gear high-pressure pump	M 18x1,5			100 Nm + 10 Nm
Fastening screw high-pressure pump on crankcase	M 10x40	8.8		45 Nm
Hexagon socket head screw adapter flange	M 10x25	8.8		45 Nm
Oil filler plug high-pressure pump	M 10x1			18 Nm
Assembly sequence injector — high-pressure line				
1. Screw hold-down plate of the injector (1)			1,5 Nm	
2. High-pressure line (3)			10 Nm	
3. Screw for the adapter to the high-pressure line (2)			10 Nm	
4. Screw hold-down plate of the injector (1)			25 Nm	90°
5. Screw for the adapter to the high-pressure line (2)				20 Nm
Screw for the adapter to the high-pressure line (2), angular torque				90°
6. High-pressure line (3), initial mounting				60°
6. High-pressure line (3), subsequent mounting				30°
Electrical connections to the injector				1,5 Nm
Fastening screw pressure pipe	M 8x65	8.8		22 Nm
Pressure sensor				100 Nm 5 Nm
Rail pressure sensor				70 Nm 5 Nm

Fuel-Service-Centre (KSC)				
			Initial tightening	Definitive tightening
Hand pump tappet				4 Nm
Fastening screws holding plate	M 6x20	8.8		9 Nm
Fastening screws heating element	M 5x10			6,5 Nm
Banjo bolts	M 14x1,5			max. 22 Nm
Check valve	M 14x1,5			30 Nm + 10 Nm
Fuel filter cover				22,5 Nm + 5 Nm
Fuel pre-filter cover				22,5 Nm + 5 Nm
Pressure switch	M 18x1,5			40 Nm + 10 Nm

Flame-type start system				
			Initial tightening	Definitive tightening
Flame glow plug	M 32x1,5			max. 25 Nm
Fastening screws solenoid valve	M 6x12	8.8		9 Nm
Support solenoid valve	M 10x1			15 Nm
Electrical connection flame glow plug	M 4			5 Nm
Line to heater plug	M 10x1			10 Nm

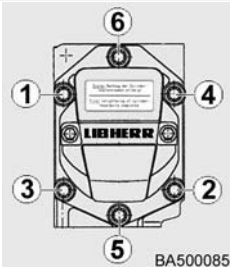
Air compressor				
			Initial tightening	Definitive tightening
Fastening nuts stud bolts	M 8	10.9		30 Nm
Air compressor to aggregate support top	M 8x55	10.9		30 Nm
Air compressor to aggregate support bottom	M 8x65	10.9		30 Nm
Air compressor to crankcase	M 10x135	10.9		65 Nm
Fastening screw pipe clamp	M 8x30	8.8		22 Nm
Fastening screw power steering pump	M 10x30	10.9		45 Nm
Fastening screw cylinder liner	M 8x30	10.9		40 Nm
Cylinder head bolts	M 8x100	10.9	21 Nm	90°
Fastening screw drive gear	M 18x1,5	10.9		360 + 3 Nm
Fastening screw sealing cap	M 8x25	8.8		23 Nm
Connecting rod bolts	M 8x38	10.9	10 Nm	90°
pressure regulating valve	M 26x1,5			95 Nm
Screw plugs for air connections	M 26x1,5			80 Nm
Screw plugs for coolant connections	M 22x1,5			80 Nm
Installation temperature bearing inner ring				100 °C — 120 °C

Accessories				
			Initial tightening	Definitive tightening
Starter mounting on flywheel housing	M 12x1,5			80 Nm
Fastening nut ribbed V-belt pulley	M 16x1,5			75 Nm + 10 Nm
Fastening screw generator	M 10x120	8.8		45 Nm
Fastening screw generator	M 12x45	8.8		75 Nm
Fastening screw belt tensioner				150 Nm
Fastening screw fan clutch	M 10x20	10.9		75 Nm
Fan drive on aggregate support	M 8x28	8.8		22 Nm
Operation torque fan drive				7 Nm
Fastening screws drive gear air compressor	M 10x35	10.9		65 Nm
Fastening screw coolant compressor	M 10x130	8.8		45 Nm
Fastening screw coolant compressor	M 10x40	8.8		45 Nm

2.2.19 Cylinder head bolts

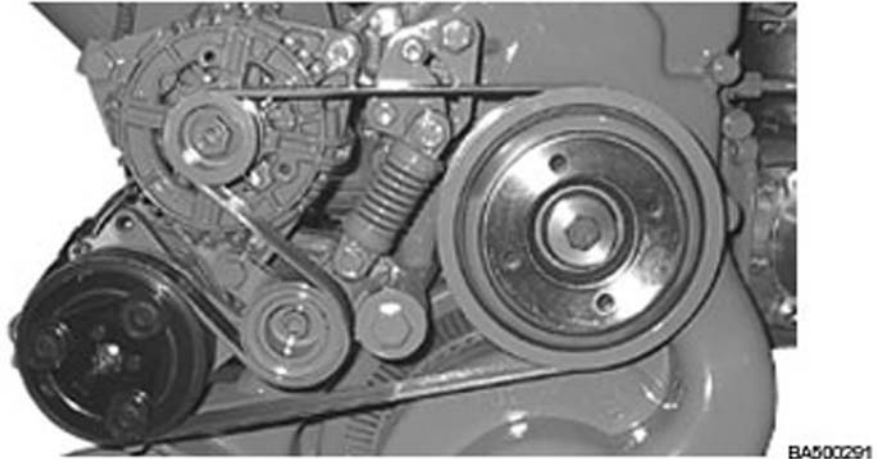
Summary of tightening torques for cylinder head bolts (angle of rotation screws with Torx head)

For detailed information and working steps, see "Cylinder head".

Reuse	L-min.	L-max.	
Ident. no.10222344	225,80 mm \pm 0,05	227,80 mm	
Ident. no.10222343	mm 287,30 mm \pm 0,05	289,30 mm	
Tightening torque following repair 1. Initial tightening 2. Initial tightening 3. Initial tightening 4. Angular torque 5. Definitive tightening	Initial tightening 10 Nm 80 Nm 150 Nm 90° + 10°	Definitive tightening 90° + 10°	

Checking condition of the ribbed V-belt

The ribbed V-belt with automatic tensioning device is located at the front on the diesel engine, running of the ribbed V-belt varies depending on the circumference of the diesel engine, e.g. with generator and generator drive with coolant compressor.



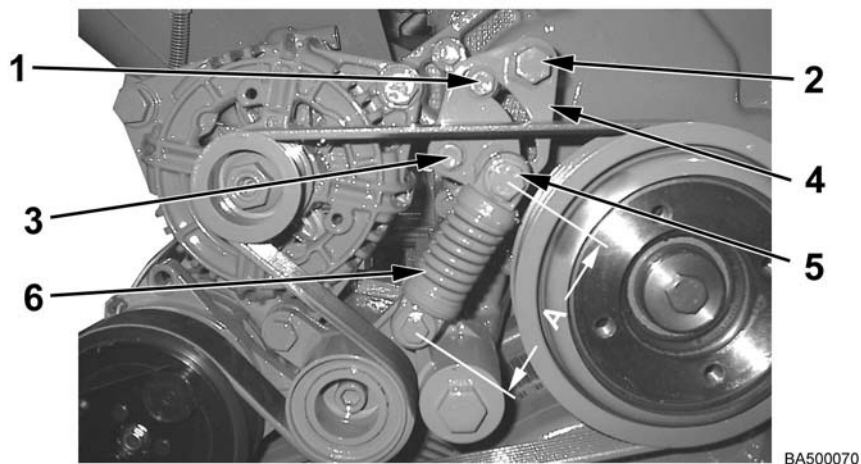
Generator drive with coolant compressor

It must be ensured that:

- the diesel engine is in the maintenance position

Checking ribbed V-belt for external damage:

- Rib fractures
- Transversal fractures of several ribs
- Rubber nodules in between the ribs
- Deposition of dirt, oil or stones
- Ribs becoming loosened from the belt
- Transversal fractures on the belt exterior



1 Screw
2 Retainer

3 Screw
4 Tensioning plate

5 Fastening screw

6 Damping unit

A Tensioning clearance

- Check the tensioning clearance **A** using the slide gauge from the middle of the screw head to the middle of the screw head on the damping unit **6**.

Pretensioning on the automatic tensioning device is correct when the tensioning clearance **A** is within the tolerance.

- Should damage or stretching occur, replace the viscous coupling.

Name	Value	Units
Tensioning clearance A	91,5 ±1	mm mm

Replacing the ribbed V-belt, see "Drive and fan".

Cylinder head

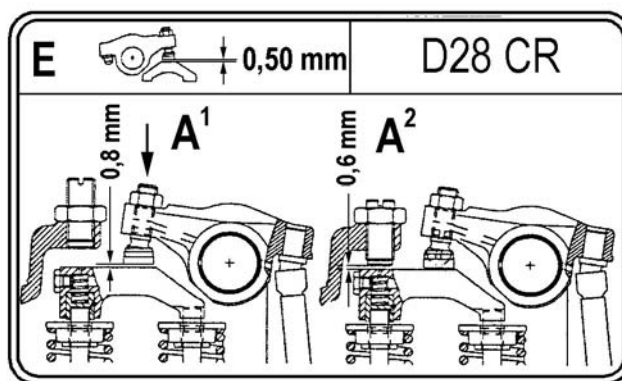
A retightening of the cylinder head bolts is not required within the parameters of the maintenance work.



NA120685

The information plate is mounted on one of the cylinder head bolts.

Preparation for checking and adjustment of valve clearance

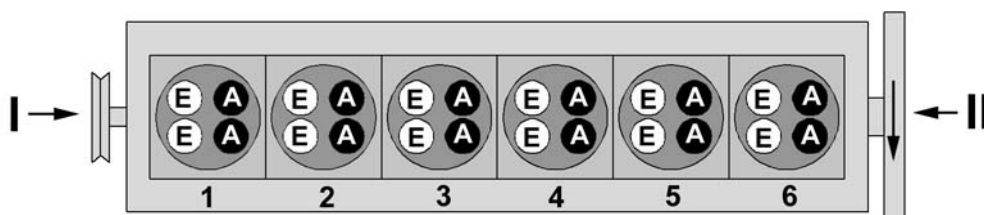


BA500530

Test clearance/adjustment clearance

E = Intake valve fitting/rocker arm = 0.5 mm
 A¹ = Exhaust valve fitting/rocker arm = 0.8 mm
 A² = Exhaust valve fitting/retainer = 0.6 mm

Diesel engines with 4-valve cylinder heads and ZBS are identified via this sign, attached to one of the valve covers.



BA500345

I the opposite side to the flywheel
 II flywheel side of the diesel engine

A Exhaust valve
 E Intake valve

Diagram of the cylinder sequence and the valve arrangement for 6-cylinder diesel engine with 4 valve heads.

The 1st cylinder is located on the opposite side of the flywheel.

Run the diesel engine until the rocker arm of the cylinder which is to be adjusted is relieved of load. The rocker arms of the constant velocity cylinder are then overlapping.

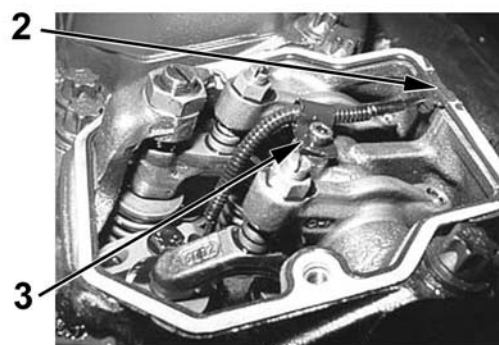
Valves of the cylinder						
overlap	1	5	3	6	2	4
adjust	6	2	4	1	5	3

It must be ensured that:

- the diesel engine is in the maintenance position,
- the diesel engine is lukewarm (below 50° C),
- tools 1 — 1.1 and 34 are on-hand,
- the adjustment values are on-hand, see sign, attached to one of the valve covers, or see "Technical Data".



1 Control cable for injector
2 Cylinder head cover seal with cable bushing



3 Fastening screw

BA500393

- Unscrew the fastening screws of the cylinder head cover.
- Remove cylinder head cover.
- Unscrew the control cable for the injector 1.
- Remove cylinder head cover seal with cable bushing. 2



BA500346

- Unscrew cover from inspection hole on the flywheel housing.
- Mount the diesel engine turning gear on the inspection hose of the fly wheel housing (tool no. 1 to 1.1).

Check and adjust intake valve clearance

Note



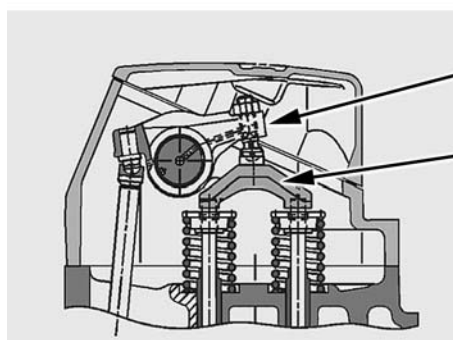
Whenever a check is carried out, the valve fitting must be pushed all the way down to the stop.

! Ensure that the valve fitting and the bearing face of the adjusting screws do not tilt, otherwise the feeler gauge will stick and the outcome of the measurement will be incorrect.

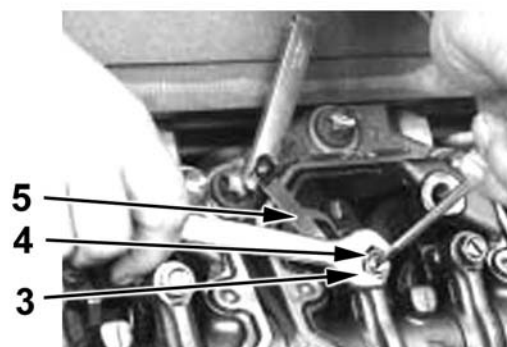
- Turn the diesel engine with the turning gear so that the piston in the cylinder to be adjusted is in the "TDC" position and all valves are closed.

This will be the case if the valves for the cylinder with constant velocity piston overlap.

Valves of the cylinder						
overlap	1	5	3	6	2	4
adjust	6	2	4	1	5	3



- 1 Rocker arm
- 2 Valve fitting
- 3 Lock nut



- 4 Adjusting screw
- 5 Feeler gauge — tool no. 34

BA500347

Both intake valves are actuated together via a valve fitting 2 by a rocker arm 1.

- Insert the 5 0.5 mm feeler gauge between valve fitting 2 and rocker arm 1.
- Loosen the lock nut 3 and turn the adjusting screw 4 with the screw driver until the feeler gauge can be moved with little resistance.
- Tighten the lock nut with the prescribed tightening torque, see "Technical Data".

Retain the adjusting screw using the screwdriver.

Countercheck: Push rods must indicate clearance.

- Measure the clearance again.

Troubleshooting

The valve clearance does not correspond with the adjustment values? See "Technical Data".

- Loosen the lock nut on the adjusting screw of the respective rocker arm and adjust the setting.
- Tighten the lock nut with the prescribed tightening torque, see "Technical Data".
- Check adjustment again

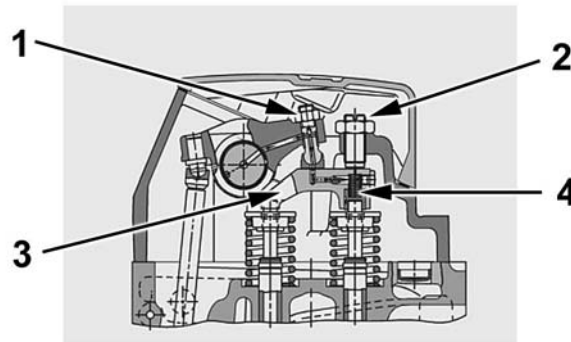
Check the exhaust valve and adjust with diesel engine auxiliary braking system (ZBS)

Note



Whenever a check is carried out, the valve fitting must be pushed all the way down to the stop.

! Ensure that the valve fitting and the bearing face of the adjusting screws do not tilt, otherwise the feeler gauge will stick and the outcome of the measurement will be incorrect.



BA500348

- 1 Adjusting screw (rocker arm-valve fitting)
2 Adjusting screw (retainer-valve fitting)

- 3 Valve fitting
4 Piston

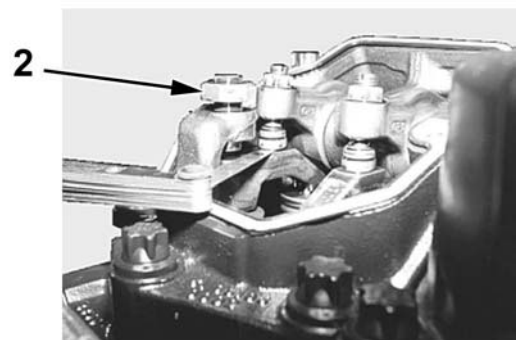
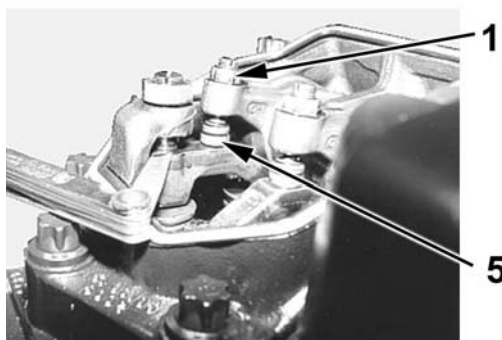
Attention



Adjusting screw, rocker arm-valve fitting **1** for ZBS is different from the adjusting screw for intake valves as they feature a lateral bore.

! With the ZBS, **never** use screws without lateral bore.

- Insert the 0.8 mm feeler gauge between valve fitting and adjusting screw (rocker arm -valve fitting **1**) and check the valve clearance, adjust as necessary
- Insert the 0.6 mm feeler gauge between valve fitting and adjusting screw (retainer -valve fitting **2**) and check the valve clearance, adjust as necessary



BA500349

- 1 Adjusting screw (rocker arm-valve fitting)

- 2 Adjusting screw (retainer-valve fitting)
5 Ball socket (rocker arm-elephant foot)

- Turn back the adjusting screw (retainer-valve fitting **2**) until the contact face of the adjusting screw in the retainer is no longer visible.
- Turn back the adjusting screw (rocker arm-valve fitting **1**) until it is possible to insert the 0.80 mm feeler gauge.

- Screw in the adjusting screw (rocker arm-valve fitting **1**) until the piston in the valve fitting reaches the stop and the feeler gauge clamps.

In order that remaining oil from the ball socket (rocker arm-elephant foot **5**) is forced out.

- Loosen the adjusting screw (rocker arm-valve fitting **1**) until it is possible to remove the feeler gauge against moderate resistance (suction).
- Tighten the lock nut with the prescribed tightening torque, see "Technical Data".

Retain the adjusting screw using the screwdriver.

- Screw in the adjusting screw (retainer-valve fitting) **2** with the 0.60 mm feeler gauge inserted until the piston of the valve fitting reaches the stop the clamps the feeler gauge.
- Loosen the adjusting screw (retainer-valve fitting) **2** until it is possible to remove the feeler gauge against moderate resistance (suction).
- Tighten the lock nut with the prescribed tightening torque, see "Technical Data".

Retain the adjusting screw using the screwdriver.

Countercheck: Push rods must indicate clearance.

- Measure the clearance again.

Troubleshooting

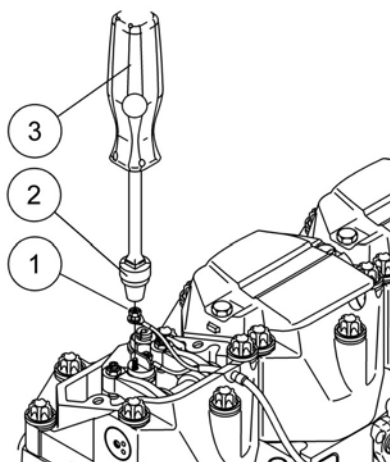
The valve clearance does not correspond with the adjustment values? See "Technical Data".

- Loosen the lock nut on the adjusting screw of the respective rocker arm and adjust the setting.
- Tighten the lock nut with the prescribed tightening torque, see "Technical Data".
- Check adjustment again

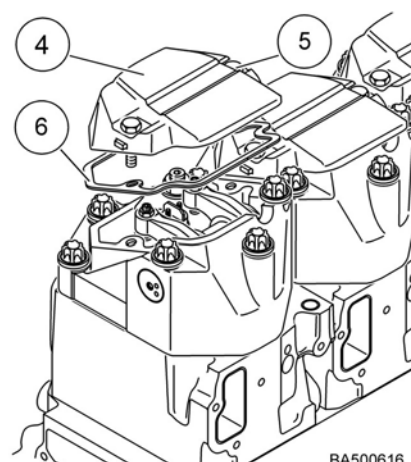
Finally, check and adjust the working valve clearance

Ensure that the following are on-hand:

- respective new cylinder head cover seals
- Dismantling the diesel engine turning gear.
- Fit the inspection hole cover and tighten with prescribed tightening torque.



1 Injector cable
2 7 mm socket
3 Torque wrench



4 Cylinder head cover
5 Fastening screw
6 Seal

- Tighten the injector cable **1** with 7 mm socket **2** and torque wrench **3** with the prescribed tightening torque.
- Guide the injector cable through the seal **6** and apply the seal.
- Align the cylinder head cover seal, ensuring that the cable bushing is sitting correctly.
- Mount the cylinder head cover **4** and tighten the fastening screws **5** with the prescribed tightening torque, see "Technical Data".

Checking the cooling system for leaks and for sound condition

- Check cooler, coolant pump and heat exchanger for the heating system for leaks.
- Check all lines and hoses of the cooling and heating system for leaks, ensure that they are correctly arranged without abrading one another and that they are free of damage.
- The washers should not become clogged with dirt.
Check cooler for external contamination.

Troubleshooting

Determine any leaks in the cooling system:

- Do not start the diesel engine.
 - Determine and remedy the cause, if necessary, consult the documentation of the engine manufacturer.
-

Checking the anticorrosive and antifreeze in the coolant

The coolant is to be checked for effectiveness if corrosion protection and frost protection is to be guaranteed.

- Run the diesel engine warm.
- Open the sealing cap of the filler neck.
- Obtain a sample of coolant using the areometer and take a coolant density reading on the float.

Should the analysis indicate insufficient antifreeze, the mix ratio is to be corrected, see "Fuel and Lubricants".

- Close the sealing cap of the filler neck.
- Run the diesel engine to operating temperature, whereby the thermostat must have opened at least once.
- Check anticorrosive and antifreeze in the coolant again.

Checking the oil system and fuel system for leaks and for sound condition

- Check oil sump, oil filter, injection pump and fuel filter for leaks.
- Check all lines and hoses of the oil and fuel systems, ensure that they are correctly arranged without abrading one another, are free of damage and are securely fastened.

Troubleshooting

Determine any leaks in the oil and fuel system:

- Do not start the diesel engine.
 - Determine and remedy the cause.
-

3.3.4 Maintenance tasks every 800 operating hours

Before carrying out the 800 operating hours maintenance tasks:

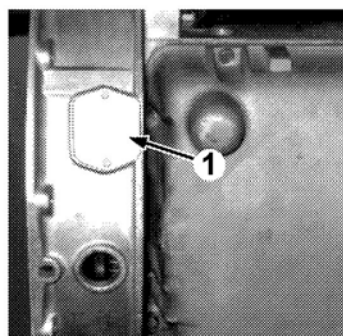
- perform the daily maintenance tasks, see “Maintenance tasks (daily) every 10 operating hours”.
- perform the weekly maintenance tasks, see “Maintenance tasks (weekly) every 50 operating hours”.
- perform the 400 operating hours maintenance tasks, see “Maintenance tasks every 400 operating hours”.

Lubricate ring gear on the flywheel

The inspection hole cover is mounted on the right-hand side of the diesel engine on the underside of the flywheel housing.

It must be ensured that:

- the diesel engine is in the maintenance position



BA500498

1 Inspection hole cover

- Unscrew the inspection hole cover **1** from the flywheel housing.

Do not over-lubricate the ring gear, otherwise the speed sensors will become smeared and fail.

- Check ring gear and, if necessary, grease lightly with regular lubricating grease
- Screw on the inspection hole cover once again and tighten with the prescribed tightening torque.

Checking the oil sump and diesel engine bracket for secure seating

It must be ensured that:

- the diesel engine is in the maintenance position
- Ensure that the oil sump is seated securely, if necessary retighten screws with the prescribed tightening torque.
- Check diesel engine brackets for sound condition and secure seating, if necessary retighten screws with the prescribed tightening torque.

Checking air intake and exhaust gas system for leaks and for sound condition

It must be ensured that:

- the diesel engine is in the maintenance position
- Check air intake lines between air filter and diesel engine for leaks, sound condition and secure seating, and remedy any faults which are determined.
- Check exhaust gas pipes for leaks, sound condition and secure seating, and remedy any faults which are determined.

Checking the flame-type start system

The flame-type start system is mounted on the left-hand side of the diesel engine.

Danger

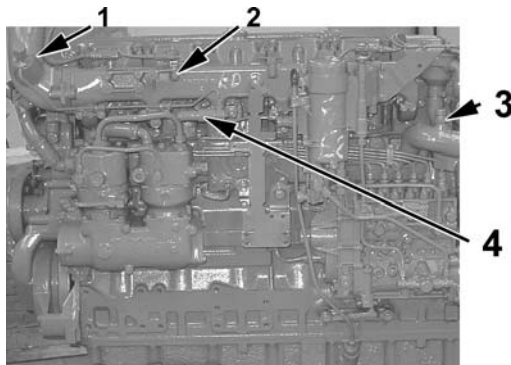


Risk of fire and explosion!

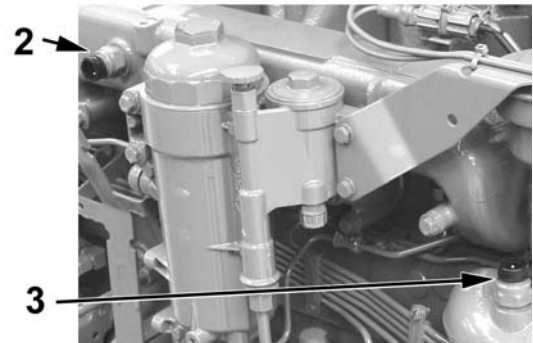
- ! No smoking.
- ! Avoid naked flames.

To check the flame-type start system above 20°C, the temperature cut-off can be deactivated, whereby the pin terminals are withdrawn from the temperature sensors. If the temperature sensor is disconnected, the system can be checked when the diesel engine is warm.

Should any faults occur with the flame-type start system, electrical functioning of the system should first be checked.



1 Flame glow plug
2 Solenoid valve



3 Temperature sensor
4 Temperature sensor

BA500397

- Disconnect cable from temperature sensor 3 and temperature sensor 4.
- Activate the system and allow the diesel engine to run at low speed. At the same time, observe the flame glow plug 2 directly through the induction pipe.

The flame must be fully developed and burning fiercely with low speed of the diesel engine, or if direct observation is not possible, the induction pipe must be warm to the touch where the spark plug is located.

Troubleshooting

No flame on the flame glow plug

- Replacing the flame glow plug, see "Flame-type start system".

- Connect cable to temperature sensor 3 and temperature sensor 4.

Clean and replace fuel pre-filter filter element

The KSC with fuel pre-filter is located on the left-hand side of the diesel engine, or the fuel pre-filter with water separator is mounted at a distance from the diesel engine.

Ensure that the following are on-hand:

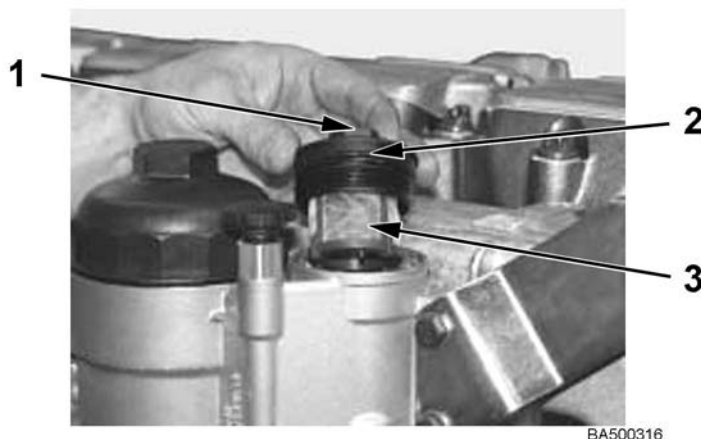
- an original Liebherr filter element
- the respective new sealing ring

Danger

Risk of fire and explosion!

- ! No smoking.
- ! Avoid naked flames.
- ! Only work on the diesel engine while the diesel engine is switched off.

- Close the fuel shut-off valve if featured.
- Clean the fuel pre-filter and the surrounding area thoroughly.



1 Housing cover

2 Sealing ring

3 Filter insert

- Unscrew housing cover 1.
- Remove and clean housing cover and filter insert 3.
- Replace sealing ring 2.
- Screw in the filter insert with housing cover and tighten with the prescribed tightening torque, see "Technical Data."
- Open fuel shut-off valve if featured.
- Bleed the fuel system, see further down in this chapter.
- Check the filter for leaks.

Cleaning and replacing fuel pre-filter with water separator filter element

Ensure that the following are on-hand:

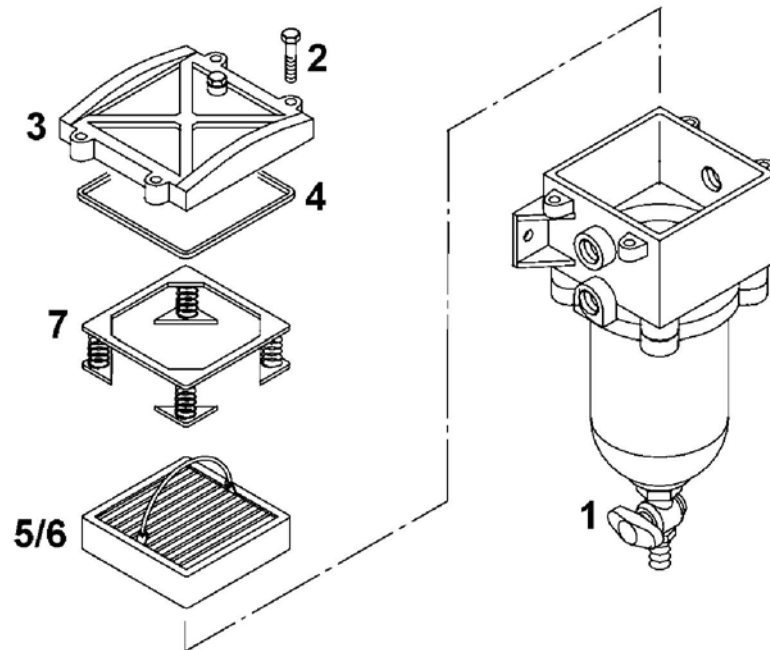
- an original Liebherr filter element
- a respective new seal

Danger

Risk of fire and explosion!

- ! No smoking.
- ! Avoid naked flames.
- ! Only work on the diesel engine while the diesel engine is switched off.

- Close the fuel shut-off valve if featured.
- Clean fuel pre-filter and surrounding area thoroughly.



BA500317

1 Drain tap
2 Screw
3 Cover
4 Seal

5 Paper filter element
6 Filter insert
7 Spring cartridge

- Press in the drain tap grip **1** and turn in an anticlockwise direction.
- Drain fuel into a suitable vessel.
- Unscrew screws **2**.
- Remove cover **3** with seal **4**.
- Take out paper filter element **5** or filter insert **6** together with the spring cartridge **7**.
- Dispose of the paper filter element in an environmentally-friendly manner, or clean or replace filter insert.
- Install the new paper filter element or cleaned filter insert.
- Insert spring cartridge.
- Remount cover with new seal.
- Tighten the screws with the prescribed tightening torque.
- Open fuel shut-off valve if featured.
- Bleed the fuel system, see further down in this chapter.
- Check the filter for leaks.

Replacing the fuel fine filter

The fuel fine filter is located on the left-hand side of the diesel engine.

Ensure that the following are on-hand:

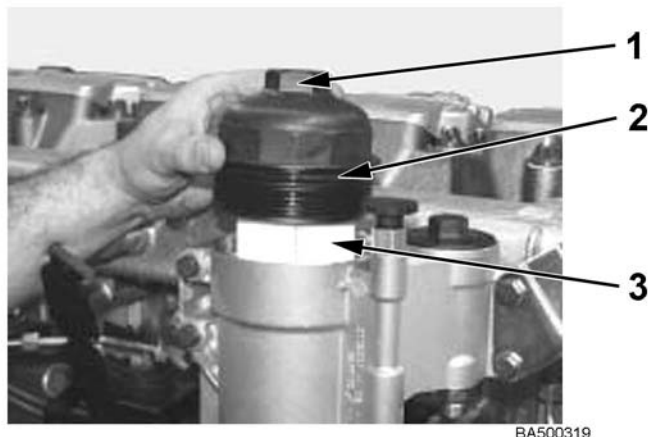
- an original Liebherr filter element
- the respective new sealing ring

Danger

Risk of fire and explosion!

- ! No smoking.
- ! Avoid naked flames.
- ! Only work on the diesel engine while the diesel engine is switched off.

- Close the fuel shut-off valve if featured.
- Clean fuel fine-filter and surrounding area thoroughly.



BA500319

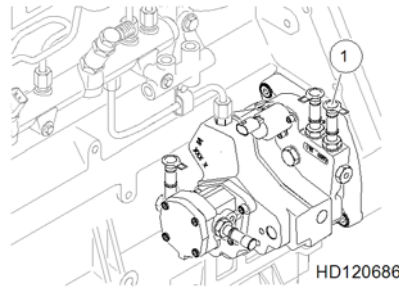
1 Housing cover
2 Filter element

3 Sealing ring

- Unscrew housing cover 1 using a ring spanner.
- Wait until the fuel has flowed back into the filter housing.
- Pull out cover with filter element.
- Remove filter element 2 from housing cover 1.
- Dispose of used filter element in an environmentally-friendly manner.
- Replace sealing ring 3, if necessary, clean cover.
- Attach new original Liebherr filter element.
- Screw in the filter element with cover and tighten with the prescribed tightening torque, see "Technical Data."
- Open fuel shut-off valve if featured.
- Bleed the fuel system, see further down in this chapter.
- Check the filter for leaks.

Bleeding the fuel system

- All tasks on the components of the Common Rail System may only be carried out by specially trained personnel.
- The diesel engine must be shut down at least 1 minute before commencing any work in order that any pressure in the Rail (pressure pipe) may be allowed to dissipate.
- Utmost cleanliness of all areas must be ensured during all tasks carried out (e.g. washed hands, clean overalls). Avoid moisture at all costs.



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- Open the return-flow line 1 on the high-pressure pump.
- Seal the return-flow line 1 using a plug.



KF119358

- Unscrew the tappet 1 from the hand pump.
- Continue to pump with the hand pump until fuel is exuded at the connection of the high-pressure pump for the return-flow line.
- Push the tappet of the pump downwards and tighten with the prescribed tightening torque, see "Technical Data".
- Remove the plug from the line.
- Close the return-flow line once again.
- Check the seals of the Common Rail System.

3.3.5 Maintenance tasks every 3200 operating hours

Before carrying out the 3200 operating hours maintenance tasks:

- perform the daily maintenance tasks, see "Maintenance tasks (daily) every 10 operating hours".
- perform the weekly maintenance tasks, see "Maintenance tasks (weekly) every 50 operating hours".
- perform the 400 operating hours maintenance tasks, see "Maintenance tasks every 400 operating hours".
- perform the 800 operating hours maintenance tasks, see "Maintenance tasks every 800 operating hours".

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Replacing the coolant

Danger

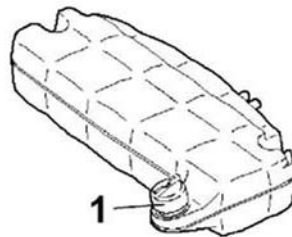


Risk of scalding when replacing the coolant.

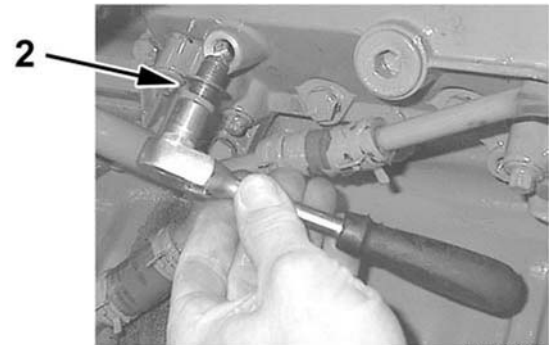
! Collect the coolant when draining and dispose of as prescribed.

It must be ensured that:

- the diesel engine is in the maintenance position
- the diesel engine has cooled
- the heating taps, if featured, are open
- a suitable collecting vessel is on-hand
- There is a sufficient amount of coolant and the coolant indicates the correct mix ratio, see "Maintenance"



1 Sealing cap



2 Drain plug

IMPORTANT: Before opening the sealing cap 1, ensure that the diesel engine has cooled.

- Turn the sealing cap 1 anticlockwise slightly until the excess pressure is dissipated, then open.
- Position a suitable collecting vessel beneath the diesel engine.
- Open the drain plug at the lowermost point of the cooling circuit or on the cooler, see documentation of the engine manufacturer.

The coolant from the cooling system flows into the collecting vessel.

To drain the coolant completely from the diesel engine, the following steps may be required.

- Unscrew the drain plug 2 on the heat exchanger on the right-hand side of the diesel engine.

When the coolant has completely drained from the cooling system or from the heat exchanger.

- Screw in both drain plugs again and tighten with the prescribed tightening torque.

Only fill in prepared coolant with 50 vol.– % anticorrosive/antifreeze at the expansion tank

- Fill in coolant slowly (max. 10 lt./min)

Fill cooling system to maximum level.

- Remount sealing cap on the expansion tank and close.
- Start the diesel engine and allow to run warm.
- Check the coolant level again and top up as required.

Ensure that the coolant contains at least 50 vol.– % anticorrosive / antifreeze.

3.3.6 Maintenance tasks as required

It must be ensured that:

- the diesel engine is in the maintenance position

Replacing the crankcase breather

- Replacing the crankcase breather, see “Lubrication”.

Replacing the dry air filter main element

The dry air filters vary depending on the design of the machine .

If an air filter contamination continues to be displayed following maintenance of the main element, the safety element must also be replaced.

- Replacing the main element, see the “Manufacturer's Documentation”.

Replacing the dry air filter safety element

The safety element is to be replaced after every third change of the main element, **but at least once a year**.

- Replacement of the safety element, see “Manufacturer's documentation”.

Lubricating the cooling system

It may be necessary to degrease the cooling system if leaks at the:

- cylinder head gaskets,
- oil cooler seals,
- oil cooler and oil cooler grill

cause diesel engine oil to run into the cooling water circuit.

Following rectification of any damage, the cooling system must be degreased before coolant is filled in.

It must be ensured that:

- the diesel engine is in the maintenance position,
- the coolant has been drained, see “Thermostats”
- a degreasing agent: 5%-diluted solution of P3 Standard or P3T 5124, supplied by the Henkel company is on-hand and the manufacturer's instructions are adhered to.
- the respective new seal for the thermostat housing is on-hand.
- a collecting vessel and coolant, mix ratio see “Fuel and Lubricants”, filling amount see the “Manufacturer's Documentation” are on-hand.
- Remove both coolant thermostats, lock in an open position and reinstall
- Fill cooling system completely with a mixture of water and 5% degreasing agent.
- Run the diesel engine with heating switched on until a coolant temperature of 90° C has been attained.
- Allow the diesel engine to run for approx. 5 minutes at this temperature.

Caution



Danger of scalding as a result of degreasing agent being squirted out!

! Only open the sealing cap on the expansion tank when the diesel engine has cooled - the coolant temperature display on the segment field of the display unit should be in the lower third of the segment field.

- Switch off diesel engine and allow cooling system to cool to approx. 50° C.

When the cooling system has cooled to approx. 50° C.

- Drain degreasing agent.
- Fill cooling system with fresh water.
- Allow the diesel engine to run for approx. 5 minutes for scavenging.

- Drain scavenging water, fill cooling system once again with fresh water and repeat the scavenging procedure.
- Remove coolant thermostats, readjust them back to the normal position and install with new thermostat housing.

Filling in coolant, see "Thermostats".

Decalcifying and derusting the cooling system

Decalcifying and derusting of the cooling system is necessary if coolant has been filled:

- which is not permissible,
- or has too low a mix ratio.

Impermissible coolant can lead to sedimentation or corrosion in the cooling system.

Sedimentation can cause leaks in the coolant pumps or deficient cooling capacity due to the interior of the cooler becoming clogged.

It must be ensured that:

- the diesel engine is in the maintenance position,
- the coolant has been drained, see "Thermostats"
- a decalcifying or derusting agent: 10%-diluted solution of citric acid, tartaric acid or oxalic acid, obtainable from chemical dealers, is on-hand.
- a respective new seal for the thermostat housing is on-hand.
- a collecting vessel and coolant, mix ratio see "Fuel and Lubricants", filling amount see the "Manufacturer's Documentation" are on-hand.
- Remove both coolant thermostats, lock in an open position and reinstall
- Fill cooling system completely with a mix of water 10% decalcifying or derusting agent.
- Run the diesel engine with heating switched on until a coolant temperature of 90° C has been attained.
- Allow the diesel engine to run for approx. 10 minutes at this temperature.

Caution



Danger of scalding as a result of decalcifying or derusting agent squirting out!

! Only open the sealing cap on the expansion tank when the diesel engine has cooled - the coolant temperature display on the segment field of the display unit should be in the lower third of the segment field.

- Switch off diesel engine and allow cooling system to cool to approx. 50° C.

When the cooling system has cooled to approx. 50° C.

- Drain decalcifying or derusting agent .
- Fill cooling system with fresh water.
- Allow the diesel engine to run for approx. 5 minutes for scavenging.
- Drain scavenging water, fill cooling system once again with fresh water and repeat the scavenging procedure 3 to 5 times.
- Remove coolant thermostats, readjust them back to the normal position and install with new thermostat housing.

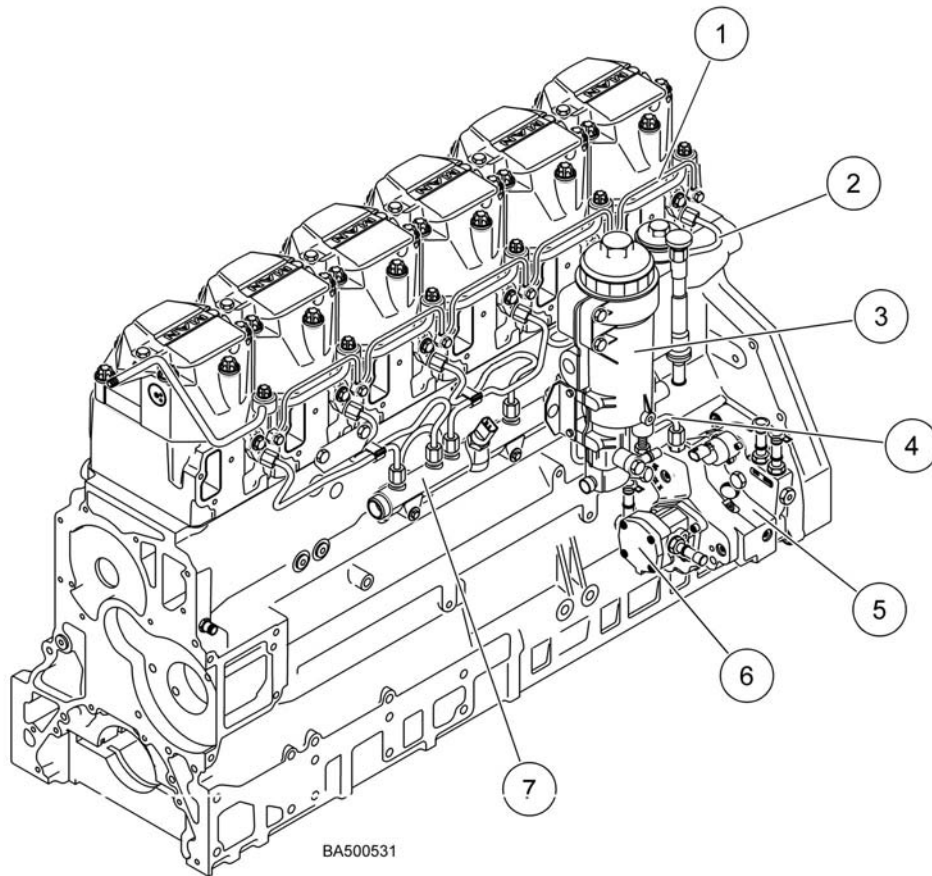
Filling in coolant, see "Thermostats".

7 Common Rail System

Chapter contents

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7.1.1	Removing the high-pressure system	7.1 - 2
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7.1.3	Dismantling the injector	7.1 - 5
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7.1.5	Installing the high-pressure system	7.1 - 11
7.2	Removing and installing the high-pressure pump	7.2 - 1
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7.2.2	Installing the high-pressure pump	7.2 - 5

Function description



1 Return-flow line fuel
2 6 x high-pressure lines Rail
injectors

3 Fuel-Service-Center (KSC)
4 1 x high-pressure line high-
pressure pump — Rail

5 High-pressure pump
6 Transfer pump
7 Pressure pipe (Rail)

Common Rail System

Pressure generation and injection are disconnected for the “Common Rail” injection system.

The injection pressure is generated independently of the diesel engine speed and the injection amount from the high-pressure pump with flange-mounted transfer pump (up to 1600 bar) and is available in the pressure pipe (Rail) for injection via the injector. The flow rate of the high-pressure pump is regulated via a proportional valve. The precise moment of injection, as well as the injection amount, is calculated in the electronic control unit and applied from the solenoid valve-controlled injectors. Multiple injections can be resulted with the utilisation of solenoid valve-controlled injectors.

Pilot injection

The pilot injection serves to improve combustion, reduce combustion noise and reduce combustion pressure peaks.

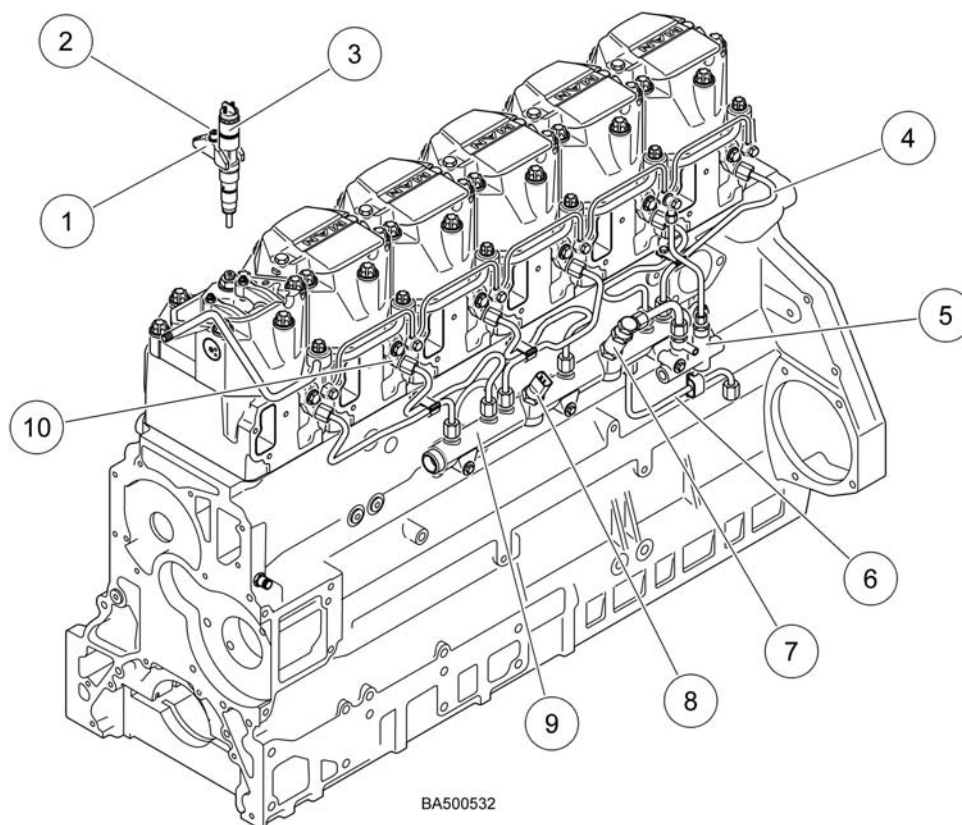
Main injection

With the main injection, the energy for the power resulted is realised. Monitoring and control of the system is resulted via sensors. Filtering of the fuel is resulted via the Fuel-Service-Center (KSC).

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7.1 Removing and installing the high-pressure system

Layout



- 1 Flange bearing
- 2 Fastening screw flange bearing
- 3 Injector
- 4 6 x high-pressure lines Rail — injectors

- 5 Return-flow collector
- 6 1 x high-pressure line high-pressure pump — Rail
- 7 Pressure limiting valve
- 8 Pressure pipe sensor

- 9 Pressure pipe (Rail)
- 10 Lug for inlet connector

Attention



Deterioration in the Common Rail System and the diesel engine can be resulted.

! Before commencing any tasks on the Common Rail System, see “Special notes regarding tasks to the Common Rail System”

! All work on the components of the Common Rail System may only be carried out by specially trained personnel.

! Before commencing work, the diesel engine must be switched off for at least 5 min. in order that pressure is allowed to dissipate in the pressure sensor (Rail).

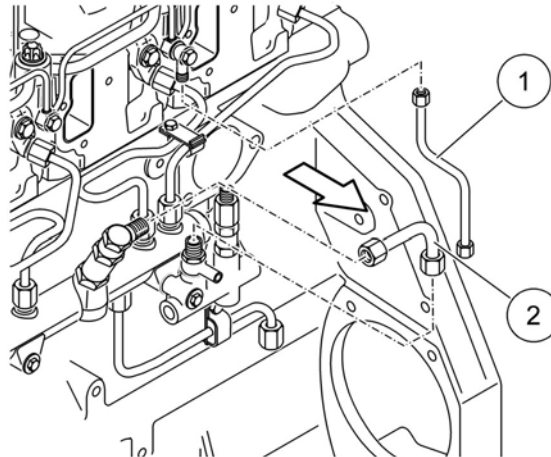
! Utmost cleanliness in all areas is to be ensured for all tasks. Avoid moisture at all costs.

! If inlet connectors are loosened, even once, they must be replaced.

! Used sealing plugs for the high-pressure lines, pressure pipe (Rail), inlet connector and injectors may not be reused.

It must be ensured that:

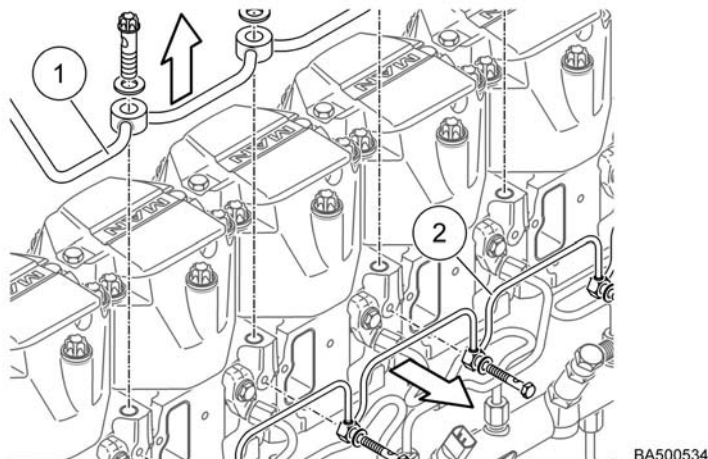
- the KSC has been removed, see “Fuel-Service-Center (KSC)”
- the air induction pipe has been dismantled, see “Air induction pipe / exhaust gas pipe”
- tool no. 89 — socket wrench SW 19
- tool no. 90 — angle extension
- tool no. 97 - protective closure set is on-hand



Disassembling fuel return-flow lines

- 1 Connecting line 2 Fuel return-flow line

- Dismantle the connecting line **1** to the fuel return-flow line on the cylinder head.
- Dismantle the fuel return-flow line **2** from the pressure limiting valve.



Dismantling the fuel lines and coolant lines

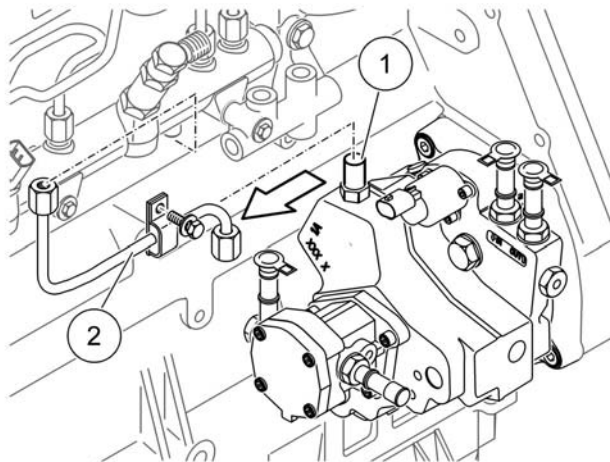
- 1 Coolant line 2 Fuel return-flow lines

Attention

When removing the injectors, fuel may run into the combustion chamber causing major damage of the diesel engine.

! The return-flow channel in the cylinder head must be emptied before the injectors are removed.

- Empty the return-flow channels in the cylinder heads by unscrewing the banjo bolt at the fuel line.
- Dismantle the fuel return-flow lines **2**.
- Unscrew the banjo bolt from the coolant line **1** and remove the coolant line.



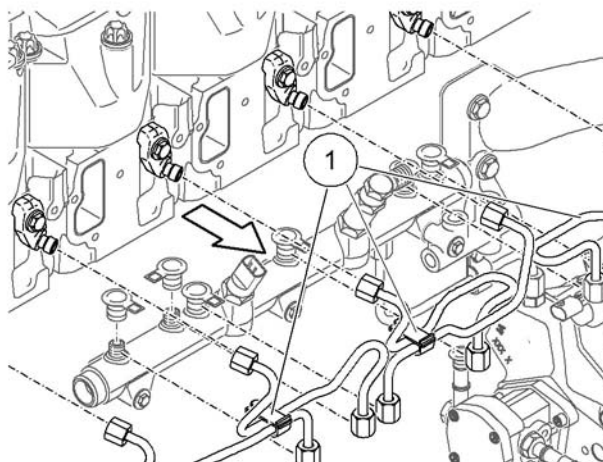
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Dismantling the high-pressure lines

1 Connections

2 High-pressure line

- Dismantle the high-pressure line **2** from the pump to the pressure pipe (Rail).
- Seal the high-pressure line **2** to the high-pressure pump and the Rail immediately using plugs from the protective closure set - tool no. 97.
- Seal the connections **1** to the high-pressure pump immediately using plugs from the protective closure set - tool no. 97.



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Dismantling the high-pressure lines

1 High-pressure lines

Attention

The penetration of dirt into the high-pressure system will cause damage to the injectors.

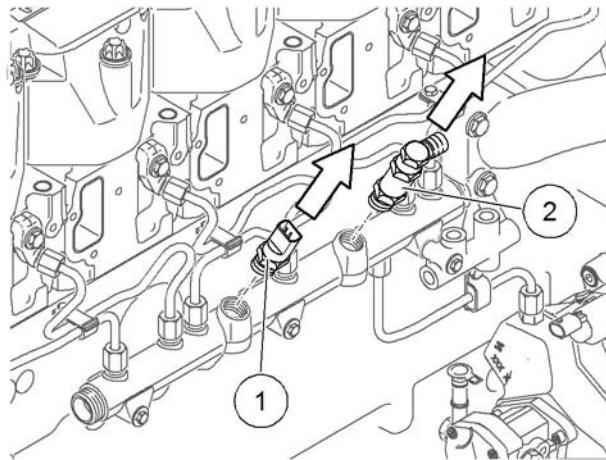
! Only unscrew one line at a time and then seal the connections with new, clean plastic plugs from the protective closure set - tool no. 97.

- Unscrew the high-pressure lines **1** from the lugs and the pressure pipe (Rail).

7.1.2 Dismantling the pressure pipe

It must be ensured that:

- tool no. 97 - protective closure set is on-hand
- the high-pressure system has been dismantled, see further up in this chapter



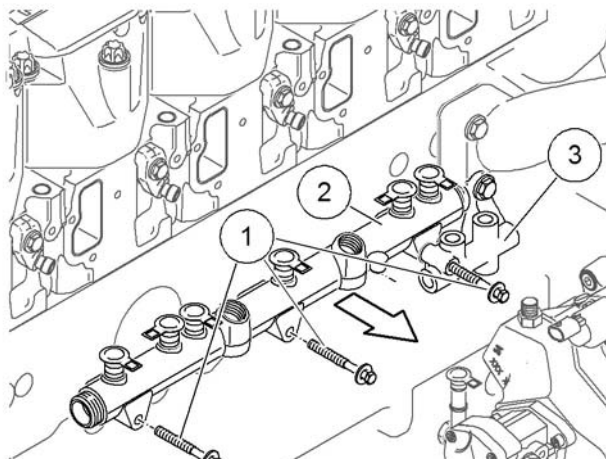
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*Dismantling the **pressure limiting valve / pressure sensor***

1 Pressure sensor

2 Pressure limiting valve

- Dismantle the pressure sensor **1** and pressure limiting valve **2**.
- Seal the openings in the pressure pipe immediately using plugs from the protective closure set - tool no. 97.



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*Dismantling the **pressure pipe (Rail)***

1 Fastening screws
2 Pressure pipe

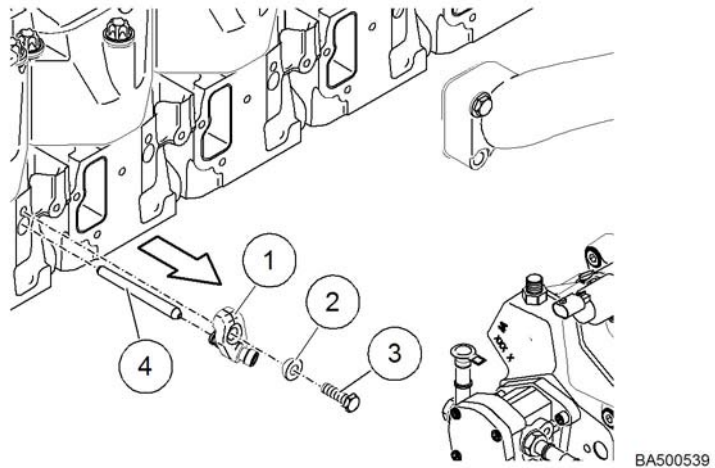
3 Return-flow collector

- Dismantle the return-flow collector **3** from the pressure pipe **2**.
- Unscrew the fastening screws **1** at the pressure pipe **2**.
- Remove the pressure pipe (Rail) and store in a safe place where it is protected against contamination.

7.1.3 Dismantling the injector

Ensure that the following are on-hand:

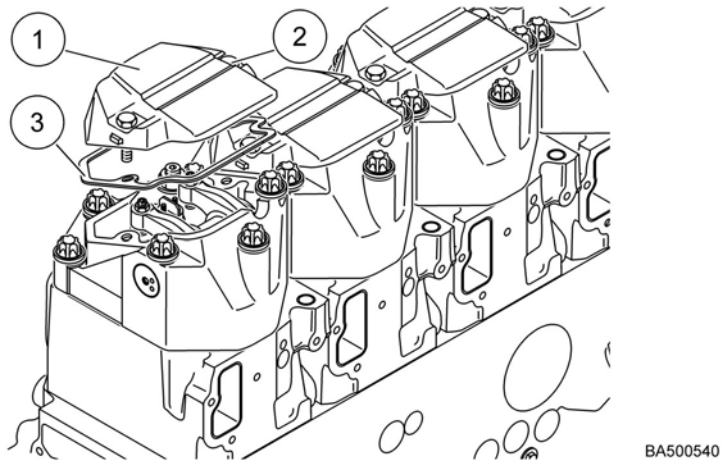
- tool no. 97 — protective closure set,
- tool no. 91 — extraction device for injectors
- tool no. 92 — support bridge
- tool no. 93 — torque wrench
- tool no. 94 — adapter
- tool no. 95 — socket spanner
- tool no. 96 — retention sheath
- the high-pressure system has been dismantled, see further up in this chapter



Dismantling the inlet connector

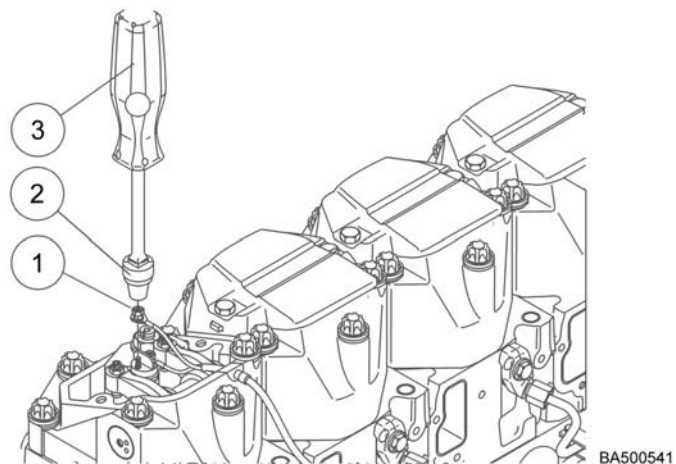
- | | |
|---------------------|--------------------|
| 1 Lug | 3 Fastening screws |
| 2 Spherical washers | 4 Inlet connector |

- Unscrew the fastening screws **3** with spherical washers **2** from the lug **1**.
- Remove the lug **1** from the cylinder head by turning gently.
- Pull out the inlet connector **4** from the cylinder head using a magnet.

***Remove the cylinder head cover***

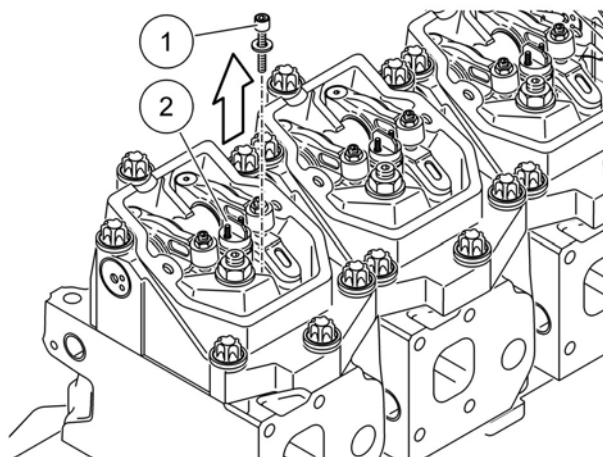
- 1 Cylinder head cover
2 Fastening screws
3 Seal

- Unscrew the fastening screws **2** for the cylinder head cover.
- Remove the cylinder head cover **1** with seal **3**.

***Dismantling the injector cable***

- 1 Electrical connections
2 7 mm socket
3 Insertion handle

- Detach the electrical connections **1** at the injector with 7 mm socket **2** and insertion handle **3**.



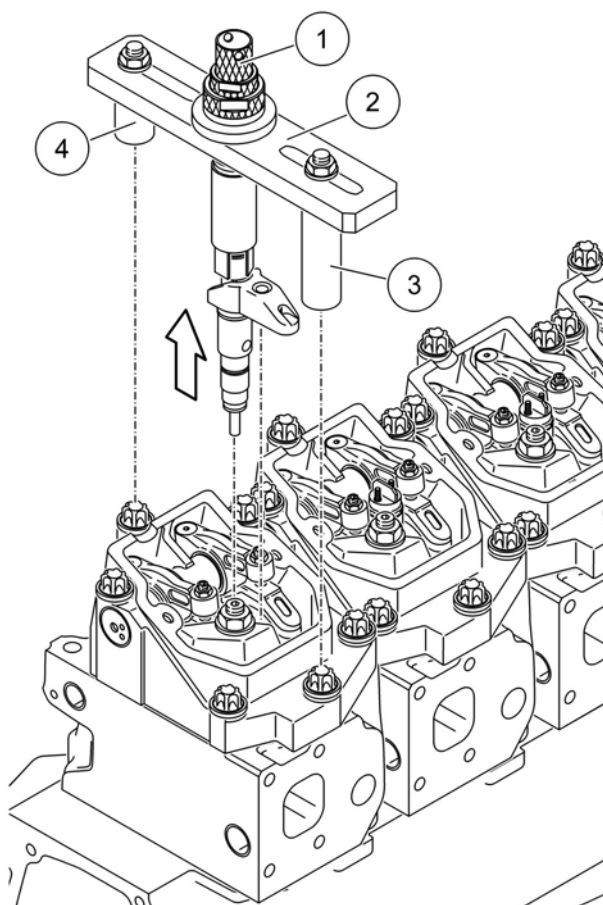
BA500542

Fastening screws flange bearing

1 Fastening screw

2 Flange bearing

- Unscrew the fastening screw 1 for the flange bearing 2.



BA500543

Extracting the injector

1 Extraction tool — tool no. 91
 2 Support bridge — tool no. 92

3 Spacer
 4 Spacer

Attention

The injector will be damaged if dismantled improperly.

- ! Before dismantling the injector, always remove the respective inlet connector first.
- ! Only ever dismantle one injector.
- ! Store the injectors in the retention sheath immediately following dismantling.

- Set the support bridge **2** with the spacers **3** and **4** onto the cylinder head.
- Push the extraction tool **1** through the support bridge **2** above the injector, ensuring at the same time that the split taper socket is turned back far enough.
- Apply tension to the split taper socket and extract the injector with the knurled nut from the cylinder head.
- After dismantling the injector, seal the nozzle immediately using a clean, new plastic plug from the protective closure set — tool no. 97.
- Seal the coupling hole for the inlet connector using a new, clean plastic plug from the protective closure set.
- Always extract used O-rings away from the injector toward the magnet.
- Store the injector in the retention sheath immediately following dismantling.

7.1.4 Installing injector and pressure pipe

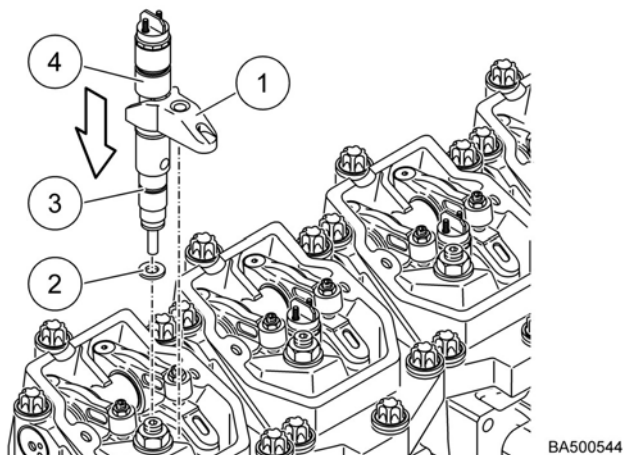
Ensure that the following are on-hand:

- tool no. 93 — torque wrench
- tool no. 94 — adapter
- tool no. 95 — 7 mm socket
- tool no. 100 — thrust piece
- new seals and new O-rings
- new inlet connectors

Note

Always install the injectors together with flange bearing.

- ! A subsequent installation of the flange bearing is not possible.



Installing the injector

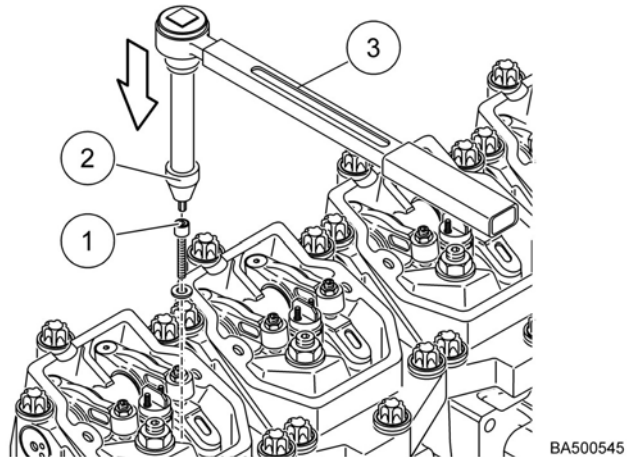
1 Flange bearing
2 new seal

3 new O-ring
4 Injector

- Only remove the injector from the protective packaging immediately prior to installation and remove the sealing plugs.
- Push the flange bearing **1** onto the injector **4**.

Ensure at the same time that the inlet for the “fuel” is turned to the suction side. The injector can no longer be turned following installation.

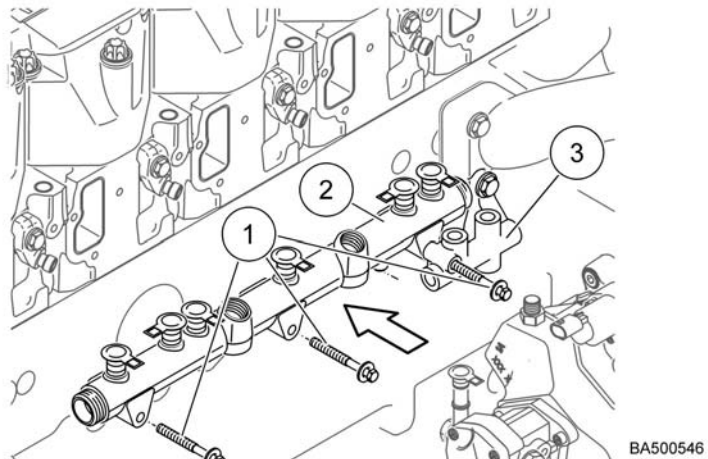
- Press in the injector **4** with new O-ring **3** and new seal **2** into the cylinder head.



Initial tightening of injector

- | | |
|---|-----------------|
| 1 Fastening screw | 3 Torque wrench |
| 2 Tool no. 95 with no. 94 — Allen wrench with adapter | |

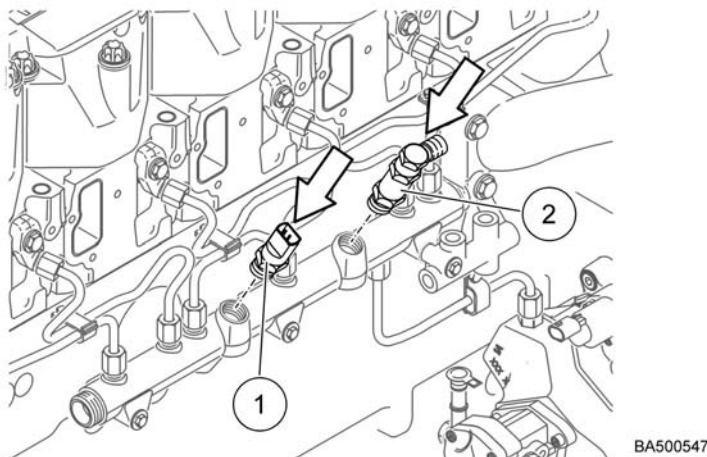
- To allow subsequent adjustment, only tighten the fastening screws **1** with Allen wrench **2** and torque wrench **3** to the initial tightening value, see “Technical Data.”



Mounting the pressure pipe (Rail)

- | | |
|--------------------|------------------------------|
| 1 Fastening screws | 3 Return-flow collector pipe |
| 2 Pressure pipe | |

- Mount the pressure pipe **2** with return-flow collector pipe **3** on the crankcase. The fastening screws **1** should not be fastened tightly in order that subsequent adjustment is possible.

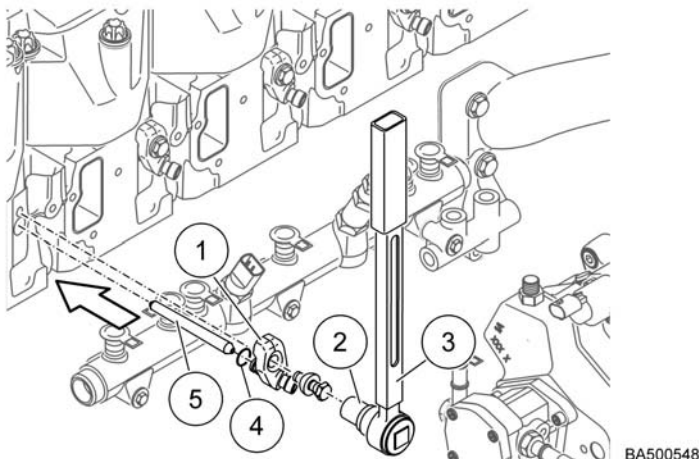


Installing the **pressure limiting valve / pressure sensor**

1 Pressure sensor

2 Pressure limiting valve

- Screw the pressure limiting valve **2** and pressure sensor **1** into the pressure pipe and tighten with the prescribed tightening torque, see "Technical Data."



Installing the **inlet connector**

1 Lug

4 new O-ring

2 Allen wrench

5 Inlet connector

3 Torque wrench

Attention



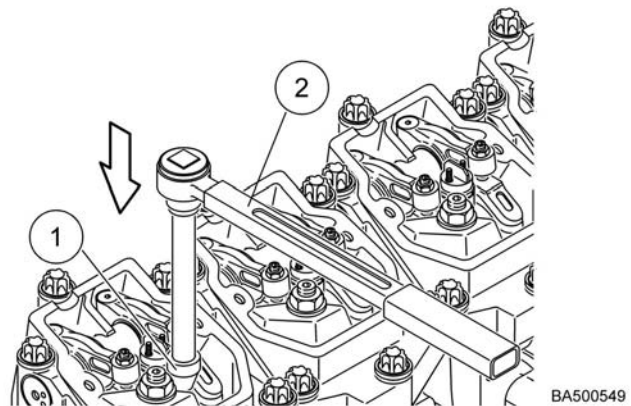
Inlet connectors are pushed together when being installed at the cone.

! Inlet connectors may not be reused if they have already been installed.

- Insert new inlet connectors **5** into the cylinder head.

Ensure at the same time that the thinner point latches into the inflow of the injector.

- Coat new O-ring **4** with a little oil.
- Insert the lug **1** with new O-ring **4** into the cylinder head by turning gently.
- Screw in the fastening screw with spherical washer.
- To allow subsequent adjustment, only tighten the fastening screws with Allen wrench **2** and torque wrench **3** to the initial tightening value, see "Technical Data."



Secure fastening of the injector

1 Allen wrench

2 Torque wrench

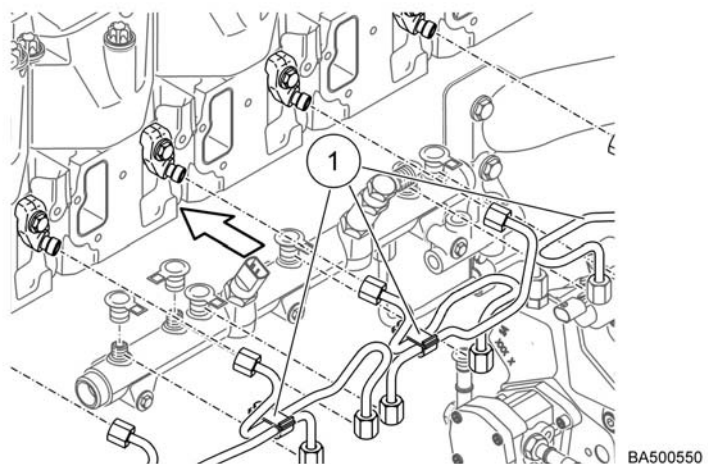
- After installing the inlet connector, tighten the injector with the prescribed tightening torque / angle of rotation, see "Technical Data."
- Loosen the fastening screws of the lug again (hand-tight) for mounting of the high-pressure lines.

Installing the high-pressure system, see further down in this chapter.

7.1.5 Installing the high-pressure system

Ensure that the following are on-hand:

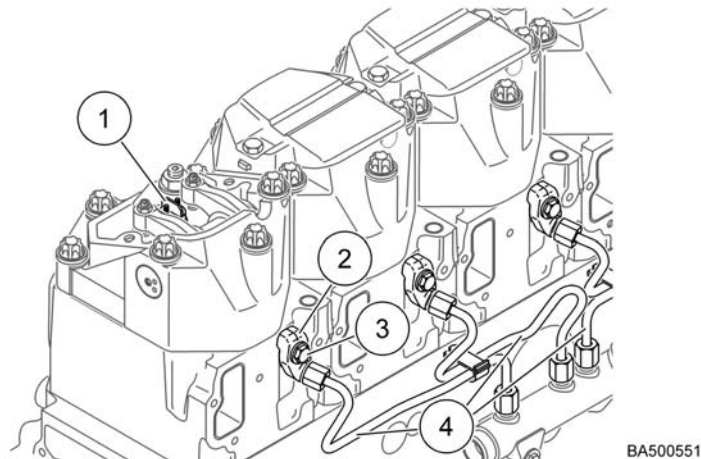
- tool no. 89 — socket wrench SW 19
- tool no. 90 — angle extension
- tool no. 93 — torque wrench
- tool no. 94 — adapter
- tool no. 95 — socket spanner
- new seals



Mounting the high-pressure lines

1 High-pressure lines

- Only remove the sealing plugs of the high-pressure lines **1** immediately prior to screwing onto the pressure pipe and onto the lug.
- Screw on the high-pressure lines and tighten hand-tight to allow adjustment.



Tightening sequence for the high-pressure system

1 Injector
2 Lug

3 Fastening screw
4 High-pressure lines

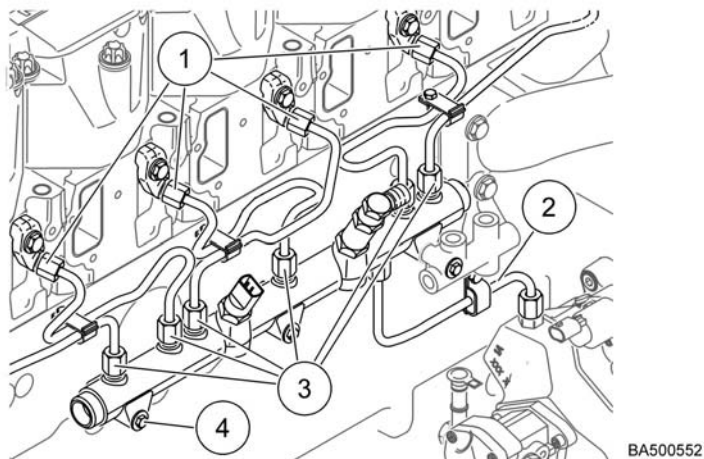
Attention



If the tightening sequence is not adhered to, the injector and the inlet connector will become damaged.

! To guarantee sound functioning of the Common Rail System, it is absolutely imperative that the tightening sequence is adhered to.

- Ensure secure seating of the injector **1**.
- Tighten the lug **2** and fastening screw **3** with the prescribed torque / angle of rotation, see "Technical Data."
- First screw the high-pressure lines **4** onto the lugs, and then onto the pressure pipe.

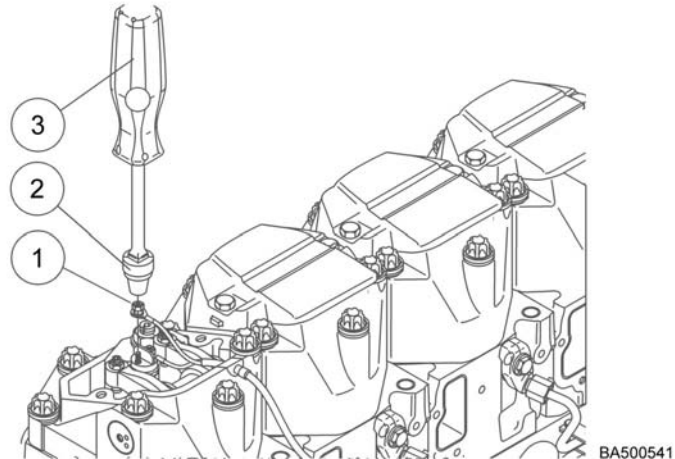


Tightening the high-pressure lines

1 Lug
2 High-pressure line pump — pressure pipe

3 Pressure pipe
4 Fastening screws

- Tighten the pressure pipe **3** with fastening screws **4** onto the crankcase with the prescribed tightening torque, see “Technical Data.”
- First tighten the high-pressure lines at the lugs **1**, and then on the pressure pipe **3** with the prescribed tightening torque / angle of rotation, see “Technical Data.”
- Mount the high-pressure line pump — pressure pipe **2** and tighten with the prescribed tightening torque / angle of rotation, see “Technical Data.”



Mounting the injector cable

1 Injector cable
2 7 mm socket

3 Torque wrench — tool no. 93

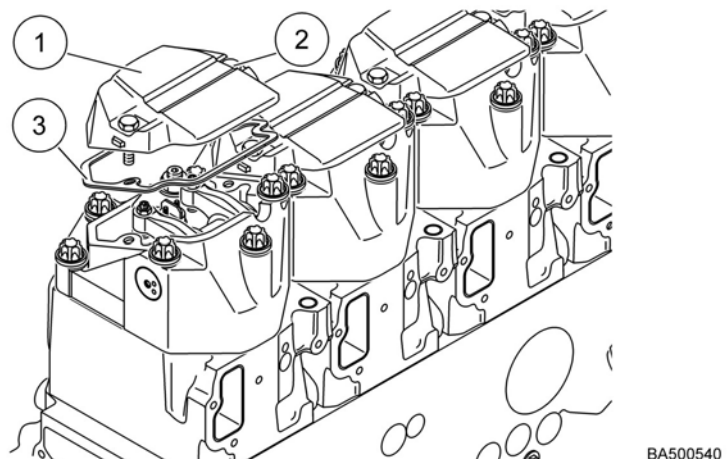
Attention



The connecting thread in the solenoid valve can become damaged.

! Use the prescribed torque wrench — tool no. 93 **3**.

- Tighten the injector cable **1** with 7 mm socket **2** and torque wrench — tool no. 93 **3** with the prescribed tightening torque, see “Technical Data.”

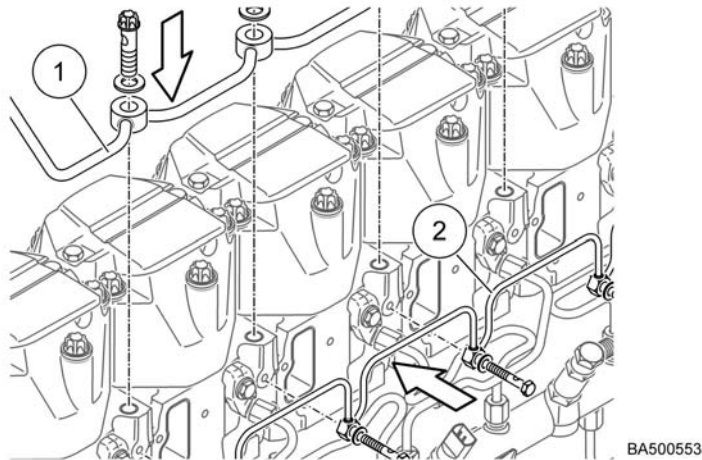


Mounting the cylinder head cover

1 Cylinder head cover
2 Fastening screws

3 Seal

- Guide the injector cable through the seal **3** and apply the seal **3**.
- Mount the cylinder head cover **1** and screw in the fastening screws **2**.
- Tighten the fastening screws with the prescribed tightening torque, see "Technical Data."



Mounting the fuel lines and coolant lines

1 Coolant line

2 Fuel return-flow line

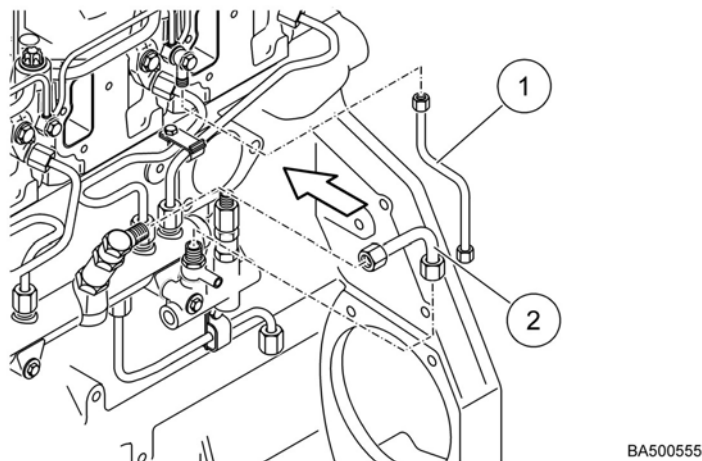
Note



A longer banjo bolt featuring a connecting tube for the return flow to the tank is affixed to cylinder no. 6.

! Do not mix up the banjo bolts.

- Mount the coolant line **1** with new seals onto the cylinder head.
- Mount the fuel return-flow line **2** with new seals onto the cylinder head.



Mounting the fuel return-flow lines

1 Connecting line

2 Fuel return-flow line

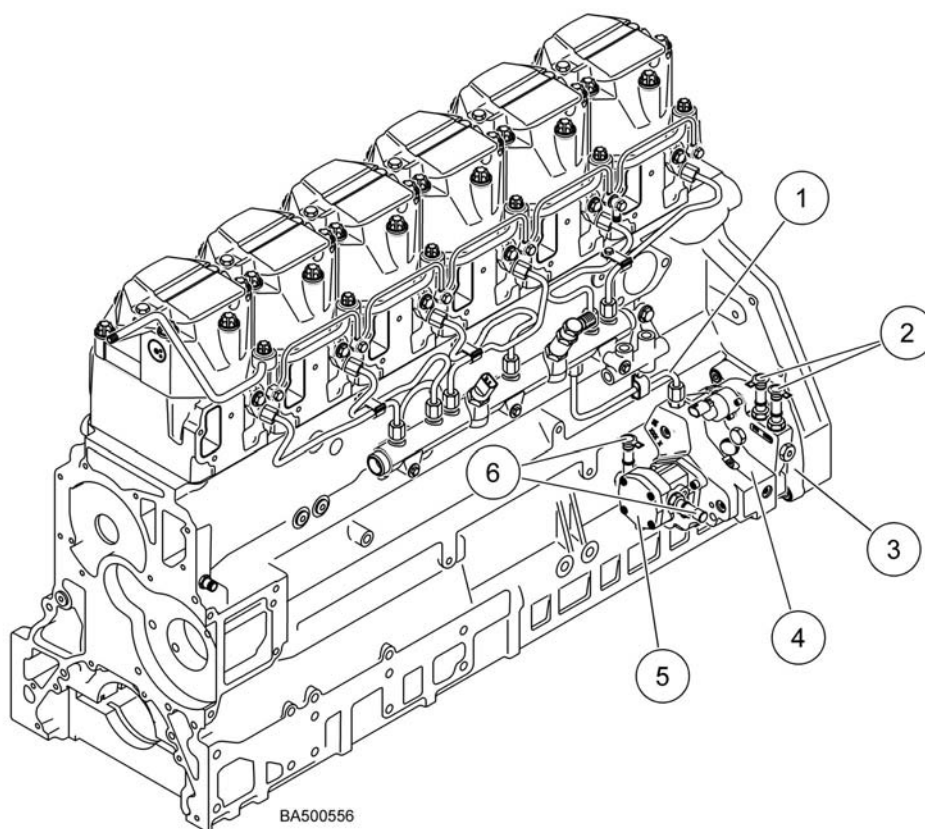
- Mount the connecting line **1** to the fuel return-flow line on the cylinder head.
- Mount the fuel return-flow line **2** to the pressure limiting valve.

Installing the KSC, see "Fuel-Service-Center (KSC)"

Mounting the air induction pipe, see "Air induction pipe / exhaust pipe"

7.2 Removing and installing the high-pressure pump

Lavout



1 High-pressure line high-pressure pump — pressure pipe

2 Inlet — outlet high-pressure pump
3 Adapter flange

4 High-pressure pump
5 Delivery pump
6 Inlet — outlet delivery pump

Attention



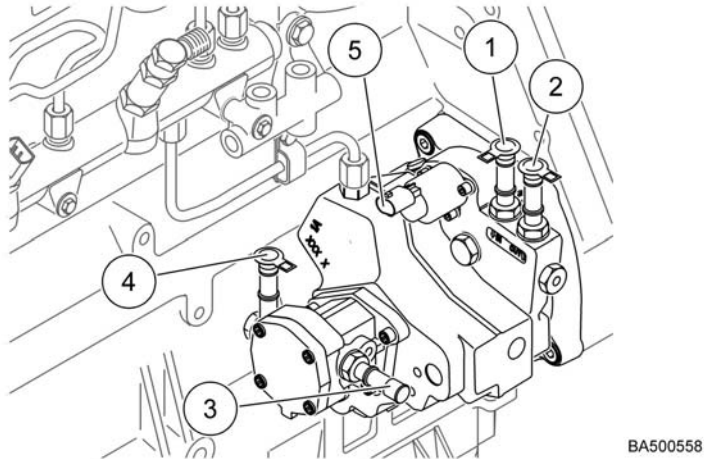
Deterioration in the Common Rail System and the diesel engine can be resulted.

- ! Before commencing any tasks on the Common Rail System, see "Special notes regarding tasks to the Common Rail System"
- ! All work on the components of the Common Rail System may only be carried out by specially trained personnel.
- ! Before commencing work, the diesel engine must be switched off for at least 5 min. in order that pressure is allowed to dissipate in the pressure sensor (Rail).
- ! Utmost cleanliness in all areas is to be ensured for all tasks. Avoid moisture at all costs.
- ! If inlet connectors are loosened, even once, they must be replaced.
- ! Used sealing plugs for the high-pressure lines, pressure pipe (Rail), inlet connector and injectors may not be reused.

7.2.1 Removing the high-pressure pump

It must be ensured that:

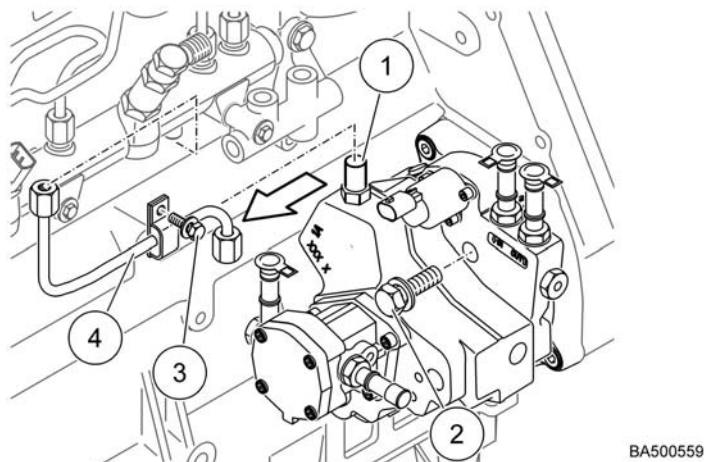
- the KSC has been removed, see “Fuel-Service-Center (KSC)”
- tool no. 97 - protective closure set is on-hand
- tool no. 102 — mounting fixture for the high-pressure pump is on-hand
- tool no. 101 — striking tool is on-hand
- tool no. 103 — extraction plate is on-hand



Sealing the line connections

- | | |
|---------------------------------|----------------------------|
| 1 Connection high-pressure pump | 4 Connection delivery pump |
| 2 Connection high-pressure pump | 5 EDC plug connection |
| 3 Connection delivery pump | |

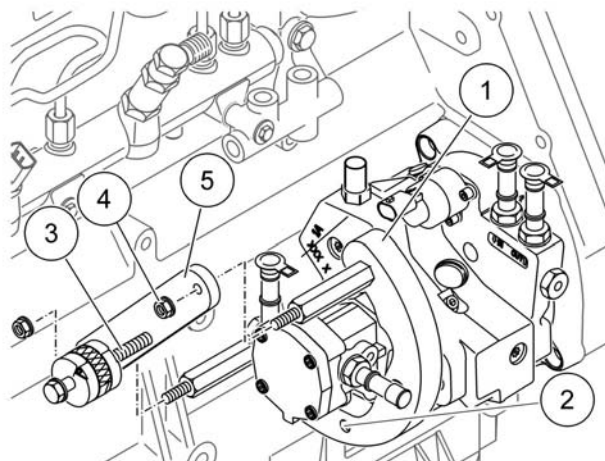
- Disconnect the EDC plug connection 5.
- The delivery pump connections **3 und 4** and the high-pressure pump connections **1 und 2** are to be sealed immediately following dismantling of the lines, using new, clean plastic plugs from the protective closure set - tool no. 97.



Dismantling the high-pressure lines

- | | |
|----------------------|----------------------|
| 1 High-pressure pump | 3 Fastening screw |
| 2 Fastening screw | 4 High-pressure line |

- Dismantle the high-pressure line **4** on the high-pressure pump **1** and seal immediately using new, clean plastic plugs from the protective closure set - tool no. 97.
- Unscrew the fastening screw **2** of the high-pressure pump from the adapter flange.
- Unscrew the fastening screw **3** of the clamping shell from the return-flow collector.



BA500560

Mount **special tool no. 102**

- | | |
|--|---|
| 1 Underside of the mounting fixture — tool no. 102 | 4 Hexagonal nut |
| 2 Inner hexagonal screw | 5 Upper side of the mounting fixture — tool no. 102 |
| 3 Hexagonal screw | |

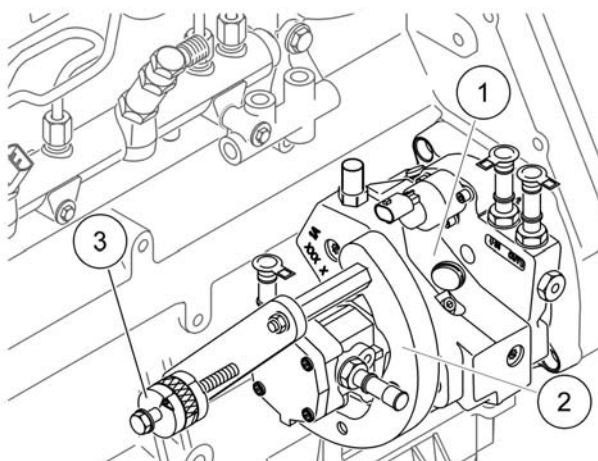
Attention



If the hexagonal screw **3** is protruding from the upper side of the mounting fixture **5**, the fuel delivery pump will sustain damage.

! The hexagonal screw **3** for the sliding weight may only be screwed in flush in the upper side of the mounting fixture **5**.

- Screw the underside of the mounting fixture **1** with 2 hexagon socket head screws **2** to the high-pressure pump.
- Fasten the upper side of the mounting fixture **5** with 2 hexagonal nuts **4** to the underside of the mounting fixture **1**.



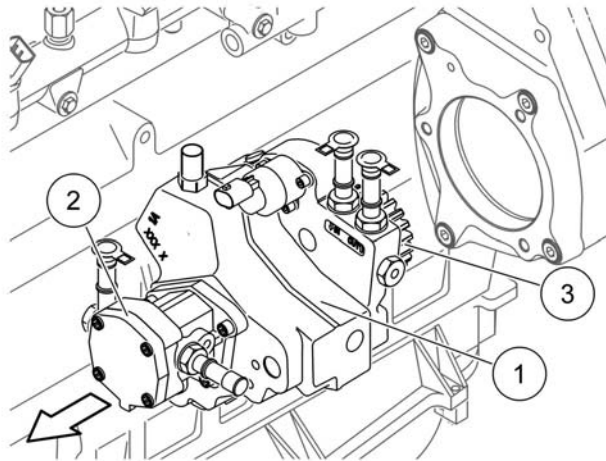
BA500561

Removing the high-pressure pump

- | | |
|----------------------|-----------------------------------|
| 1 High-pressure pump | 2 Mounting fixture — tool no. 102 |
|----------------------|-----------------------------------|

3 Sliding weight

- Strike out the high-pressure pump **1** with mounting fixture **2** and sliding weight **3** from the adapter flange.



BA500562

Remove the high-pressure pump

1 High-pressure pump
2 Delivery pump

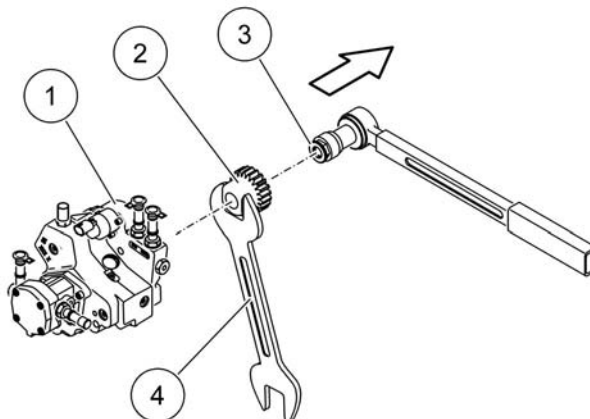
3 Drive gear

Attention

The clamping flange of the high-pressure pump may not sustain any damage when being removed.

! Only use the tool specifically prescribed for removal.

- Remove the high-pressure pump **1** with delivery pump **2** and drive gear **3** from the adapter flange.



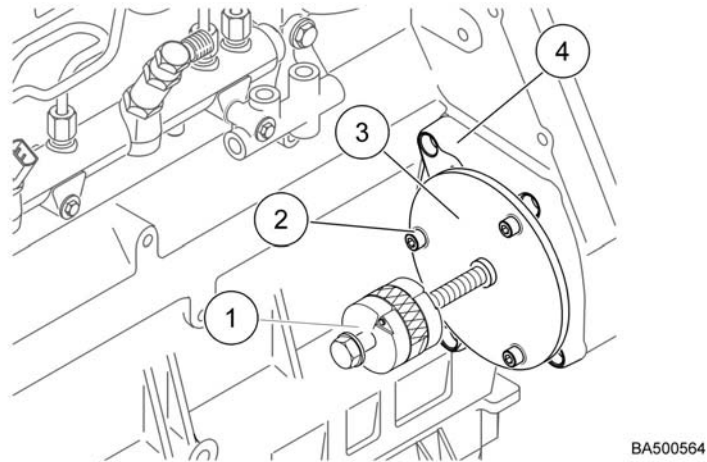
BA500563

Dismantling the drive gear

1 High-pressure pump
2 Drive gear

3 Fastening nut
4 Suitable tool

- Hold the drive gear **2** securely using a suitable tool **4**.
- Unscrew the fastening nut **3** for the drive gear **2** from the high-pressure pump **1**.
- Unscrew the drive gear **2**.



BA500564

Removing the adapter flange

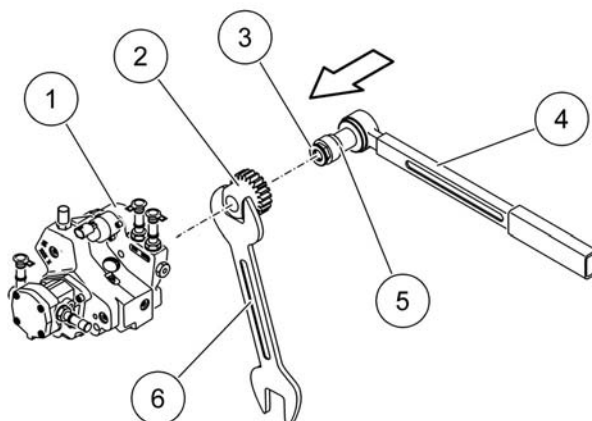
- | | |
|--------------------------------|-----------------------------------|
| 1 Striking tool — tool no. 101 | 3 Extraction plate — tool no. 103 |
| 2 Fastening screw | 4 Adapter flange |

- Unscrew the fastening screws from the adapter flange 4.
- Screw the extraction plate 3 with the fastening screws 2 securely to the adapter flange 4.
- Remove the adapter flange 4 with extraction plate 3 using the striking tool 1.

7.2.2 Installing the high-pressure pump

Ensure that the following are on-hand:

- guide mandrels — tool no. 104
- new O-ring
- 0.04 l of new diesel engine oil in compliance with the specifications, see “Fuel and Lubricants”

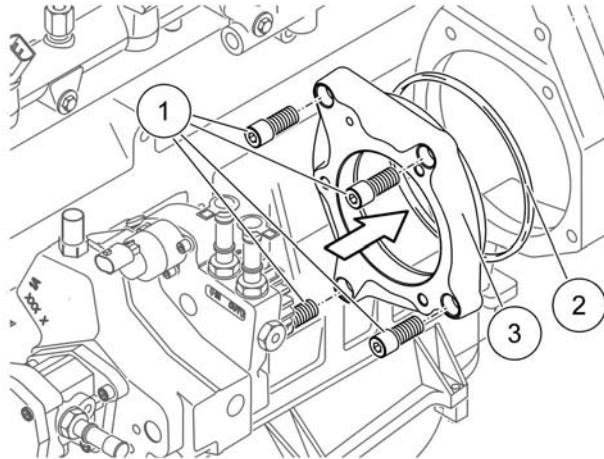


BA500565

Installing the drive gear

- | | |
|----------------------|--------------------|
| 1 High-pressure pump | 4 Torque wrench |
| 2 Drive gear | 5 Hexagonal socket |
| 3 Fastening nut | 6 Suitable tool |

- Push the drive gear **2** onto the drive shaft of the high-pressure pump **1**.
- Hold the drive gear **2** securely using a suitable tool **6**.
- Tighten the fastening nut **3** with hexagonal socket **5** and torque wrench **4** with the prescribed tightening torque, see "Technical Data."

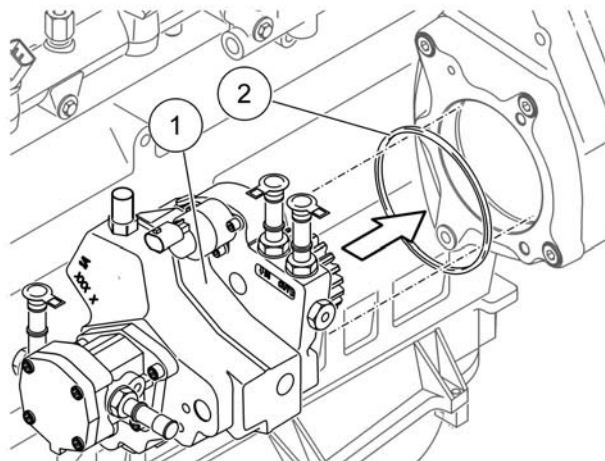


Installing the adapter flange

1 Fastening screws
2 new O-ring

3 Adapter flange

- Screw in the guide mandrels — tool no. 104 into the crankcase.
- Insert the adapter flange **3** with new O-ring **2** into the crankcase.
- Unscrew the guide mandrels and screw in the fastening screws **1**.
- Tighten the fastening screws **1** with the prescribed tightening torque, see "Technical Data."

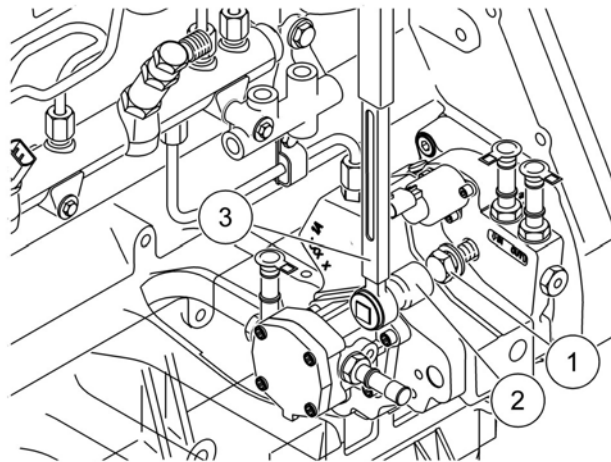


Installing the high-pressure pump

1 High-pressure pump

2 new O-ring

- Screw in the guide mandrels — tool no. 104 into the adapter flange.
- Insert the high-pressure pump **1** with new O-ring **2** into the adapter flange via the guide mandrels.
- Unscrew the guide mandrels and screw in the fastening screws.

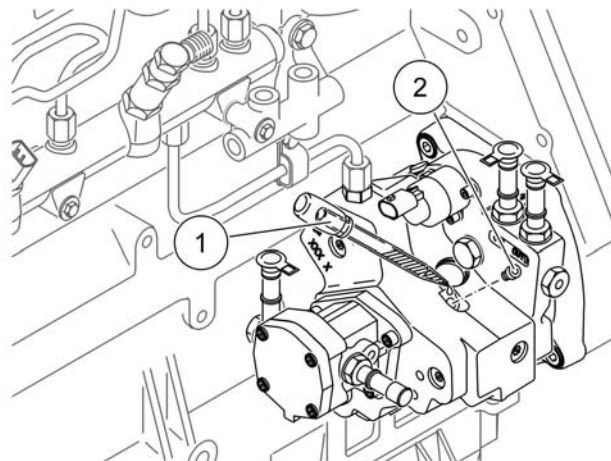


Tightening the high-pressure pump

1 Fastening screw
2 Socket

3 Torque wrench

- Apply the torque wrench **3** with socket **2** and tighten the fastening screws **1** with the prescribed tightening torque, see "Technical Data."
- Connect the EDC plug connection.



Filling in oil

1 Screw plug

2 Suitable tool

Attention



The high-pressure pump could become ruined.

! Ensure when filling in oil that no dirt is allowed to penetrate the pump.

- Unscrew the screw plug **1** and fill in 0.04 litres of diesel engine oil using a suitable implement **2**.
- Screw in the screw plug **1** and tighten with the prescribed tightening torque, see "Technical Data."

Installing the KSC, see "Fuel-Service-Center (KSC)"