

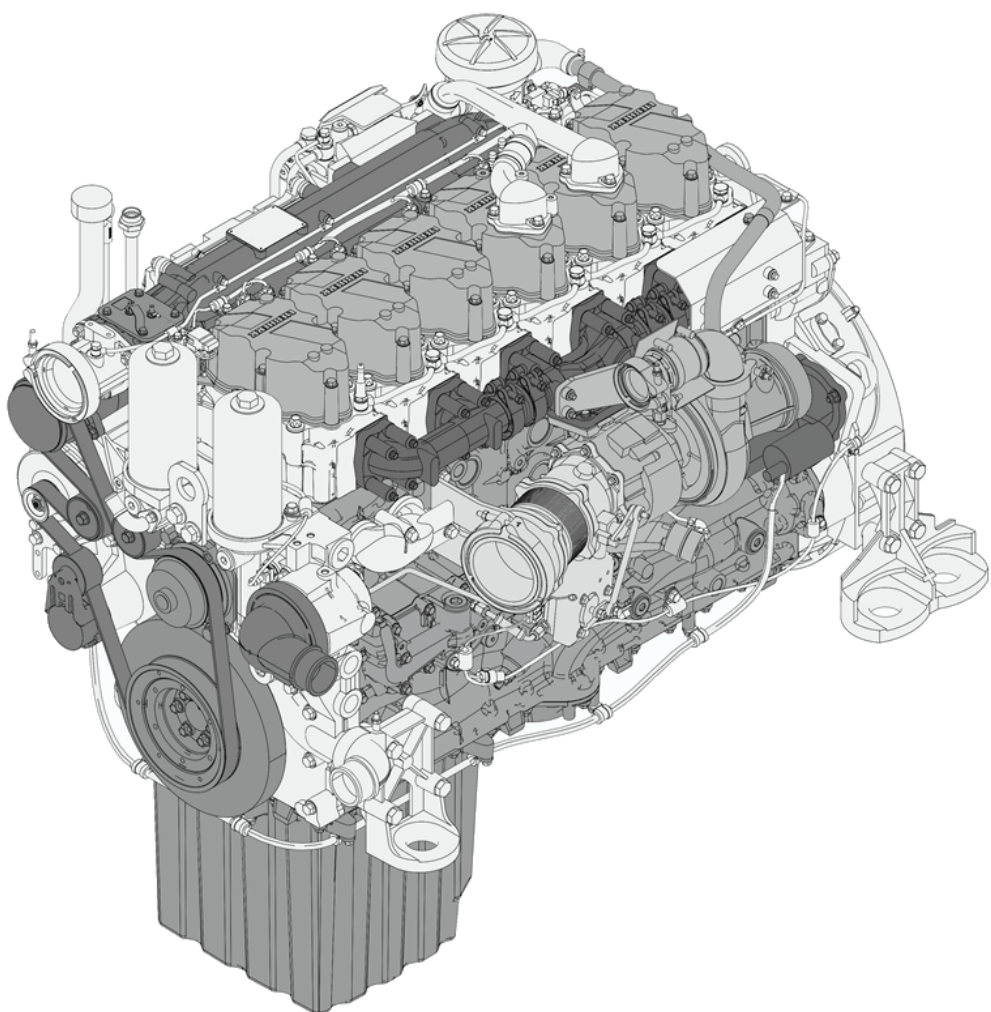
Diesel engine

D934 A7-04 / D944 A7-04 / D936 A7-04 / D946 A7-04

D934 A7-00 / D944 A7-00 / D936 A7-00 / D946 A7-00

BAL: 10154726-01-en

Operator's manual



en

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Diesel engine

D934 A7-04 / D944 A7-04 / D936 A7-04 / D946
A7-04 / D934 A7-00 / D944 A7-00 / D936 A7-00 /
D946 A7-00 -

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D936 A7-00 / D946 A7-00
Type no.:
From Serial no.: 2014030001 / 2014040001

Contact

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45, rue de l'Industrie
CH-1630 BULLE
SWITZERLAND

Machine data:

Enter the following information on taking delivery. *You will find the information on the type plate of the machine. This will also be useful when you order spares.

*** Engine ID number:**

.....

*** Year of manufacture:**

.....

Commissioning date:

..... / /

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Preface

These operating instructions have been written for the **operator** and for the **maintenance personnel** of the diesel engine.

They contain descriptions of:

- Technical data
- Safety regulations
- Handling and operation
- Maintenance

The operating instructions are to be read carefully and applied before the first commissioning and later at regular intervals by each person who is assigned to work with or on the diesel engine.

Work with or on the diesel engine is, for example:

- **Handling**, care, disposal of operating fluids and auxiliary materials.
- **Servicing**, including maintenance, inspection.

The operating manual facilitates the operator's familiarisation with the diesel engine and prevents faults through incorrect operation.

You will understand that we cannot allow any warranty claims that arise due to incorrect operation, insufficient maintenance, use of unapproved operating fluids or non-compliance with safety regulations.

Liebherr will cancel all possible obligations received by Liebherr and/or its dealers, such as guarantees, service contracts etc., without advance notice if any parts other than original Liebherr parts or spare parts purchased from Liebherr are used for maintenance and repairs.

In extreme conditions, more frequent maintenance than scheduled in the inspection plan can be required.

Changes, conditions, copyright:

- Subject to changes to technical details of the diesel engine compared with the information and figures of the documents at hand without prior notice.
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Contents

1	Product description	9
1.1	Technical description	9
1.1.1	Design overview	9
1.1.2	Explanation of type designation	10
1.1.3	Design features	13
1.1.4	Diesel engine accessory equipment	14
1.2	Technical data	16
1.2.1	Diesel engine	16
1.2.2	Cylinder head standard	16
1.2.3	Cylinder head with engine auxiliary brake system (ABS)	16
1.2.4	Coolant pump D934 / D944	17
1.2.5	Coolant pump D936 / D946	17
1.2.6	Coolant thermostat	17
1.2.7	Alternator	17
1.2.8	Starter	17
1.2.9	Flywheel housing	17
1.2.10	Wabco air compressor 293 cm ³	18
1.2.11	Knorr air compressor 300 cm ³	18
1.2.12	Knorr air compressor 630 cm ³	18
2	Safety instructions	19
2.1.1	Identification of the warnings	19
2.2	General safety instructions	20
2.3	Intended use	20
2.4	Instructions for preventing crushing and burns	21
2.5	Instructions for preventing fires and explosion hazards	21
2.6	Safety precautions when starting	21
2.7	Measures for safe maintenance	22
2.8	Safety precautions for diesel engines with electronic control units	23

2.9	Safety and emergency running program for diesel engines with electronic control units	24
2.10	Special instructions for working on the common rail system	24
2.11	Particular hazards	25
2.12	Disposal of operating fluids	26
2.13	Exhaust after-treatment system (SCR)	27
3	Handling, operation	29
3.1	Control and operating elements	29
3.2	Operation	30
3.2.1	Preparing for initial commissioning	30
3.2.2	Initial commissioning / test run	30
3.2.3	Starting the diesel engine	31
3.2.4	Starting in freezing temperatures	32
3.2.5	Shutting down the diesel engine	32
3.2.6	Exhaust after-treatment system (SCR)	33
4	Operating faults	41
4.1	Faults - Cause - Remedy	41
5	Maintenance	47
5.1	Maintenance and inspection schedule	47
5.2	Fill quantities	50
5.2.1	Lubricants and operating fluids	50
5.3	Lubricants and operating fluids	51
5.3.1	Diesel fuels	51
5.3.2	Engine oils	51
5.3.3	Diesel engine coolant	52
5.4	Special tools for maintenance activities	54
5.5	Preparatory maintenance activities	57
5.6	Maintenance activities (daily) every 10 operating hours	58
5.6.1	Checking the engine oil level	58
5.6.2	Visual inspection (leaks, contaminations, damage)	58
5.6.3	Checking the coolant level	59
5.6.4	Checking / draining water trap on the fuel prefilter	59
5.6.5	Check underpressure display of the air filter	61

5.6.6	SCR system visual inspection	61
5.7	Maintenance activities every 50 operating hours (weekly)	62
5.7.1	Draining water and sediments from the fuel tank	62
5.7.2	Clean the dust extraction valve of the air filter	62
5.8	Maintenance activities every 500 operating hours	63
5.8.1	Check state of belt drive and replace	63
5.8.2	Checking the intake and exhaust system for condition and leaks	65
5.8.3	Check cooling and heating system for condition and leaks	65
5.8.4	Checking the lubricant and fuel system for condition and leaks	65
5.8.5	Check batteries and cable connections	66
5.8.6	Check condition of control unit bearings.	66
5.8.7	Checking condition of sensors, actuators, cable holders and plugs	66
5.8.8	Inspect SCR system profile clips	66
5.9	Maintenance activities every 1000 operating hours	68
5.9.1	Checking that engine bearing and diesel engine console are securely seated	68
5.9.2	Changing the fuel prefilter insert	68
5.9.3	Changing the fuel fine filter	69
5.10	Maintenance activities every 1500 operating hours	72
5.10.1	Changing the diesel engine oil and oil filter	72
5.10.2	Replacing the oil separator filter insert	75
5.10.3	Checking and setting the valve clearance	77
5.11	Maintenance activities every 2000 operating hours	82
5.11.1	Checking the corrosion frost protection agent concentration in the coolant	82
5.12	Maintenance activities every 6000 operating hours	84
5.12.1	Replacing the coolant	84
5.13	Maintenance activities every 10000 operating hours	86
5.13.1	Replacing the heating flange	86
5.14	Occasional maintenance activities	87
5.15	Checking the heating flange	88
5.16	Venting fuel system	89
5.17	Replacing the dry air filter main element	91
5.18	Replacing the dry air filter safety element	92
5.19	Transport and storage	93
5.19.1	Suspension device	93

5.19.2	Storage up to 6 months	93
5.19.3	Storage over 6 months up to 24 months	94
6	Supplemental information for the USA	95
6.2.1	EPA/CARB fuel label	95
6.3	Emission control warranty statement warranty rights and obligations	96
6.3.1	Manufacturer's warranty coverage	96
6.3.2	Owner's warranty responsibilities	96
6.3.3	Warranty coverage	97
6.3.4	Warranted parts	97
	Index	99

1 Product description

1.1 Technical description

1.1.1 Design overview

This section contains an overview of the diesel engine with the names of the parts shown.

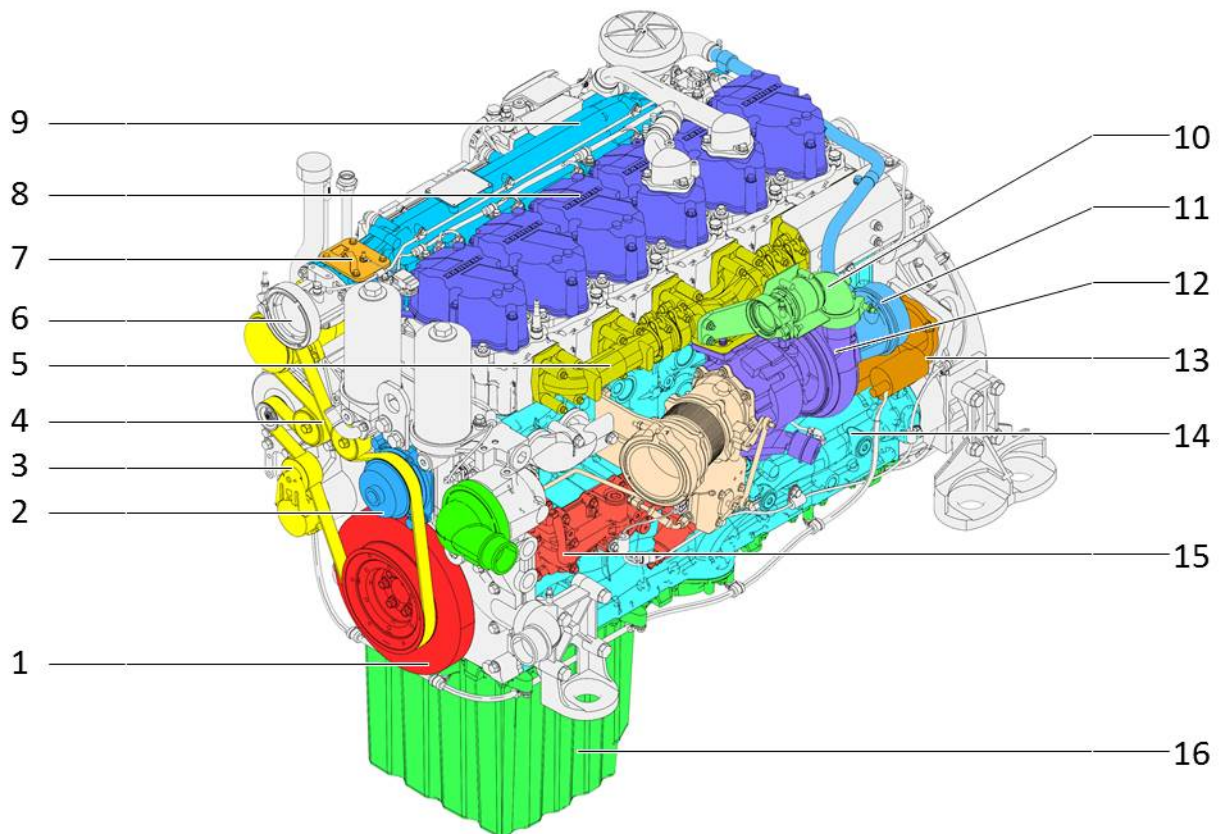


Fig. 1: Parts of the diesel engine D936 A7-04 / view from the left

1	Visco dampers	7	Heating flange	13	Starter
2	Water pump	8	Cylinder head cover	14	Crankcase
3	Automatic tensioning roller	9	Air intake pipe	15	Oil cooler
4	Belt drive	10	Connecting line	16	Oil pan
5	Exhaust pipe	11	Intake branch		
6	Air intake	12	Exhaust turbocharger		

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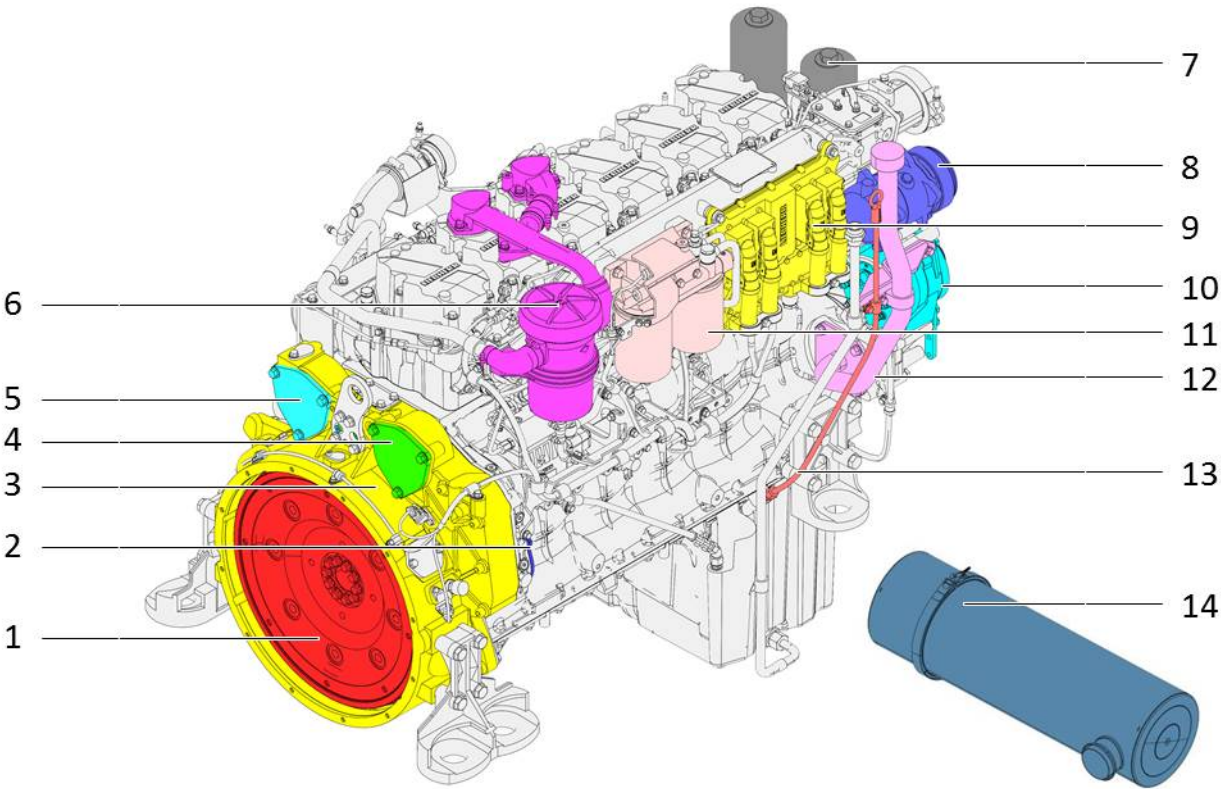


Fig. 2: Parts of the diesel engine D936 A7-04 / view from the right

- 1 Flywheel
- 2 Auxiliary output NA3
- 3 Flywheel housing
- 4 Auxiliary output NA1
- 5 Auxiliary output NA2
- 6 Crankcase ventilation
- 7 Oil filter
- 8 A/C compressor
- 9 Motor control unit
- 10 Alternator
- 11 Fuel fine filter
- 12 Oil filler neck
- 13 Oil dipstick
- 14 SCR box

1.1.2 Explanation of type designation

Type designation

					Description
D	93	6	A7	04	Engine type designation
D					Engine type: D = diesel engine
	93				Hole: 122 mm (94 = 130 mm) / stroke: 150 mm
		6			Number of cylinders
			A7		Injection system: A7 = Common Rail
				04	Exhaust after-treatment system: SCR (selective catalytic reduction)
				00	Diesel engines without emission type approval (without exhaust after-treatment system)

Tab. 1

Diesel engine type plate

The diesel engine type plate is attached on the right side of the crankcase as seen from the flywheel. There is a second type plate on the air intake pipe.

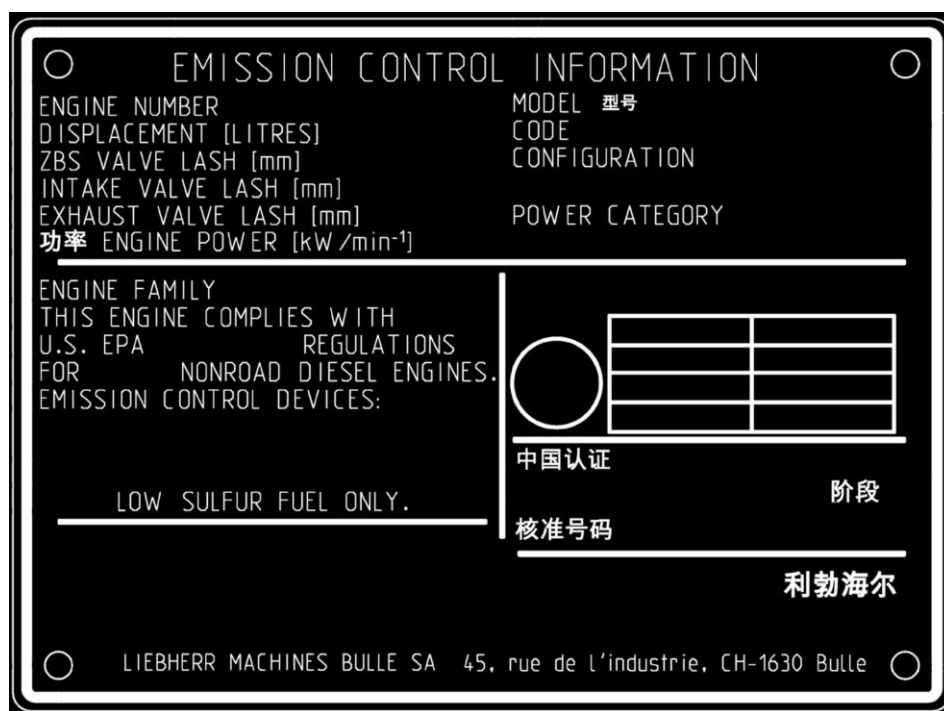


Fig. 3: Type plate

Diesel engine number

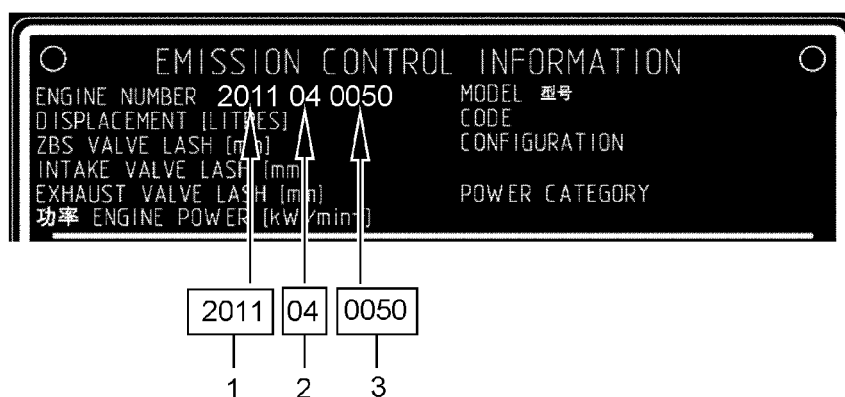


Fig. 4: Diesel engine number


- | | |
|--|-------------------------------|
| <p>1 Year</p> <p>2 Number of cylinders (03=4 cylinders / 04=6 cylinders)</p> | <p>3 Serial number</p> |
|--|-------------------------------|

Engine control unit type plate



Fig. 5: Example of an engine control unit type plate

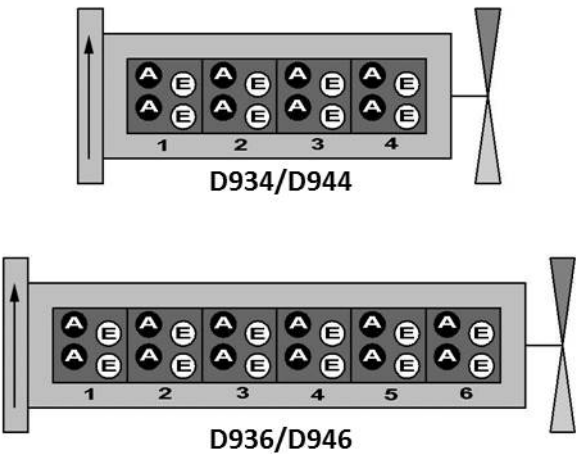
1	Delivery date	6	Engine serial number
2	2D barcode	7	Control unit ID number
3	Engine type	8	Revision index
4	Control unit description	9	Software version
5	Engine ID no.	10	Control unit serial number

**Note**

The information on the engine control unit type plate corresponds to the delivery status (ex works Liebherr Machines Bulle). Depending on software updates in the field, it may be the case that this information is no longer up to date. The real information can be viewed in the device display or read out with Liebherr diagnosis.

Tab. 2

Cylinder designation, direction of rotation



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Fig. 7: Cylinder designation / direction of rotation

Cylinder 1 is on the flywheel side. The cylinder numbers and also the firing order are moulded onto the right upper side of the crankcase as seen from the flywheel.

1.1.3 Design features

Diesel engine design

Water-cooled 4 and 6 cylinder series diesel engine with Common Rail (CR) direct injection process, exhaust gas turbo charging and charge air cooling.

Diesel engine attributes

A robust basic design and generous dimensioning form the basis for high operational safety and a long service life. Low fuel consumption, low noise and exhaust gas emissions due to a combustion process that is especially adapted to the high requirements. Low maintenance effort to easily accessible components and a large number of attachment options for accessories help to maximise the overall economic efficiency of the diesel engine.

Driving gear

The 4-cylinder diesel engines have a 5-fold mounted steel crankshaft with 2 mass balancing shafts with inductively hardened contact surfaces / the 6-cylinder diesel engines have a 7-fold mounted steel crankshaft with inductively hardened contact surfaces. A torsional vibration damper is attached to the crankshaft on the unit support side. Forged, inclined connecting rods, engine mount system in lead/bronze three-layer friction bearings or sputter bearings. Three-ring piston out of steel alloy with ring carrier and combustion bowl in the piston head. Replaceable, wet cylinder liners.

Crankcase

One-piece crankcase out of alloyed cast iron. 4-valve individual cylinder heads with a swirl channel, as well as replaceable valve seat inserts and valve guides. Flywheel housing, front unit support and oil pan on the bottom close the diesel engine.

Drive control

Two inlet and outlet valves hang in the cylinder head for each cylinder. Actuated through 5 or 7-fold mounted steel camshaft via roller tappet, push rod and rocker arm. Drive of camshaft, fuel feed pump, lubricating oil pump, air compressor and hydraulic auxiliary pumps of the crankshaft via nitrated gear wheels on the flywheel side and water pump on the unit support side.

Lubrication

Forced-feed lubrication with gear pump for crankshaft bearing, crank bearing and camshaft bearing as well as piston pin bushing and rocker arm. Oil filtration through two replaceable cartridge filters in the power line. Auxiliary units such as the turbocharger, auxiliary outputs, fuel feed pump and air compressor are connected to the diesel engine lubricating oil circuit. The oil cooler is integrated in the cooling water flow.

Cooling

Thermostatically controlled liquid cooling with coolant pump. Individual supply of each cylinder unit via distribution channels cast into the crankcase. Piston cooling via cooling duct from the lubricating oil circuit of the diesel engine.

Injection system

Volume-controlled high pressure pump which is supplied from a flanged mounted pre-feed pump. Fuel filter, high pressure accumulator, CR injectors with 8 blind hole nozzles.

Electronic diesel engine control

The electronic diesel engine controller (EDC) is designed to control the speed, injection start of LIEBHERR diesel engines. The EDC basically consists of sensors, the injection system and the motor control unit. The diesel engine side and vehicle side installations are connected to the motor control units via cable harnesses.

Electronic sensors on engine side

The charge air pressure sensor, fuel pressure sensor, oil pressure sensor, temperature sensor for coolant, charge air and speed sensors are interfaces for external monitoring and control functions. The individual functions and error messages are described in the respective user documentation.

Attachment options for pumps

Hydraulic pumps can be mounted on up to four auxiliary outputs.

1.1.4 Diesel engine accessory equipment

Diesel engine brake and auxiliary brake system

The diesel engine exhaust brake flap is installed in the exhaust line that leads from the exhaust gas turbocharger to the exhaust after-treatment system. It is actuated by an electric motor; the engine braking effect is achieved by closing the exhaust brake flap. In order to increase the engine braking effect, a diesel engine auxiliary brake system (ABS) is installed in addition to the exhaust gas brake flap. The ABS increases the engine braking effect by keeping a gap open in the outlet valves during the engine braking process.

Air compressor

The air compressor is attached to the flywheel housing. The air compressor cooling and lubrication systems are connected to the appropriate circuits on the diesel engine.

A/C compressor

The A/C compressor can be directly mounted on the diesel engine and powered via a magnetic coupling with a V-ribbed belt. The magnetic coupling is active when the A/C system is switched on and the compressor is working.

Cooling set

The interfaces for retrofitting preheating devices such as coolant, fuel and engine oil have already been integrated.

1.2 Technical data

1.2.1 Diesel engine

Description	Unit	Value
Design		Series diesel engine
Number of cylinders (D934 / D944)		4
Ignition sequence		1-3-4-2
Number of cylinders (D936 / D946)		6
Ignition sequence		1-5-3-6-2-4
Hole (D934 / D936)	mm	122
Hole (D944 / D946)	mm	130
Stroke	mm	150
Displaced volume (D934)	l	7.0
Displaced volume (D936)	l	10.5
Displaced volume (D944)	l	8
Displaced volume (D946)	l	11.95
Compression ratio		17.4:1
Direction of rotation of the diesel engine (seen from flywheel)		Left
Power group		LG1 to LG5
Power specification as per		See type plate
Rated power		See type plate
Rated speed		See type plate
Emission limits (A7-04 engines)		Stage IV / Tier 4
D934/D944 diesel engine weight dry	kg	870
D936/D946 diesel engine weight dry	kg	1210

1.2.2 Cylinder head standard

Description	Unit	Value
Inlet valve clearance, cold		See type plate
Outlet valve clearance, cold		See type plate

1.2.3 Cylinder head with engine auxiliary brake system (ABS)

Description	Unit	Value
Inlet valve clearance, cold		See type plate

LMB/10154726/01/11/2015/en

Description	Unit	Value
Outlet valve bridge / rocker arm valve clearance, cold		See type plate
Outlet valve bridge / counterholder valve clearance, cold		See type plate

1.2.4 Coolant pump D934 / D944

Description	Unit	Value
Pump rate (at rated speed 1800 / 1900 rpm and counterpressure 0.6 bar)	l/min	470 / 500

1.2.5 Coolant pump D936 / D946

Description	Unit	Value
Pump rate (at rated speed 1800 / 1900 rpm and counterpressure 0.6 bar)	l/min	485 / 515

1.2.6 Coolant thermostat

Description	Unit	Value
Opening start	°C	82
Completely open	°C	92

1.2.7 Alternator

Description	Unit	Value
Voltage	V	28
Current, type 1	A	140
Current, type 2	A	180

1.2.8 Starter

Description	Unit	Value
Voltage	V	24
Capacity	kW	7.8

1.2.9 Flywheel housing

Description	Unit	Value
Connection		SAE 1 / SAE 2

1.2.10 Wabco air compressor 293 cm³

Description	Unit	Value
Pump rate at rated speed of 1800 / 1900 rpm and 10 bar	l/min	400 / 415
Gear ratio		1 : 1.389
Water-cooled		yes

1.2.11 Knorr air compressor 300 cm³

Description	Unit	Value
Pump rate at rated speed of 1800 / 1900 rpm and 10 bar	l/min	390 / 410
Gear ratio		1 : 1.389
Water-cooled		yes

1.2.12 Knorr air compressor 630 cm³

Description	Unit	Value
Pump rate at rated speed of 1800 / 1900 rpm and 10 bar	l/min	695 / 740
Gear ratio		1 : 1.389
Water-cooled		yes

2 Safety instructions

Working on the diesel engine involves dangers to life and limb that you can encounter as the operating company, machine operator or maintenance specialist. If you carefully read and follow the various safety instructions time and again, you can prevent dangers and accidents.

This applies in particular to personnel who only occasionally work on the diesel engine during maintenance.

Safety regulations are listed below, the conscientious observance of which ensures your safety and the safety of other persons and prevents damage to the diesel engine.

The required safety precautions are described in the description of work in this manual which could cause dangers to persons or the diesel engine.

2.1.1 Identification of the warnings



This is the warning sign. It warns of possible risk of injury. Comply with all measures that are identified with these warning signs in order to avoid injuries or death.

Tab. 3

The warning sign always appears in connection with the signal words

DANGER
WARNING
CAUTION

	DANGER	Identifies an immediately dangerous situation that will result in death or serious bodily injuries if it is not prevented.
	WARNING	Identifies a dangerous situation that could result in death or serious bodily injuries if it is not prevented.
	CAUTION	Identifies a dangerous situation that could result in minor or moderate bodily injuries if it is not prevented.
	ATTENTION	Identifies a dangerous situation that could result in property damage if it is not prevented.

Tab. 4

Additional identifications



Note

Identifies useful information and tips.

Tab. 5

Additional rules and directives

Following these instructions does not excuse you from observing additional rules and directives!

2.2 General safety instructions

1. Familiarise yourself with the **operating instructions** before commissioning the machine.
Make sure that you have in your possession, or have read and understood, any potential additional instructions relating to special equipment for your machine.
2. Only persons expressly authorised to do so may operate, maintain or repair the machine.
Adhere to the legally permitted minimum age!
3. Use only trained or instructed personnel, clearly establish the responsibility of the personnel for operation, set-up, maintenance and repairs.
4. Only allow personnel who are being trained, instructed or are present for general educational purposes to work on the diesel engine under constant supervision of an experienced person.
5. Check that personnel are conscious of safety and hazards involved in their work regularly considering the **operating instructions**.
6. Wear safe work clothing when working on the diesel engine.
Avoid wearing rings, wristwatches, ties, scarves, open jackets, dresses that are not close-fitting etc. A risk of injury exists, e.g. by getting caught or pulled in.

2.3 Intended use

1. This diesel engine is built exclusively for the purpose corresponding to the scope of the delivery (intended use). Any other use above and beyond this is considered to be improper use. The manufacturer is not liable for any damages resulting from this. The risk is born solely by the user.
2. Observance of the operating, maintenance and servicing conditions prescribed by the manufacturer is also part of intended use. The diesel engine may only be used, maintained and repaired by persons who have familiarised themselves with this and are aware of the dangers.
3. Unauthorised changes to the diesel engine void the liability of the manufacturer for any resulting property damage or personal injury. Likewise, interference with the injection and control system may influence the power and exhaust gas parameters of the diesel engine, meaning that compliance with statutory environmental requirements is no longer assured.

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2.4 Instructions for preventing crushing and burns

1. Do not use any load suspension means, such as ropes or chains, that are damaged or do not have sufficient load capacity.
Wear work gloves when handling wire ropes.
2. When the diesel engine is running, make sure that no objects come into contact with the fan.
Objects that fall into or project into the fan will be catapulted out again or destroyed and may damage the fan.
3. The diesel engine cooling system is hot and under pressure near the operating temperature.
Avoid contact with parts carrying cooling water.
A risk of burns exists!
4. Only check the cooling water level when the end cover of the expansion tank has cooled off enough that you can touch it.
Carefully open the lid in order to first let off the excess pressure.
5. The diesel engine oil is hot near the operating temperature.
Avoid skin contact with hot oil or oil-bearing parts.
6. Wear safety glasses and work gloves when working on the battery.
Avoid sparks and naked flames while doing so.

2.5 Instructions for preventing fires and explosion hazards

1. The diesel engine must be shut down during refilling.
Switch off any additionally installed parking heater.
2. Do not smoke and avoid naked flames while refuelling and where batteries are being charged.
3. Always start the diesel engine according to the instructions in the **operating instructions**.
4. Check the electrical system.
Immediately rectify all errors, such as loose connections and frayed cables.
5. Regularly check all lines, hoses and screw connections for leaks and damage.
6. Immediately rectify the leaks and replace the damaged parts.

2.6 Safety precautions when starting

1. If you have not received any other instructions, start the diesel engine according to the instructions in the **operating instructions**.
2. Start the diesel engine and then check all display units and control devices.
3. Only run the diesel engine in an enclosed space if sufficient ventilation is available.
If necessary, open doors and windows to ensure sufficient fresh air supply.

2.7 Measures for safe maintenance

1. Do not perform any maintenance or repair work which you are not proficient in.
2. Observe the prescribed time periods, or the time periods stated in the operating instructions, for recurring checks or inspections.
Workshop equipment adequate for the work is absolutely necessary for performing the maintenance measures.
3. It is precisely defined by means of the schedule at the end of these **operating instructions** who must or may perform which work.
The machine driver or the maintenance personnel may only perform the work indicated in the maintenance and inspection schedule with "by maintenance personnel". The rest of the work may only be performed by specialised personnel with appropriate training.
4. Spare parts must comply with the technical requirements established by the manufacturer. This is always guaranteed with original spare parts.
5. Wear safe work clothing during maintenance.
6. Unless otherwise stated in these **operating instructions**, perform all maintenance work on the diesel engine on level, solid ground and with the diesel engine turned off.
7. Tighten screw connections loosened during maintenance and repair work using the prescribed tightening torque.
8. Clean the diesel engine and in particular, clean connections and screw fittings of oil, fuel and care products at the start of the maintenance or repair work. Do not use aggressive cleaning agents. Use lint-free cleaning cloths.
Do not use any flammable liquids to clean the diesel engine.
9. Before cleaning the machine with water, steam jets (high pressure cleaner) or other cleaning agents, cover or tape shut all openings into which water, steam or cleaning agents must not penetrate due to safety or functional reasons.
Crankcase ventilation, electronics box, starter, generator and exhaust after-treatment system are especially at risk.

Additional procedures:

- Completely remove the covers or tape after cleaning.
 - Inspect all fuel lines, diesel engine oil lines and hydraulic oil lines for leaks, loosened connections, abrasions and damage after cleaning.
 - Correct deficiencies discovered immediately.
10. Observe the safety regulations that apply for the product when handling oils, greases and other chemical substances.
 11. Arrange for safe and environmentally friendly disposal of operating and auxiliary materials as well as replaced parts.
 12. Use caution when handling hot operating and auxiliary materials (risk of burns and scalding).
 13. Wear work gloves when searching for leaks. A fine stream of liquid, under pressure, can penetrate the skin.
 14. Turn the diesel engine off before removing the oil lines.
 15. Operate combustion engines only in sufficiently ventilated spaces. Make sure that there is adequate ventilation before starting the engine in an enclosed room. Follow the regulations applicable for the respective site of operation.
 16. Do not attempt to lift heavy parts. Use suitable aids with sufficient load capacity for this.

Procedure:

- Carefully fasten and secure individual parts and larger assemblies to lifting equipment during replacement so that no danger exists here.
- Use only appropriate and technically faultless lifting equipment and lifting devices with sufficient loading capacity.

Loitering or working under suspended loads is prohibited.

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17. Do not use damaged ropes or ropes that do not have a sufficient load capacity. Wear work gloves when handling wire ropes.
18. Work on electrical equipment of the machine may only be carried out by a skilled electrician or by trained persons under the direction and supervision of a skilled electrician according to electrical rules.
19. Disconnect the battery when working on the electrical system and also remove the plug from the control unit when carrying out electric welding work on the machine. Always disconnect negative poles first and connect them last.

2.8 Safety precautions for diesel engines with electronic control units

1. Do not start the diesel engine unless the batteries are securely connected.
2. Do not disconnect the batteries when the diesel engine is running.
3. Do not start the diesel engine unless the control unit is connected.
4. Do not use a rapid charging device to start the diesel engine. Only jump start with separate batteries.
5. For rapid charging of the batteries, the battery terminals must be removed. Observe the operating instructions for the rapid charging device.
6. When carrying out welding work, the batteries must be disconnected and the two cables (plus and minus) must be securely connected to each other. In addition, the connection plugs must be disconnected for all control units.
7. The connection of the control units may only be disconnected or reconnected when the electrical system is switched off. Tighten the fixing screws for the interface plugs with the prescribed torque.
8. Reversing the polarity of the control unit supply voltage (e.g. by reversing the battery polarity) can result in destruction of the control units.
9. Tighten the connections to the injection system with the prescribed torque.
10. If temperatures over 80 °C are to be expected (e.g. drying kilns) the control units must be removed.
11. Only use suitable test cables for measurements at plug connections.
12. The sensors or actuators may be connected individually to or between external voltage sources for testing purposes and only in connection with the electronic control unit as otherwise there is a risk of the diesel engine being destroyed or malfunctioning.
13. The electronic control unit is only adequately protected against dust and water ingress when the mating connector is mounted and attached. If the mating connectors are not mounted, the control unit must be adequately protected against dust and water.
14. Telephones and wireless devices that are not connected to an external antenna may result in malfunctions of the vehicle electronics and hence endanger the operational safety of the diesel engine.

2.9 Safety and emergency running program for diesel engines with electronic control units

1. The diesel engine is equipped with an electronic control system which monitors both the diesel engine and itself (self-diagnosis).

As soon as a fault is identified, one of the following actions is automatically initiated, after assessment of the fault that has occurred:

- Issue of a fault message with a fault code.
- In combination with the vehicle diagnosis system, the fault code is directly shown via a display.
- Switch over to appropriate backup functions for further, yet restricted operation of the diesel engine (for example, constant limp-home speed).

Get faults immediately fixed by the responsible LIEBHERR customer service.

2.10 Special instructions for working on the common rail system

1. When the diesel engine is running, the fuel lines are under a constant pressure of up to 2200 bar.
 - Never loosen the screw fittings on the fuel high pressure side on the common rail system when the diesel engine is running.
2. Fuel escaping under pressure can penetrate the skin and cause severe injuries. There is a risk of fire due to vaporisation of the fuel.
 - When the diesel engine has come to a halt, wait at least one minute until the pressure in the rail system has fallen.
 - Avoid being in close proximity to the diesel engine when it is running.
 - Persons with pacemakers may not come closer than 20 cm to the diesel engine when it is running.
 - Do not touch electrically live parts of the injector connections when the diesel engine is running.
3. Modern components of the diesel injection system consist of high precision parts that are subject to extreme loading. Due to this high precision engineering, the highest standards of cleanliness should be maintained for all work on the fuel system.
Even dirt particles greater than 0.2 mm can result in component failures.
4. Therefore, before starting work, it is **essential** to observe the precautions described below:
 - Before working on the clean side of the fuel system, the diesel engine and the diesel engine compartment must be cleaned (steam jets), whereby the fuel system must be kept closed.
 - Perform visual inspections for leaks or damage in the fuel system.
 - Do not direct the steam jet at electrical components or cover these first.
 - Move the diesel engine to a clean area of the workshop where work that can stir up dust is not performed (grinding and welding work, brake repairs, brake and performance tests etc.).
 - Avoid air movements (such as dust being stirred up by starting diesel engines, workshop ventilation or heating, draughts etc.).

LMB/10154726/01/01/11/2015/en

- The area around the fuel system that is still closed should be cleaned and dried using compressed air.
 - Remove loose dirt particles such as paint chips and insulation material with suitable equipment (industrial vacuum cleaners).
 - Cover the areas of the diesel compartment which could produce dirt particles with a new and clean covering film.
 - Before beginning the dismantling work, the hands must be washed and fresh overalls put on.
5. When performing the work, it is **essential** to observe the precautions described below:
- After opening the clean-side fuel system, it is not permitted to use compressed air for cleaning.
 - Any loose dirt is to be removed during installation work using suitable equipment (industrial vacuum cleaners).
 - Only lint-free cleaning cloths may be used on the fuel system.
 - Tools and working materials must be cleaned before starting work.
 - Only tools that are undamaged (no cracked chromium coatings, for example) may be used.
 - When removing and installing components, no materials such as cloths, cardboard or wood may be used as these may produce particles and fibres.
 - If paint chips are produced when connections are loosened (possibly due to repainting), then these paint chips are to be carefully removed before final detachment.
 - The connection openings of all removed parts from the clean-side fuel system are to be **immediately** sealed with suitable sealing caps.
 - This sealing material must be kept in dust-free packaging until use and is to be disposed of after a single use.
 - The components are then to be carefully placed in a clean, sealed container.
 - **Never** use used cleaning or testing fluids for these components.
 - New components may only be removed from the original packaging immediately before use.
 - Work on removed components may only be performed at a suitably equipped workplace.
 - If parts that were removed are shipped, always use the original packaging for the new part.

2.11 Particular hazards

1. **Risk of injury due to moving components**
Rotating components or those with a linear motion can result in serious injuries.
 - Do not reach into moving components or handle them during operation.
 - Do not open covers during operation.
 - Be aware of the run-down time; before opening the covers, make sure that no parts are still moving.
 - Wear closely fitting protective clothing when in the danger area.
2. **Risk to life from falling loads**
Loads may fall during lifting operations. This can cause severe and even fatal injuries.
 - Only use transport equipment to carry the engine with no additional attachments.
 - Pulling the engine diagonally is not permitted, so a suspension device must be used.

3. **Risk of fire due to highly flammable materials**
Highly flammable materials, liquids or gases can catch fire and cause severe or even fatal injuries.
 - Do not smoke within the danger area or in the vicinity. Prohibit use of naked flames or ignition sources.
 - Keep a fire extinguisher at the ready.
 - Report suspicious materials, liquids or gases immediately to the responsible party.
 - In case of fire, stop work immediately. Leave the danger area until an all-clear is issued.
4. **Risk of injury due to noxious coolants**
Coolants contain noxious substances. Contact with these substances can lead to serious poisoning, allergies, skin irritation and damage to the eyes.
 - Observe the safety data sheets from the manufacturer.
 - When handling coolants, always wear protective clothing, chemical-resistant protective gloves and safety goggles.
 - Avoid spills and misting.
5. **Risk of burns from hot operating fluids**
Operating fluids can reach high temperatures during operation and cause burns on contact.
 - Before handling operating fluids, check if they are hot. If necessary, allow them to cool.
6. **Risk of burns from hot surfaces**
Contact with hot components can result in burns.
 - Protective clothing and protective gloves must always be worn for all work in the vicinity of hot components.
 - Before beginning all work, ensure that all components have cooled down to ambient temperature.
7. **Hearing damage due to noise**
The noise level present in the working area can cause severe damage to hearing.
 - Hearing protection must be worn for all work.
 - Only remain in the danger area when strictly necessary.
8. **Risk of injury on edges and corners**
Sharp edges and pointed corners can graze and cut the skin.
 - Take care when carrying out work in the vicinity of sharp edges and pointed corners.
 - If in doubt, wear protective gloves
9. **Tripping hazard due to dirt and objects left lying around**
Dirt and objects left lying around pose a slipping and tripping hazard, and can cause significant injuries.
 - Always keep the working area clean.
 - Remove objects that are no longer needed.
 - Identify trip points with black/yellow marking tape.

2.12 Disposal of operating fluids

Concerning scrap materials and hazardous waste, such as for example:

- Oils, lubricant, refrigerant from air conditioning systems etc.
- Coolant
- Fuels
- Reducing agent
- Filter, oil filter cartridges etc.

**DANGER**

Inadvertent filling of operating fluids in food or beverage containers
Operating fluids could be drunk accidentally.
Danger to health and life.

- ▶ Do not use food or beverage containers to drain operating fluids!
- ▶ Use leak-proof containers to drain operating fluids!

**Note**

Danger to environment and health

- ▶ Observe the country-specific regulations regarding environmental protection when disposing of used consumables.
- ▶ Before disposing or recycling waste products, ask for the correct method at the responsible environmental or recycling centre.
- ▶ Different operating fluids are to be collected and disposed in separate containers.
- ▶ Make sure that no operating fluids end up in the soil, sewer system or water.

2.13 Exhaust after-treatment system (SCR)

NOTICE

If water, steam or other cleaning agents gets into the SCR module:
The coating of the substrates peels off.
NO_x sensor defective.

- ▶ Cover all openings before cleaning.
- ▶ Make sure that no liquids or dirt get into the tail pipe opening on the SCR module.
- ▶ Allow the SCR system to cool down before cleaning (surface temperature < 50 °C).

LMB/10154726/01/01/11/2015/en

3 Handling, operation

3.1 Control and operating elements

The control and operating elements are part of the devices and are described in the manufacturer's documentation.

Data, for example in relation to oil pressure, coolant temperature, speed, operating hours and service code are transmitted to the device for operation and control of the diesel engine via the electronic interface on the diesel engine.

3.2 Operation

3.2.1 Preparing for initial commissioning

Diesel engines straight from the factory are filled with operating oil ex works. Overhauled and replacement engines are usually delivered without operating fluids.

The high quality initial operating oils support the running-in process and enable the first oil change to be performed at normal oil change intervals.

For filling quantities, see the section "Filling quantities".

For quality, see the chapter "Lubricants and operating fluids".

Filling the operating fluids

Fill the following operating fluids before the initial commissioning:

- **Diesel engine oil**
For suitable lubricating oil for the diesel engine, see the chapter "Lubricants and operating fluids".
- **Coolant**
For coolant composition, see the chapter "Lubricants and operating fluids".
- **Diesel fuel**
Use summer or winter fuel, depending on the season.
Diesel fuels must correspond to the permitted fuel specifications, see the chapter "Lubricants and operating fluids".
- **Reducing agent (water/urea solution)**
For suitable reducing agents, see the chapter "Exhaust after-treatment system (SCR)".



WARNING

Naked flames!
Fire and explosion.

- ▶ Do not smoke and avoid naked flames while refuelling.
- ▶ Only refuel when the diesel engine is switched off.

After filling the operating fluids, perform the following work:

- ▶ Check batteries (see documentation from the device manufacturer for procedure).
- ▶ Check diesel engine oil level (see the chapter "Maintenance" for procedure).

3.2.2 Initial commissioning / test run

Test run

- ▶ Start diesel engine.
- ▶ Check the oil pressure gauge immediately after starting the diesel engine.

Troubleshooting

No oil pressure is achieved within 5 seconds?

- ▶ Turn off diesel engine immediately.
- ▶ Determine cause and rectify.

- ▶ Gradually increase the diesel engine speed up to 3/4 of the highest permitted speed until the operating temperature is reached.

NOTICE

Impermissible loading of the diesel engine in a cold state!
Damage to the diesel engine.

- ▶ Let the diesel engine warm up until the operating temperature has been reached.
- ▶ Warm up the diesel engine.
 - ▷ Coolant temperature > 60 °C

Performing work after test run

Make sure that:

- ☐ The diesel engine is turned off.
- ▶ Check coolant level (see "Maintenance" chapter for procedure).
- ▶ Check diesel engine oil level (see "Maintenance" chapter for procedure).
- ▶ Check diesel engine for leaks (see "Maintenance" chapter for procedure).

3.2.3 Starting the diesel engine

Make sure that there is sufficient fuel in the tank.

- ▶ Start the diesel engine in idle running position with the contact key or the starter pushbutton.

Troubleshooting

Does the diesel engine not start?

- ▶ Take a break for 1 minute.

If the diesel engine does not start after three attempts:

- ▶ Determine cause and rectify.

- ▶ Check the oil pressure gauge immediately after starting the diesel engine.

Troubleshooting

No oil pressure is achieved within 5 seconds?

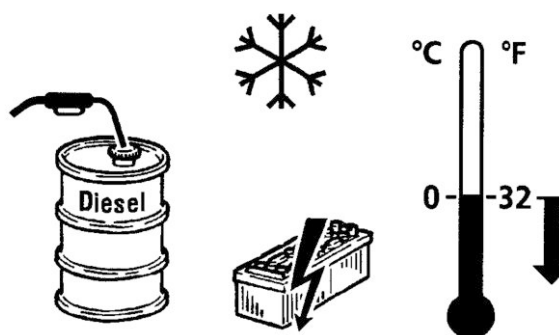
- ▶ Turn off diesel engine immediately.
- ▶ Determine cause and rectify.

NOTICE

Impermissible loading of the diesel engine in a cold state!
Damage to the diesel engine.

- ▶ Let the diesel engine warm up until the operating temperature has been reached.
- ▶ Warm up the diesel engine.
 - ▷ Coolant temperature > 60 °C

3.2.4 Starting in freezing temperatures



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Fig. 13: Winter operation

The following precautions improve the starting performance at low temperatures.

Precautions:

- Check charge of battery.
- Recharge battery if required.
- Use diesel fuel with sufficient flow characteristics (see chapter Lubricants and operating fluids under Diesel fuels at low temperatures).
- Prewarming of the intake air (see device manufacturer's documentation).

**WARNING**

Use of starting aids containing ether!
Risk of explosion.

- ▶ Do not use starting aids containing ether.

NOTICE

Impermissible loading of the diesel engine in a cold state!
Damage to the diesel engine.

- ▶ Let the diesel engine warm up until the operating temperature has been reached.

3.2.5 Shutting down the diesel engine

**WARNING**

Shutting down the diesel engine at full load speed! (exhaust gas turbocharger continues running for some time without oil supply).
Risk of damage to the diesel engine.

- ▶ Do not shut down the diesel engine at full load speed.

- ▶ Reduce the diesel engine speed to idle running speed.
- ▶ Let the diesel engine idle for another 10 to 15 seconds.
- ▶ Shut down the diesel engine.

3.2.6 Exhaust after-treatment system (SCR)

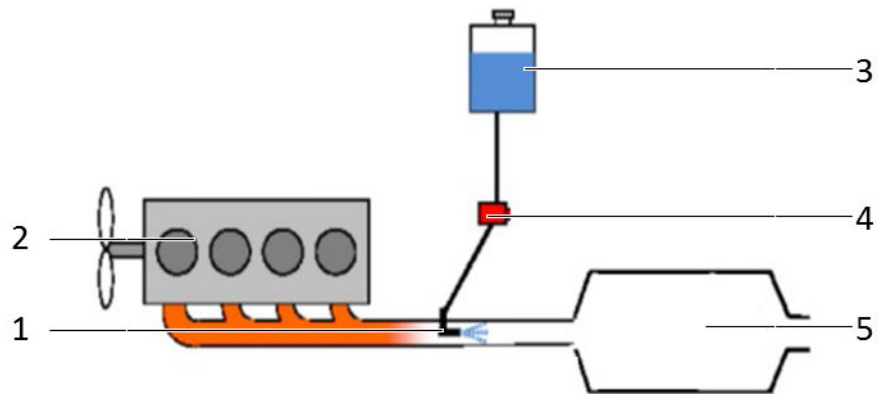


Fig. 14: A simple schematic diagram of the SCR system

- | | |
|--|-------------------------------|
| 1 Reducing agent supply / Mixing section | 4 Dosing unit / SCR urea pump |
| 2 Diesel engine | 5 SCR module |
| 3 Reducing agent tank | |

The SCR exhaust after-treatment system (selective catalytic reduction) describes a technique for converting or reducing nitrogen oxides (NO_x) in the exhaust gas by adding a reducing agent (water/urea solution) into nitrogen (N_2) and water (H_2O).

Reducing agent

Designations:

- AdBlue® in Europe
- DEF (diesel exhaust fluid) in the USA

NOTICE

Operating without reducing agent!
Statutory exhaust gas limits will be exceeded.
The operator is liable for prosecution.

- ▶ Operating the system **with** reducing agent.
- ▶ Top up the reducing agent promptly.

Specification

Reducing agent must comply with the specifications listed below. Specifications:

- DIN 70 070
- ISO 22241

Handling and use



CAUTION

Reducing agent can cause injuries to the eyes and allergic skin reactions.

- ▶ Avoid skin contact with reducing agent.
- ▶ Note manufacturer instructions.



Note

If reducing agent comes into contact with painted or aluminium surfaces during filling:

- ▶ Wash off the affected areas immediately with water.

NOTICE

Mixing in special additives and dilution of the reducing agent (e.g. with tap water) are not permitted.

Statutory exhaust gas limits will be exceeded.

and the exhaust after-treatment system will be destroyed.

- ▶ Do not mix reducing agent with special additives or dilute.
- ▶ Make sure that no dirt gets into the reducing agent.
- ▶ Do not fill the reducing agent tank with operating fluids.
- ▶ Do not fill the diesel fuel tank with reducing agent.



Note

- ▶ The diameter of the filler neck on the reducing agent tank is smaller than on the diesel fuel tank.

NOTICE

If diesel fuel is poured into the reducing agent tank, or vice-versa:

- ▶ Do **not** start the diesel engine.
- ▶ Contact Liebherr customer service.

The reducing agent must remain absolutely pure.

For example, if the reducing agent has to be pumped out of the tank for a repair, it must not be used again, as there is no longer any guarantee as to the purity of the fluid.

Disposal

Dispose of reducing agent in an environmentally friendly manner. For procedure, see chapter "Disposal of old consumables".

Suitability for storage / Temperature resistance

See documentation from the manufacturer.

Availability

Reducing agent can be purchased at petrol stations, service stations, from dealers, or direct from the manufacturer. For varieties available in Europe, see also www.findadblue.com

To procure reducing agent in the USA, please contact Liebherr Newport News, VA, (757) 245-5251, info.lme@liebherr.com or see www.discoverdef.com.







Consumption

The reducing agent consumption of the diesel engine depends on vehicle usage. Filling is not based on maintenance intervals. The fill level of the reducing agent tank is displayed via a tank gauge in the vehicle's cab. See documentation from the device manufacturer for procedure and information on filling.

Indicator and warning lamps

The possible error conditions of the SCR system are shown to the operator by the illumination of the corresponding indicator and warning lights.

Indicator and warning lamps:













Lamp	Name	Meaning	Remedy
 	MIL lamp (Malfunction Indicator Lamp)		
 	MIL lamp (used by LWE)	Exhaust after-treatment system malfunction or reducing agent tank fill level not OK	Top up the reducing agent and/or contact Liebherr customer service
 	DEF lamp		

Tab. 6: SCR indicator and warning lamps













Warning and malfunction strategies













The SCR system is monitored by a diagnostics system. If the diagnostics system detects an error, for example reducing agent tank fill level not OK, low reducing agent quality, malfunction of an SCR component or tampering with the SCR system, a warning or malfunction strategy is activated.

EU strategies (Stage IV) / US-EPA/CARB (Tier4)

Application	On-screen display	System status	Limitation
Stationary applications for mobile cranes (OW)	 MIL off  DEF yellow  Signal tone	DEF level < 10% or Exhaust after-treatment system malfunction 0 min - 60 min	No limitation
	 MIL yellow  DEF yellow  Signal tone	DEF level < 5% or Exhaust after-treatment system malfunction 60 min - 180 min	Torque limited to 80%
	 MIL yellow  DEF red  Signal tone	DEF level < 2.5% or Exhaust after-treatment system malfunction 180 min - 210 min	Torque limited to 20%
	 MIL red  DEF red  Signal tone	DEF level = 0 or Exhaust after-treatment system malfunction from 210 min	Torque limited to 20%

LMB/10154726/01/01/11/2015/en

Application	On-screen display	System status	Limitation
On-road applications for mobile cranes (UW)	 MIL off  DEF yellow  Signal tone	DEF level < 10% or Exhaust after-treatment system malfunction 0 min - 60 min	No limitation
	 MIL yellow, flashing  DEF yellow  Signal tone	DEF level < 5% or Exhaust after-treatment system malfunction 60 min - 180 min	Maximum vehicle speed 72 kmh (45 mph)
	 MIL yellow, flashing  DEF yellow, flashing  Signal tone	DEF level < 2.5% or Exhaust after-treatment system malfunction 180 min - 210 min	Maximum vehicle speed 8 kmh (5 mph)
	 MIL yellow  DEF yellow, flashing  Signal tone	DEF level < 0% or Exhaust after-treatment system malfunction from 210 min	Maximum vehicle speed 8 kmh (5 mph)

Application	On-screen display	System status	Limitation
Off-road applications	 MIL off  DEF yellow  Signal tone	DEF level < 10% or Exhaust after-treatment system malfunction 0 min - 60 min	No limitation
	 MIL yellow  DEF yellow  Signal tone	DEF level < 5% or Exhaust after-treatment system malfunction 60 min - 180 min	Torque limited to 80%
	 MIL yellow  DEF red  Signal tone	DEF level < 2.5 % or Exhaust after-treatment system malfunction 180 min - 210 min	Torque limited to 20%
	 MIL red  DEF red  Signal tone	DEF level < 0% or Exhaust after-treatment system malfunction from 210 min	Torque limited to 20%

Tab. 7: EU strategies (Stage IV) / US-EPA/CARB (Tier4)

LMB/10154726/01/01/11/2015/en

Attempting to operate the unit with a malfunction for more than 4 operating hours will mean that the power limitation cannot be deactivated even by turning off the ignition. A repair is strictly necessary. If another error is detected within 40 operating hours of the problem being rectified, then the limitations will be applied after shorter intervals. The final limitation of the system will occur within one operating hour.



Note

- The limitations will not occur all of a sudden, but rather will ramp up in severity.
-



DANGER

Lower vehicle speed for on-road applications for mobile cranes (UW)!
Traffic blocks/increased risk of accidents

- Observe the on-screen display.
 - Top up the reducing agent in good time or contact Liebherr customer service.
-

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4 Operating faults

Troubleshooting with diesel engines can be difficult. For some diesel engine problems with possible cause and corrective measures see the table Faults - Cause - Remedy.



Note

Diesel engine faults are displayed by means of a fault code on the device display for diagnostic purposes. The explanation and remedies are explained in the respective device documentation.

Tab. 8

Basic logical steps for diagnosis are contained in the following list:

- Know the diesel engine and the associated systems.
- Thoroughly study the problem.
- Relate symptoms to existing knowledge about the diesel engine and systems.
- Diagnose problem, starting from the most obvious assumptions.
- Examine closely before starting to take the engine apart.
- Identify the causes and perform repair work thoroughly.
- After repair, run the diesel engine under normal operating conditions and check whether the problem and its cause have been remedied.

4.1 Faults - Cause - Remedy

Malfunction / error	Cause	Remedy
Starter does not turn	Main fuse blown	Replace fuse.
	Battery connections loose or corroded	Clean and tighten loose connections.
	Battery voltage too low	Recharge or replace battery.
	Starter circuit broken or contacts corroded.	Contact Liebherr customer service.
	Starter defective	Contact Liebherr customer service.
Starter turns over slowly	Battery voltage too low	Recharge or replace battery.
	Battery connections loose or corroded	Clean and tighten loose connections.
	Outdoor temperature too low	Implement measures for winter operation.

LMB/10154726/01/01/11/2015/en

Malfunction / error	Cause	Remedy
Diesel engine does not start or comes immediately to halt again.	Fuel tank empty	Refuel, vent fuel system.
	Fuel filter blocked	Replace fuel filter.
	Fuel line, precleaner or sieve in fuel tank blocked	Clean and vent fuel system.
	Fuel system or filter leaking	Seal and vent.
	Air in the fuel system	Vent fuel system.
	Fuel not cold-resistant	Clean pre-filter, replace fuel filter; use winter fuel.
	Outdoor temperature too low	Implement measures for winter operation.
	Heating flange defective (at low temperatures)	Check heating flange, replace if necessary.
Diesel engine starts badly.	Leaks or pressure too low in fuel low pressure circuit	Leak testing (visual inspection); get Liebherr customer service to check engine
	Diesel engine compression too low	Contact Liebherr customer service.
	Heating flange defective (at low temperatures)	Check heating flange, replace if necessary.
	Fault in electronics	Read out fault memory of engine control unit, contact Liebherr customer service.
Diesel engine shuts down when not desired.	Voltage supply interrupted	Contact Liebherr customer service.
	Leaks or pressure too low in fuel low pressure circuit	Leak testing (visual inspection); get Liebherr customer service to check engine
	Fault in electronics	Read out fault memory of engine control unit, contact Liebherr customer service.

Malfunction / error	Cause	Remedy
Low diesel engine power (lack of power)	Defect in fuel system (blocked, leaking)	Visual inspection for leaks, change filter, contact Liebherr customer service.
	Charging pressure too low	Loose clips, defective seals and hoses, air filter contaminated, turbo-charger has no power.
	Charging air temperature too high (automatic power reduction by engine control unit)	Charge air cooler contaminated, low fan power, ambient temperature too high, contact Liebherr customer service.
	Coolant temperature too high (automatic power reduction by engine control unit)	Check cooler for contamination, check fan and thermostat, check coolant level, contact Liebherr customer service.
	Fuel temperature too high (automatic power reduction by engine control unit)	Contact Liebherr customer service.
	Area of use over 1800 m above sea level	No remedy, diesel engine power has been automatically reduced.
	Injection nozzles stuck or do not vaporise.	Contact Liebherr customer service.
	Diesel engine compression too low	Contact Liebherr customer service.
	Fault in electronics	Read out fault memory of engine control unit, contact Liebherr customer service.
	Exhaust after-treatment system blocked	Contact Liebherr customer service.
Poor diesel engine braking	Diesel engine brake flap does not function	Functional and visual check; contact Liebherr customer service.
	Electronics fault	Contact Liebherr customer service.
Diesel engine too hot (according to coolant temperature display)	Too little coolant	Replenish
	Cooler internally contaminated or scaled, outside of cooler heavily contaminated	Clean or descale.
	Thermostat defective	Check, replace if necessary, contact Liebherr customer service.
	Coolant temperature sensor defective	Check, replace if necessary, contact Liebherr customer service.
	Fan speed too low (hydrostatic fan drive only)	Check fan drive, replace if necessary, contact Liebherr customer service.

Malfunction / error	Cause	Remedy
Charge current indicator light illuminates when diesel engine running	V-ribbed belt tension insufficient	Check V-ribbed belt tension, if necessary replace tensioning roller.
	V-ribbed belt torn	Replace V-ribbed belt.
	Cable connections loose or separated	Fix or replace cable.
	Alternator, rectifier or regulator defective	Contact Liebherr customer service.
Black smoke from diesel engine.	Exhaust after-treatment system defective	Contact Liebherr customer service.
Exhaust gases blue.	Oil level in the diesel engine too high	Adjust oil level.
	Lubricating oil is reaching the combustion chamber and is being burned.	Contact Liebherr customer service.
	Compressor-side seal on the exhaust gas turbocharger defective	Contact Liebherr customer service.
	Crankcase ventilation defective	Check, if necessary replace.
Exhaust gases white.	Injection start too late	Contact Liebherr customer service.
	Heating flange defective (at low temperatures)	Check heating flange and replace if necessary.
Diesel engine rattles.	Combustion faults	Contact Liebherr customer service.
Diesel engine knocking.	Valve clearance too great	Set valve clearance.
	Injection nozzles damaged or carbonised	Contact Liebherr customer service.
	Bearing damage	Contact Liebherr customer service.
	Piston rings worn or broken, pistons eroded	Contact Liebherr customer service.
Abnormal noises	Leaks in the suction and exhaust lines cause whistling noise.	Seal leaks, replace seal if necessary.
	Turbine or compressor wheel rubbing against the housing; foreign bodies in the compressor or turbine; seized up bearings of rotating parts	Contact Liebherr customer service.
Lubricating oil pressure too low	Oil level in the oil pan too low	Fill oil to prescribed mark.
	Lubricating oil is too thin (oil diluted by diesel fuel)	Drain off oil, fill with prescribed oil.
	Pressure sensor defective	Check oil pressure and replace damaged oil pressure sensor; contact Liebherr customer service.
	End control valve does not work properly or dirt in the end control valve.	Contact Liebherr customer service.
	Bearing clearance too great due to wear or bearing damage	Contact Liebherr customer service.
Lubricating oil in the cooling system	Oil cooler or oil cooler plate leaking	Contact Liebherr customer service.

LMB/10154726/01/01/11/2015/en

Malfunction / error	Cause	Remedy
Cooling water in the lubricating oil	O-rings on the cylinder liners are leaking	Contact Liebherr customer service.
	Oil cooler or oil cooler plate leaking	Contact Liebherr customer service.

LMB/10154726/01/01/11/2015/en

5 Maintenance

5.1 Maintenance and inspection schedule

The abbreviations used in this section are: OH or h = operating hours

Various signs (circle, box, star - filled and circle, box, star - empty) divide up the maintenance work into two groups.

Table with circle, box, star - filled means:

The machine operating company or its maintenance personnel is responsible for performing the maintenance work.

Table with circle, box, star - empty means:

Authorised specialised personnel from Liebherr or its authorised dealers must perform or guide the maintenance and inspection work. Maintenance intervals: upon delivery and every 500, 1000, 2000 operating hours (h) and at special intervals.

Power groups	
LG 0 — LG 2	Mobile construction crane (MK crane), mobile crane, crawler crane, duty-cycle crawler crane, crawler crane, rotary drilling rigs, piling and drilling rigs (LRB series), hanging or swing leader (LRH series), reachstacker, maritime crane
LG 3 — LG 5	Crawler excavator, demolition excavator, wheeled excavators, articulated dumper truck, wheel loader, crawler tractor, crawler loader, pipe layer, mobile material handling machines, crawler material handling machines

Tab. 9: Devices

Customer:..... Machine type:..... Serial no.:..... Operating hours:..... Date:.....

Maintenance / inspection after service hours								Tasks to be performed	
On handover	All 8-10 h	All 50 h	All 500 h	All 1000 h	All 2000 h	All 3000 h	Other intervals	By maintenance staff ■ Once-only activity ● Repeat interval † If necessary ✱ Annually before the winter	By authorised specialist staff □ Once-only activity ○ Repeat interval ✧ If necessary
Diesel engine									
	●	●	○	○	○	○		Check engine oil level (or use oil level sensor reading in vehicle cab)	
	●	●	○	○	○	○		Visual inspection (leaks, contaminations, damage)	
			○	○	○	○		Check state of belt drive, replace if necessary.	
			□	○	○	○		Check intake and exhaust system for condition, seating and leaks.	
				○	○	○		Check that engine bearing and diesel engine console are securely seated.	
							✱	Check heating flange.	
							○10000h	Replace heating flange.	
Replace diesel engine oil (at least every 2 years). See the chapter 5.10.									
						○	○1500h	Stage IV / Tier 4 diesel engines of power group 0 — 2 (LG see chapter 5.1). Applicable only for Liebherr engine oil 5W-30.	
						○		Stage IV / Tier 4 diesel engines of power group 3 — 5 (LG see chapter 5.1). Applicable only for Liebherr engine oil 5W-30.	
								Diesel engines without emission type approval, see chapter 5.3.2 section "Lubricating oil change intervals for diesel engines without emission type approval".	
Replace oil filter (at least every 2 years). See the chapter 5.10.									
						○	○1500h	Stage IV / Tier 4 diesel engines of power group 0 — 2 (LG see chapter 5.1). Applicable only for Liebherr engine oil 5W-30.	
						○		Stage IV / Tier 4 diesel engines of power group 3 — 5 (LG see chapter 5.1). Applicable only for Liebherr engine oil 5W-30.	
								Diesel engines without emission type approval, see chapter 5.3.2 section "Lubricating oil change intervals for diesel engines without emission type approval".	
Replace the oil separator filter insert. See the chapter 5.10.									
						○	○1500h	Stage IV / Tier 4 diesel engines of power group 0 — 2 (LG see chapter 5.1). Applicable only for Liebherr engine oil 5W-30.	
						○		Stage IV / Tier 4 diesel engines of power group 3 — 5 (LG see chapter 5.1). Applicable only for Liebherr engine oil 5W-30.	
								Diesel engines without emission type approval, see chapter 5.3.2 section "Lubricating oil change intervals for diesel engines without emission type approval".	
Check / set valve clearance. See the chapter 5.10.									
						○	○1500h	Stage IV / Tier 4 diesel engines of power group 0 — 2 (LG see chapter 5.1)	
							○4000h	D934 A7-04 / D936 A7-04 Stage IV / Tier 4 diesel engines of power group 3 — 5 (LG see chapter 5.1)	
						○		D944 A7-04 / D946 A7-04 Stage IV / Tier 4 diesel engines of power group 3 — 5 (LG see chapter 5.1)	

LMB/10154726/01/11/2015/en

Customer:..... Machine type:..... Serial no.:..... Operating hours:..... Date:.....

Maintenance / inspection after service hours								Tasks to be performed	
On handover	All 8-10 h	All 50 h	All 500 h	All 1000 h	All 2000 h	All 3000 h	Other intervals	By maintenance staff <input checked="" type="checkbox"/> Once-only activity <input checked="" type="checkbox"/> Repeat interval <input checked="" type="checkbox"/> If necessary <input checked="" type="checkbox"/> Annually before the winter	By authorised specialist staff <input type="checkbox"/> Once-only activity <input type="checkbox"/> Repeat interval <input type="checkbox"/> If necessary
							<input type="radio"/> 1500h	Diesel engines without emission type approval	
Cooling system									
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check coolant level.	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check cooling and heating system for condition and leaks.	
					<input type="checkbox"/>		<input checked="" type="checkbox"/>	Check corrosion protection and antifreeze concentration in the coolant (at least once per year).	
							<input type="radio"/> 6000h	Replace coolant (at least every 4 years) when using Liebherr Anti-freeze OS.	
Fuel system									
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check water trap on the fuel prefilter and if necessary drain water.	
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Drain water and sediments from fuel tank.	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check the condition of the lubricating oil and fuel system and check for leaks.	
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Replace fuel prefilter (or in case of low performance).	
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Replace fuel fine filter (or in case of low performance).	
							<input checked="" type="checkbox"/>	Vent fuel system (injection lines may not be detached)	
Air filter									
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check underpressure display of the air filter.	
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Clean the dust extraction valve of the air filter.	
							<input checked="" type="checkbox"/>	Replace dry air filter main element (after maintenance indicator / annually)	
							<input checked="" type="checkbox"/>	Replace dry air filter safety element (with every 3rd change of the main element / annually)	
Electrical system									
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check batteries and cable connections.	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check condition of control unit bearings.	
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check condition of sensors, actuators, cable holders and plugs.	
SCR system									
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		SCR system visual inspection	
		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		Check that profile clip is tightened to the correct torque.	

5.2 Fill quantities

5.2.1 Lubricants and operating fluids

Description	Quantity	Engine type
Engine oil	25 l (1.5 l per filter)	D934 A7-04 / D944 A7-04 / D934 A7-00 / D944 A7-00
	44 l (1.5 l per filter)	D936 A7-04 / D946 A7-04 / D936 A7-00 / D946 A7-00
Coolant	15 l	D934 A7-04 / D944 A7-04 / D934 A7-00 / D944 A7-00
	20 l	D936 A7-04 / D946 A7-04 / D936 A7-00 / D946 A7-00
Reducing agent	See documentation from the device manufacturer.	

Tab. 10: Fill quantity guide values for lubricants and operating fluids

5.3 Lubricants and operating fluids

5.3.1 Diesel fuels

Minimum quality requirements

Permitted diesel fuels according to DIN EN 590 and ASTM D975 1-D / 2-D	For Stage IV / Tier 4 diesel engines	For diesel engines without emission type approval
Maximum sulphur content in fuel	15 ppm	5000 ppm
Lubricating ability at 60°C	460 µm	
Minimum cetane number	45	

Tab. 11: Minimum requirement for diesel fuels

Reducing agent

Permitted reducing agent:

- Reducing agent standardised according to ISO 22241
- Reducing agent standardised according to DIN 70070

Designations:

- AdBlue® in Europe
- DEF (diesel exhaust fluid) in the USA

5.3.2 Engine oils

Liebherr recommends for Stage IV / Tier 4 diesel engines

Ambient temperature	Name
-30 °C to 35 °C	Liebherr engine oil 5W-30

Tab. 12: Recommendations for engine oils

Minimum quality requirements

Specification
ACEA E4 for Stage IV / Tier 4 diesel engines
Liebherr specification 500

Tab. 13: Minimum requirements for engine oils

When using engine oils from third-party manufacturers, information on the change intervals is to be obtained from the respective manufacturer.

Lubricating oil change intervals for diesel engines without emission type approval

If difficulty factors or difficult operating conditions exist, the oil and filter change must be performed according to the following table.

Difficulty factor	Oil quality	
	ACEA E4	Liebherr engine oil 5W-30
Sulphur content in fuel	Interval (h = operating hours)	
up to 300 ppm	500 h	1000 h
300 - 2000 ppm	250 h	500 h
2000 - 5000 ppm	125 h	250 h

Tab. 14: Oil change intervals in accordance with difficulty factors

Ensure that the following minimum requirements are met at 500 h:

- TBN (Total base number) > 6
- SiO (Soot in Oil) < 1 %

5.3.3 Diesel engine coolant

Composition

Coolant consists of the following components:

- Water
- Corrosion protection agent
- Frost protection agent

Corrosion frost protection agent combines the properties of the corrosion protection agent and the frost protection agent.



Note

Mixing different corrosion frost protection agents can diminish the properties of the coolant.

- Do not combine different products!
- Silicate-containing and silicate-free coolants may not be mixed under any circumstances since this can lead to damage to the cooling system!

Mixing ratio for Liebherr Antifreeze products

Ambient temperature	Water	Corrosion frost protection agent
up to -37 °C	50 %	50 %
to -50 °C	40 %	60 %

Tab. 15: Mixing ratio

Requirements for water used

Make sure that the water used fulfils the following prerequisites:

- Corresponds to the guideline for drinking water from the World Health Organisation (WHO) from 2006

Corrosion frost protection agent

Liebherr recommendation

Type	Name
Concentrate	Liebherr Antifreeze OS Concentrate
Premix ^{A)}	Liebherr Antifreeze OS Mix

Tab. 16: Recommendations for corrosion frost protection agent

A) Premix = ready mixture (50 % water and 50 % corrosion frost protection agent)

Minimum quality requirements



Note

If Liebherr coolant cannot be obtained locally:

- Use coolant, which corresponds to the "Coolant specification for Liebherr diesel engines 11657930" (consult customer service).
- Obtain information on the change intervals from the respective manufacturer or supplier.

5.4 Special tools for maintenance activities

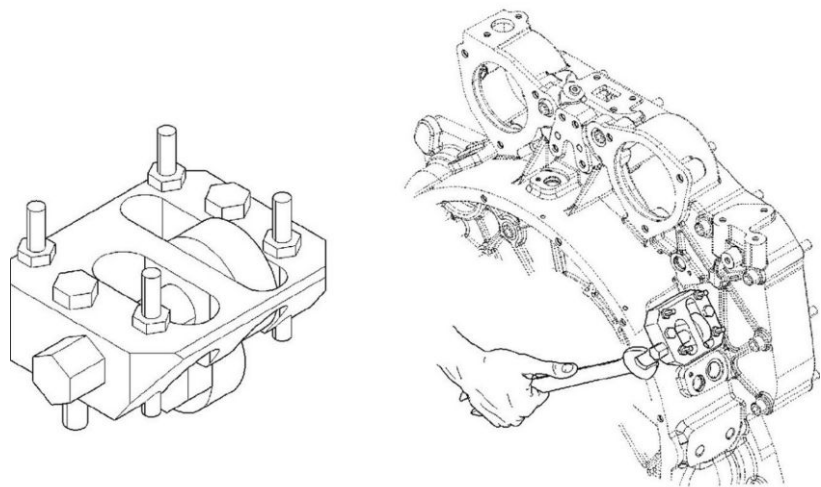


Fig. 58: Turning device - Flywheel housing attachment special tool no. 30

The turning device special tool no. 30 is optional and can be attached to any flywheel housing.

No.	ID no.	Name	See section
30	0524045	Turning device	Check / set valve clearance

Tab. 17

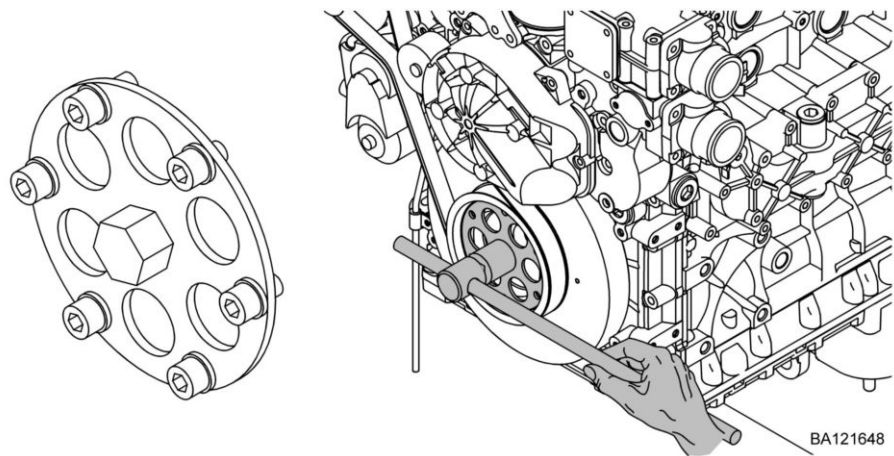


Fig. 59: Turning device - Crankshaft belt pulley attachment special tool no. 30a

The turning device special tool no. 30a is only included in the scope of delivery and attached to the diesel engine as a special case.

No.	ID no.	Name	See section
30a	10116805	Turning device	Check / set valve clearance

Tab. 18

LMB/10154726/01/01/11/2015/en

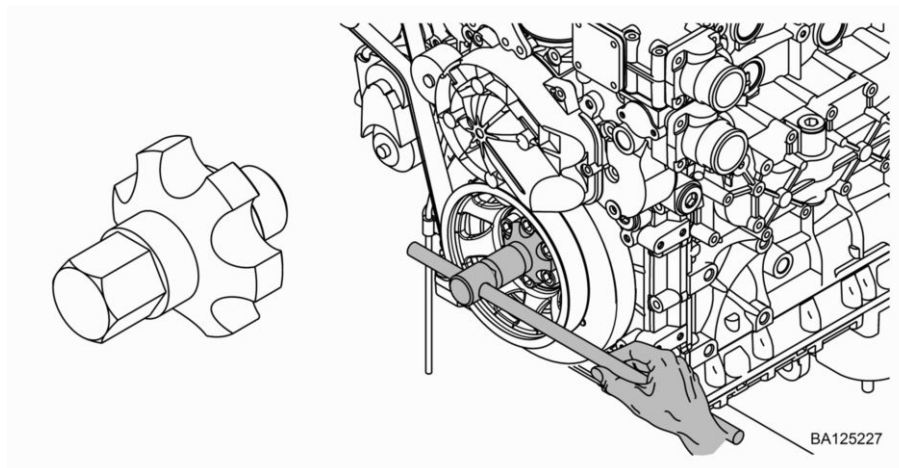


Fig. 60: Turning device - Crankshaft belt pulley attachment special tool no. 30c

Can only be used if the vibration damper is screwed together with hexagon socket screws.

No.	ID no.	Name	See section
30c	10118801	Turning device	Check / set valve clearance

Tab. 19

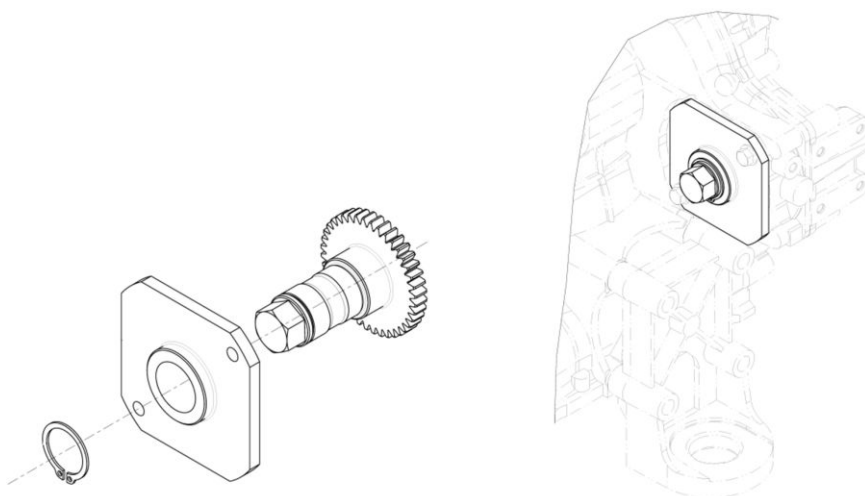


Fig. 61: Turning device - Auxiliary output NA4 attachment special tool no. 30d

The turning device special tool no. 30d is optional and is not included in the scope of delivery of the diesel engine. Can only be used if auxiliary output 4 is accessible.

No.	ID no.	Name	See section
30d	10134822	Turning device	Check / set valve clearance

Tab. 20

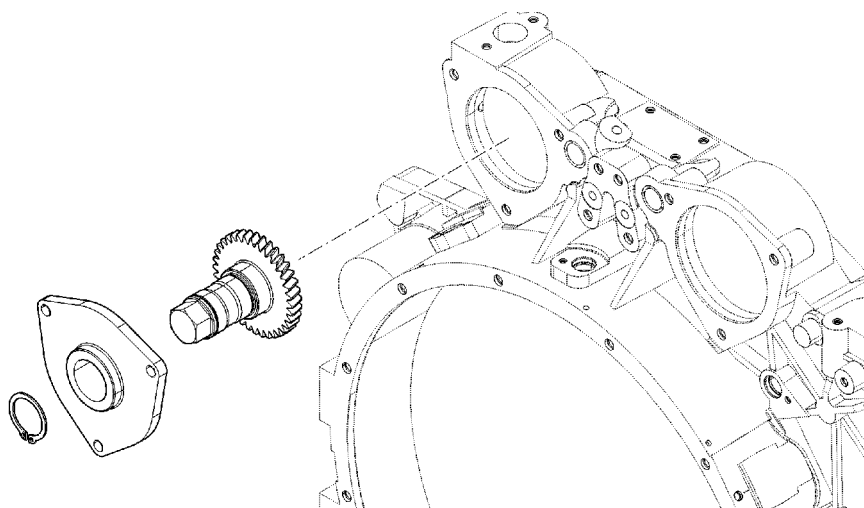


Fig. 62: Turning device - Auxiliary output NA2 attachment special tool no. 30e

The turning device special tool no. 30e can only be mounted if the intermediate wheel is included in the scope of delivery of the diesel engine (not standard).

No.	ID no.	Name	See section
30e	10138480	Turning device	Check / set valve clearance

Tab. 21

5.5 Preparatory maintenance activities

Before performing various maintenance work, the diesel engine must be brought into the maintenance position, unless otherwise specified.

This work includes:

- Oil level check or oil change.
- Filter change, as well as setting work and repair work.

Safety precautions for maintenance

The safety regulations must be followed while performing maintenance work as a matter of principle! See "Safety regulations" chapter.

Maintenance position

The diesel engine is in the maintenance position when:

- The diesel engine is horizontal.
- The diesel engine is turned off.
- The diesel engine has cooled down to the ambient temperature.
- The battery main switch, if present, is turned off and the main switch key is removed.

5.6 Maintenance activities (daily) every 10 operating hours

Make sure that:

- The diesel engine is in the maintenance position.

5.6.1 Checking the engine oil level

The oil dipstick and the oil filler neck is arranged differently depending on the diesel engine, e.g. oil dipstick on the left or right side of the engine, oil filler neck located on the oil pan, flywheel housing or cylinder head cover.

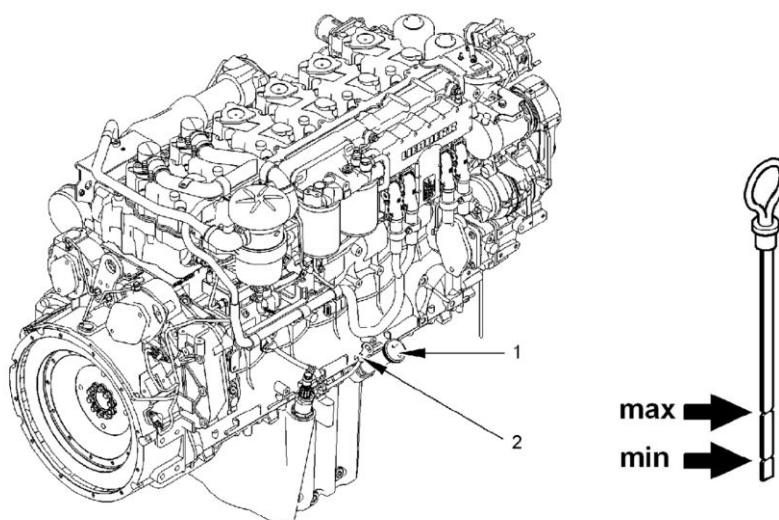


Fig. 63: Example of oil dipstick / oil filler neck

- ▶ Pull out oil dipstick 2, wipe with clean cloth and reinsert as far as it will go.
- ▶ Pull out the oil dipstick again and determine the oil level. The oil level must be between the "min." and "max." marks.



Note

Check the engine oil level using the oil level sensor reading.

- ▶ See documentation from the device manufacturer.

If the oil level is too low:

- ▶ Remove oil filling cap.
- ▶ Replenish oil via the oil filler neck 1.
- ▶ Do not replenish diesel engine with oil over the "max." mark.
- ▶ Clean filling cap, place on the filler neck and tighten.

5.6.2 Visual inspection (leaks, contaminations, damage)

- ▶ Perform visual check of diesel engine for leaks.

- ▶ Perform visual check of lines and hoses for leaks.
- ▶ Check lines and hoses for undamaged condition, that they are laid free from chafing and are properly secured.

5.6.3 Checking the coolant level

**DANGER**

Hot cooler parts and hot cooler fluid!
Risk of burns.

- ▶ Only perform maintenance and inspection work on the cooling system when the diesel engine has cooled down.
- ▶ Wear protective equipment.

See documentation from the device manufacturer for procedure for checking coolant level.

5.6.4 Checking / draining water trap on the fuel prefilter

Make sure that:

- ☐ A container with the required capacity is ready.

The location of the fuel prefilter with water trap and manual fuel feed pump is removed from the diesel engine and the attachment method depends on the device design.

**WARNING**

Naked flames!
Fire and explosion.

- ▶ Avoid naked flames or lights when performing maintenance or inspection work on the fuel system.
- ▶ Only perform maintenance and inspection work when the diesel engine has been shut down.

Draining fuel prefilter

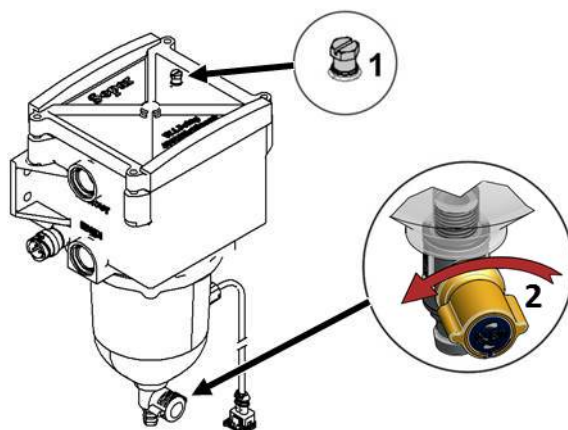


Fig. 64: Draining fuel prefilter

- ▶ Check the fuel prefilter water trap.

Troubleshooting

Have you found water in the fuel prefilter water trap?

- ▶ Do not start the diesel engine.
 - ▶ Place receptacle under the water trap.
 - ▶ Loosen the venting screw **1** by turning it through two revolutions (anticlockwise).
 - ▶ To open the shut-off cock: Push the toggle **2** and at the same time turn it 90° anticlockwise.
-

When the water has been drained off:

- ▶ Close the shut-off cock. Turn the toggle **2** 90° clockwise (the toggle snaps back into place automatically).
- ▶ Close the venting screw with a tightening torque of 6 Nm .

Venting the fuel prefilter

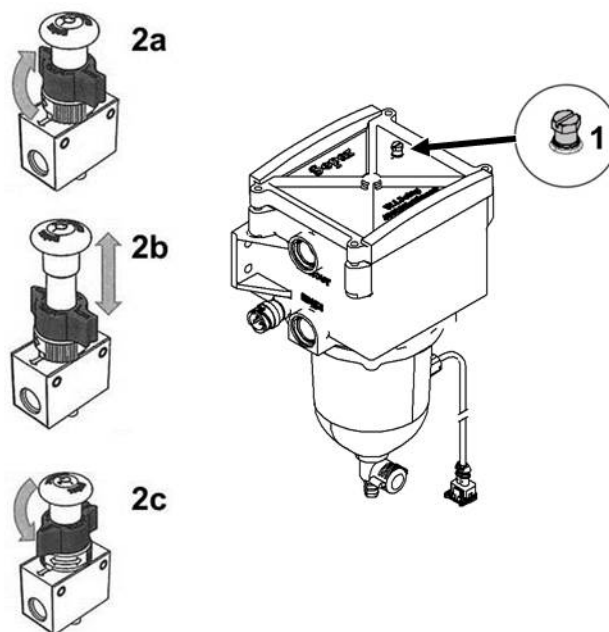


Fig. 65: Venting the fuel prefilter

- ▶ Turn the “PUMP” mark **2a** in the direction of the arrow (clockwise).
- ▶ Keep actuating manual feed pump **2b** until a strong resistance is felt.

In order to start the diesel engine:

- ▶ Turn the “RUN” mark **2c** in the direction of the arrow (anticlockwise).

5.6.5 Check underpressure display of the air filter

See documentation from the device manufacturer for procedure for checking underpressure display of air filter.

5.6.6 SCR system visual inspection

- ▶ Carry out a visual inspection of the SCR system for leaks and tight fit.
- ▶ Check the interfaces between the exhaust gas turbocharger outlet and the SCR system inlet, as well as the pipes for leaks.
- ▶ Check the fuel line between the dosing and injection unit for leaks.

Troubleshooting

Have you detected leaks or fittings that are not tight?

- ▶ Do not start the diesel engine.
 - ▶ Rectify cause.
-

5.7 Maintenance activities every 50 operating hours (weekly)

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.7.1 Draining water and sediments from the fuel tank



WARNING

Naked flames!

Fire and explosion.

- ▶ Avoid naked flames or lights when performing maintenance or inspection work on the fuel system.
 - ▶ Only perform maintenance and inspection work when the diesel engine has been shut down.
-

For procedure for draining off water and sediments in the fuel tank, see the device manufacturer's documentation.

When refuelling, keep the fuel level in the tank as high as possible to prevent condensation to the extent possible.

5.7.2 Clean the dust extraction valve of the air filter

See documentation from the device manufacturer for procedure for cleaning dust extraction valve of the air filter.

5.8 Maintenance activities every 500 operating hours

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.8.1 Check state of belt drive and replace

Damage to the V-ribbed belt includes:

- Rib breaks.
- Rubber nodules in the belt base.
- Deposits of dirt and / or stones.
- Ribs detached from belt base.
- Traverse cracks on the back.
- Traverse cracks in several ribs.

The belt attachment is self-tensioning and maintenance-free.

The belt drive is located at the front of the diesel engine.

The V-ribbed belt run varies according to the scope of delivery of the diesel engine, e.g. for alternator and alternator drive with A/C compressor.

Checking the V-ribbed belt



WARNING

Rotating components!

- ▶ Shut down the diesel engine.
- ▶ Be aware of the run-down time; before opening the covers, make sure that no parts are still moving.

- ▶ Fit V-ribbed belt guard (optional).
- ▶ Check V-ribbed belt for damage.
- ▶ Check that the belt rollers and tensioning pulley are in a perfect condition and check their play.

Troubleshooting

Do you notice any damage?

- ▶ Replace the damaged parts.

Replace V-ribbed belt

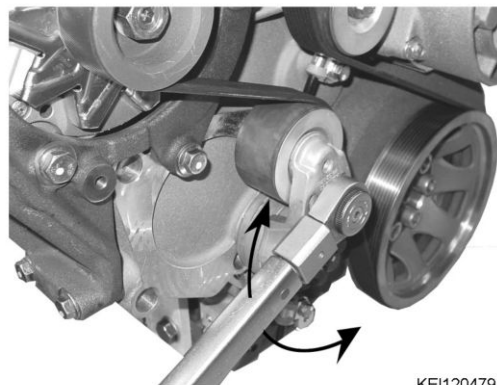
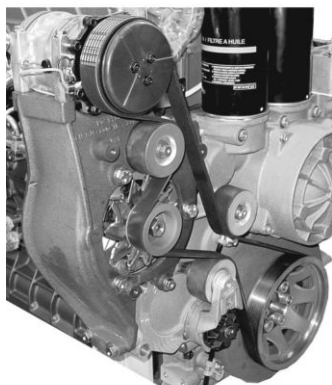
Make sure that:

- ☐ A new V-ribbed belt is at hand.
- ☐ A ratchet DIN 3122 D 12.5 (1/2") is at hand.

**WARNING**

Rotating components!

- ▶ Shut down the diesel engine.
- ▶ Be aware of the run-down time; before opening the covers, make sure that no parts are still moving.



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Fig. 66: V-ribbed belt for alternator drive with A/C compressor

- ▶ Pivot back the tensioning device in an anticlockwise direction against the spring force to the limit stop.
- ▶ Remove the V-ribbed belt.
- ▶ Check that the tensioning roller and belt rollers are in perfect condition (e.g. worn out bearings on the tensioning roller or tread wear on the belt rollers).

Troubleshooting

Do you notice any damage?

- ▶ Replace the damaged parts.

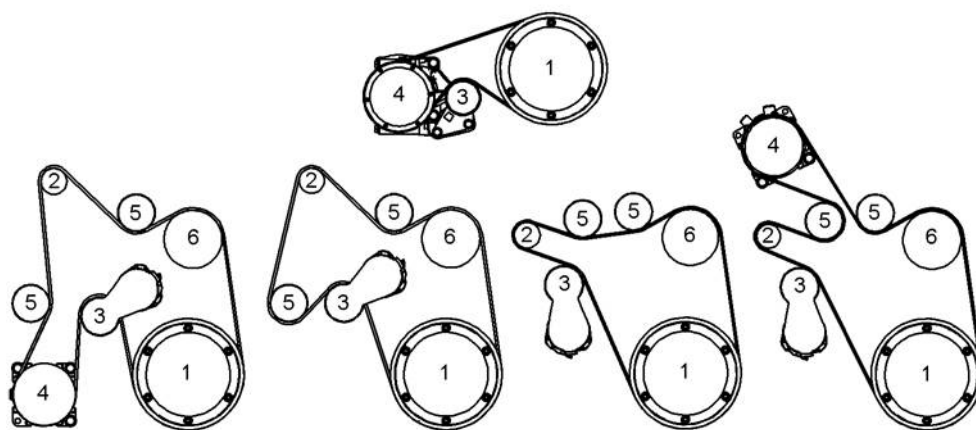


Fig. 67: V-ribbed belt run - variants

- | | | | |
|---|------------------------|---|---|
| 1 | Crankshaft belt pulley | 4 | Air conditioning compressor belt pulley |
| 2 | Alternator belt pulley | 5 | Deflection roller |
| 3 | Tensioning device | 6 | Water pump belt pulley |

LMB/10154726/01/01/11/2015/en

- ▶ With the tensioning device pivoted back, place new V-ribbed belt on the belt pulleys of the crankshaft, air conditioning compressor, alternator and deflection roller.
- ▶ Fit V-ribbed belt guard (optional).

5.8.2 Checking the intake and exhaust system for condition and leaks



Note

Control interval is at 1000 h.

- ▶ Perform this maintenance work only once at 500 h.

- ▶ Check intake lines between air filter and diesel engine for condition, leaks and tight fit.
- ▶ Check exhaust lines for condition, leaks and tight fit.

5.8.3 Check cooling and heating system for condition and leaks



DANGER

Hot cooler parts and hot cooler fluid!
Risk of burns.

- ▶ Only perform maintenance and inspection work on the cooling system when the diesel engine has cooled down.
- ▶ Wear protective equipment.

- ▶ 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, undamaged condition, and that they are laid free from chafing and properly secured.
- ▶ Check cooler for external contamination. The fins may not be blocked with dirt.

Troubleshooting

If leaks are discovered in the cooling system:

- ▶ Do not start the diesel engine.
- ▶ Rectify cause.

5.8.4 Checking the lubricant and fuel system for condition and leaks

- ▶ Check the oil pan, oil filter fuel feed pump and fuel filter for leaks.
- ▶ Check all lines and hoses of the oil and fuel system for leaks, undamaged condition, and that they are laid free from chafing and properly secured.

Troubleshooting

Have you identified leaks in the oil and fuel system?

- ▶ Do not start the diesel engine.
- ▶ Identify and rectify the cause as well as replacing damaged parts.

5.8.5 Check batteries and cable connections**Note**

Control interval is at 1000 h.

- ▶ Perform this maintenance work only once at 500 h.

See documentation from the device manufacturer for procedure for checking batteries and cable connections.

5.8.6 Check condition of control unit bearings.

- ▶ Check control unit mounting for damage and that it is firmly seated.

Troubleshooting

Do you notice any damaged bearings?

- ▶ Do not start the diesel engine.
- ▶ Replace all bearings.

5.8.7 Checking condition of sensors, actuators, cable holders and plugs**Note**

Control interval is at 1000 h.

- ▶ Perform this maintenance work only once at 500 h.

- ▶ Check that all sensors, actuators, cable connections and plugs are firmly seated and check their condition.
- ▶ Check the condition of cables and the cable harness, check that they have been laid so as to avoid chafing and that they are properly secured.

Troubleshooting

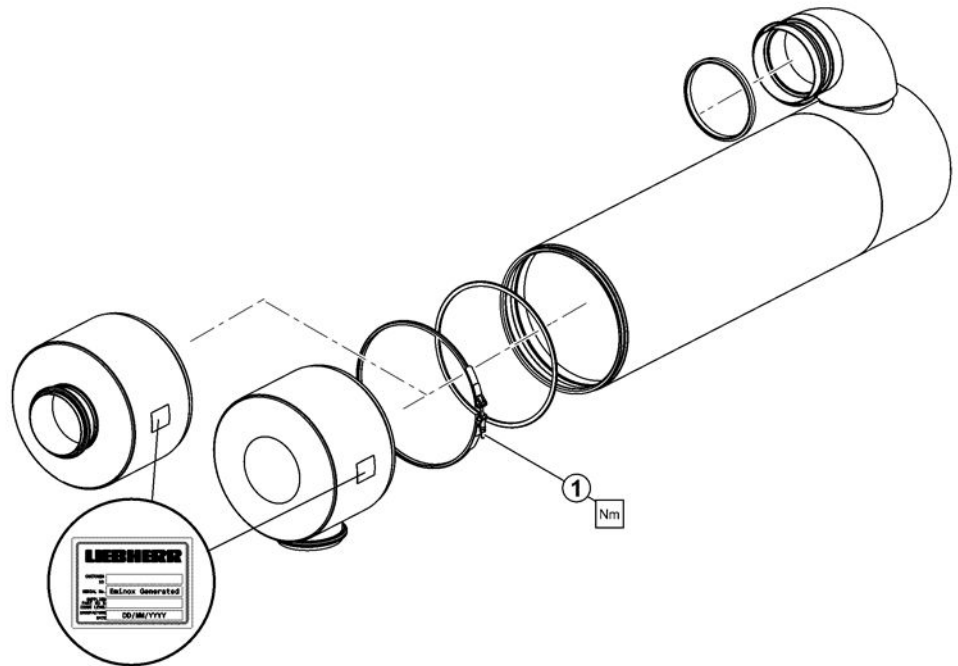
Have you noticed damage to cable connections, cable harness or sensors?

- ▶ Do not start the diesel engine.
- ▶ Replace defective parts.

5.8.8 Inspect SCR system profile clips**CAUTION**

Hot parts!
Risk of burns.

- ▶ Allow the SCR system to cool.



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Fig. 68: SCR system clip

- ▶ Check that profile clip 1 is tightened to the correct torque (23 Nm).
- ▶ Re-tighten the screw.

5.9 Maintenance activities every 1000 operating hours

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.9.1 Checking that engine bearing and diesel engine console are securely seated

- ▶ Check that the oil pan is firmly seated, tighten screws if necessary.
- ▶ Check condition of diesel engine consoles and engine bearing and that they are firmly seated, tighten screws if necessary.

5.9.2 Changing the fuel prefilter insert

Make sure that:

- ☐ A container with the required capacity is ready.
- ☐ A replacement fuel prefilter insert is at hand.

The location of the fuel prefilter with water trap and manual fuel feed pump is removed from the diesel engine and the attachment method depends on the device design.



WARNING

Naked flames!
Fire and explosion.

- ▶ Avoid naked flames or lights when performing maintenance or inspection work on the fuel system.
 - ▶ Only perform maintenance and inspection work when the diesel engine has been shut down.
-

If a fuel shut-off cock is present:

- ▶ Close the fuel shut-off cock.

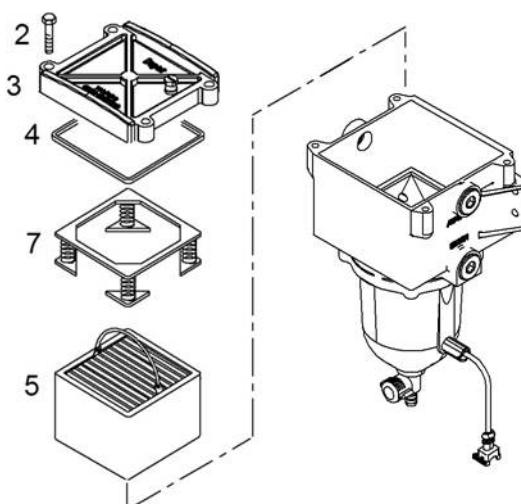


Fig. 69: Fuel prefilter

- ▶ Place receptacle under the fuel prefilter.
- ▶ Open shut-off cock. For procedure see chapter "Check / drain water trap on the fuel prefilter".
- ▶ Unscrew screws **2** and take off lid **3** with seal **4**.
- ▶ Take out fuel prefilter insert **5** along with spring cartridge **7**.
- ▶ Dispose of old fuel prefilter insert **5**.

NOTICE

Dirt!

Destruction of common rail system.

- ▶ Make sure that no dirt gets onto the clean side of the filter.
 - ▶ Leave the residual diesel fuel in the filter housing.
 - ▶ Never reuse a fuel prefilter once used.
 - ▶ Note special instructions for working on the common rail system, see chapter "Safety instructions".
-
- ▶ Install new fuel prefilter insert **5**.
 - ▶ Check seal **4**, replace if necessary and assemble in reverse order.
 - ▶ Open fuel shut-off cock and vent fuel system. See the chapter "Venting fuel system" for procedure.

5.9.3 Changing the fuel fine filter

Make sure that:

- ☐ A container with the required capacity is ready.
- ☐ One or two original LIEBHERR fuel fine filters are at hand.
- ☐ A suitable drainage hose from the device manufacturer is available.

The fuel fine filters are located on the right side of the diesel engine.

**WARNING**

Naked flames!
Fire and explosion.

- ▶ Avoid naked flames or lights when performing maintenance or inspection work on the fuel system.
- ▶ Only perform maintenance and inspection work when the diesel engine has been shut down.

If a fuel shut-off cock is present:

- ▶ Close the fuel shut-off cock.
- ▶ Place receptacle under the fuel fine filter.
- ▶ Carefully clean the fuel fine filter and the surrounding area.

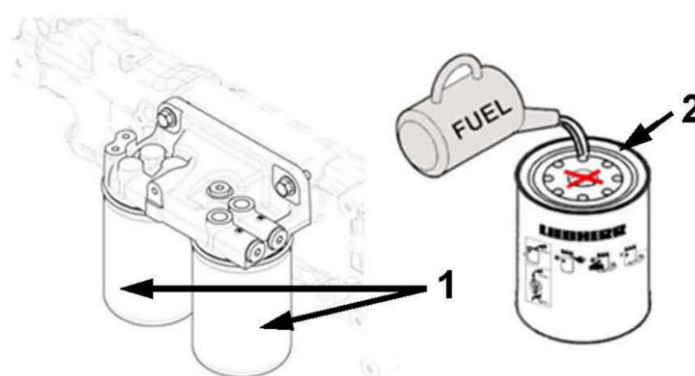


Fig. 70: Changing the fuel fine filter

- ▶ Loosen the filter cartridge **1** with strap spanner or similar tool and unscrew it.
- ▶ Dispose of old fuel fine filter.
- ▶ Check the filter base for cleanliness and make sure that the thread adapter is firmly seated in the filter base.

If the filter base is dirty:

- ▶ Clean the filter base.
- ▶ Lubricate the sealing ring **2** of the new filter with clean fuel or oil.

**WARNING**

Dirt!
Destruction of common rail system!

- ▶ Make sure that no dirt gets onto the clean side of the filter.
- ▶ Never reuse a fuel fine filter once used.
- ▶ Note special instructions for working on the common rail system, see chapter "Safety instructions".
- ▶ Fill the new filter with clean fuel.
- ▶ Screw on the filter until the sealing ring is resting on the filter head.

- ▶ Tighten the filter **by hand** 3/4 revolution.
- ▶ Open fuel shut-off cock and vent fuel system. See the chapter "Venting fuel system" for procedure.

5.10 Maintenance activities every 1500 operating hours

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.10.1 Changing the diesel engine oil and oil filter

The oil drainage valve is on the diesel engine, at the bottom or at the side of the oil pan.

Make sure that:

- ☐ The diesel engine is horizontal.
- ☐ The diesel engine is turned off.
- ☐ The diesel engine is warm.
- ☐ Two original LIEBHERR oil filter cartridges are at hand.
- ☐ A container with the required capacity is ready.
- ☐ A suitable drainage hose from the device manufacturer is available.
- ☐ Diesel engine oil is at hand. For the diesel engine quantity, see the chapter "Fill quantities table". For lubricant specification, see the chapter "Lubricants and operating fluids".

Draining off diesel engine oil

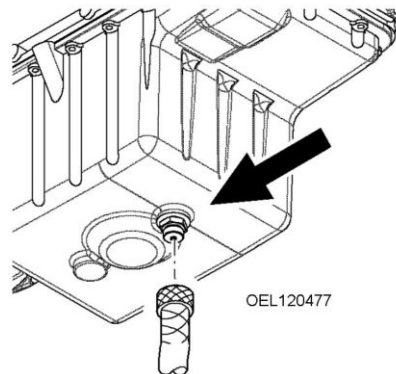


Fig. 71: Drain valve with drain hose



CAUTION

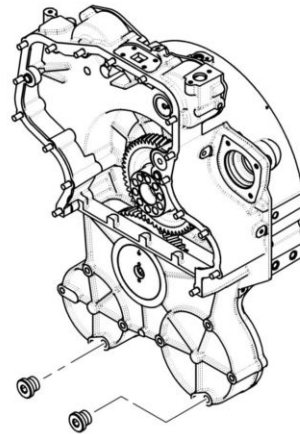
Hot engine oil!
Risk of burns.

- ▶ Avoid skin contact with the engine oil.
 - ▶ When changing engine oil, wear protective gloves.
-
- ▶ Unscrew the cap on the oil drain valve on the oil pan.
 - ▶ Screw the oil drain hose onto the oil drain valve.
 - ▶ Let oil drain into the container provided.
 - ▶ Dispose of the oil (for procedure, see chapter "Disposal of old consumables").

- Unscrew the oil drain hose and screw the closing cap onto the oil drain valve.

**Note**

- For diesel engines with integrated auxiliary outputs on the bottom of the flywheel housing, the drain plugs must be opened when changing the diesel engine oil.



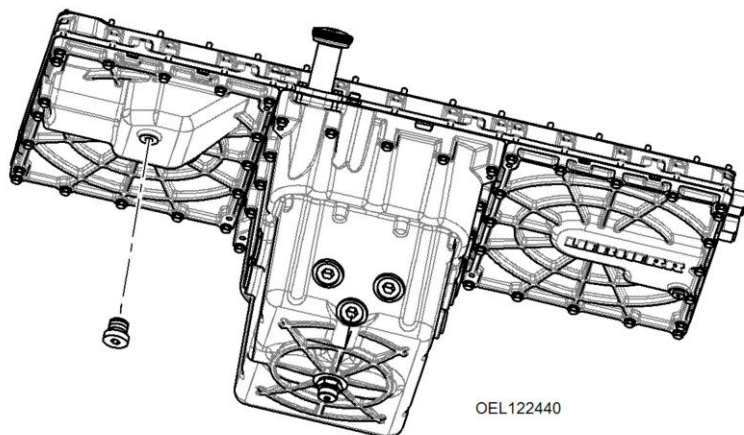
BA121646

Fig. 72: Flywheel housing with auxiliary outputs

- Unscrew the two screw plugs.
- Let oil drain into the container provided.
- Screw in the screw plugs.

**Note**

- For diesel engines with oil pan (small sump), the drain plug must be opened when changing the diesel engine oil.



OEL122440

Fig. 73: Oil pan (small sump)

- Unscrew screw plug.
- Let oil (approx. 3 L) drain into the container provided.
- Screw in the screw plug.

Replacing the oil filter

The oil filters are attached upright on the diesel engine's unit support.

Make sure that:

- ❑ A strap spanner or an Allen key WAF 30 as well as Original LIEBHERR oil filters (2 units) are at hand.

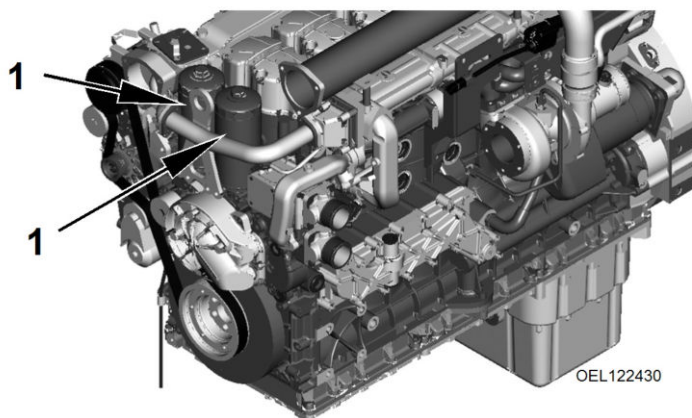


Fig. 74: Oil filter



Note

- ▶ Protect the V-ribbed belt against escaping oil when changing the oil filter cartridges.
 - ▶ After changing the oil filter, remove all oil spills on the diesel engine, including behind the vibration damper, so that they cannot subsequently be misdiagnosed as a leak in the rotary shaft lip seal.
-
- ▶ Release the oil filter **1** with a strap spanner or Allen key WAF 30, and unscrew the filter.
 - ▶ Clean sealing surfaces of the filter bracket.
 - ▷ All filter seals and any remnants have been fully removed.
 - ▶ Thinly coat the rubber seal on the new oil filter with diesel engine oil.
 - ▶ Screw in the new oil filter until the sealing ring is resting on the filter bracket.
 - ▷ Sealing ring is resting on the filter bracket.
 - ▶ Tighten the oil filter 3/4 to 1 turn / 20 Nm- 5 Nm.

Filling with diesel engine oil

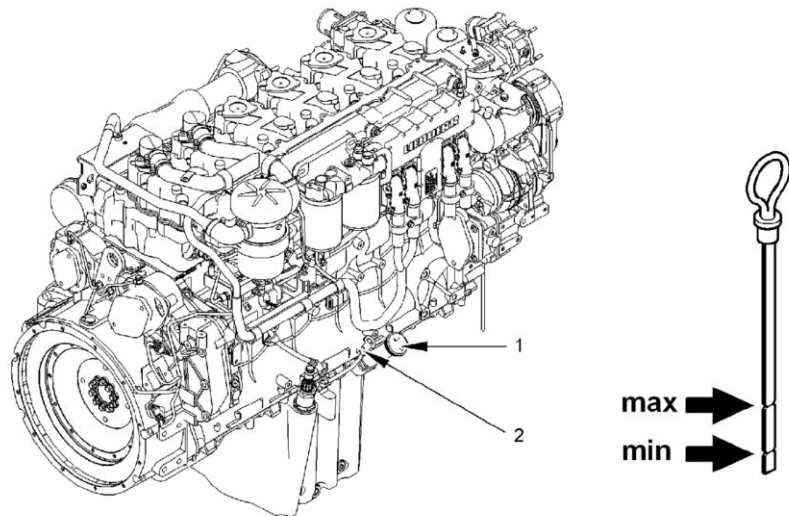


Fig. 75: Diesel engine oil filler neck

- Fill the oil via the oil filler neck 1.
- Do not replenish diesel engine with oil over the “max.” mark.
- Clean filling cap, place on the filler neck and tighten.
- Start the diesel engine and check oil pressure.
- Turn off the diesel engine and check the oil level on the dipstick after 2 - 3 minutes.

Troubleshooting

Oil level is not between the min. and max.?

- Adjust the oil level.

5.10.2 Replacing the oil separator filter insert

Make sure that:

- ☐ An oil separator filter insert is available.

The oil separator is fitted on the flywheel side, on the right side of the diesel engine.

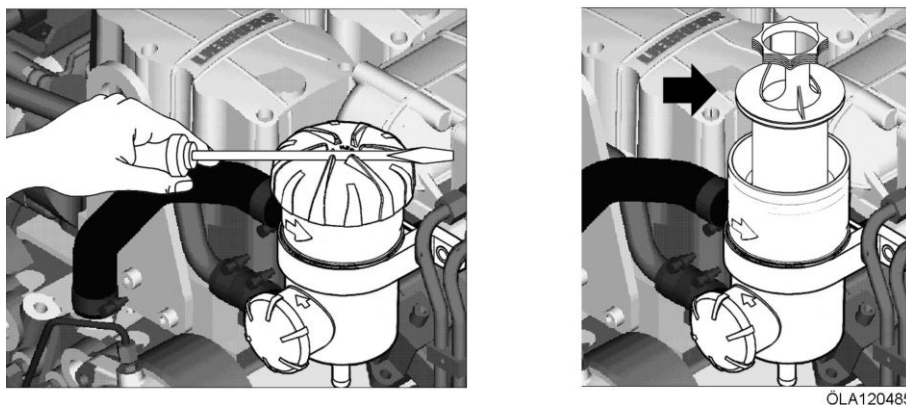


Fig. 76: Oil separator

- ▶ Carefully clean the oil separator and its surroundings.
- ▶ Open the oil separator cap and remove; if necessary use a screwdriver.
- ▶ Pull out the oil separator filter insert and dispose of in an environmentally friendly manner (for procedure, see chapter "Disposal of old consumables").
- ▶ Install a new oil separator filter insert and push all the way in.



Note

- ▶ Pay attention to the direction of the arrows on the cap and the housing!

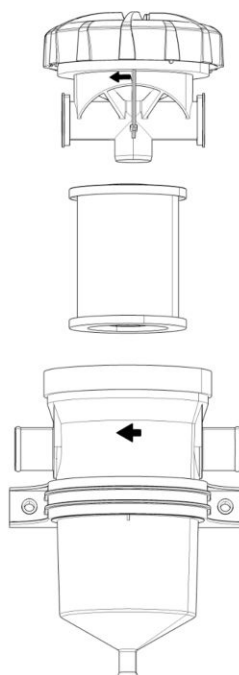


Fig. 77: Oil separator - direction of arrows

- ▶ Fit the oil separator cap and screw all the way closed by hand.

5.10.3 Checking and setting the valve clearance

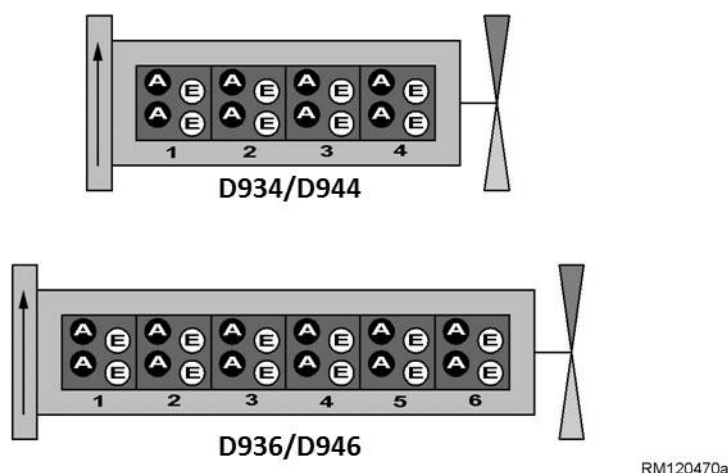
Make sure that:

- ❑ A turning device special tool is available. See chapter "Special tools for maintenance activities".



Note

- Cylinder 1 is located on the flywheel side.
- Direction of rotation as seen from the left side of flywheel
- The outlet valve of the respective cylinder is located on the flywheel side.



RM120470a

Fig. 78: Cylinder valves

A = Outlet valve

E = Inlet valve

Cylinder valves D934 / D944				
Overlap	4	2	1	3
Set	1	3	4	2

Tab. 22: Cylinder valves D934 / D944

Cylinder valves D936 / D946						
Overlap	6	2	4	1	5	3
Set	1	5	3	6	2	4

Tab. 23: Cylinder valves D936 / D946

Checking and setting the standard valve clearance

- Remove cylinder head cover.
- Mount turning device.
- Turn crankshaft using the turning device in the direction of rotation until the valves belonging to the cylinders to be set overlap. For information, see tables "Cylinder valves D934 / D944" or "Cylinder valves D936 / D946".

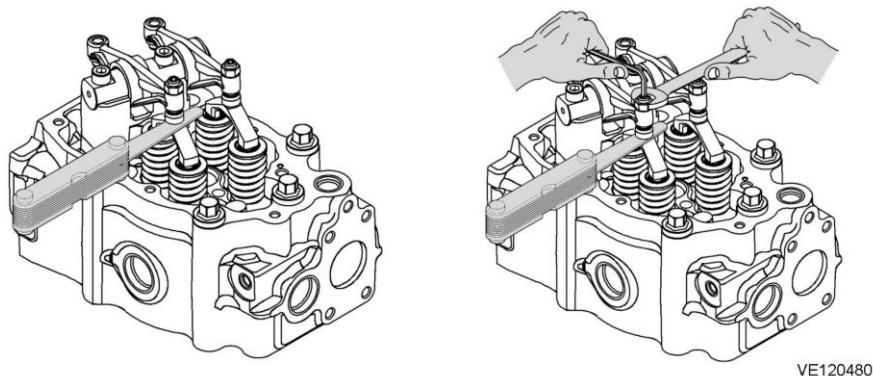


Fig. 79: Checking / setting inlet valve clearance

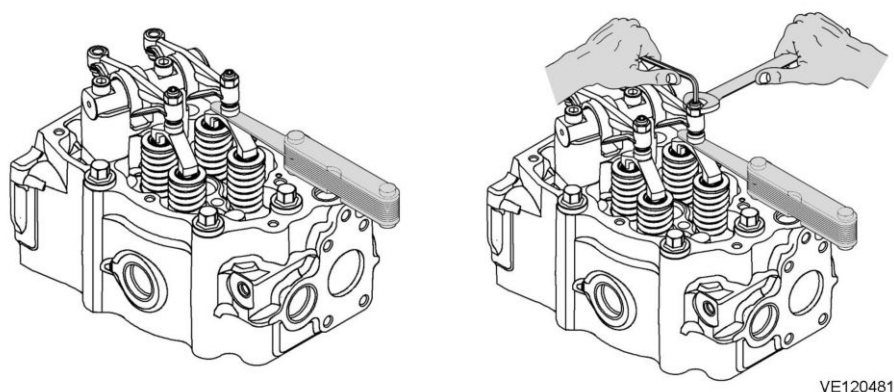


Fig. 80: Checking / setting outlet valve clearance

- ▶ Slide feeler gauge between valve bridge and rocker arm and check valve clearance.

Troubleshooting

Is the clearance not in agreement with the setting values (see chapter "Valve clearance technical data")?

- ▶ Unscrew lock nut on the adjusting screw of the respective rocker arm and correct setting.
- ▶ Tighten lock nut to 45 Nm.

- ▶ Check setting again.
- ▶ After checking and/or setting all valves, install cylinder head cover with inspected, undamaged seals.
- ▶ Dismantle turning device.

Checking and setting the valve clearance using engine auxiliary brake system (ABS)

Checking and setting the inlet valve clearance

- ▶ Remove cylinder head cover.

- ▶ Mount turning device.
- ▶ Turn crankshaft using the turning device in the direction of rotation until the valves belonging to the cylinders to be set overlap. For information, see tables "Cylinder valves D934 / D944" or "Cylinder valves D936 / D946".

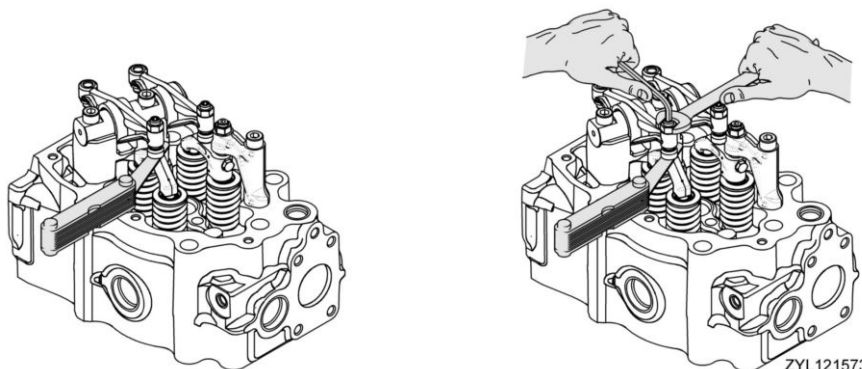


Fig. 81: Checking / setting inlet valve clearance

- ▶ Slide feeler gauge between valve bridge and rocker arm and check valve clearance.

Troubleshooting

Is the clearance not in agreement with the setting values (see chapter "Valve clearance technical data")?

- ▶ Unscrew lock nut on the adjusting screw of the respective rocker arm and correct setting.
- ▶ Tighten the lock nut to 45 Nm .

- ▶ Check setting again.
- ▶ After checking and/or setting all valves, install cylinder head cover with inspected, undamaged seals.
- ▶ Dismantle turning device.

Checking outlet valve clearance

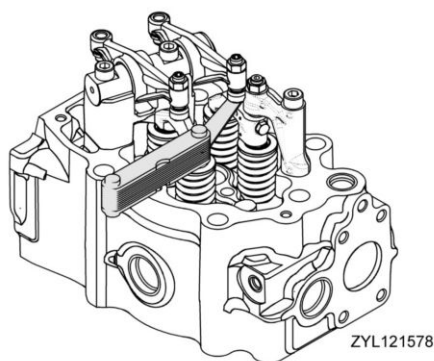


Fig. 82: Outlet valve bridge / rocker arm valve clearance

- ▶ Slide feeler gauge between the outlet valve bridge and rocker arm adjusting screw and check valve clearance.

Troubleshooting

Is the clearance not in agreement with the setting values (see chapter "Valve clearance technical data")?

- ▶ Set valve clearance.

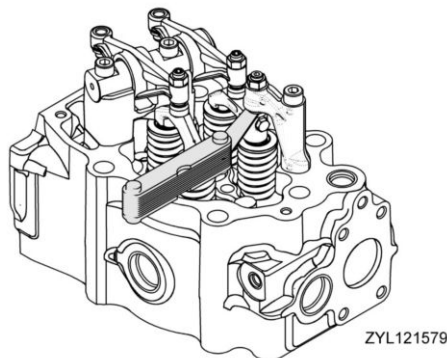


Fig. 83: Outlet valve bridge / counterholder valve clearance

- ▶ Slide feeler gauge between the outlet valve bridge and counterholder adjusting screw and check valve clearance.

Troubleshooting

Is the clearance not in agreement with the setting values (see chapter "Valve clearance technical data")?

- ▶ Set valve clearance.

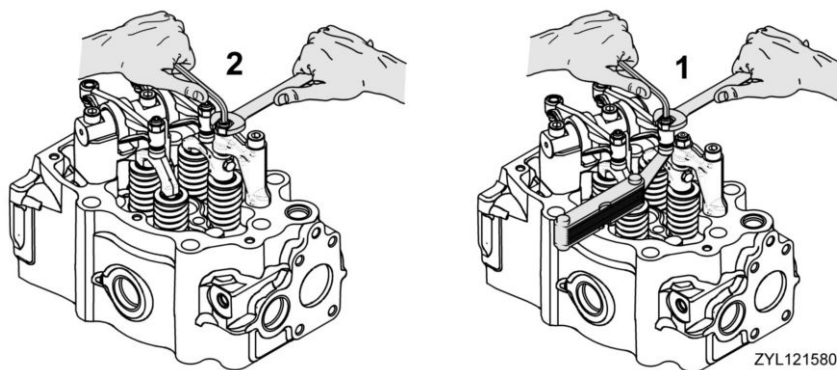
Setting outlet valve clearance

Fig. 84: Outlet valve bridge / rocker arm valve clearance

- ▶ Turn back adjusting screw **2** until the contact surface of the adjusting screw disappears into the counterholder.
- ▶ Turn back adjusting screw **1** to the extent that the feeler gauge that corresponds to the setting value can be pushed in.
- ▶ Turn in adjusting screw **1** until the piston in the outlet valve bridge arrives at the stop and the feeler gauge locks.
- ▶ Untighten adjusting screw **1** until the feeler gauge can be pulled out against moderate resistance (suction).
- ▶ Tighten adjusting screw **1** lock nut to 45 Nm .

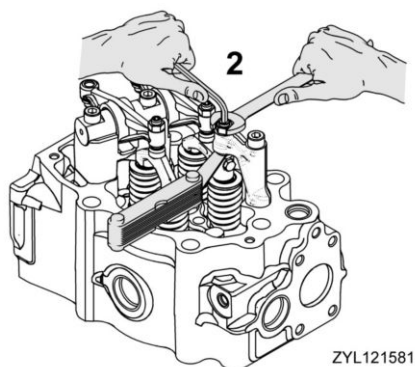


Fig. 85: Outlet valve bridge / counterholder valve clearance

- ▶ Turn in adjusting screw **2**, while a feeler gauge corresponding to the setting value is pushed in, until the piston of the valve bridge arrives at the stop and the feeler gauge locks.
- ▶ Untighten adjusting screw **2** until the feeler gauge can be pulled out against moderate resistance (suction).
- ▶ Tighten adjusting screw **2** lock nut to 45 Nm .
 - ▷ Push rod must have play.
- ▶ Check settings again.
- ▶ After checking and/or setting all valves, install cylinder head cover with inspected, undamaged seals.
- ▶ Dismantle turning device.

5.11 Maintenance activities every 2000 operating hours

Make sure that:
☐ The diesel engine is in the maintenance position.

5.11.1 Checking the corrosion frost protection agent concentration in the coolant

The coolant must contain at least 50 vol. %, but not more than 60 vol. %, of corrosion frost protection agent year-round. A coolant with 50 vol. % corrosion frost protection agent corresponds to a frost protection up to approx. -37 °C.

Checking the corrosion frost protection agent concentration



DANGER
Hot coolant!
Risk of burns.

- ▶ Let engine cool off before opening the filler neck.
 - ▶ Carefully open the cap on the filler neck.
 - ▶ Take coolant sample and analyse using an appropriate test method.
- If the analysis results in too low frost protection:
- ▶ Adjust the mixing ratio of the corrosion frost protection agent in the coolant.

Correcting the corrosion frost protection agent concentration

- If the corrosion frost protection agent concentration is too low:
- ▶ Drain coolant and refill corrosion frost protection agent according to the calculation formula below.

Coolant content (total)

=

50 litres

Measured concentration

=

29 Vol. %

50

-

29

=

21

x

50

:

71

=

14.8 litres

100

-

29

=

71

→

↑

→

↓

↓

↓

→

Corrosion frost protection agent refilling quantity:

This amount must normally be drained beforehand!

Tab. 24: Corrosion frost protection agent refilling quantity calculation formula, example 29 vol. % (corresponds to -15 °C)

NOTICE

Amount of corrosion frost protection agent in coolant too high!
Diesel engine overheats and may be damaged.

- ▶ Do not use more than 60% corrosion frost protection agent.
-
- ▶ See documentation from the device manufacturer for coolant fill quantity.

5.12 Maintenance activities every 6000 operating hours

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.12.1 Replacing the coolant

Make sure that:

- ☐ Heating valves, if present, are open.
- ☐ A container with the required capacity is ready.
- ☐ A drain hose is at hand.
- ☐ The required quantity of coolant is at hand.

Draining the coolant

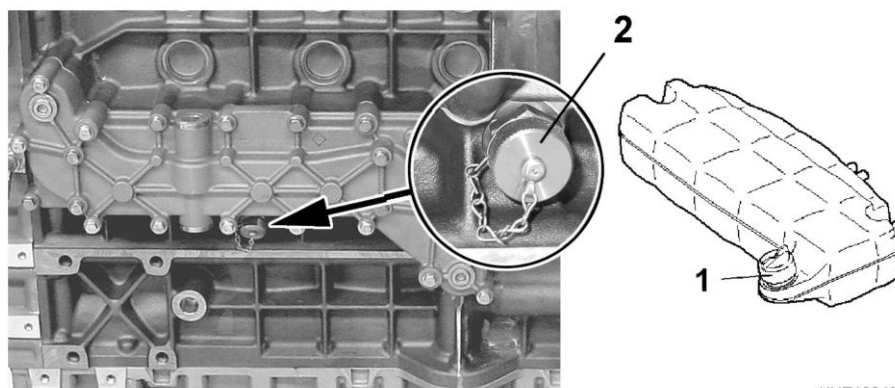


DANGER

Hot cooler fluid!

Risk of burns.

- ▶ Let engine cool off before opening the filler neck.
- ▶ Note overpressure when opening the filler neck.
- ▶ Do not fill the cooling system when the engine is hot under any circumstances.



KUE120489

Fig. 86: Draining the coolant

- ▶ Turn the closing cap 1 anticlockwise until the overpressure is released, then open.



CAUTION

Coolant can cause injuries to the eyes and allergic skin reactions!

- ▶ You must avoid skin contact with coolant.
- ▶ Note manufacturer instructions.
- ▶ Wear rubber gloves and protective glasses when mixing coolants.
- ▶ Immediately irrigate eye or skin splashes with water.

- ▶ Place receptacle under the diesel engine.
- ▶ Open the protecting cap **2** for the drain valve on left cooler plate on the diesel engine.
- ▶ Screw the drain hose onto the drain valve; this opens the drain valve.
- ▶ Open the drain plug on the cooler (see device manufacturer documentation).
 - ▷ Coolant from the oil cooler housing and cooler flows into the receptacle.
- ▶ If the coolant has been drained, unscrew the drain hose from the drain valve.
- ▶ Attach protecting cap and close cooler again.

Filling the coolant

- ▶ Fill with coolant via the filler neck with preblended coolant as per chapter "Diesel engine coolant".
- ▶ Fill cooling system up to the maximum.
- ▶ Put the sealing cap on the equalising reservoir and tighten.
- ▶ Start the diesel engine, let it warm up.
- ▶ Check the coolant level again when the diesel engine has cooled down and correct if necessary.

5.13 Maintenance activities every 10000 operating hours

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.13.1 Replacing the heating flange

Make sure that:

- ☐ A new heating flange is available.

The heating flange is installed on the right side of the diesel engine or in the air intake pipe.

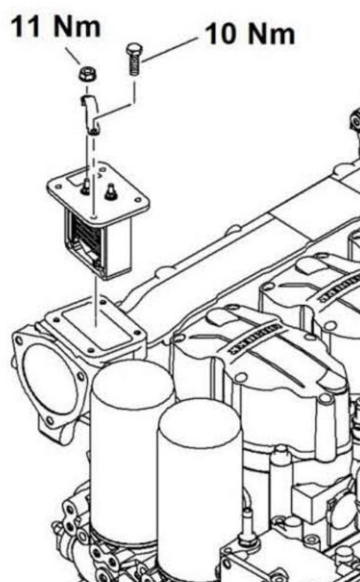


Fig. 87: Removing and installing the heating flange

- ▶ If present, turn off the battery master switch and detach the minus cable from the battery.
- ▶ Detach electrical connecting cables from the heating flange.
- ▶ Remove heating flange.
- ▶ Install new heating flange.
- ▶ Connect electrical connecting cables to the heating flange and the minus cable to the battery.

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5.14 Occasional maintenance activities

Make sure that:

- ☐ The diesel engine is in the maintenance position.

5.15 Checking the heating flange

Make sure that:

- A ohmmeter and multimeter is available.

The heating flange (1) is installed on the right side of the diesel engine or in the air intake pipe.

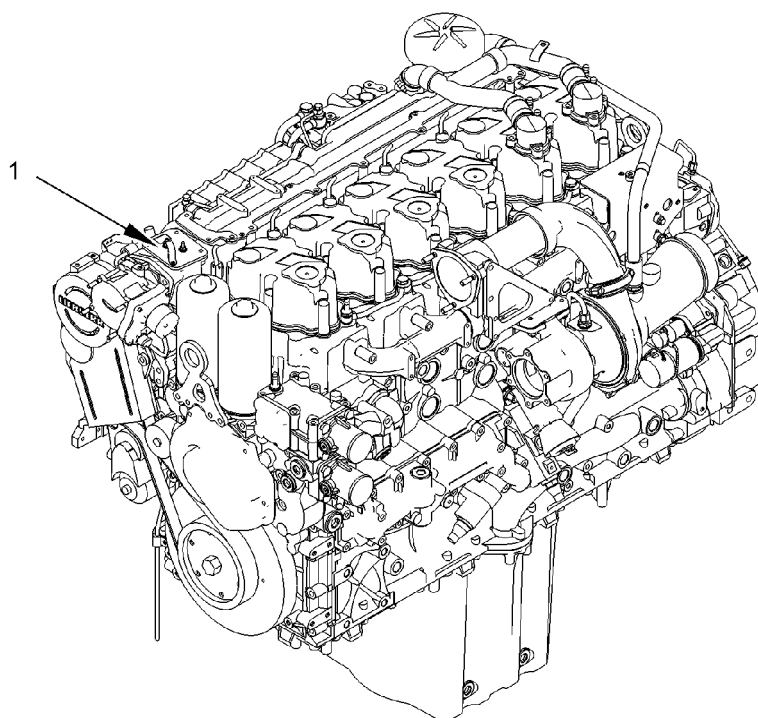


Fig. 88: Heating flange

- ▶ If present, turn off the battery master switch and detach the minus cable from the battery.
- ▶ Detach electrical connecting cables from the heating flange.
- ▶ Connect the ohmmeter or multimeter to the terminals and measure resistance.

Troubleshooting

If a resistance value of 250 mOhm +/- 10% at 20 °C is not reached:

- ▶ Replace heating flange.
-
- ▶ Connect electrical cables to heating flange and minus cable to the battery.

5.16 Venting fuel system

Venting of the fuel prefilter and fuel low pressure system is required after:

- ☐ changing the fuel prefilter
- ☐ running the fuel tank dry
- ☐ initial commissioning of the diesel engine



WARNING

Dirt!

Destruction of common rail system.

- ▶ No injection lines may be opened or detached.
 - ▶ Ensure complete cleanliness for all work.
 - ▶ Note special instructions for working on the common rail system, see chapter "Safety instructions".
-



WARNING

Naked flames!

Fire and explosion.

- ▶ Avoid naked flames or lights when performing maintenance or inspection work on the fuel system.
 - ▶ Only perform maintenance and inspection work when the diesel engine has been shut down.
-

NOTICE

If the venting screw on the fuel prefilter is open, then the system will not be vented properly.

- ▶ Do **not** open the venting screw on the fuel prefilter.
-

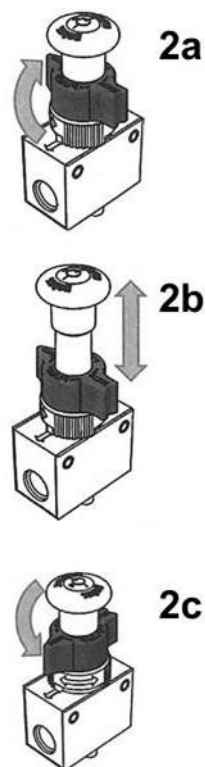


Fig. 89: Manual feed pump

- ▶ Turn the "PUMP" mark **2a** in the direction of the arrow (clockwise).
- ▶ Actuate the manual feed pump **2b**.
- ▶ Keep actuating the manual pump until a strong resistance is felt.

In order to start the diesel engine:

- ▶ Turn the "RUN" mark **2c** in the direction of the arrow (anticlockwise).
- ▶ Start diesel engine.

Troubleshooting

If the starting procedure is still unsuccessful after approx. 20 seconds:

- ▶ Take a break for 1 minute.

If you have repeated this procedure three times without success:

- ▶ Repeat air venting procedure.



Note

- ▶ Low pressure circuit (NDK) of the motor is vented by permanently installed restrictor bores; no additional measures are necessary.

5.17 Replacing the dry air filter main element

For procedure for replacing dry air filter main element, see documentation from the device manufacturer.

5.18 Replacing the dry air filter safety element

For procedure for replacing dry air filter safety element, see documentation from the device manufacturer.

5.19 Transport and storage

5.19.1 Suspension device

**DANGER**

Falling load!
Danger to life.

- ▶ Only use transport equipment to carry the engine with no additional attachments.
- ▶ Working and remaining under a suspended load is prohibited.

To lift the diesel engine, attach a proper suspension device to the transport equipment intended for this.

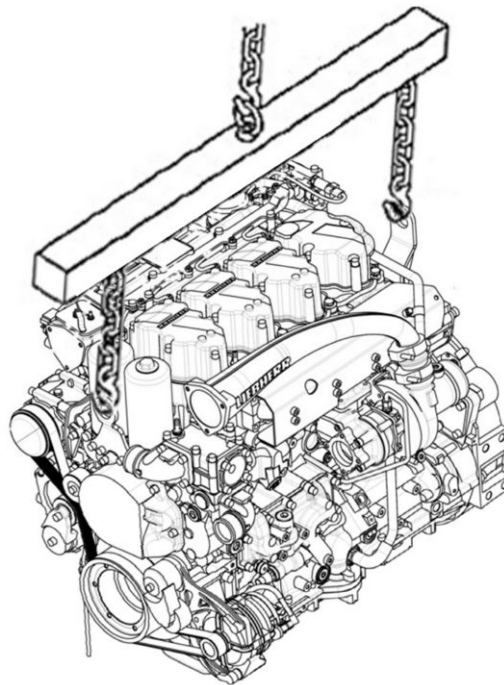


Fig. 90: Suspension device

5.19.2 Storage up to 6 months

The LIEBHERR diesel engine is preserved from the shipping date; under normal storage conditions in a dry, well ventilated place, the normal conservation protection duration is 6 months.

If the diesel engine is covered with a film cover, it can also be stored outdoors for up to one month.

The cover must be waterproof and loosely rest against the diesel engine so that air can circulate around the diesel engine and so that the formation of condensation is prevented.

A shorter conservation protection period is to be expected in case of departure from the measures mentioned, whereby the conserved diesel engine is exposed to less favourable conditions (situated outdoors for longer periods of time or storage in damp, unventilated locations etc.).

5.19.3 Storage over 6 months up to 24 months

For storage over 6 months up to 24 months, contact LIEBHERR Service or an authorised LIEBHERR dealer.

6 Supplemental information for the USA

Additional information for the United States Environmental Protection Agency (mentioned in the following "EPA") and the California Air Resources Board (mentioned in the following "CARB").

6.2.1 EPA/CARB fuel label

The engine must be operated with "ULTRA LOW SULFUR FUEL ONLY".

Within the proximity of the filler neck the following label with the remark "ULTRA LOW SULFUR FUEL ONLY" must be attached in a such way that it is well visible and permanently readable when refueling.

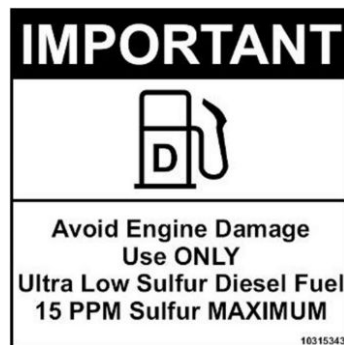


Fig. 91: Fuel label "ULTRA LOW SULFUR FUEL ONLY" 10315343

6.3 Emission control warranty statement warranty rights and obligations

In the United States of America, new non-road engines must be designed, built and equipped so they conform at the time of sale to the ultimate purchaser with the requirements of US EPA CFR Part 1039 and with all applicable regulations adopted by the Air Resources Board pursuant to its authority for Title 13, California Code of Regulations, Section 2425. Liebherr Machines Bulle S.A. (Liebherr) warrants the emission control system on its engines for the periods of time listed below provided there has been no abuse, neglect, improper maintenance or unauthorized modification on your engine.

The emission control system may include parts such as the fuel injection and the air induction system. Also included may be hoses, connectors and other emission-related assemblies.

Where a warrantable condition exists, an authorized dealer of Liebherr Construction Equipment Co. (LCE), a company of Liebherr Mining & Construction Equipment, Inc., on behalf of Liebherr, will repair the non-road engine at no cost to the machine owner, including diagnosis, parts and labor.

6.3.1 Manufacturer's warranty coverage

All emission related parts of 2011 and later non-road engines, which are purchased in the United States of America, are warranted for a period of five years or 3,000 hours of operation, whichever occurs first. If any emission-related part on the engine is defective, the part will be repaired or replaced by an authorized Liebherr Dealer.

6.3.2 Owner's warranty responsibilities

- A non-road compression-ignition engine owner is responsible for the performance of the required maintenance listed in the machine's Operation & Maintenance Manual. Liebherr recommends that the owner maintains a log book and retains all receipts covering maintenance on the non-road engine, but Liebherr cannot deny warranty solely for the lack of receipts or for failure to ensure the performance of all scheduled maintenance.
- Liebherr may deny warranty coverage if the non-road compression-ignition engine or a part thereof has failed due to abuse, neglect, improper maintenance, or unapproved modifications.
- The non-road compression-ignition engine is designed to operate on ultra low sulfur diesel fuel only. Use of any other fuel may result in the engine no longer operating in compliance with US Environmental Protection Agency (EPA) and California Air Resources Board (ARB) emission requirements.
- The owner is responsible for initiating the warranty process. The US Environmental Protection Agency and California Air Resources Board suggests that non-road engines or machines be made available to an authorized Liebherr dealer to perform warranty service on behalf of Liebherr as soon as a problem arises. The warranty repairs should be completed by the authorized dealer as expeditiously as possible.

Questions in regard to warranty rights and responsibilities or the location of the nearest authorized Liebherr dealer should be directed to Liebherr service department in Newport News, VA, (757) 245-5251.

6.3.3 Warranty coverage

Liebherr warrants any 2011 and later model year non-road diesel engine certified for sale and registered in the United States of America and the State of California is designed, built, and equipped so as to conform to all applicable regulations adopted by the EPA and ARB. Liebherr warrants that such engine is free from defects in materials and workmanship which cause the failure of a warranted part to be identical in all material respects to the part as described in the engine manufacturer's application for certification for a period of five (5) years or 3,000 hours of operation, whichever occurs first. The warranty period begins on the date the engine or machine is delivered to an ultimate purchaser. Liebherr also warrants that any part that is on the warranted emission parts list of this warranty and installed as original equipment is free from defects in material and workmanship, which would cause this engine not to be in compliance with the emission standards adopted by the EPA and ARB for five (5) years or 3,000 hours, whichever occurs first. Except for any warranted part that is scheduled for replacement as required maintenance, if any warranted part fails during the period of warranty coverage, the part will be repaired or replaced by LCE at no charge to the owner by any authorized Liebherr dealer. Any such part repaired or replaced during the warranty period will be warranted for the remaining warranty period. If any warranted part that is scheduled for replacement as required maintenance fails prior to the first scheduled replacement point for that part, that part will be repaired or replaced by Liebherr at no charge to the owner at any authorized Liebherr dealer. Any such part repaired or replaced prior to the first scheduled replacement point will be warranted for the remainder of the period prior to the first scheduled replacement point.

The owner will not be charged for diagnostic labor that leads to the determination that a warranted part is in fact defective, so long as such diagnostic work is performed by an authorized Liebherr dealer. If a warranted part fails because of a defect, Liebherr will repair or replace it at any authorized Liebherr dealer. Any other engine components damaged by the failure of a warranted part will also be repaired or replaced at no charge to the owner.

6.3.4 Warranted parts

Following are the only parts warranted under this Emission Control Warranty.

1. Fuel Injection System
2. Intake Manifold
3. Turbocharger System
4. Charge Air Cooling System
5. Exhaust Gas Recirculation (EGR) System
6. EGR Control System
7. Exhaust Manifold
8. Diesel Particulate Filter System
9. Diesel Oxidation Catalyst
10. Fuel Additive Devices
11. Selective Catalyst Reduction
12. Reductant Containers
13. Electronic Control Unit, Sensors, Solenoids and Wiring Harnesses
14. Emission Control Information Label

Exclusions

This warranty does not cover:

- Malfunctions in any part caused by abuse, misuse, alterations, tampering, disconnection, or improper or inadequate maintenance.

- Damage resulting from fire, accident, negligence, act of God or other events beyond the control of Liebherr.
- Consequential damages such as loss of use of the engine or equipment powered by the engine, towing, machine transportation, loss of time, downtime, inconvenience, telephone, travel, lodging, or any other indirect or direct damages.
- Loss or damage to personal property, loss of revenue, commercial loss or any other matters not specifically included in this warranty statement
- Any replacement part may be used in the performance of any maintenance or repairs. However, the manufacturer is not liable for non-manufacturer parts.
- Any damages resulting from use of non-genuine Liebherr parts.

Index

A

A/C compressor 14
Additional identifications 20
Additional rules and directives 20
Air compressor 14
Air filter 49
Alternator 17
Attachment options for pumps 14
Availability 35

C

Changing the diesel engine oil and oil filter 72
Changing the fuel fine filter 69
Changing the fuel prefilter insert 68
Check / set valve clearance. See the chapter 5.10. 48
Check batteries and cable connections 66
Check condition of control unit bearings. 66
Check cooling and heating system for condition and leaks 65
Check state of belt drive and replace 63
Check underpressure display of the air filter 61
Checking and setting the inlet valve clearance 78
Checking and setting the standard valve clearance 77
Checking and setting the valve clearance 77
Checking and setting the valve clearance using engine auxiliary brake system (ABS) 78
Checking condition of sensors, actuators, cable holders and plugs 66
Checking outlet valve clearance 79
Checking that engine bearing and diesel engine console are securely seated 68
Checking the coolant level 59
Checking the corrosion frost protection agent concentration 82
Checking the corrosion frost protection agent concentration in the coolant 82
Checking the engine oil level 58
Checking the heating flange 88
Checking the intake and exhaust system for condition and leaks 65
Checking the lubricant and fuel system for condition and leaks 65
Checking the V-ribbed belt 63
Checking / draining water trap on the fuel prefilter 59
Clean the dust extraction valve of the air filter 62
Composition 52
Consumption 35

Control and operating elements 29
Coolant pump D934 / D944 17
Coolant pump D936 / D946 17
Coolant thermostat 17
Cooling 14
Cooling set 15
Cooling system 49
Correcting the corrosion frost protection agent concentration 82
Corrosion frost protection agent 53
Crankcase 13
Cylinder designation, direction of rotation 12
Cylinder head standard 16
Cylinder head with engine auxiliary brake system (ABS) 16

D

Design features 13
Design overview 9
Diesel engine 16, 48
Diesel engine accessory equipment 14
Diesel engine attributes 13
Diesel engine brake and auxiliary brake system 14
Diesel engine coolant 52
Diesel engine design 13
Diesel engine number 11
Diesel engine type plate 11
Diesel fuels 51
Disposal 34
Disposal of operating fluids 26
Draining fuel prefilter 60
Draining off diesel engine oil 72
Draining the coolant 84
Draining water and sediments from the fuel tank 62
Drive control 13
Driving gear 13

E

Electrical system 49
Electronic diesel engine control 14
Electronic sensors on engine side 14
Emission control warranty statement warranty rights and obligations 96
Engine control unit type plate 12
Engine oils 51
EPA/CARB fuel label 95
EU strategies (Stage IV) / US-EPA/CARB (Tier4) 36
Exclusions 97
Exhaust after-treatment system (SCR) 27, 33
Explanation of type designation 10

F

Faults - Cause - Remedy 41
Fill quantities 50
Filling the coolant 85

Filling the operating fluids 30
 Filling with diesel engine oil 75
 Flywheel housing 17
 Fuel system 49

G

General safety instructions 20

H

Handling and use 34
 Handling, operation 29

I

Identification of the warnings 19
 Index 99
 Indicator and warning lamps 35
 Initial commissioning / test run 30
 Injection system 14
 Inspect SCR system profile clips 66
 Instructions for preventing crushing and burns 21
 Instructions for preventing fires and explosion hazards 21

K

L

Liebherr recommendation 53
 Liebherr recommends for Stage IV / Tier 4 diesel engines 51
 Lubricants and operating fluids 50, 51
 Lubricating oil change intervals for diesel engines without emission type approval 52
 Lubrication 13

M

Maintenance 47
 Maintenance activities (daily) every 10 operating hours 58
 Maintenance activities every 1000 operating hours 68
 Maintenance activities every 10000 operating hours 86
 Maintenance activities every 1500 operating hours 72
 Maintenance activities every 2000 operating hours 82
 Maintenance activities every 50 operating hours (weekly) 62
 Maintenance activities every 500 operating hours 63
 Maintenance activities every 6000 operating hours 84
 Maintenance and inspection schedule 47
 Manufacturer's warranty coverage 96
 Measures for safe maintenance 22
 Minimum quality requirements 51, 51, 53
 Mixing ratio for Liebherr Antifreeze products 52

O

Occasional maintenance activities 87
 Operating faults 41
 Operation 30
 Owner's warranty responsibilities 96

P

Particular hazards 25
 Performing work after test run 31
 Preparatory maintenance activities 57
 Preparing for initial commissioning 30
 Product description 9

R

Reducing agent 33, 51
 Replace diesel engine oil (at least every 2 years). See the chapter 5.10. 48
 Replace oil filter (at least every 2 years). See the chapter 5.10. 48
 Replace the oil separator filter insert. See the chapter 5.10. 48
 Replace V-ribbed belt 63
 Replacing the coolant 84
 Replacing the dry air filter main element 91
 Replacing the dry air filter safety element 92
 Replacing the heating flange 86
 Replacing the oil filter 74
 Replacing the oil separator filter insert 75
 Requirements for water used 53

S

Safety and emergency running program for diesel engines with electronic control units 24
 Safety instructions 19
 Safety precautions for diesel engines with electronic control units 23
 Safety precautions when starting 21
 SCR system 49
 SCR system visual inspection 61
 Setting outlet valve clearance 80
 Shutting down the diesel engine 32
 Special instructions for working on the common rail system 24
 Special tools for maintenance activities 54
 Specification 33
 Starter 17
 Starting in freezing temperatures 32
 Starting the diesel engine 31
 Storage over 6 months up to 24 months 94
 Storage up to 6 months 93
 Suitability for storage / Temperature resistance 34
 Supplemental information for the USA 95
 Suspension device 93

T

Technical data 16
Technical description 9
Test run 30
Transport and storage 93
Type designation 10

V

Venting fuel system 89
Venting the fuel prefilter 61
Visual inspection (leaks, contaminations, damage) 58

W

Warning and malfunction strategies 35
Warranted parts 97
Warranty coverage 97

Manufacturer Confirmation

Mobilkrane
Mobile Cranes

Raupenkrane
Crawler Cranes

Statement of engine CO₂ emission results:

To comply with Annex XIV, § 6 of regulation (EU) 2017/654, we confirm the CO₂ emissions of Stage IV engines determined during the EU type-approval process.

This CO₂ measurement results from testing over a fixed test cycle under laboratory conditions a(n) (parent) engine representative of the engine type (engine family) and shall not imply or express any guarantee of the performance of a particular engine.

Test conditions:

NRSC/RMC: Non-Road Steady-state test Cycle/ Ramped Modal Cycle; 'steady-state test cycle' means a test cycle in which engine speed and torque are held at a finite set of nominally constant values; steady-state tests are either discrete mode tests or ramped-modal tests

NRTC: Non-Road Transient test Cycle; 'transient test cycle' means a test cycle with a sequence of normalized speed and torque values that vary on a second-by-second basis with time

Measurement of CO ₂ emissions				
Engine Type	Power/ Speed	EC Stage	CO ₂ Emission by NRSC or RMC [g/kWh]	CO ₂ Emission by NRTC [g/kWh]
OM 936 LA.E4-3	210kW/2200 rpm	IV	679,70	-
OM 936 LA.E4-3	260kW/2200 rpm	IV	683,00	-
D 936 A7 -04	270kW/1900 rpm	IV	663.31	710.16
D 936 A7 -04	300kW/1900 rpm	IV	654.35	701.71
D 936 A7 -04	320kW/1900 rpm	IV	650.74	694.60
D 944 A7 -04	230kW/1900 rpm	IV	682.36	750.86
D 946 A7 -04	350kW/1900 rpm	IV	657.57	711.97
D 946 A7 -04	400kW/1900 rpm	IV	655.37	705.01
D 9508 A7 -04	455kW/1900 rpm	IV	709.44	761.34
D 9508 A7 -04	505kW/1900 rpm	IV	704.30	747.97
QSB6.7	200kW/2200 rpm	IV	688,73	725,40

Herstellerbestätigung

Mobilkrane
Mobile Cranes

Raupenkrane
Crawler Cranes

Erklärung der Motor-CO₂-Emissionsergebnisse:

Zur Erfüllung des Anhang XIV, § 6 der Verordnung (EU) 2017/654 bestätigen wir die CO₂-Emissionen von Motoren der Stufe IV, die während des EU-Typgenehmigungsverfahrens ermittelt wurden.

Diese CO₂-Messung ist das Ergebnis der Erprobung eines für den Motortyp bzw. die Motorenfamilie repräsentativen (Stamm-)Motors in einem festen Prüfzyklus unter Laborbedingungen und stellt keine ausdrückliche oder implizite Garantie der Leistung eines bestimmten Motors dar.

Test-Bedingungen:

NRSC/RMC: Non-Road Steady-state test Cycle/ Ramped Modal Cycle; „stationärer Prüfzyklus“ ein Prüfzyklus, bei dem die Drehzahl und das Drehmoment des Motors eine endliche Zahl nominell konstanter Werte annehmen; stationäre Prüfungen sind entweder Einzelphasen-Prüfzyklen oder gestufte modale Prüfzyklen

NRTC: Non-Road Transient test Cycle; „dynamischer Prüfzyklus“ ein Prüfzyklus, bei dem normierte Drehzahl- und Drehmomentwerte im Sekundentakt wechseln

Messung der CO ₂ Emissions				
Motor Typ	Leistung/ Drehzahl	EU Stufe	CO ₂ Emission bei NRSC or RMC [g/kWh]	CO ₂ Emission bei NRTC [g/kWh]
OM 936 LA.E4-3	210kW/2200 min ⁻¹	IV	679,70	-
OM 936 LA.E4-3	260kW/2200 min ⁻¹	IV	683,00	-
D 936 A7 -04	270kW/1900 min ⁻¹	IV	663.31	710.16
D 936 A7 -04	300kW/1900 min ⁻¹	IV	654.35	701.71
D 936 A7 -04	320kW/1900 min ⁻¹	IV	650.74	694.60
D 944 A7 -04	230kW/1900 min ⁻¹	IV	682.36	750.86
D 946 A7 -04	350kW/1900 min ⁻¹	IV	657.57	711.97
D 946 A7 -04	400kW/1900 min ⁻¹	IV	655.37	705.01
D 9508 A7 -04	455kW/1900 min ⁻¹	IV	709.44	761.34
D 9508 A7 -04	505kW/1900 min ⁻¹	IV	704.30	747.97
QSB6.7	200kW/2200 min ⁻¹	IV	688,73	725,40