HDS 9/50 De Tr1
HDS 13/35 De Tr1
HDS 13/20 De Tr1
HDS 17/20 De Tr1
Service Manual

1 Contents

2 Preface

Good service work requires extensive and practice-oriented training as well as well-structured training materials. Hence we offer regular basic and advanced training programmes covering the entire product range for all service engineers.
In addition to this, we also prepare service manuals for important appliances - these can be initially used as instruction guides and later on as reference guides.
Apart from this, we also regular information about product enhancements and their servicing.

If you should require supplements, have corrections or questions regarding this document, please address these citing the following subject to:

international-service@de.kaercher.com

Subject:	***Fall 119377***

The responsible product specialist will take care of your issue.

Alfred Kärcher GmbH & Co. KG
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www.kaercher.com

3 Regarding this service manual

3.1 Target groups for this manual

This service manual serves as an addendum to the operating and assembly instructions.

– **Experts**
Experts are individuals, who are, according to their professional education, able to install the equipment and to operate the same.

4 Environmental protection

	The packaging materials are recyclable. Please do not throw packaging in the domestic waste but pass it on for recycling.
	Old units contain valuable recyclable materials. Batteries, oil and similar substances may not be released into the environment. Therefore please dispose of old units through suitable collection systems.

Please do not expose motor oil, fuil, diesel and gazoline into the environment. Please protect the ground and dispose of used oil properly.

5 Safety instructions

5.1 General

Mishandling or misuse can prove to be hazardous to the operator and other persons through
– high water pressure,
– hot water,
– hot exhaust,
– high electrical voltage,
– Detergent,
– damage to stomach and food pipe by drinking large quantities of permeate.

To avoid danger to persons, animals and property before the first operation of the system, read:
– the operation instructions
– all safety notices
– according to the national requirements of each country
– that safety notices included in the cleaning agents used (normally on top of the package stated).

in the area of this equipment, the regulations and requirements of the German republic does apply (can be subscribed by Carl Heymanns Verlag KG, Luxemburger Straße 449, 50939 Koeln):
– accident or regulation "working with fluit high-pressure" BGR 500

NOTICE
High pressure jets must be tested annually by an expert according to the accident protection guideline BGR 500 . Kärcher Customer Service technicians are experts and can carry out the prescribed tests. The result of this test must be documented in writing. The test results can be entered in the "Report of high-pressure testing".

– Regulation concerning the safe operation (BetrSichV).
– Federal law concerning pollution: the heating equipment must be inspected, according to the federal law concerning pollutionby an appropriate chimney sweep once a year, in order to examine the limit of the exhaust value.
– Used water must be drained off, in correspondence with the local regulations, into the canalization.

Please remember:
– that you have understood all the instructions
– that all users of the plant are informed about the instructions and have understood them.

All individuals,who are involved, in the installation, the operation, the maintenance and service of this equipment, must be
– have the requisite qualifications,
– know and have read this service manual,
– know and follow the corresponding regulations.

In the operation of self service, the owner must provide cleaned and well exposed notice signs, which have to state
– possible danger,
– Safty device,
– Operating the equipment

If the equipment is operated in a close room
– , exhaust must be lead through appropriate pipes or chimneys,
– and there has to be sufficient fresh air circulation.

⚠ ***DANGER***

Risk of burns due to hot exhaust gases; hence, do not reach over the exhaust opening. Do not touch the chimney cover.

Risk of burns due to hot system parts such as pumps and motors. Be careful when opening the system; allow system parts to cool down first

⚠ ***DANGER***

Electrical hazard. Disconnect the battery prior to replacing electric components!

5.2 Hazard levels

⚠ ***DANGER***

Pointer to immediate danger, which leads to severe injuries or death.

⚠ ***WARNING***

Pointer to a possibly dangerous situation, which can lead to severe injuries or death.

CAUTION

Pointer to a possibly dangerous situation, which can lead to minor injuries.

ATTENTION

Pointer to a possibly dangerous situation, which can lead to property damage.

5.3 Symbols on the plant

	***Risk of electric shock!***
	Only electricians or authorised technicians are permitted to work on parts of the plant.

⚠ ***DANGER***

Danger of injury by the high pressure jet. Do not point the high pressure jet towards humans or animals.

Risk of injury due to electric shock. Do not point the high pressure jet towards electrical appliances, cable and this equipment.

5.4 Hearing protection

The sound level of the system is up to 103 dB(A). If parts (such as large sheets) that amplify sound are shot blasted, it can give rise to higher noise levels. If so, wear ear plugs.

6 Technical Features

6.1 General

Mobile hot water high-pressure cleaners in various performance classes for commercial use.
- High-performance burner with an upright heating coil
- Built-in calcification protection
- Burner blower and fuel pump with separate DC motor
- A diesel engine for all performance classes:

  Water-cooled diesel engine (Yanmar 3 TNV76), 19.2 kW / 3200 1/min, 3-cylinder, 4-stroke, with electric start starter
  Diesel engine with monitoring of the oil pressure and the temperature of the coolant, start with preheating
- 1 fuel tank (100 l) for diesel engine and burner
- 2 x 250 l water storage tanks
- 1 x 35 litre float container

6.2 Field of application

- HDS 9/50 De Tr1
- HDS 13/35 De Tr1
- HDS 13/20 De Tr1
- HDS 17/20 De Tr1

6.3 Pump

- 3-piston crankshaft pump with ceramic sleeve
- Cylinder head made of brass
- High-pressure and suction valve faces made of stainless steel
- Working pressure: 20-50 MPa (200-500 bar)
- Water quantity: 900-1,700 l/h
- Manometer
- Overflow valve
- Float tank
- Safety block with safety valve and flow switch
- 2 water filters

6.4 Electronics system

- Program selection switch
- Flame sensor
- Water temperature regulation with temperature sensor
- Exhaust temperature monitor
- Water shortage safeguard (by means of pressure switch and flow switch)
- Dry-run protection for the pump
- Temperature monitoring float container
- Motor monitoring (oil pressure and temperature of the coolant)
- Level switch for liquid softener and detergent tank (option in some cases)
- Level sensor for fuel tank
- Operating hour counter
- Counter for maintenance intervals for motor, pump, burner, and gun
- Error memory
- Component tests
- Fault monitoring

6.5 Detergent

Only for devices 13/20 and 17/20:
- 1 Detergent can
- Detergent inlet with fine filter
- Dosing valve on the device with control of the suction via solenoid valve
- Detergent in high pressure

6.6 Accessories

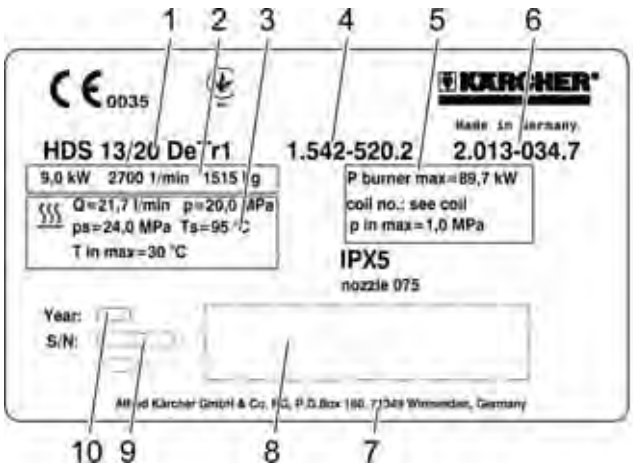
Accessories for HDS 9/50
- Industrial trigger gun 650 bar, 3000 l/h
- Stainless steel spray lance, 700 mm, 650 bar
- Power nozzle (stainless steel), 15° 030
- HP hose 620 bar, 30 metres, DN8

Accessories for HDS 13/35
- Industrial trigger gun 650 bar, 3000 l/h
- Stainless steel spray lance, 700 mm, 650 bar
- Power nozzle (stainless steel), 15° 051
- HP hose 620 bar, 30 metres, DN10

Accessories for HDS 13/20
- Gun with control knob
- Stainless steel spray lance, 1050 mm, rotating
- Power nozzle (stainless steel), 25° 075
- HP hose, 30 metres, DN8

Accessories for HDS 17/20
- Gun with control knob
- Stainless steel spray lance, 1050 mm, rotating
- Power nozzle (stainless steel), 25° 090
- HP hose, 30 metres, DN10

6.7 Type plate



Exemplary illustration for type HDS 13/200 De Tr1

1 Appliance description
2 Performance data motor, speed motor, total weight trailer
3 Information regarding the flow rate, working pressure, maximum pressure of the safety valve, maximum work temperature, maximum supply temperature
4 Superior configurable part number
5 Information burner: maximum burner power, reference to heating coil type, max. feed pressure
6 Part number
7 Address of manufacturer
8 Bar code. Contains part and serial number.
9 Serial number
10 Year of manufacture

NOTE

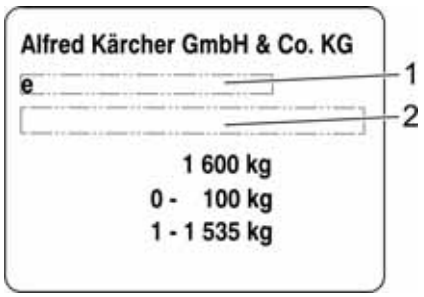
The type plate is located in the motor compartment between the high-pressure pump and the safety block.

6.8 Vehicle identification number

NOTE

The marking consists of 2 labels and the engraved vehicle identification number, which are all located in the motor compartment in the area between battery and blower motor.

1 Label
2 Engraved vehicle identification number
3 Battery



Label small

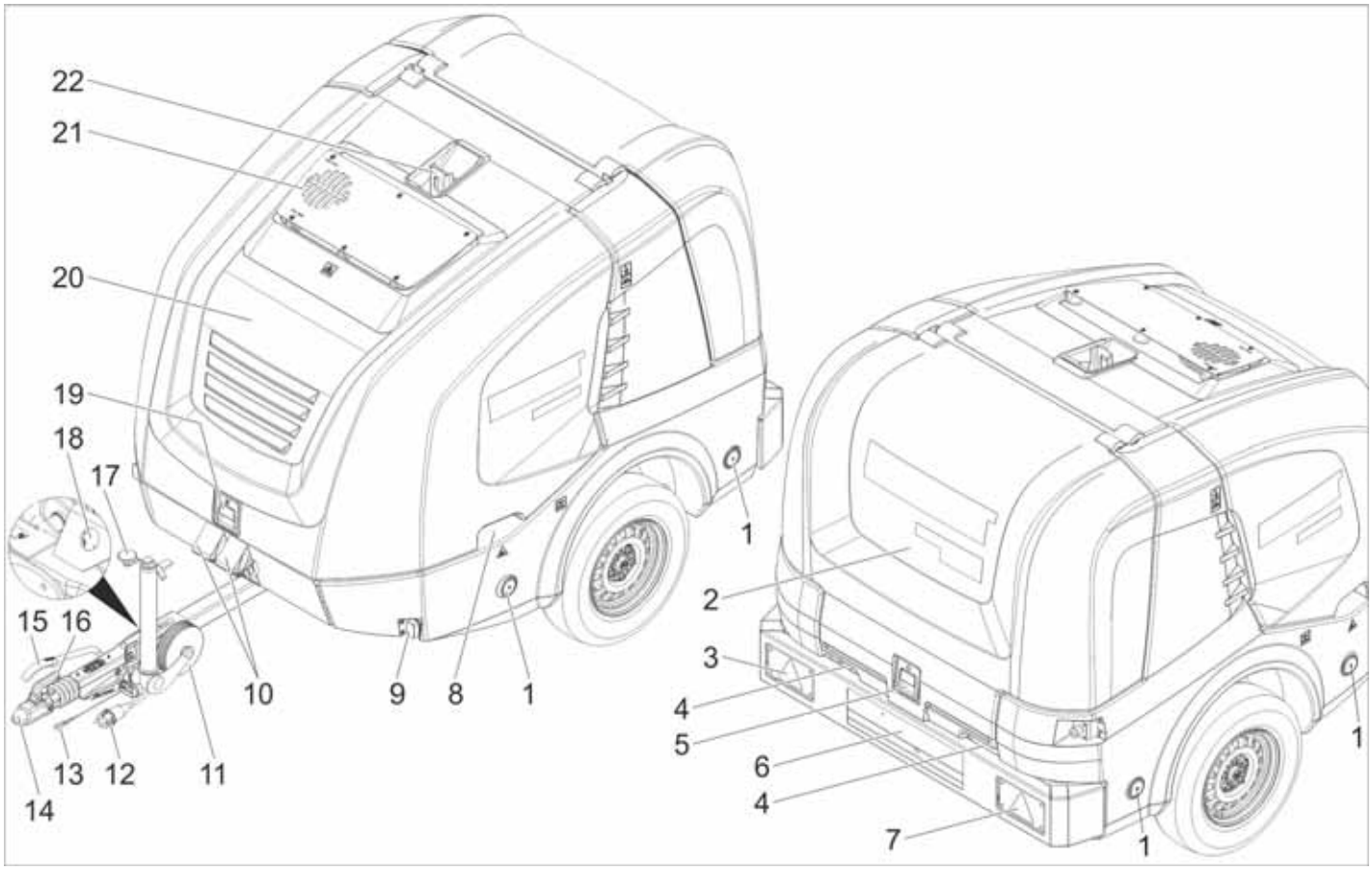
1 Type approval number
2 Vehicle identification number

Label large

1 Type approval number
2 Vehicle identification number

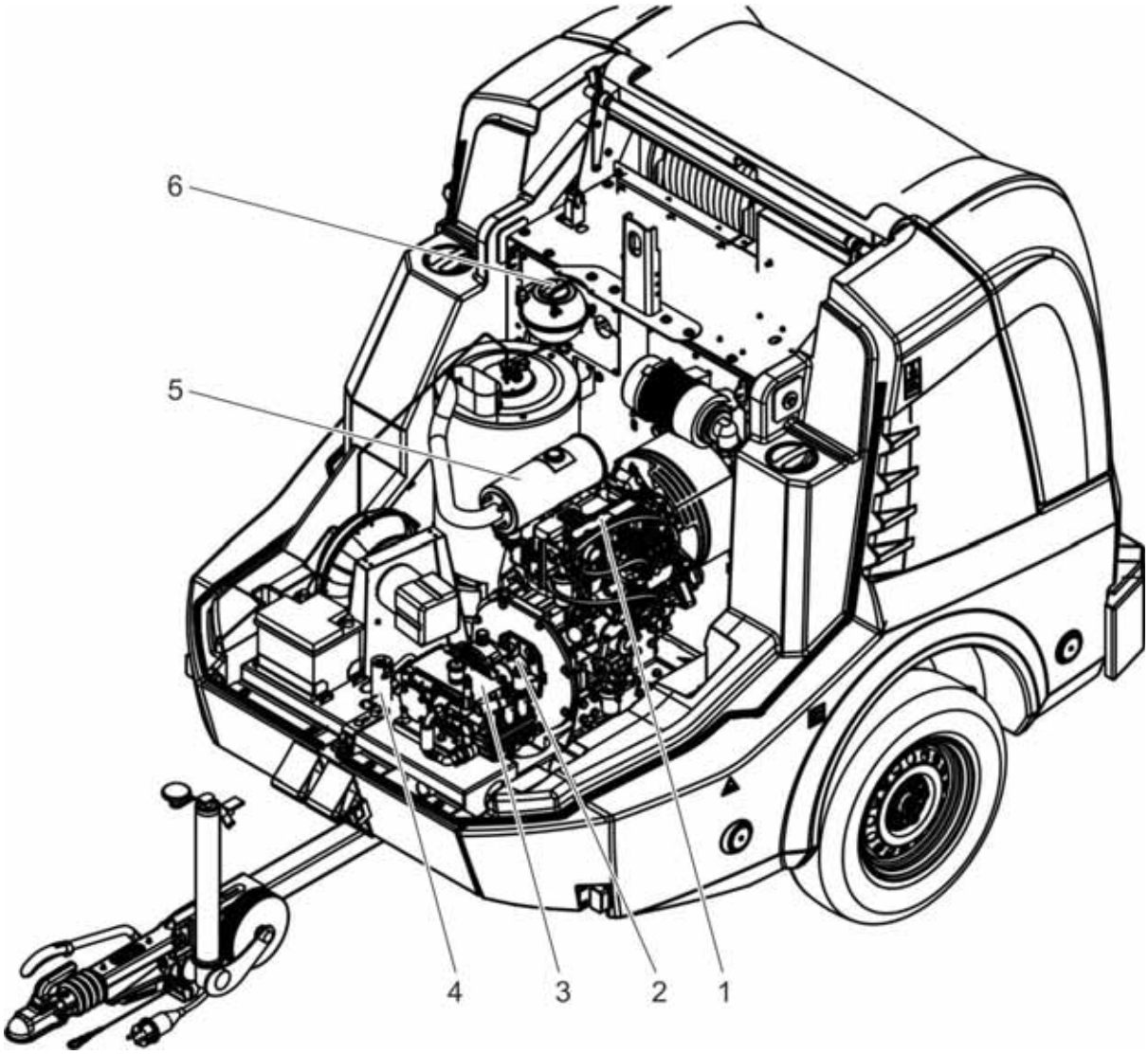
7 Parts of the system

7.1 View with closed front and rear cover

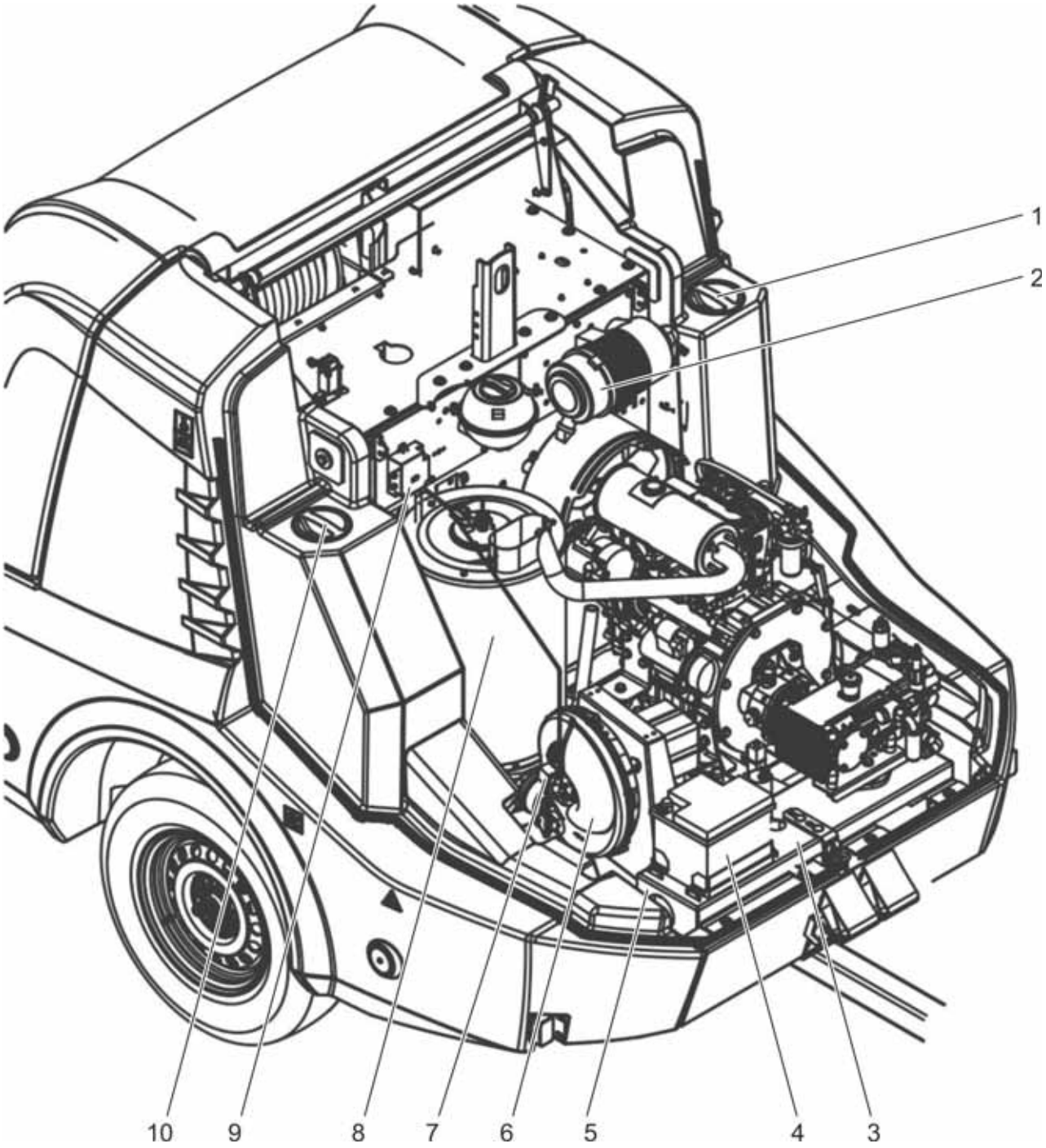


1 Reflector (on both sides)
2 Rear cover
3 Combined brake/tail light with direction indicator (left)
4 Recessed grip of the rear cover or hose inlet with closed rear cover
5 Lock rear cover
6 Licence plate with licence plate lights
7 Combined brake/tail light with direction indicator (right)
8 Recessed grip of the front cover (on both sides)
9 Marker light (on both sides)
10 Block wedge
11 Support wheel
12 Connector vehicle lighting
13 Tear-off rope
14 Towing hitch
15 Parking brake
16 Coupling lever
17 Support wheel crank handle
18 Holder for socket plug connection of the vehicle lighting
19 Lock front cover
20 Front cover
21 Exhaust outlet
22 Lifting eye

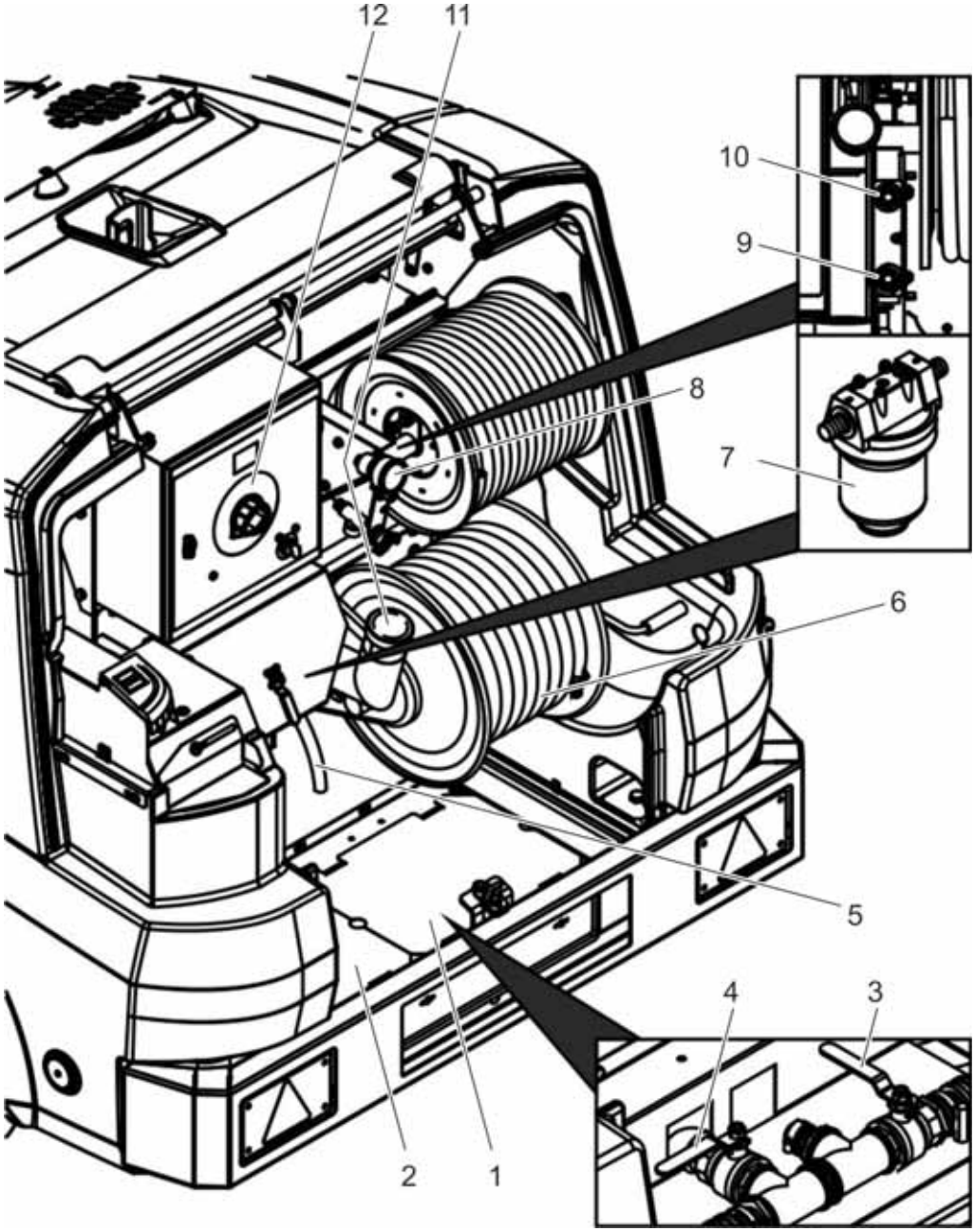
7.2 View with opened front and rear cover



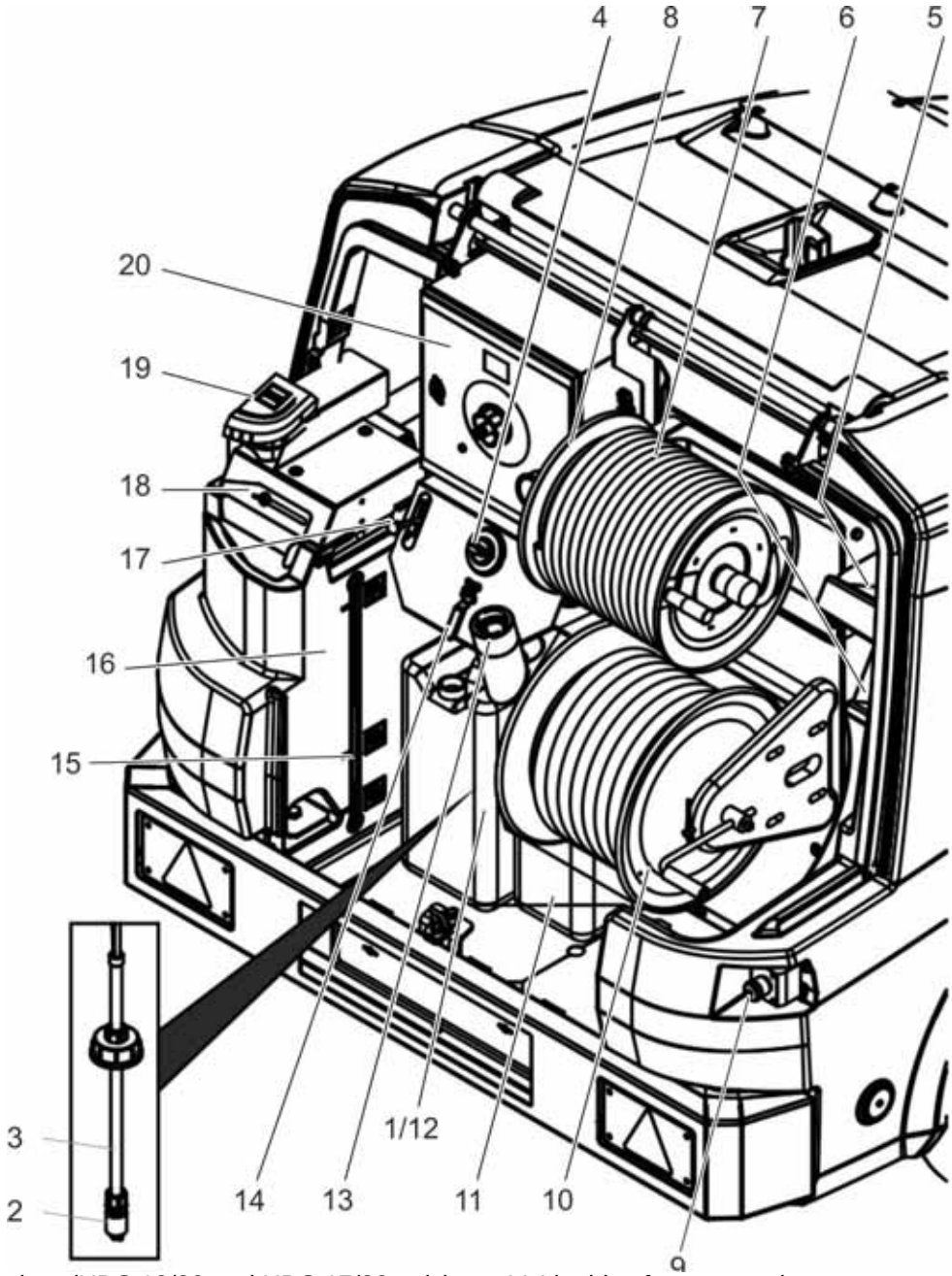
1 Diesel engine
2 Intermediate gear
3 High-pressure pump
4 Safety block
5 Exhaust
6 Expansion tank motor coolant



1 Maintenance opening water tank (left)
2 Air filter diesel engine
3 Nameplate
4 Battery
5 Vehicle identification number
6 Burner blower
7 Fuel pump
8 Continuous heater
9 Ignition transformer
10 Maintenance opening water tank (right)



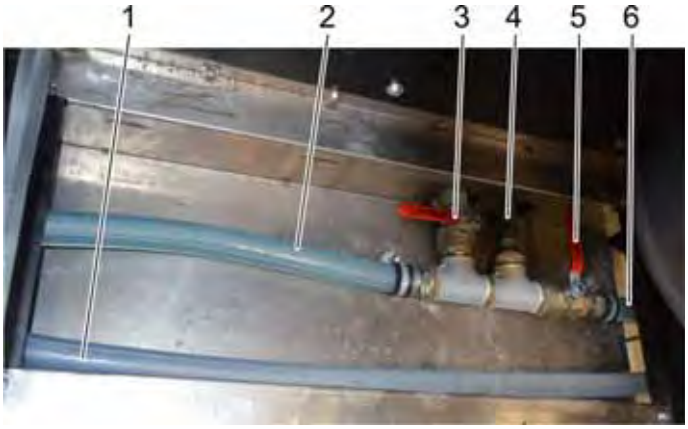
1 Cover plate (right)
2 Cover plate (left)
3 Supply tap water tanks
4 Drain-off tap
5 Antifreeze hose
6 Water pipes
7 Water filter
8 Manometer
9 Supply frost protection or parking position for GEKA low-pressure connection
10 Return flow frost protection or parking position for high-pressure connection
11 Tank lid
12 Operating field



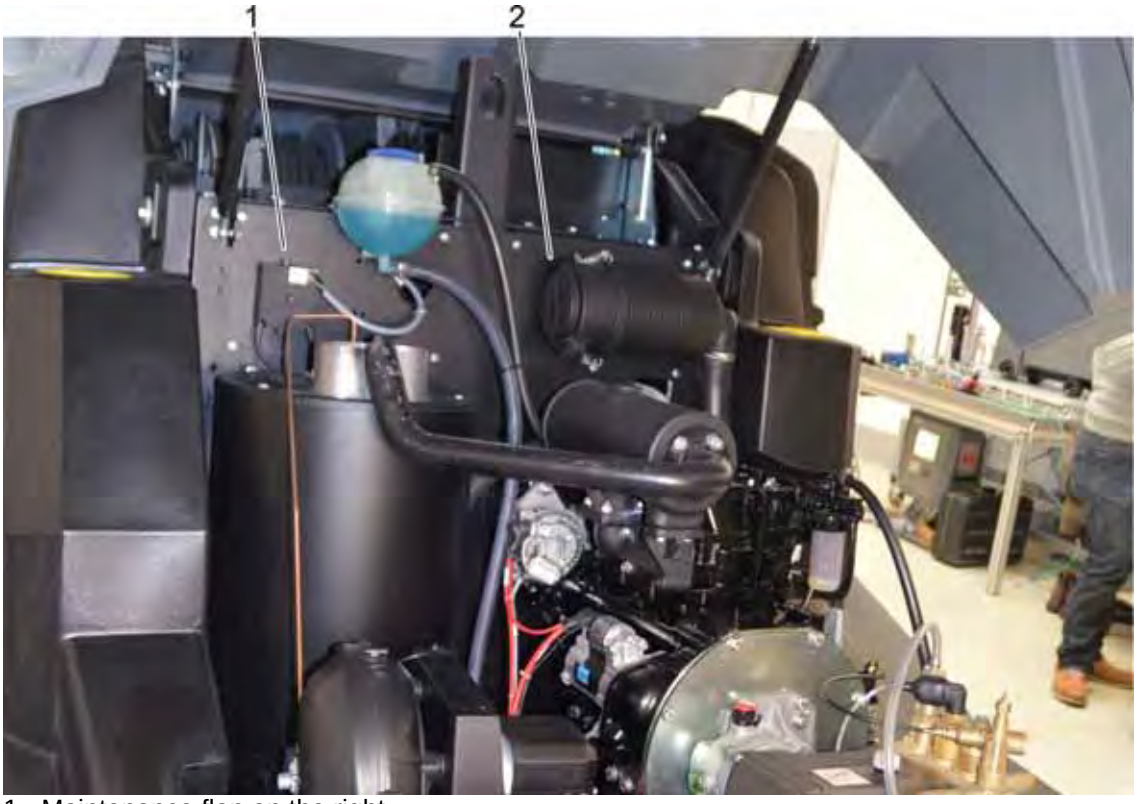
1 Detergent container (HDS 13/20 and HDS 17/20 only)
2 Filter detergent suction hose (HDS 13/20 and HDS 17/20 only)
3 Detergent suction hose with level switch (HDS 13/20 and HDS 17/20 only)
4 Detergent dosing valve (HDS 13/20 and HDS 17/20 only)
5 Storage compartment for trigger gun
6 Storage compartment for spray lance
7 High pressure hose
8 High-pressure hose drum
9 Emergency stop button
10 Low-pressure hose drum
11 Liquid softener container
12 Antifreeze container
13 Filling nozzle fuel tank with sieve
14 Ball tap frost protection
15 Filling level indicator water tanks
16 Float tank
17 Pressure and volume regulation (HDS 9/50 and HDS 13/35 only)
18 Filling hole float container with cover/wing screw
19 Pouring vent for liquid softner
20 Switch box

1 Cover plates

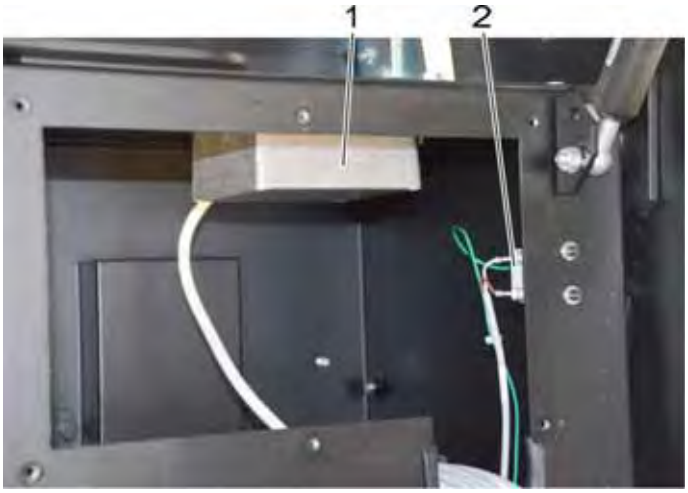
The cover plates can be lifted up and removed.



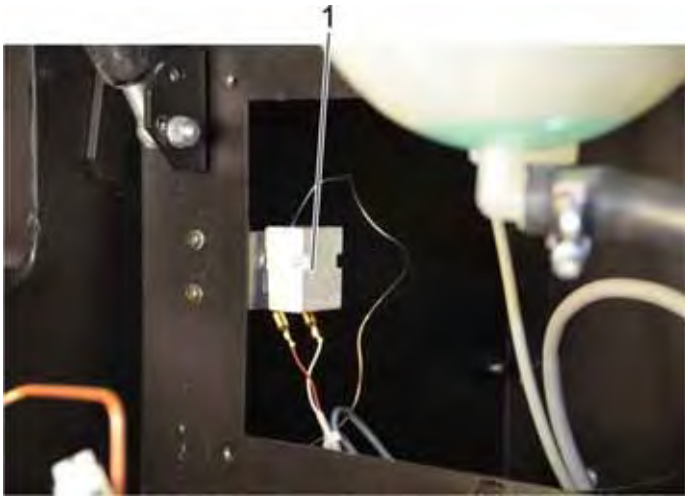
1 Connection tank on the left side - tank on the right side
2 Supply from the float container
3 Stop cock drain water tanks
4 Supply to the high-pressure pump
5 Stop cock water tanks
6 Supply from water tank on the right



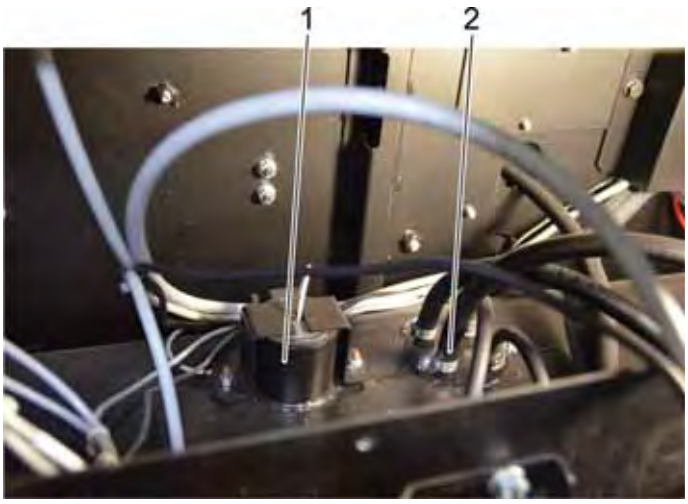
1 Maintenance flap on the right
2 Maintenance flap on the left



View with opened maintenance flap on the left
1 Inverter
2 Thermostat switch water temperature in the float container



View with opened maintenance flap on the right
1 Thermostat switch emission temperature



View with opened maintenance flap on the right
1 Level sensor for fuel tank
2 Fuel line motor and burner

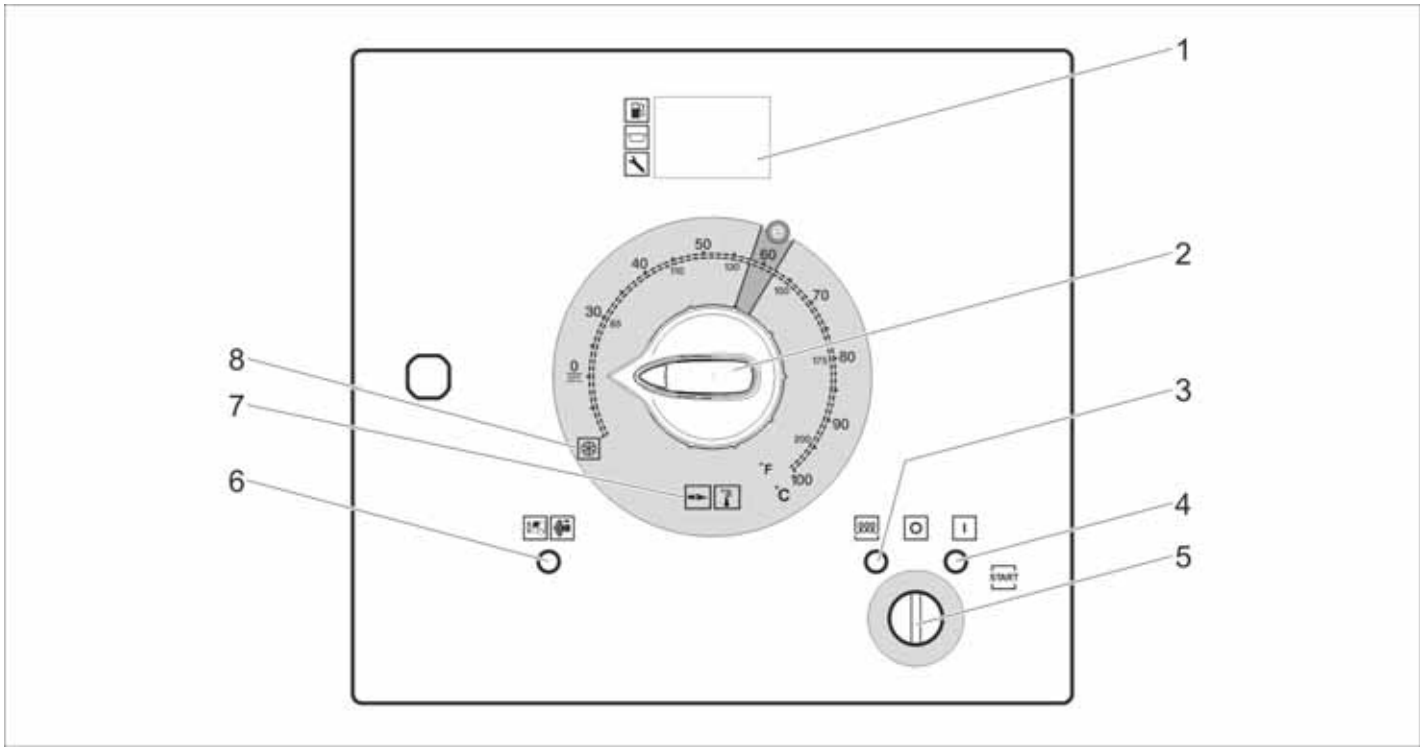
7.3 Bottom view

1 Temperature sensor booster heater
2 High-pressure line from the boiler to the high-pressure connection
3 High-pressure line from the safety block to the boiler
4 Heat exchanger
5 Drain screw heat exchanger
6 Axle (drawbar)

NOTE
In the underbody area, there is the oil drain screw of the motor as well as the drain screw for emptying the diesel tank.

7.4 Operator console

7.4.1 Operator console



1 Display
2 Operating type switch
3 Indicator light preheating (red)
4 Indicator light standby mode (red), the charge control is active
5 Key switch
6 Indicator lamp front cover/emergency stop (red)
7 Operating mode cold/warm water (0-100 °C, temperature selection)
8 Operating mode frost protection

NOTE
In the "ECO mode“ the water temperature is maintained at 60? (+/- 9?). Set water temperatures < 60°C are effective.

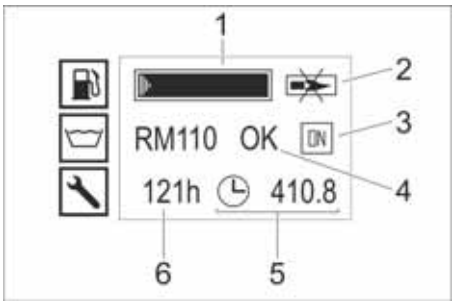
NOTE
The indicator light preheating lights up for approx. 4 seconds if the key switch is turned to the left. Then the indication goes out.
The preheating itself takes place as long as the key switch is in the "preheating" position.

NOTE
The indictor light standby mode is on for approx. 6 seconds after the start of the motor. Then the indication goes out.

During normal operating mode, the control panel display alternates between:

– Normal operation
– Service: Due maintenance tasks to be performed by the customer service (see care and maintenance).
  If more than one maintenance procedure is required, these will be shown in sequence.
  If no maintenance procedures are required, nothing will be shown.
– Failure: Malfunction incurred (see assistance in case of malfunctions).
  If more than one fault is present, these will be shown in sequence.
  If no faults are present, nothing will be shown.
– Operating hour counter

Display normal image

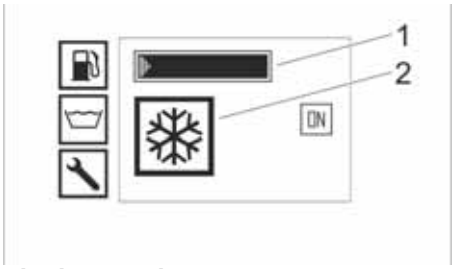


1 Fuel tank (bargraph)
2 Burner deactivated (fuel shortage)
3 Motor on (ON) or motor off (OFF)
4 Liquid softener tank RM110/detergent tank CHEM (OK/empty)
5 Operating hour counter
6 Operating hours until next service

NOTE
The indication of the detergent tank is only present if the detergent tank has been detected as full once before. For details about the initial start-up see Chapter 9.2.1
The burner is deactivated starting from fuel level 3.

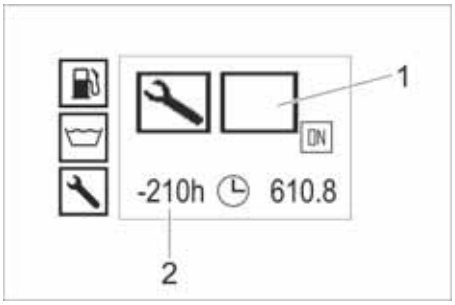
NOTE
If no bargraph of the fuel tank is depicted, there is a fault in the level sensor of the fuel tank or it is not properly connected.

Display frost protection



1 Fuel tank (bargraph)
2 Operating mode frost protection

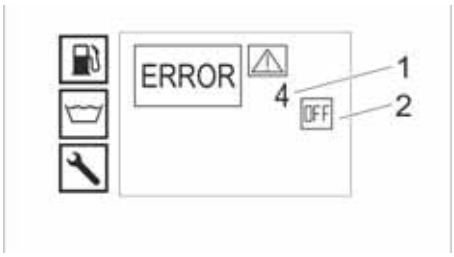
Display service



1 Type of service
2 Service overdue for 210 operating hours

Type of service	
	Burner service (400 h)
	Motor service (200 h)
	Pump service (600 h)
	Trigger gun service (8000 switching cycles)

Display malfunction



1 Malfunction no.
2 Motor off (OFF)

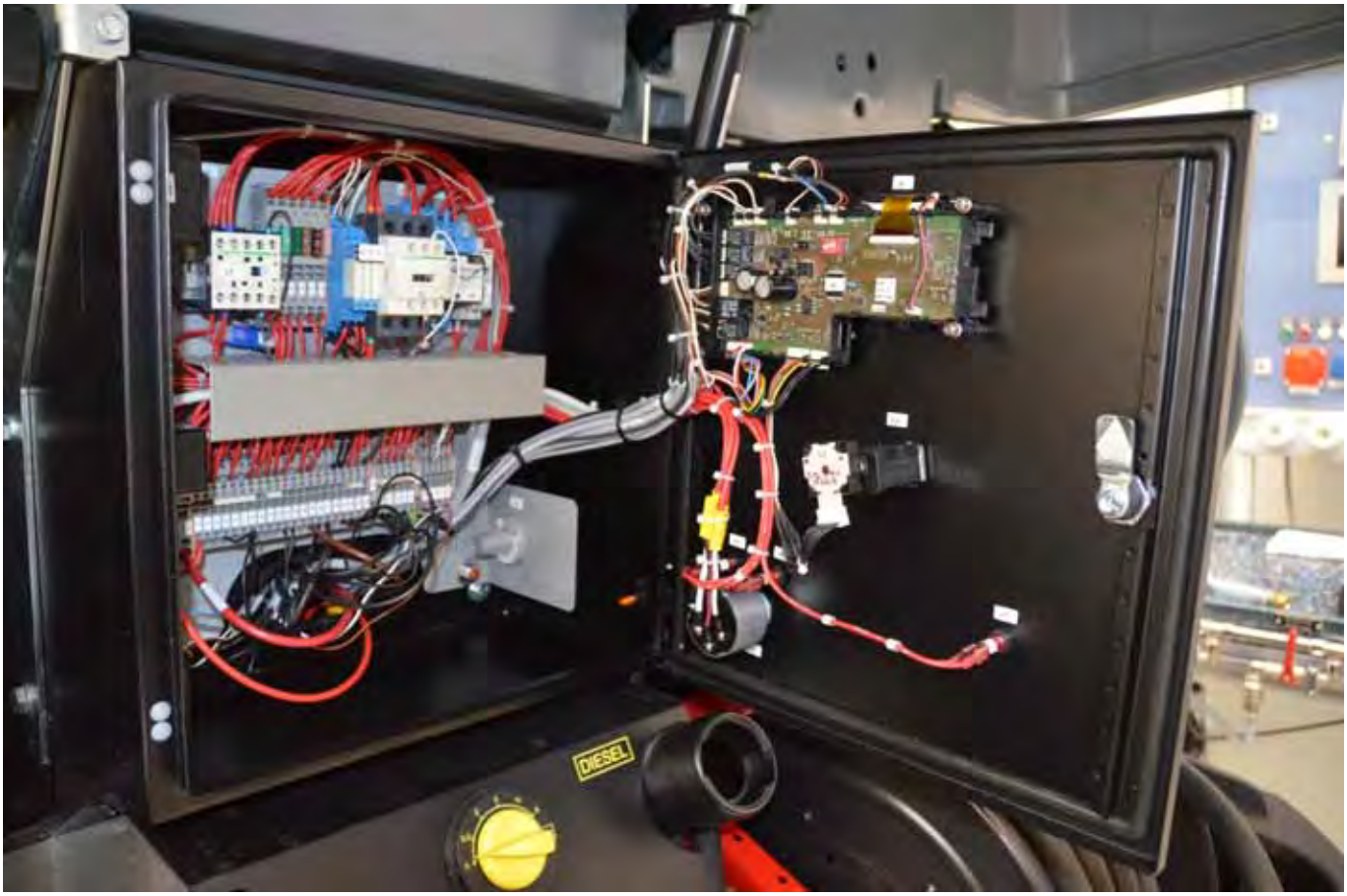
List malfunction number with corresponding error message

– ERROR 1
  Charging current
– ERROR 3
  Coolant or temperature water in the float container
– ERROR 4
  Water shortage
– ERROR 5
  Flow switch/pressure switch
– ERROR 6
  Fuel sensor
– ERROR 7
  Motor oil pressure
– ERROR 9*
  Emission temperature
– ERROR 10*
  Temperature sensor booster heater
– ERROR 11*
  Flame sensor image bright blind
– ERROR 12*
  Flame sensor image dark blind
– ERROR 14
  Switch-off after 45 minutes continuous break
– ERROR 15
  Switch-off after 45 minutes continuous operation

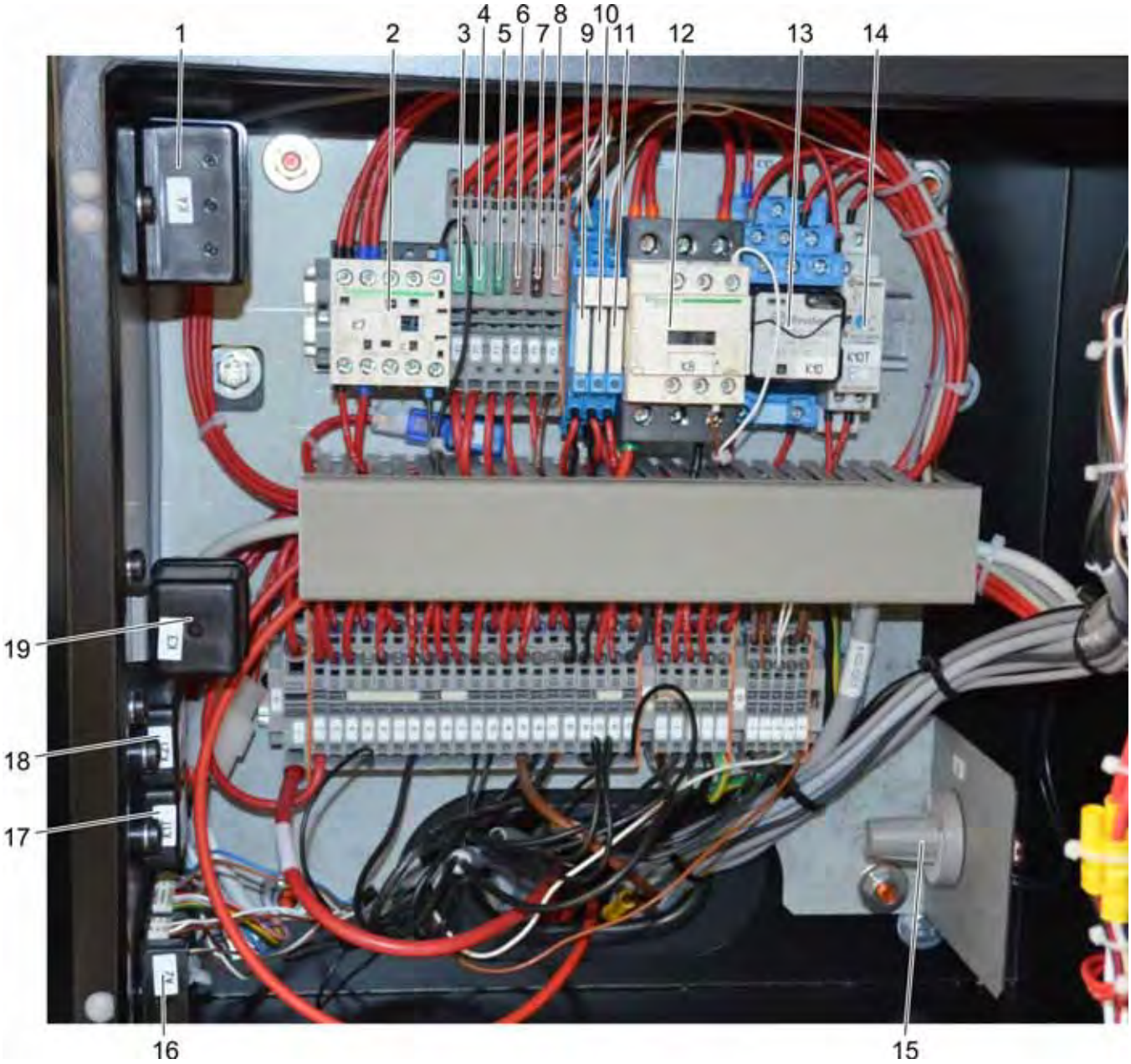
* Cleaning operation with cold water is possible.

NOTE
For details on the cause of the malfunction and its rectification see Chapter 13.

7.4.2 Control panel, view from the inside

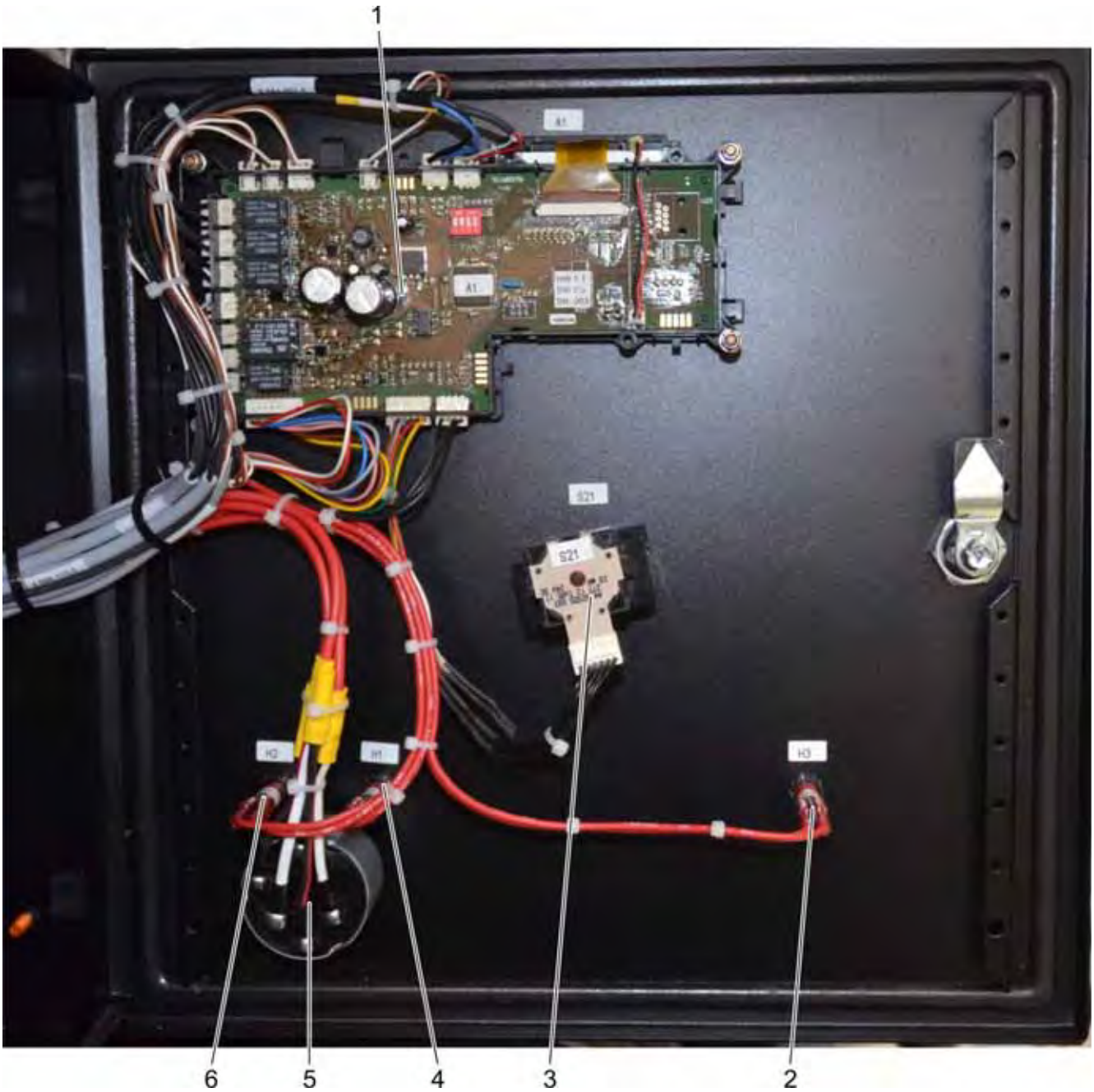


Electric components are located in the control cabinet and in the control cabinet door.



Electric components in the control cabinet

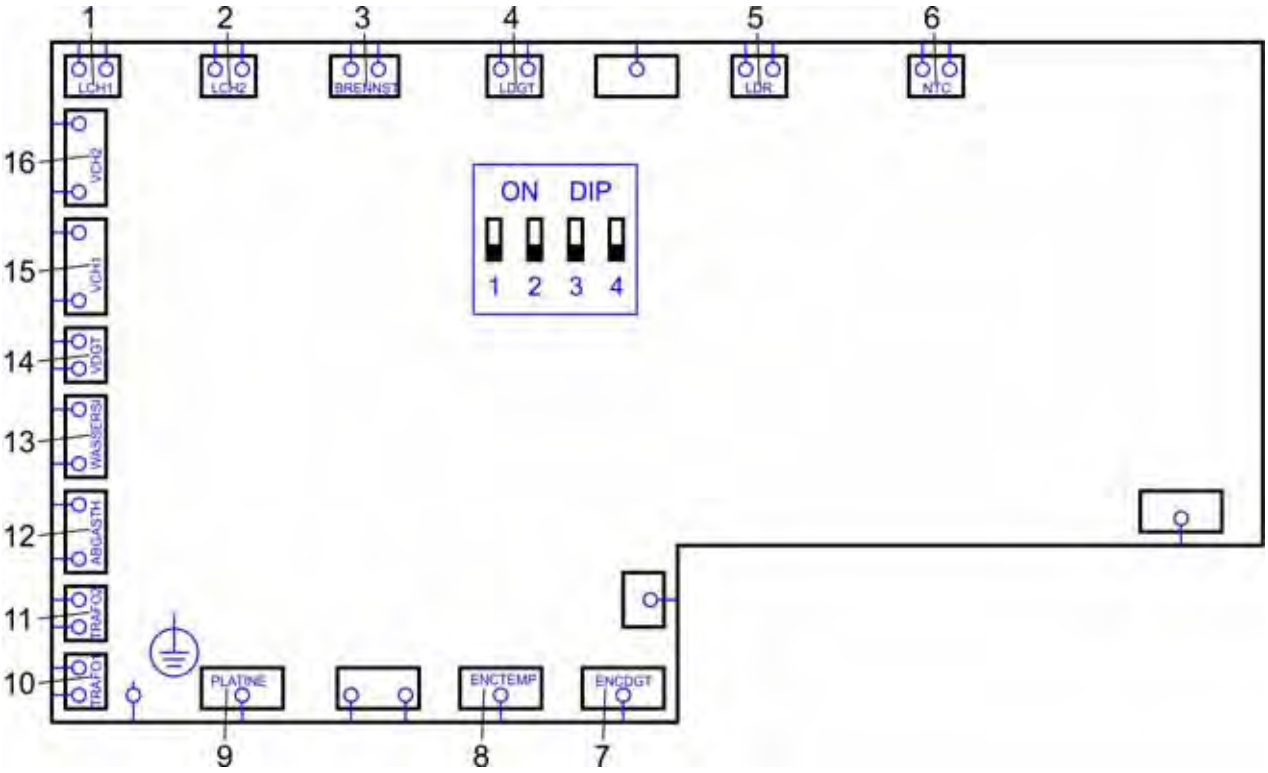
1 Relay K4 (safety relay Yanmar)
2 Relay K7, release
3 Fuse F1, 30A: Blower motor
4 Fuse F2, 30A: Pre-heat
5 Fuse F3, 30A
6 Fuse F4, 5A
7 Fuse F5, 7.5A: Emergency stop and cover switch
8 Fuse F6, 3A: Connection transformer 1 and 2 as well as power supply printed circuit board
9 Relay K5, oil pressure
10 Relay K6, coolant
11 Relay K9, charge regulator
12 Relay K8, release burner
13 Relay K10, (bypass relay)
14 Time relay K10T
15 Service switch
16 Distributor printed circuit board A2
17 Time relay K1T (Yanmar; 4 seconds for preheating)
18 Time relay K2T (Yanmar; 1 second for solenoid valve fuel)
19 Relay K3, start/stop (Yanmar)



Electric components in the control cabinet door

1 Printed circuit board A1 with display
2 Indicator light H3 front cover/emergency stop (red)
3 Operating type switch
4 Indicator light H1 preheating (red)
5 Key switch
6 Indicator light H2 charge regulator (red)

7.4.3 Control boards, control panel



Control board A1

Inputs

1 LCH1: Monitoring oil pressure diesel engine
2 LCH2: Monitoring temperature water in the float container and monitoring temperature coolant diesel engine
3 FUEL: Level sensor for fuel tank
4 LDGT: Level switch liquid softener
5 LDR: Flame sensor
6 NTC: Temperature sensor booster heater (temperature on the output after the heating coil)
7 ENCDGT: Service switch for settings liquid softener and service functions
8 ENCTEMP: Water temperature setting by encoder
9 PRINTED CIRCUIT BOARD: Connection between control board A1 and distributor board A2
10 TRANSFORMER 1: Connection transformer 1 (24V AC)
11 TRANSFORMER 2: Connection transformer 2 (24V AC)
12 ABGASTH: Thermostat switch emission temperature (permanently set)
13 WASSERSI: Flow switch

Outputs

14 VDGT: Solenoid valve liquid softener, 24VAV, 3A
15 VCH1: Relay K7, release for starting the diesel engine, 24V AC, 3A
16 VCH2: Solenoid valve detergent (for HDS 13/20 and 17/20 only), 24V AC, 3A

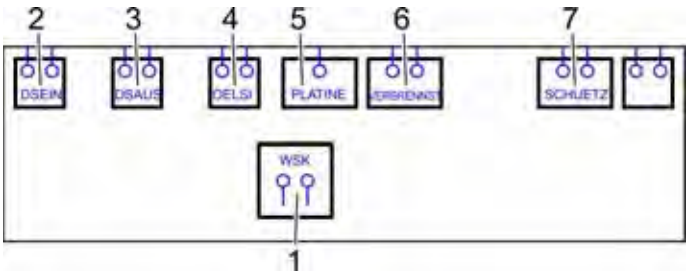
DIP switch

DIP1 on:
With flame sensor.
DIP1 off:
Ohne Flammfühler.

DIP2:
Not assigned.

DIP 3 and 4 off:
Device <1000 l/h (type HDS 9/50 only).

DIP3 and 4 on:
Device >1000l/h (all other unit types).

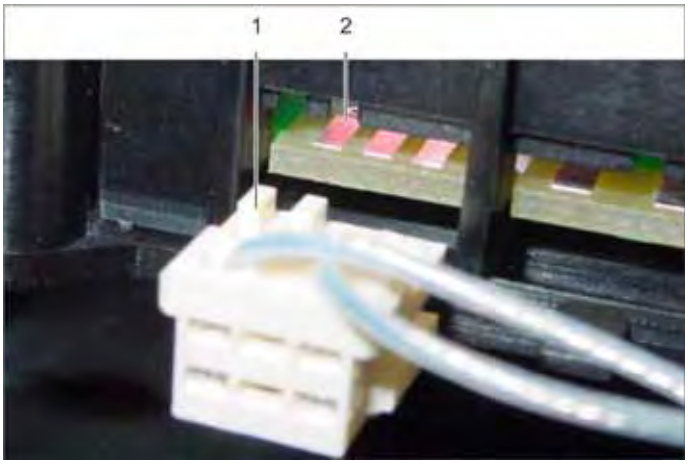


Distributor printed circuit board A2
Inputs

1 WSK: Level switch water shortage float container
2 DSEIN: Pressure switch
3 DSAUS: Charge regulator
4 OELSI: Level switch detergent can
5 PRINTED CIRCUIT BOARD: Connection between control board A1 and distributor board A2

Outputs

6 VERBRENNST: Solenoid valve fuel supply burner, 24V AC, 3A
7 Connection relay K9, release burner, 24V AC, 3A



1 Encoding pin
2 Recess for encoding pin

Plug coding

The plugs for the PCB connections are designed with encoding pins and their matching recesses in the PCB base so that only the matching plug can be attached to the respective connection.

8 Operations

8.1 General information on the operation

8.1.1 Safety instructions

⚠ ***DANGER***
Risk of explosion!
Do not spray flammable liquids.

⚠ ***DANGER***
Risk of injury! Never use the appliance without the spray lance attached. Check and ensure proper fitting of the spray lance prior to each use. The screw connection of the spray lance must be fingertight.

⚠ ***WARNING***
Long hours of using the appliance can cause circulation problems in the hands on account of vibrations.

It is not possible to specify a generally valid operation time, since this depends on several factors:
- Proneness to blood circulation deficiencies (cold, numb fingers).
- Low ambient temperature. Wear warm gloves to protect hands.
- A firm grip impedes blood circulation.
- Continuous operation is worse than an operation interrupted by pauses.

In case of regular, long-term operation of the device and in case of repeated occurrence of the symptoms (e.g. cold, numb fingers) please consult a physician.

8.1.2 Water supply

1 Stop cock water tanks

The water supply can either take place via an external water supply or via the internal water tanks (2x250 litres).
- External water supply:

➔ Close stop cock water tanks.
- Internal water supply:

➔ Open stop cock water tanks.

8.1.3 Turning on the Appliance

NOTE
The device can only be operated when the front cover is closed. If the front cover is opened, the device shuts down and the indicator light is on.

NOTE
Due to the bleeding procedure, the speed of the motor may vary until the final operating pressure has been reached.

➔ Unlock the emergency-stop switch by pulling.
➔ Open rear cover.
➔ Establish the water supply.
➔ Insert the key into the key switch.
➔ To preheat the motor, turn the key switch to the left and hold it until the indicator light preheating goes out.

NOTE
The indicator light preheating lights up for approx. 4 seconds if the key switch is turned to the left. Then the indication goes out.
The preheating itself takes place as long as the key switch is in the "preheating" position.

➔ Turn key switch to position "I". The indicator lamp for operational readiness lights up.
The control voltage is switch on and the display shows the operating status.
➔ Turn the key switch to the right until the motor is running.

NOTE
The indictor light standby mode is on for approx. 6 seconds after the start of the motor. Then the indication goes out.

Operating with cold water:
➔ Set the power switch to "0/OFF“ (burner off).

Operation with warm water:
⚠ ***DANGER***
Scalding danger!
➔ Set the power switch to the desired working temperature (max. 100 °C). The burner is switched on.
➔ Press the lever on the hand spray gun.

8.1.4 Speed control for pressure and volume regulation

HDS 9/50, HDS 13/35 only:

NOTE

If the motor speed is increased, the operating pressure also rises. This can be read from the pressure gauge.

– Increasing the speed:

➔ Push up the lever of the speed control.

– Reducing the speed:

➔ Push down the lever of the speed control.

	HDS 9/50	HDS 13/35
Minimum water volume [l/h]	500	650
Minimum pressure (specification operating instructions) [bar]	150	100
Minimum pressure (measured) [bar]	146	92

8.1.5 Set working pressure and flow rate

HDS 13/20, HDS 17/20 only:

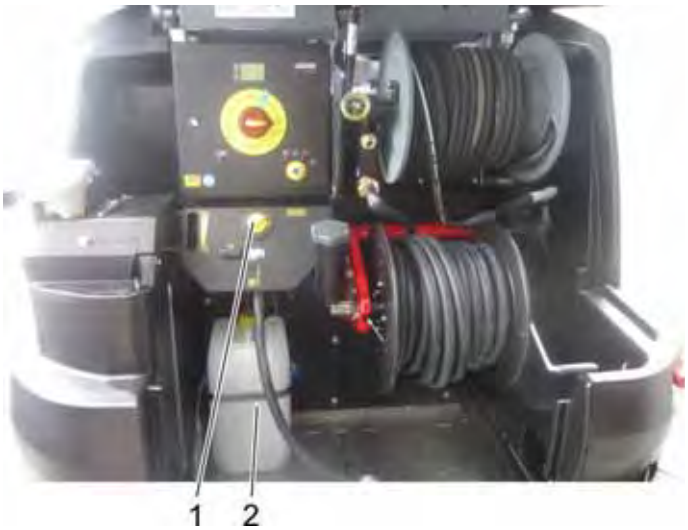
➔ Set (+/-) the working pressure and quantity by turning the pressure/ quantity regulation mechanism at the hand spray gun.

⚠ DANGER

When adjusting the pressure/quantity regulation, make sure that the screw connection of the spray lance does not become loose.

	HDS 13/20	HDS 17/20
Minimum water volume [l/h]	900	950
Minimum pressure (specification operating instructions) [bar]	60	60
Minimum pressure (measured) [bar]	69	51

8.1.6 Operation with detergent



HDS 13/20, HDS 17/20 only:

1 Dosage valve for detergent
2 Cleaning agent container

ATTENTION

Unsuitable detergents can cause damage to the appliance and to the object to be cleaned.

➔ Place the detergent suction hose in a container filled with detergent and tighten the screw cap.

➔ Set dosing value for detergent to the desired concentration.

After operation with detergent

➔ Set dosing value for detergent to "0".

➔ Open the hand spray gun and rinse the appliance for at least 1 minute.

8.1.7 Interrupting operation

➔ Release the lever on the trigger gun.

NOTE

When the lever of the hand spray gun is released, the engine continues to run at zero speed. This way the water circulates between the float container and the high-pressure pump and heats up. If the maximum admissible temperature (55 °C) is reached, the motor is switched off by the temperature sensor at the water inlet. The device can be restarted after cooling down to below 50 °C.

NOTE

If there are less then 5 litres of diesel in the fuel tank, the device switches off automatically. It can be switched back on for service purposes for a maximum run time of 5 minutes.

8.1.8 Turning Off the Appliance

⚠ ***DANGER***

Danger of scalding by hot water. After operation with hot water, the device must be operated with open end handgun with cold water for at least two minutes.

ATTENTION

Never stop the motor under full load when the hand-spray gun is opened.

➔ Set the operating mode switch to "0/OFF“ (burner off).

➔ Release the lever on the trigger gun.
Motor regulates to reach dry run speed.

➔ Turn the key switch to "0". The operation readiness indicator lamp goes off.
The control voltage is switched off and the display goes out.

➔ Shut off water supply.

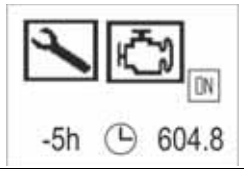
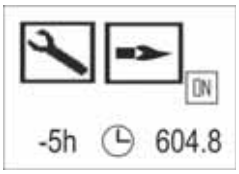
➔ Activate trigger gun until device is pressure-less.

➔ Secure the hand spray gun using the safety catch so that it doesn't open accidentally.

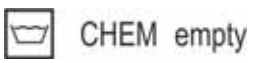
➔ With external water supply: Disconnect the water hose from the water supply and coil up the water hose onto the hose reel.

8.2 Operating displays

NOTE
Operating and maintenance displays are shown one after the other like in a slide show. Each picture for 3 seconds.
The fault displays remain until the device is switched off.

Display	Explanation	Remark
	Maintenance for motor due after 200 h.	Perform maintenance procedure. Reset motor hours.
	Maintenance for pump due after 400 h.	Perform maintenance procedure. Reset pump hours.
	Maintenance for burner due after 600 h.	Perform maintenance procedure. Reset burner hours.
	Maintenance for accessory due after 80000 gun switching operations.	Perform maintenance procedure. Reset gun switching operations.

8.3 Maintenance operating fluids

Display	Explanation	Remark
	Diesel tank is empty. **NOTE** The burner is deactivated starting from fuel level 3.	Refill diesel.
	Empty liquid softener. **NOTE** The burner can still be operated.	Refill liquid softener.
	Detergent empty. **NOTE** The indication of the detergent tank is only present if the detergent tank has been detected as full once before.	Change detergent container.

8.4 Liquid softener mode

Display	Explanation	Remark
5 1 2 3 4 OFF RM1110	Set liquid softener dosing in accordance with the water hardness. This display appears for 3s if the liquid softener setting is changed.	
5 1 2 3 4 OFF RM1110 SERVICE MODE	Attention service mode position. After the restart, the device will be in the service mode. This display remains until another liquid softener setting is selected.	

8.5 Machine frost protection

To protect from freeze damages, the appliance must be flushed with antifreeze.

NOTE

Use normal glycol-based anti-freezing agents for automobiles.

NOTE

Observe handling instructions of the anti-freeze agent manufacturer.

A certain corrosion protection is achieved with this as well.

8.5.1 Anti-freeze flush in the high-pressure circuit

NOTE

In the frost protection mode flow is recognised, however, no pressure. This is OK in this operating mode and does not lead to a fault message!

The fault message "water shortage" is deactivated with the operating mode.

The frost protection mode has a maximum work time of 5 minutes, then the motor is switched off automatically.

In case of a faulty operation that leads to a pressure build-up, the following could happen:

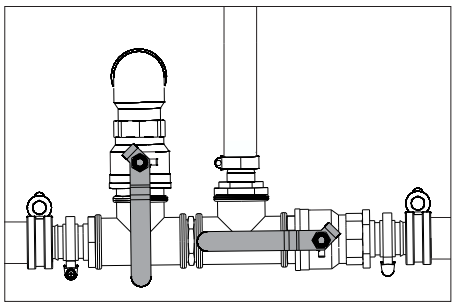
– the safety valve opens or
– the control switches off the diesel engine, as flow and pressure are synchronous. After 5 seconds, the error message ERROR 5 occurs

➔ Prepare the antifreeze in the antifreeze container. Select the mixing ratio of the water/antifreeze as per the instructions of the antifreeze manufacturer.

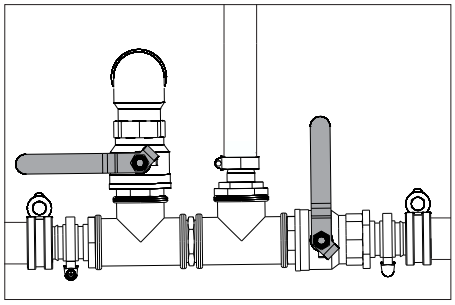
➔ Check the antifreeze concentration with a commercially available antifreeze tester and adapt if necessary.

➔ With external water supply: Disconnect the water hose from the water supply.

➔ Unpressurize the appliance.



➔ Open the supply tap of the water tanks and the drain tap in order to completely drain the device. The filling level indicator of the water tanks dips completely.



➔ Close the supply tap of the water tanks and the drain tap.

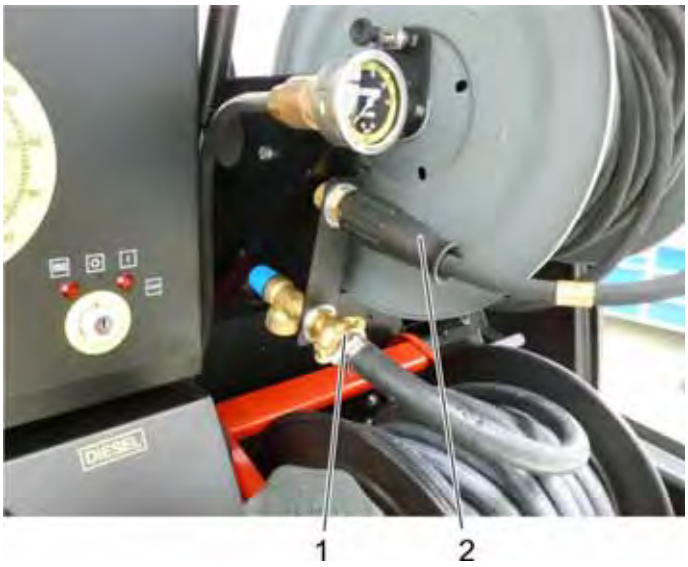
With unit types HDS 13/20 and HDS 17/20:

➔ Set the detergent dosing valve to the maximum dosing level.

➔ Take the detergent suction lance out of the container and put it down in a way that it can be sucked empty in the frost protection mode.

NOTE

The solenoid valve of the detergent is always opened in the frost protection mode irrespective of the filling level, so that the entire detergent line can be sucked empty.



1 Water pipes
2 High pressure hose

➔ Disconnect the trigger gun from the high-pressure hose.

➔ Connect the high-pressure hose to the frost protection inlet.

➔ Disconnect the water hose from the water supply.

➔ Connect the water hose to the return flow of the frost protection.

➔ Open the filling hole of the float container. In order to do so, loosen the wing screw and push the cover to the left.

➔ Fill 20 litres of antifreeze into the float container and close the filling hole.

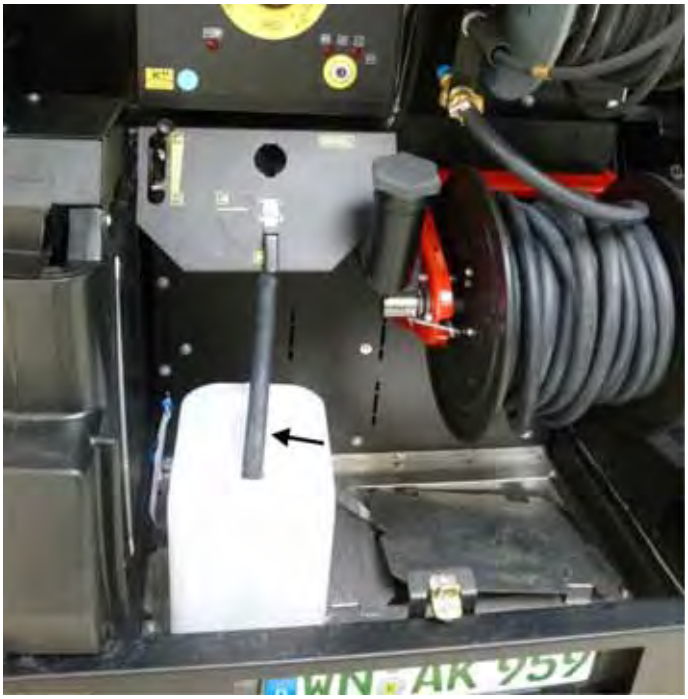
➔ Align the actuation lever of the ball tap for antifreeze vertically.

➔ Set the operating mode switch to the operating mode "frost protection".

➔ With cold engine only:
To preheat the motor, turn the key switch to the left and hold it until the indicator light preheating goes out.

➔ Turn key switch to position "I". The indicator lamp for operational readiness lights up.
The control voltage is switch on and the display shows the operating status "Antifreeze".

➔ Turn the key switch to the right until the motor is running.



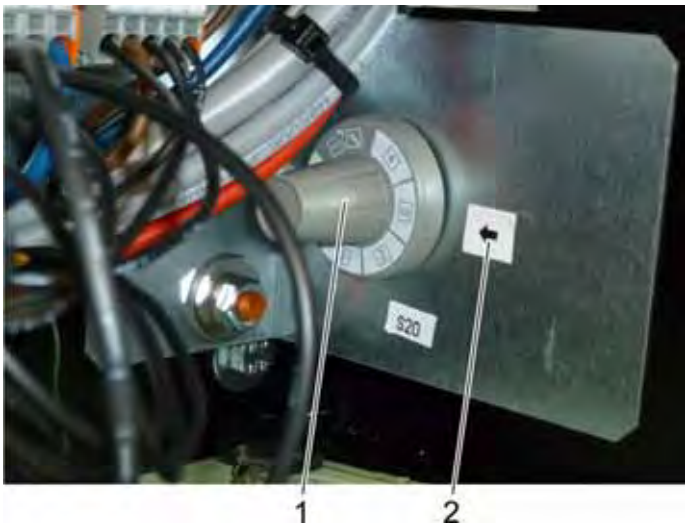
➔ The antifreeze liquid is pumped through the appliance in a circuit.
➔ Lead the residual water via the frost protection hose into the anti-freeze container.
➔ As soon as antifreeze exits the antifreeze hose, wait 5 seconds, and put the actuation lever of the frost protection ball tap in the horizontal position.
➔ Switch off the motor.
➔ Set the operating mode switch to "0/OFF“ (burner off).

8.5.2 Flush the anti-freeze out of the high-pressure circuit

NOTE
Prior to operation, the antifreeze must be pumped from the high-pressure system back into the antifreeze container. See previous chapter for pictures for further information.

➔ Align the actuation lever of the ball tap for antifreeze vertically.
➔ Connect the high-pressure hose to the frost protection inlet.
➔ Connect the water hose to the return flow of the frost protection.
➔ Open the filling hole of the float container. In order to do so, loosen the wing screw and push the cover to the left.
➔ Fill 20 litres of fresh water into the float container and close the filling hole.
➔ Set the operating mode switch to the operating mode "frost protection".
➔ With cold engine only:
To preheat the motor, turn the key switch to the left and hold it until the indicator light preheating goes out.
➔ Turn key switch to position "I". The indicator lamp for operational readiness lights up.
The control voltage is switch on and the display shows the operating status "Antifreeze".
➔ Turn the key switch to the right until the motor is running.
The antifreeze fluid is forwarded from the float container into the antifreeze container with fresh water.
➔ Rinse for approx. 2 minutes until the antifreeze container is filled.
➔ Switch off the motor.
➔ Set the operating mode switch to "0/OFF“ (burner off).

8.6 Service switch



1 Service switch
2 Position marking

Setting the water hardness
The setting of the liquid softener dosing is done in accordance with the local water hardness (ask your local water supply company or determine by means of a hardness tester).

Water hardness	Adjustments	° dH	° fH	mmol/l	ppm
very soft	OFF position	up to 3.0	up to 5.5	up to 0.55	up to 55
soft	Position 1	3,1 - 7,0	5,6 - 12,5	0,56 - 1,25	56 - 125
medium	Position 2	7,1 - 14	12,6 - 24,9	1,26 - 2,49	126 - 249
hard	Position 3	14 - 21,0	25,0 - 37,5	2,50 - 3,75	250 - 375
very hard	Position 4	> 21,0	> 37,5	> 3,75	> 375

NOTE
When using RM 111, do not fall below position 3. Mind the setting of the DIP switches 3 and 4 on the control board.

Service position
In the "Service" position the settings of the device can be edited by means of the service switch and the control panel. From the "Service" position, the service switch can be turned a little further to the "SET" position. From this position, the switch returns to the "Service" position after releasing it. The "SET" position merely fulfils a pushbutton function.

8.7 Service functions with display

1 Setting, water temperature

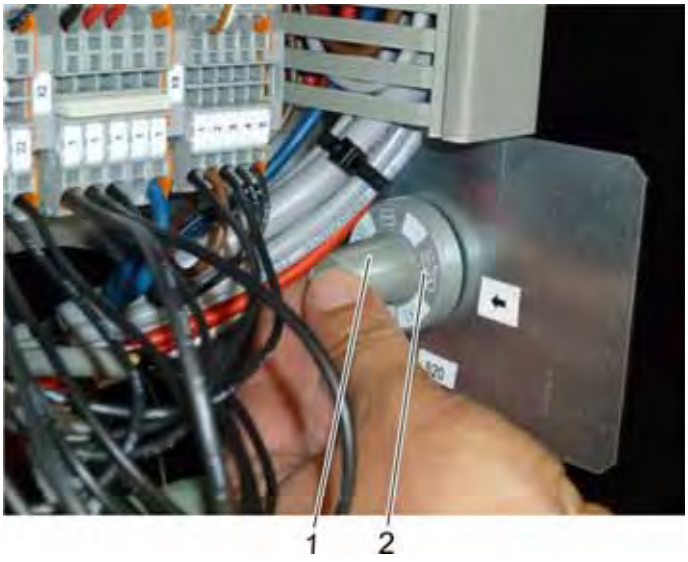
Service mode
If the service switch is in the "Service" position upon switching on the device, the service mode of the device is activated.

Selection of the service functions
The available service functions are selected via the water temperature setting.
Example: 30°C is equivalent to the function "Switch-off after 45 minutes of continuous operation".
For some functions the function selection must already be set upon switching on the device and the service switch must be kept in the "SET" position for 2-3 seconds.

1 Display

Changing the settings
The indication of the current setting takes place via the display on the control panel.
By means of the pushbutton function of the service switch (continue to turn to "SET" position, switch snaps back to the "Service" position) the settings can be changed. The change is also shown on the display.

Exiting the service mode
– Turn off the appliance.
– Set the service switch to the appropriate water hardness level or "OFF".
– Turn on the appliance.



1 Service switch
2 Position service mode

8.7.1 Quick overview for reading the service functions

- Turn off the appliance.
- Make a note of the position of the service switch.
- Set the service switch to Service.
- Turn on the appliance.
- Set temperature regulator to the relevant temperature.
- 30°C - behaviour after 45 minutes continuous operation or continuous break.
- 35°C - test flame sensor, display brightness value
- 40°C - manual switch-on/off of the actuators.
- 45°C - test temperature sensor booster heater. Indication temperature.
- 50°C - function check service switch.
- 55°C - input test of the signals (switching status of the sensors).
- 60°C - indication fault memory and software version.
- 65°C - service diesel engine.
- 70°C - service pump.
- 75°C - service burner.
- 80°C - service gun.
- Turn off the appliance.
- Bring the service switch back into the position taken down before.
- Turn on the appliance.

NOTE
The service indicators for motor, pump, burner and gun are deleted if SET is held down with the corresponding temperature indicator upon switch-on.
The number of maintenances is increased by 1 here.

8.7.2 Set up the switching off process

	**Display**	**Explanation**	**Remark**
30?		Switch-off after 45 minutes of continuous operation or continuous break is activated.	Switching with SET **NOTE** Switch-off after 45 minutes with fault message 14 or 15.
		Switch-off after 45 minutes of continuous operation or continuous break is not activated (factory setting).	Switching with SET

8.7.3 Brightness value of the flame sensor

	**Display**	**Explanation**	**Remark**
35?		Test flame sensor. Display brightness value.	0-400: bright 401-1023: dark

8.7.4 Test actuators / test output signals

NOTE
In order to change between the actuators, keep the service switch on "SET" for one second.
In order to operate the selected actuator, set the service switch to level "4".

	**Display**	**Explanation**	**Remark**
40?		Manual switch-on/off of the following actuators: – A: Valve detergent (Y2) Valve is activated – B: Contactor release (K7) – C: Relay solenoid valve fuel (Y3) – D: Contactor blower motor (K8) Blower motor is running – E: Valve liquid softener (Y4) Periodic switching of the valve, in order to avoid overload of the electronics.	**NOTE** With actuator test "C" the check can only take place via the clearly audible switching of the relay on the printed circuit board A1. As the solenoid valve fuel is in the safety chain, further criteria for activation must be fulfilled. However, these are not fulfilled in the actuator test, so that the actual switching of the solenoid valve cannot be tested.

8.7.5 Test temperature sensor booster heater

	**Display**	**Explanation**	**Remark**
45?		Test temperature sensor Indication temperature.	0°C is displayed when the temperature is below 0°C. **NOTE** With the fault cable break or short circuit, the switch-off takes place with fault message 10.

8.7.6 Function check service switch

	**Display**	**Explanation**	**Remark**
50?		Select all positions at the service switch and check the corresponding indications on the display.	

8.7.7 Input test of the signals

NOTE

The test takes place as follows:

➔ Operate the sensor manually.

➔ Observe the indicator change on the display. If the indication changes upon operation, the sensor is OK.

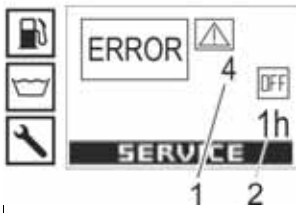
	**Display**	**Explanation**	**Remark**
55?		Indication of the current switching statuses of the following sensors: – 0/8 - 8/8: Level sensor for fuel tank 0/8: Tank empty / 8/8: Tank full – Indication position of the dip switches (ON / OFF) on the control board A1 – A: Flow (WASSERSI) – B: Emission temperature (ABGASTH) – C: Filling level float container (WSK) – D: Pressure switch (DSEIN) – E: Charging current relay K9 (DSAUS) – F: Filling level switch detergent (OELSI) – G: Filling level switch liquid softener (LDGT) – H: Oil pressure relay K5 (LCH1) – I: Coolant (LCH2) – J: not assigned	**NOTE** If the level sensor fuel tank shows „/8“, the level sensor is defective or not properly connected. In this case, the bargraph for fuel also goes out in the normal view of the display.

8.7.8 Display fault memory and software version

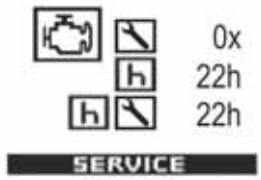
NOTE

Use SET to switch over to the next fault.

With switch-off - hold SET - switch-on the fault memory can be deleted.

	Display	Explanation	Remark
60?	 1 Malfunction no. 2 Indication, for how many hours the malfunction has occurred	– ERROR 1 Charging current – ERROR 3 Coolant or temperature water in the float container – ERROR 4 Water shortage – ERROR 5 Flow switch/pressure switch – ERROR 6 Fuel sensor – ERROR 7 Motor oil pressure – ERROR 9* Emission temperature – ERROR 10* Temperature sensor booster heater – ERROR 11* Flame sensor image bright blind – ERROR 12* Flame sensor image dark blind – ERROR 14 Switch-off after 45 minutes continuous break – ERROR 15 Switch-off after 45 minutes continuous operation	* Cleaning operation with cold water is possible. For details on the cause of the malfunction and its rectification see Chapter 13.
	SW V2.50	Software version 2.50	This is no fault. Error merely appears for design reasons, because the display is in the error menu.

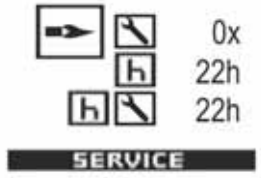
8.7.9 Service motor

	Display	Explanation	Remark
65?		Total number of motor maintenances Total operation duration motor Operation duration motor since the last maintenance	Delete service: Turn off the appliance. Hold SET (2-3 seconds). Turn on the appliance. **NOTE** The maintenance counter is automatically increased by 1 The fault memory is also deleted.

8.7.10 Service pump

	Display	Explanation	Remark
70?		Number of total pump maintenances Total operation duration of the pump Operation duration pump since the last maintenance	Delete service: Turn off the appliance. Hold SET (2-3 seconds). Turn on the appliance. **NOTE** The maintenance counter is automatically increased by 1 The fault memory is also deleted.

8.7.11 Service burner

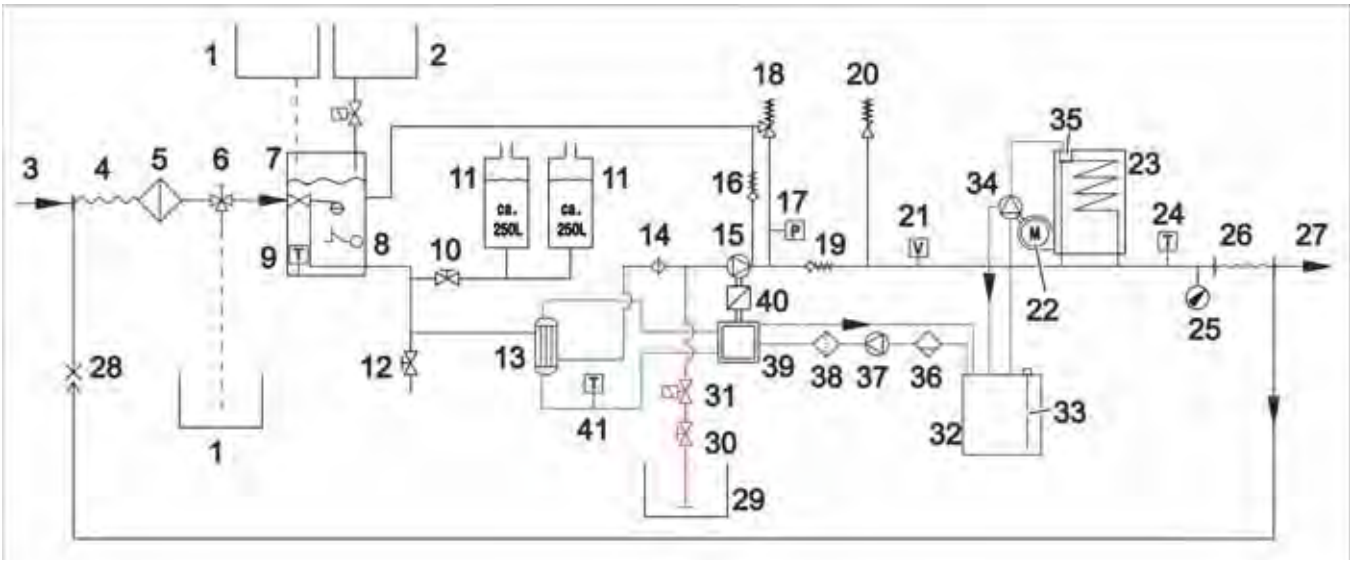
	Display	Explanation	Remark
75?		Total number of burner maintenances Total operation duration burner Operation duration burner since the last maintenance	Delete service: Turn off the appliance. Hold SET (2-3 seconds). Turn on the appliance. **NOTE** The maintenance counter is automatically increased by 1 The fault memory is also deleted.

8.7.12 Service gun

	Display	Explanation	Remark
80?		Total number of gun maintenances Total number of switching cycles of the gun Switching cycles gun since the last maintenance	**NOTE** The gun switching operations are saved every 240 seconds. Delete service: Turn off the appliance. Hold SET (2-3 seconds). Turn on the appliance. **NOTE** The maintenance counter is automatically increased by 1 The fault memory is also deleted.

9 Function

9.1 Flow pattern



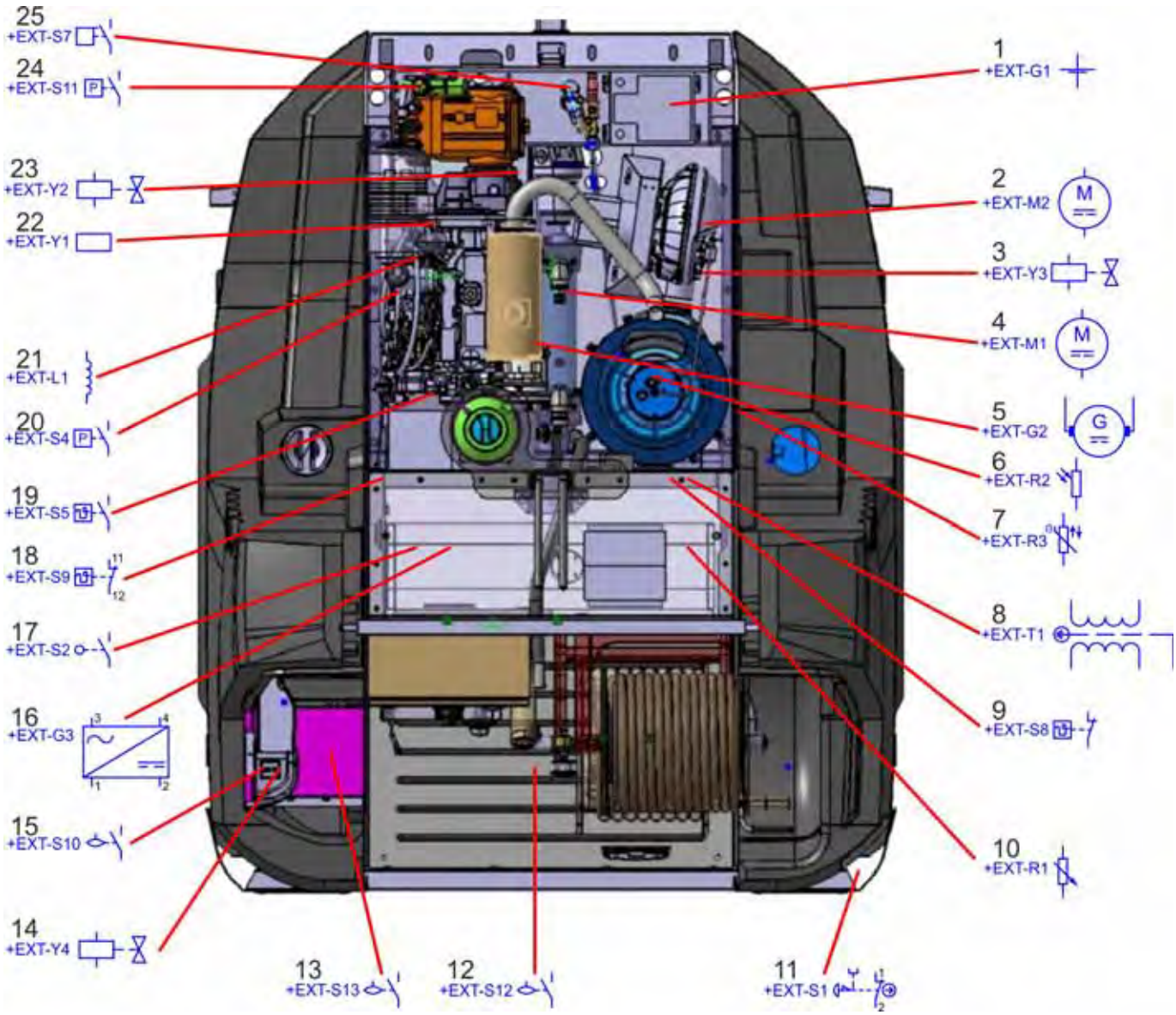
Colour assignment:
black: Water
red: Detergent
brown: Fuel (diesel)
blue: Cooling circuit motor

1 Antifreeze container
2 Liquid softener container with level switch and dosing valve
3 Water inlet
4 Low-pressure hose drum
5 Water filter
6 Ball tap frost protection
3-way valve with positions:
- horizontal: Normal operation
- vertical: Frost protection mode
7 Float tank
8 Water shortage safeguard
9 Temperature sensor water float container
10 Stop cock water tanks
11 Water tanks (2 x 250 l)
12 Drain tap water tanks
13 Heat exchanger
14 Fine filter
15 High-pressure pump
16 Frost protection valve
17 Pressure switch
18 Overflow valve
19 Backflow valve
20 Safety valve
21 Flow switch
22 Motor burner blower
23 Continuous heater
24 Temperature sensor burner
25 Manometer
26 High-pressure hose drum
27 High-pressure outlet
28 Return flow (breaks, frost protection mode)
29 Cleaning agent container
30 Dosage valve for detergent
31 Detergent solenoid valve
32 Fuel tank
33 Level sensor for fuel tank
34 Fuel pump burner
35 Burner
36 Water separator
37 Fuel pump diesel engine
38 Fuel filter
39 Diesel engine
40 Intermediate gear
41 Temperature sensor coolant

Water is fed into the float container via the water filter. When connected to the mains, the operation takes place with external water supply, as an alternative, both tanks can be filled and the operation takes place independently. The feed to the HP pump takes place by means of the coupled filling levels between the tanks and the float container until there is no more water in the float container.
The water is lead through a heat exchanger that is connected to the cooling circuit of the motor. This way, the water is already heated by approx. 10K and the motor is cooled.
Via a fine filter, the water reaches the high-pressure pump that is driven by the diesel engine via an intermediate gear. With systems with detergent, detergent is added on the suction side of the pump.

Through the booster heater and via the high-pressure hose the water reaches the work machine. In case of warm water operation, the water is softened in the float container.
If there is no water removal at the gun, the water in the circuit is lead through the overflow valve back to the float container.
A temperature sensor in the float container checks the water temperature. If the temperature is too high, the device stops automatically as the water cooling of the motor depends on it.
The motor itself is equipped with the relevant sensor technology concerning the oil pressure an coolant temperature.

9.2 Overview sensor technology and electrical components



1 Battery
2 Motor burner blower
3 Valve fuel burner
4 Starter motor
5 Alternator
6 Flame sensor
7 Temperature sensor high-pressure outlet (booster heater)
8 Ignition transformer
9 Thermostat switch emission temperature
10 Level sensor for fuel tank
11 Emergency stop button
12 Level switch detergent container
13 Level switch float container
14 Valve liquid softener
15 Level switch liquid softener container
16 Inverter
17 Safety switch cover opening (cover switch)
18 Thermostat switch water temperature in the float container
19 Temperature switch coolant circuit motor
20 Oil pressure switch motor
21 Glow plug
22 Solenoid valve fuel supply motor (start / stop motor)
23 Solenoid valve detergent dosing
24 Water shortage safeguard (pressure switch)
25 Flow switch

9.2.1 Switching functions of the sensor technology

NOTE

The following switching functions serve the general understanding of the respective functionality as well as the possibility how which sensor can be tested.

Emergency stop and cover switch

When operating the emergency stop switch (-S1) or the cover switch (-S2):

– the diesel engine stops immediately.
– The inverter (-G3) switches off, the electronics is no longer supplied with voltage.
– The contactor K7 trips.
– The emergency stop light (-H3) lights up.

Preheating the diesel engine

By turning the key switch to the left, the preheating control (-H1) lights up for approx. 4 seconds. The preheating takes place as long as the key switch is kept in the relevant position, irrespective of the indicator light!

Start process

If the key switch is in the "Start" position, the relay 10KT (single shot function) receives a start pulse and closes the contact 15/18 for 10 seconds, the bypass valve K10 responds.

The start-up process must take place within the 10 seconds:

– The diesel engine must run.
– Inverter and electronics are energized and function.
– the release contactor K7 is activated.

Lock key switch

If you try to turn the key switch to "Start" while the diesel engine is running (speed >650/min), the starter must not start. The safety relay K4 prevents the motor start.

Indication charge regulator (-H2)

When switching on the ignition, the lamp H2 lights up (it is a little brighter after 1 second) and the relay K9 responds. The lamp H2 goes out within approx. 3 seconds after the start of the diesel engine. The relay K9 responds and signals to the electronics via contacts 11/12 that the charge control is active.

Relay motor oil pressure K5

The relay responds if the oil pressure of the diesel engine has not built up. As soon as the oil pressure is present, the relay K5 is released. The checkback signal to the electronics takes place via contact 11/14.

Missing oil pressure (oil pressure switch closed, relay K5 open) leads to a stop of the diesel engine, the fault message **ERROR 7** appears.

Indication motor ON/OFF

NOTE

The ON/OFF indication of the motor is controlled via the signal input of the motor oil pressure switch and the charging current relay.

Motor oil pressure switch (K5 11/14 open and charging current relay K9 closed:

– Diesel engine is running.
– Indication ON appears on the display.

Motor oil pressure switch (K5 11/14) closed and charging current relay K9 open:

– Diesel engine is not running.
– Indication OFF appears on the display.

Relay coolant diesel engine K6

The relay responds if the coolant in the diesel engine becomes too hot. The checkback signal to the electronics takes place via contact 11/12 (open in case of a fault) After 4 seconds, the fault leads to a stop of the diesel engine, the fault message **ERROR 3** appears.

Charging current / motor oil pressure switch

Charging current relay K9 closed and motor oil pressure switch open:

– Diesel engine is running.

Charging current relay K9 open and motor oil pressure switch open:

– Diesel engine stops.
– **ERROR 1** is displayed after 4 seconds.

Charging current relay K9 closed and motor oil pressure switch closed:

– Diesel engine stops.
– **ERROR 7** is displayed after 4 seconds.

Temperature sensor water in the float container

If the water temperature in the float container is >50?, the contact S9 11/12 opens.

The temperature exceedance leads to a stop of the diesel engine, fault message **ERROR 3** occurs.

The monitoring of the temperature in the float container as well as the temperature of the coolant in the motor are serially connected.

Exhaust gas thermostat (-S8)

The exhaust gas thermostat is permanently set to the switch point 292°C +/-7K. Reclosing after a temperature drop by 9+/-4.5K.

Exhaust gas thermostat closed:

– Device is running.

Exhaust gas thermostat open:

– Burner blower as well as solenoid valve fuel supply burner (-Y3) are switched off after 4 seconds.
– **ERROR 9** is displayed after 4 seconds.

Level switch liquid softener (-S10)

Level switch open:

– Indication "RM 110 empty" in the slide show on the display.

Level switch closed:

– Indication "RM 110 OK" in the slide show on the display.

Dosing liquid softener, valve -Y4
Burner programme selected and flow present:
– Pulse time liquid softener is approx. 85ms, equals approx. 0.5 ml.
– The waiting time between the pulses depends on the position of the DIP switches and the set level:

Level	1	2	3	4
DIP 3+4 ON	36s	18s	12s	7s
DIP 3+4 OFF	54s	27s	18s	11s

NOTE
Dip switch 3 and 4 OFF only for HDS 9/50.

Flow switch (-S7) and pressure switch (-S11)
Upon the start, the electronics waits for approx. 1 minute until the two signals are synchronous. This is necessary, as the flow is already present shortly after the start, however, it takes a certain time until the pressure is built up, too (e.g. due to air in the device). For this reason, the check of the synchronicity of both switches takes place only after 1 minute after the start, then the two signals must be synchronous within 4 seconds.
Flow switch closed and pressure switch closed within 4 seconds:
– Diesel engine is running.
Flow switch open and pressure switch open within 4 seconds:
– Diesel engine is not running.
Flow switch closed and pressure switch open within 4 seconds:
– Diesel engine stops.
– **ERROR 5** is displayed.
Flow switch open and pressure switch closed within 4 seconds:
– Diesel engine stops.
– **ERROR 5** is displayed.
NOTE
In the frost protection mode only flow, but no pressure may be applied! Should pressure be detected, **ERROR 5** occurs.

Level switch detergent (-S12)
Initial start-up:
➔ Plug the float switch into the control.
➔ Switch on the device, wait for 20 seconds.
➔ Indication "CHEM OK" in the slide show on the display
Level switch open:
– Indication "CHEM empty" in the slide show on the display.
Level switch closed:
– Indication "CHEM OK" in the slide show on the display.
NOTE
For HDS 13/20 and HDS 17/20 only. As soon as the device with the detergent is detected, the solenoid valve detergent (-Y2) is activated when the gun is pressed. The quantity of the detergent is controlled via the dosing valve.

Level switch float container (-S13)
Float contact closed:
– Filling level OK.
Float contact open:
– Diesel engine stops after 4 seconds.
– **ERROR 4** is displayed.

Temperature sensor booster heater (-R 3)
The sensor measures the temperature after the boiler outlet and reports the value directly to the control.
Rated value: R100°C, 3.3kOhm +/-1%.
Short circuit sensor:
– Burner blower as well as solenoid valve fuel supply burner (-Y3) are switched off after 4 seconds.
– **ERROR 10** is displayed.
Cable break or sensor defective (no signal to control):
– Burner blower as well as solenoid valve fuel supply burner (-Y3) are switched off after 4 seconds.
– **ERROR 10** is displayed.

Flame sensor (-R 2)
Range 0 - 400: Bright.
Range 401 - 1023: Dark.
DIP switch 1 OFF or operation "cold water":
– no evaluation of the flame sensor, no fault messages.
DIP switch 1 ON and operation "warm water". The flame sensor does not become bright although the solenoid valve fuel burner is open:
– Burner blower as well as solenoid valve fuel supply burner (-Y3) are switched off after 4 seconds.
– **ERROR 11** is displayed.
DIP switch 1 ON and operation "warm water". The flame sensor does not become dark although the solenoid valve fuel burner is closed:
– Solenoid valve fuel supply burner (-Y3) is switched off after 4 seconds.
– **ERROR 12** is displayed.

Level sensor fuel tank (-R 1)
Level sensor with 9 switch points, corresponding bargraph on the display.
Filling level <= 3 bars for at least 30 seconds:
– Burner blower as well as solenoid valve fuel supply burner (-Y3) are switched off after 4 seconds.
– Symbol "burner deactivated" is shown on the display.
Filling level 0 bars (0/8):
– Diesel engine switches off after 5 minutes.
– **ERROR 6** is displayed.
No bargraph (/8):
– Cable break, level sensor unplugged or defective.
– Diesel engine is not running.
– **ERROR 6** is displayed.

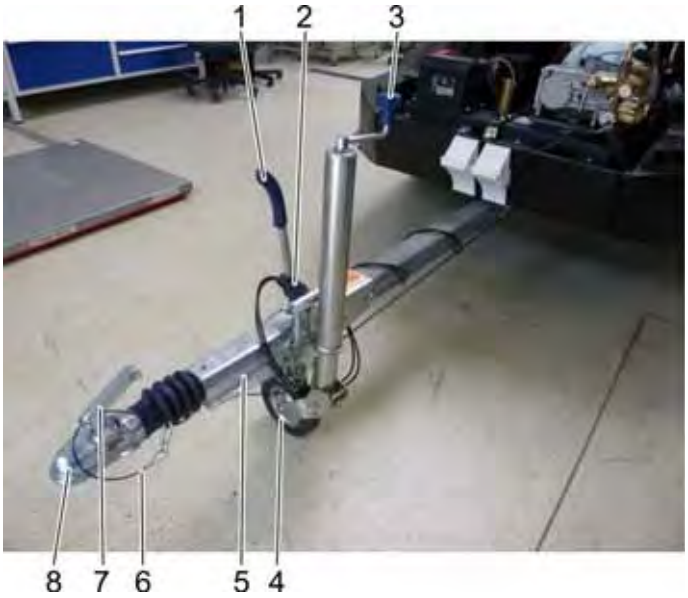
Burner operation, contactor K8
For the release of the burner the following conditions must be met:
– Flow present (-S7).
– Level fuel tank > 3 bars.
– Temperature sensor booster heater (-R 3) is connected.
– Hot water operation selected.
– Measured temperature < target temperature:
  The burner switches on, the solenoid valve fuel burner opens 4 seconds after the start of the blower motor.

45 minutes continuous operation
The switch-off continuous operation is activated:
– Diesel engine switches off after 45 minutes continuous operation.
– **ERROR 15** is displayed.
The gun is closed within 45 minutes:
– The countdown of 45 minutes is reset, the device does not switch off.
Switch-off continuous operation is deactivated:
– The diesel engine does not switch off after 45 minutes of continuous operation.

45 minutes continuous break
The switch-off continuous break is activated:
– The diesel engine switches off after 45 minutes of continuous break.
– **ERROR 14** is displayed.
The gun is opened within 45 minutes:
– The countdown of 45 minutes is reset, the device does not switch off.
Switch-off continuous break is deactivated:
– The diesel engine does not switch off after 45 minutes continuous break.

Counter gun switching operations
The number of gun switching operations are saved every 240 seconds.
To test the counter, proceed as follows:
➔ Read the number of gun switching operations in the service menu "Service gun" (80°C switch position).
➔ Perform 10 gun switching operations.
➔ Wait for 240 seconds
➔ Read the number of gun switching operations in the service menu again, this must be higher by 10 now.

9.3 Axle / drawbar



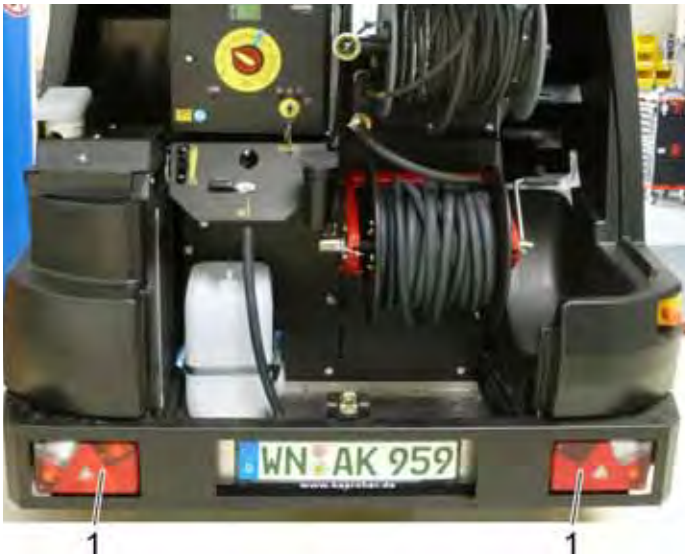
1 Parking brake
2 Connector vehicle lighting
3 Support wheel crank handle
4 Support wheel
5 Overrun brake
6 Tear-off rope
7 Coupling lever
8 Towing hitch

The axle is an approved purchased item with its own type plate for axle and overrun unit that is located in the front area of the drawbar.

The axle accommodates the carrier frame on which all components for the operation of the high-pressure unit are located.

NOTE
Further information about the operation and maintenance can be found in the relevant documents of the manufacturer. These are recorded as a pdf-document in German, English and French in the DISIS plus.

9.4 Lights



1 Combined brake/tail light with direction indicator and integrated license plate lighting

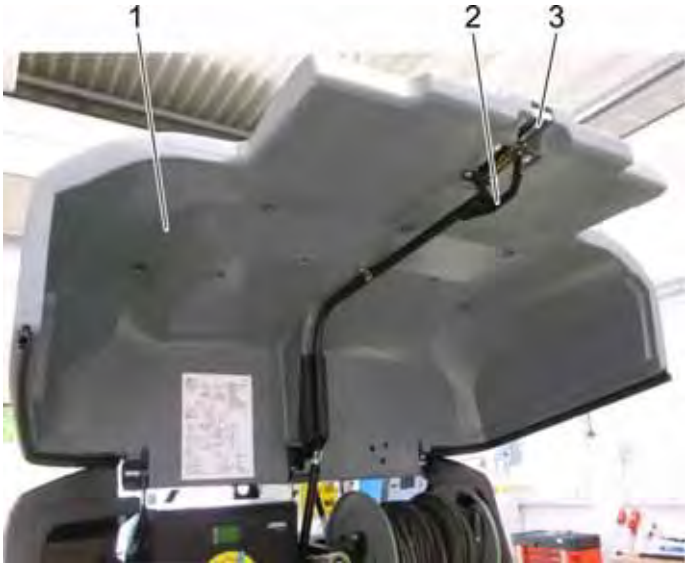
The trailer is equipped with a lighting system and reflectors approved for road service.

The voltage supply and signalling takes place via a socket plug connection to the towing vehicle.

1 Reflector (on both sides)
2 Marker light (on both sides)

9.5 Covers

Front cover
1 Recessed grip
2 Hood
3 Locking



Rear cover
1 Hood
2 Handle
3 Locking

The entire technical unit with motor, high-pressure pump and burner is located underneath the front cover. An exhaust opening serves the discharge of the exhaust gases of the burner and the diesel engine.
The control unit as well as the water supply, high-pressure and detergent components are located underneath the rear cover.
The covers are equipped with gas pressure dampers for support upon opening and for keeping the cover open.
Every cover is equipped with a lockable lock and recessed grips for lifting it up.

NOTE
It is not possible to operate the trailer in normal operation when the front cover is opened! The safety switched must be bridged for service tasks, see Chapter 10.

⚠ ***CAUTION***
Risk of damage!
To perform maintenance tasks, set the device up in a wind-protected area.
Do not open the cover too far, this may damage the cover and the gas pressure damper.

9.6 Water tanks (2x250 l)

1 Maintenance opening tank on the right
2 Maintenance opening tank on the left

The trailer is equipped with two water tanks that are connected to each other. Each tank has a capacity of 250 litres.
The tanks enable independent work without a connection to an external water supply for a certain period of time.
For inspection purposes, each tank is equipped with a maintenance opening.

ATTENTION

The tanks must not be filled via the maintenance openings! The supply must always take place via the water filter in the water inlet in order to filter rejects and to ensure controlled filling via the float container with filling level monitoring.

1 Float tank
2 Filling level indicator water tanks (2 x 250 l)

NOTE

The filling level indicator does not show the water level in the float container, but the level in the two 250 l water tanks.

9.7 Storage compartments

1 Storage operating instructions
2 Storage compartment for trigger gun
3 Storage compartment for 2nd spray lance
4 Storage compartment for helmet

Slide-in units, which can be used as storage compartments, are integrated in the rotation parts of the two water tanks.

1 Storage for oil container for high-pressure pump

9.8 Battery / inverter

Safety instructions
Please observe the following warning notes when handling batteries:

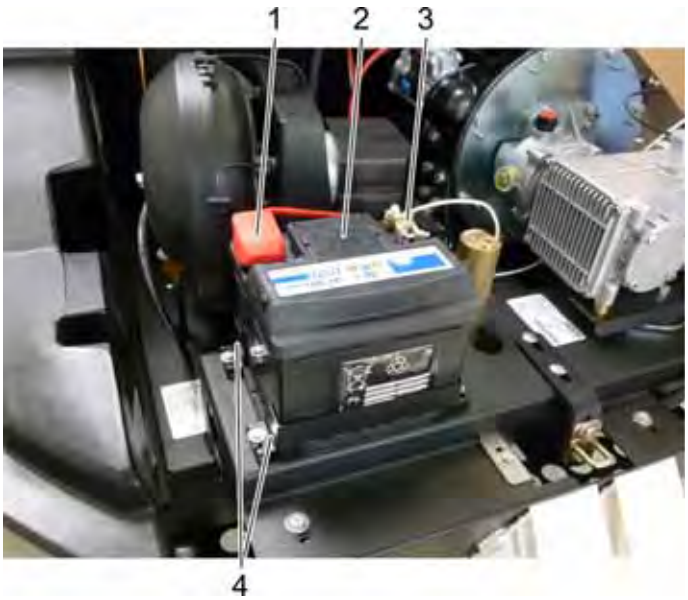
	Observe the notes on the battery and in the operating instructions!
	Wear an eye shield!
	Keep away children from acid and batteries!
	Risk of explosion!
	Fire, sparks, open light, and smoking not allowed!
	Danger of causticization!

	First aid!
	Warning note!
	Disposal!
Pb	*Do not throw the battery in the dustbin!*

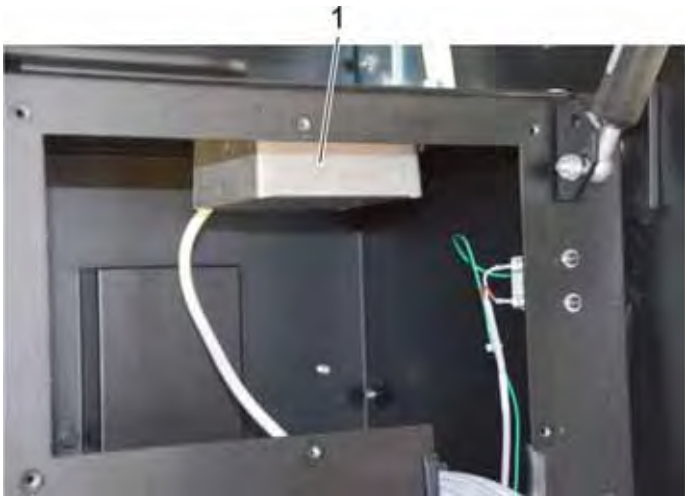
⚠ DANGER
Risk of explosion! Do not put tools or similar on the battery, i.e. on the terminal poles and cell connectors.

⚠ DANGER
Risk of injury! Ensure that wounds never come into contact with lead. Always clean your hands after having worked with batteries.

Frost protection battery
➔ If the appliance is not used for an extended period and if there is frost, remove the battery and store it in a location protected from frost.



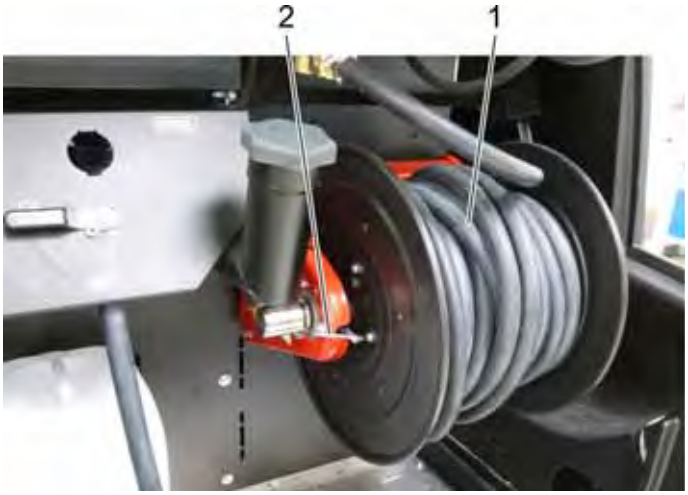
Battery 12V, 36Ah
1 Battery terminal (+), red
2 Battery (voltage and capacity, see "Specifications“)
3 Battery terminal (-), black
4 Battery holder



View with opened maintenance flap on the left
1 Inverter

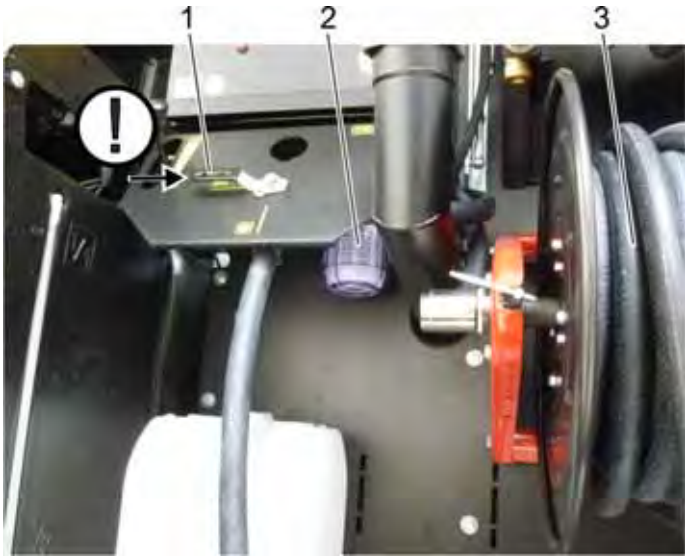
Inverter
The control board A1 requires a supply voltage of 24V AC. This is generated by the inverter by conversion of the incoming battery voltage (12V DC).

9.9 Water inlet



Low-pressure hose drum
1 Water supply hose
2 Brake lever

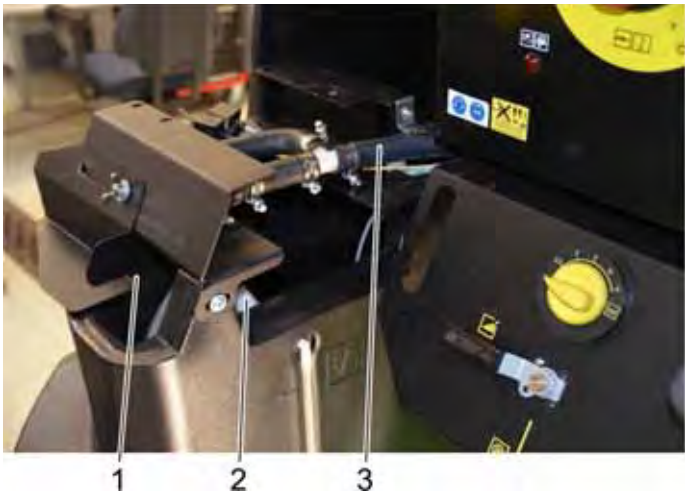
Connection to an external water supply is established by means of the water supply hose DN19, connection, max. length: 30 metres
To unroll or roll up the hose, the brake must be released. For this purpose, open the brake lever in the counter-clockwise direction.
NOTE
Ensure an even distribution of the hose when rolling it up. Finally lock the hose reel by locking the brake lever in the clockwise direction.



1 Ball tap
2 Water filter
3 Low-pressure hose drum

The inflowing water is freed from rejects by means of a filter prior to further use.
In normal operation the ball tap must be set to "operation" (horizontal position).

9.10 Swimmer tank



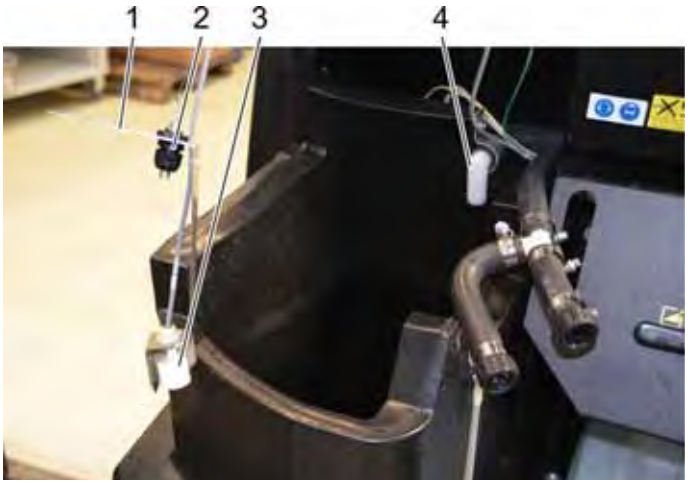
Float container, illustration with dismantled liquid softener container
1 Filler neck
2 Swimmer ball
3 Water inlet

NOTE
The filling level indicator does not show the water level in the float container, but the level in the two 250 l water tanks.

Float tank
The float container is integrated in the left water tank. It is located underneath the liquid softener tank.
The swimmer reservoir supplies the pump evenly with water. It is also used to separate the water inlet and the pump and prevents detergent from entering the water supply line in case of damage.
The filling of the two 250-litres water tanks also takes place through the float container.

Float valves
Water flows into the float container through the two opened float valves.
When the water level is rising, the relevant float ball rises and closes the associated float valve.
The float valve is adjusted permanently and must not be readjusted.
Due to the high volume flow of up to 1700 l/h, two float valves are necessary.

In the lower area of the float container the sensors for the filling level monitoring (empty message) and water temperature are mounted onto a joint holder.

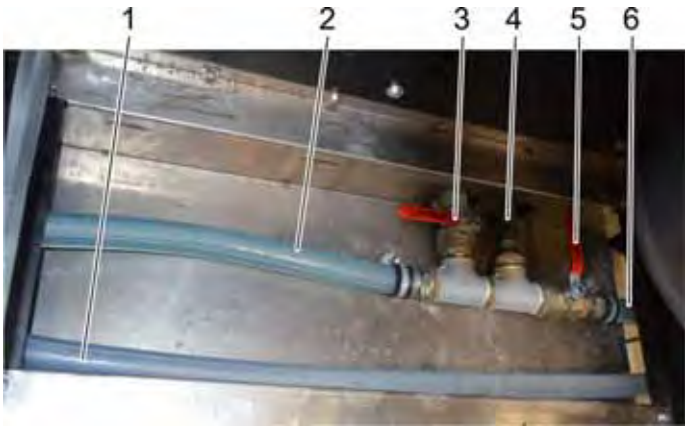


1 Support
2 Temperature sensor
3 Filling level monitoring (empty message)
4 Inflow return line of high-pressure pump

View with opened maintenance flap on the left
1 Thermostat switch water temperature in the float container

NOTE
When the set water temperature of 55°C in the float container is exceeded, the motor switches off automatically.

9.11 Water distribution



1 Connection tank on the left side - tank on the right side
2 Supply from the float container
3 Stop cock drain water tanks
4 Supply to the high-pressure pump
5 Stop cock water tanks
6 Supply from water tank on the right

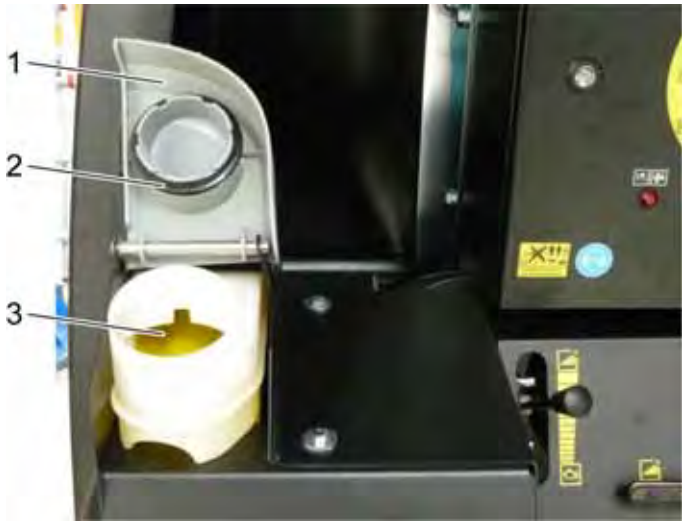
Operation with water supply via the water tanks
When the tap (5) is open, water flows from the float container into the water tank on the right and from there via the connection (1) back into the water tank on the left.
This way, the filling level is the same in both 250-litre tanks and the float container itself; it is monitored by the filling level detector in the float container.
When operated via the water tanks, the water supply to the high-pressure pump (4) takes place via the inlets of the float container (2) and the supply (6) of the corresponding water tanks.

Operation with external water supply
When operated with external water supply, the tap (5) is closed so that the pump is only supplied by the supply (2) from the float container.

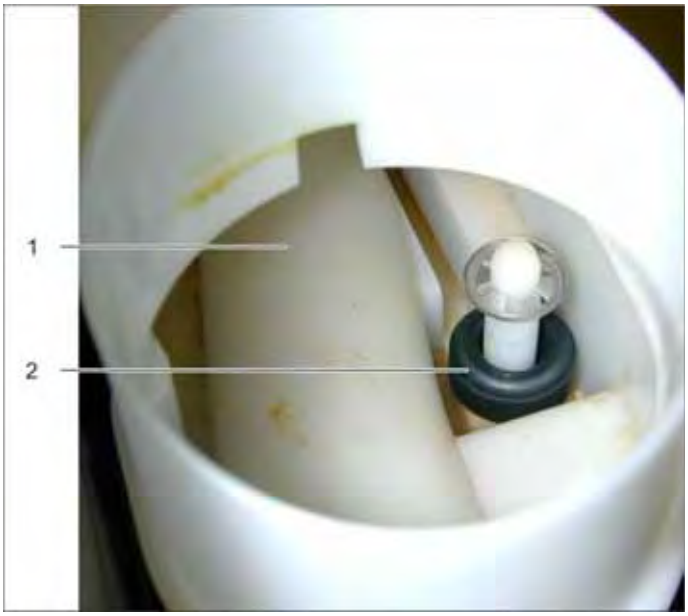
9.12 Liquid softener

The feed of the liquid softener takes place in accordance with the setting on the service switch. The setting is described under "Service switch". The feed only takes place in the programme switch position "ECO" and "Warm water" at a set water temperature ≥ 50°C.
The empty message takes place via the level switch and is shown on the display.
The burner operation is also possible without liquid softener. With hard water, however, malfunctions due to lime deposits must be expected.

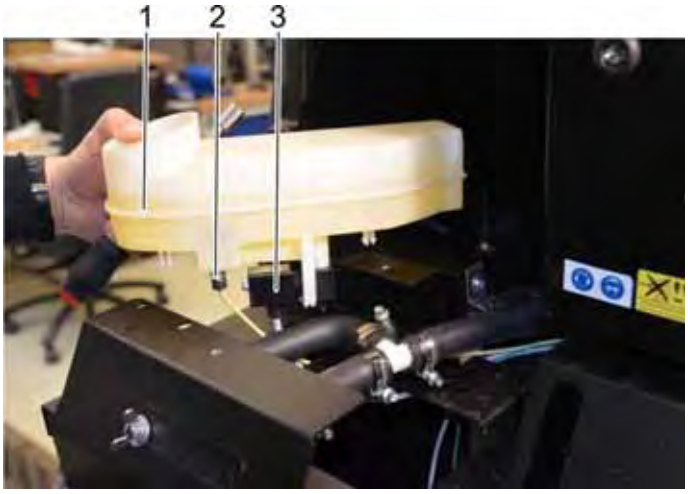
NOTE
The dosing unit must not be switched off when using RM 110.



1 Lock
2 Washer
3 Liquid softener reservoir



1 Liquid softener reservoir
2 Level sensor



1 Liquid softener reservoir
2 Level sensor
3 Dosing valve

9.13 Heat exchanger

1 Supply from the water distribution
2 Supply to the high-pressure pump

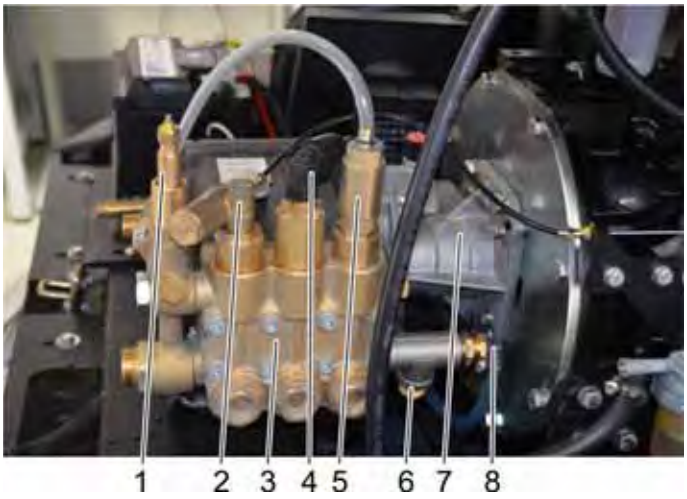
The heat exchanger serves the motor cooling and the simultaneous preheating of the washing water.
The temperature increase with the full water volume is max.:

– with HDS 9/50: 13.5K
– with HDS 13/35: 10.0K
– with HDS 17/20: 7.5K
– with HDS 13/20: 7.0K

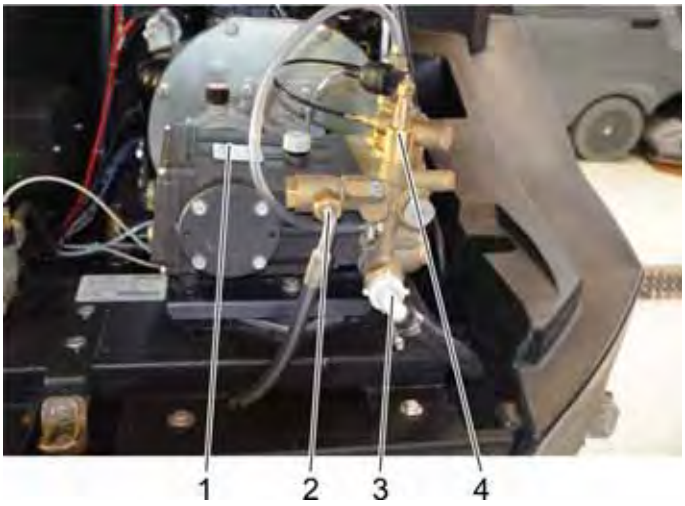
When the motor is running and no water removal takes place via the high-pressure lance, the heat exchanger can ensure sufficient cooling of the motor for approx. 25 minutes. The motor switches off if the water temperature of the float container >55? or the coolant temperature is approx. 98?. A restart can only take place after the coolant has cooled down accordingly

9.14 High-pressure pump

Overview pump types 13/20 and 17/20



1 Overflow
2 Speed control idle mode / full load
3 Pump head
4 Pressure switch
5 Valve set frost protection
6 Supply water with fine filter
7 Intermediate gear
8 Detergent supply to the pump

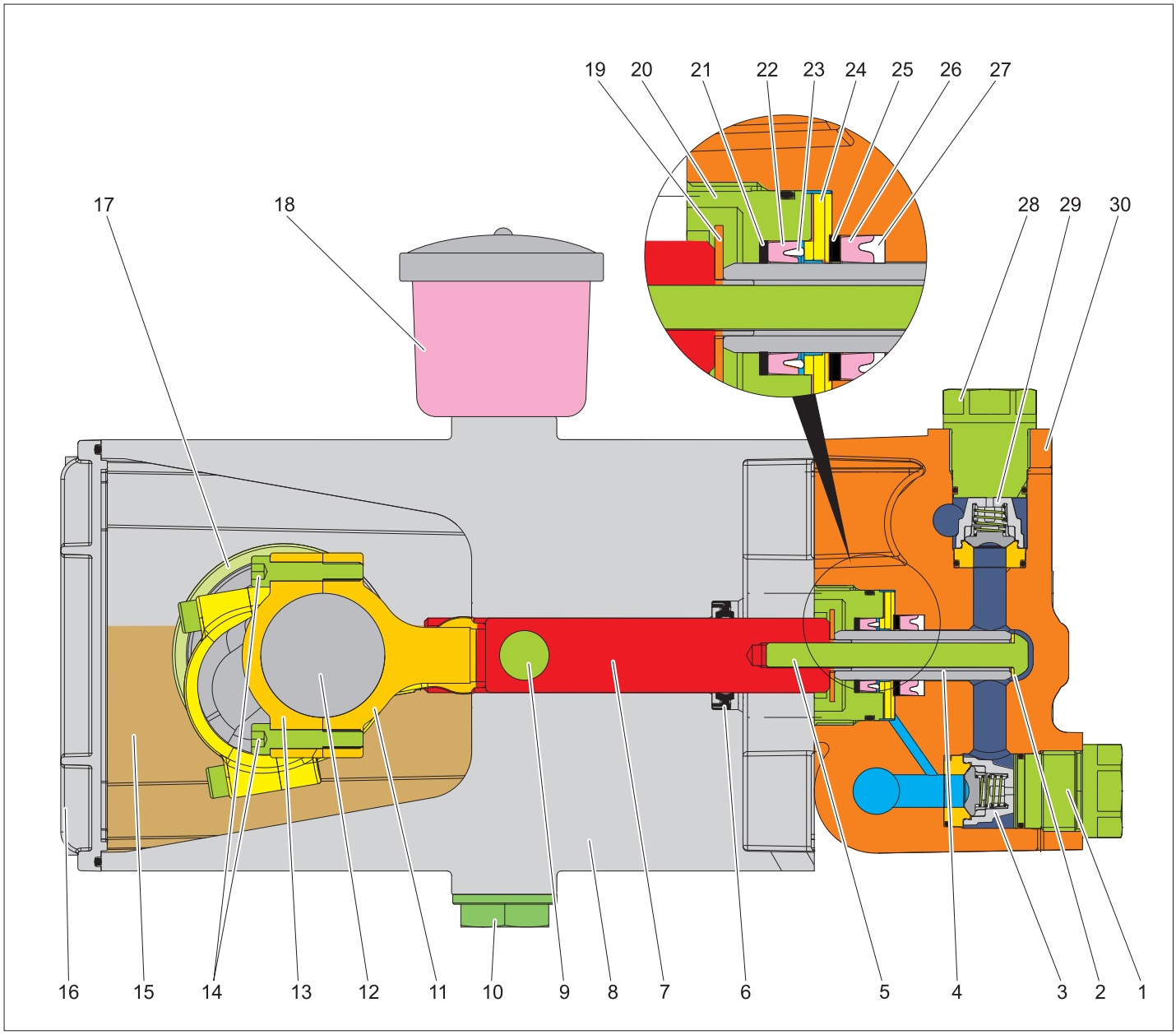


1 Pump casing
2 Outlet high pressure
3 Outlet return line to the float container
4 Overflow

Overview pump types 9/50 and 13/35

1 Pump casing
2 Oil filling nozzle
3 Overflow
4 Speed control idle mode / full load
5 Pressure switch
6 Valve set frost protection
7 Pump head
8 Outlet return line to the float container
9 Outlet high pressure

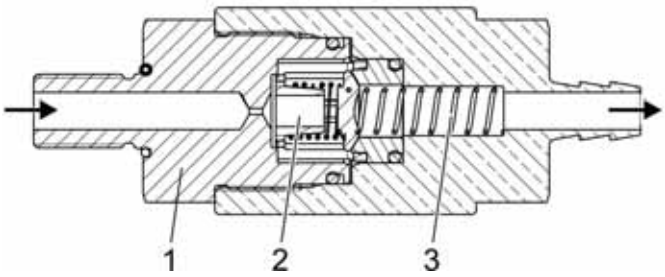
9.14.1 Pump diagram (general)



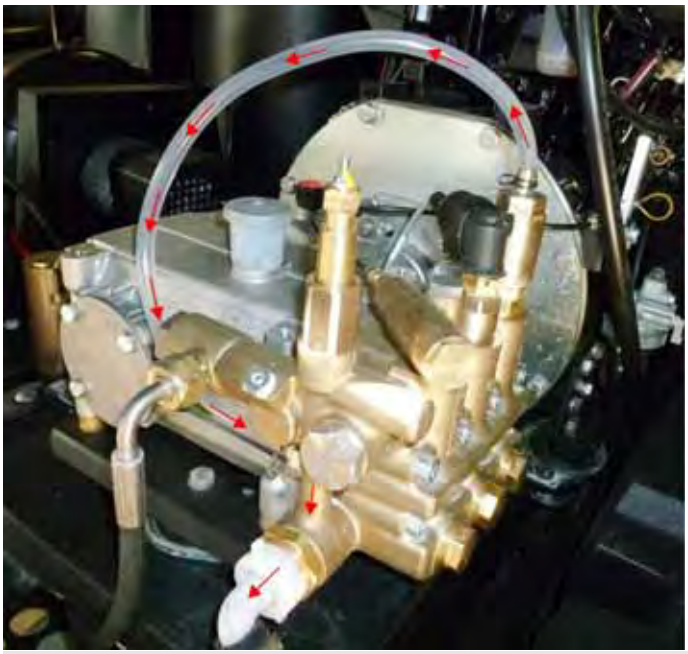
Schematic diagram for all pump types

1 Lock screw, suction side, with O-ring
2 Disc
3 Suction valve with O-ring
4 Ceramic piston
5 Piston screw
6 Oil seal ring
7 Push bar
8 Pump casing
9 Bolt, push bar
10 Oil drain screw
11 Piston rod top
12 Crankshaft
13 Piston rod bottom
14 Piston rod screw
15 Oil bath
16 Crankshaft housing cover, with O-ring
17 Crankshaft bearing (1 x left, 1 x right)
18 Oil filling nozzle
19 Distance-/labyrinth discs
20 Crown nut
21 Disc (back ring)
22 Low pressure seal
23 Support ring, low pressure seal
24 Support disc, brass
25 Disc (back ring)
26 High pressure seal
27 Support ring, high pressure seal
28 Lockscrew, pressure side, with O-ring
29 Pressure valve, with O-ring
30 Cylinder head

9.14.2 Function frost protection valve



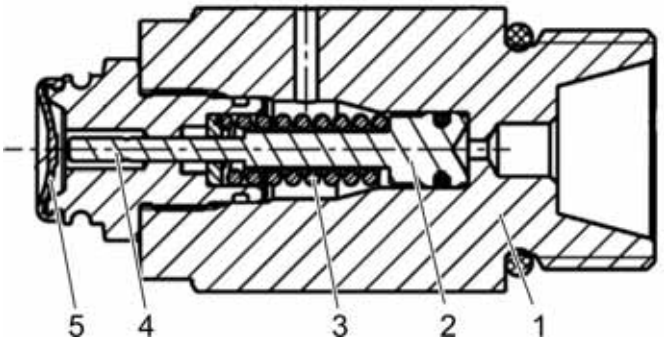
1 Casing
2 Valve
3 Spring



If pressure is applied to the casing (1) during operation of the pump, the valve (2) closes and no flow is possible.
In low pressure operation the spring (3) pushes onto the valve (2) so that the gate of the valve is opened. As a result, water flows through the overflow valve back to the float container. In the frost protection mode water is flushed this way and Glysantin is filled in.
Upon starting work (until pressure has built-up) water also flows from the valve into the return line, which has a positive effect for the bleeding of the pump.

NOTE
If the valve is defective, the maximum pump pressure is no longer reached. In this case, the valve must be renewed.

9.14.3 Function pressure switch

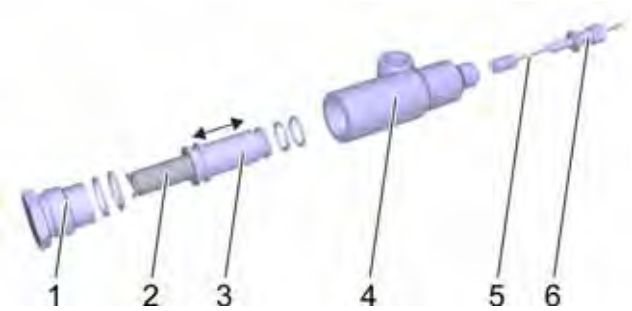


1 Casing
2 Piston
3 Spring
4 Tappet
5 Diaphragm

If pressure is applied to the casing (1) during operation of the pump, the piston (2) is pressed against the spring (3) and pushes the tappet (4) onto the membrane (5). This way, the pressure switch is operated.
In work brakes the spring (3) pushes back the piston (2) so that the tappet is moved down and releases the pressure switch.

ATTENTION
Risk of property damage! If water or moisture should leak from the component, it must be replaced entirely.
Replacing the O-rings only does not provide a remedy in the long run.

9.14.4 Function speed control full load / idle mode



1 Screwed sealing plug
2 Spring
3 Piston
4 Casing
5 Bowden cable
6 Adjustment screw

If pressure is applied to the casing (5) during operation of the pump, the piston (3) is pressed against the spring (2) and thus pulls the Bowden cable (6) into the casing. This way the speed control on the motor is changed and the motor reaches the maximum speed.

In work brakes the spring (2) pushes back the piston (3) so that the Bowden cable slackens and the motor is operated in the idling speed.

ATTENTION
Risk of property damage! If water or moisture should leak from the component, it must be replaced entirely. Replacing the O-rings only does not provide a remedy in the long run.

9.14.5 Crank drive disassembled

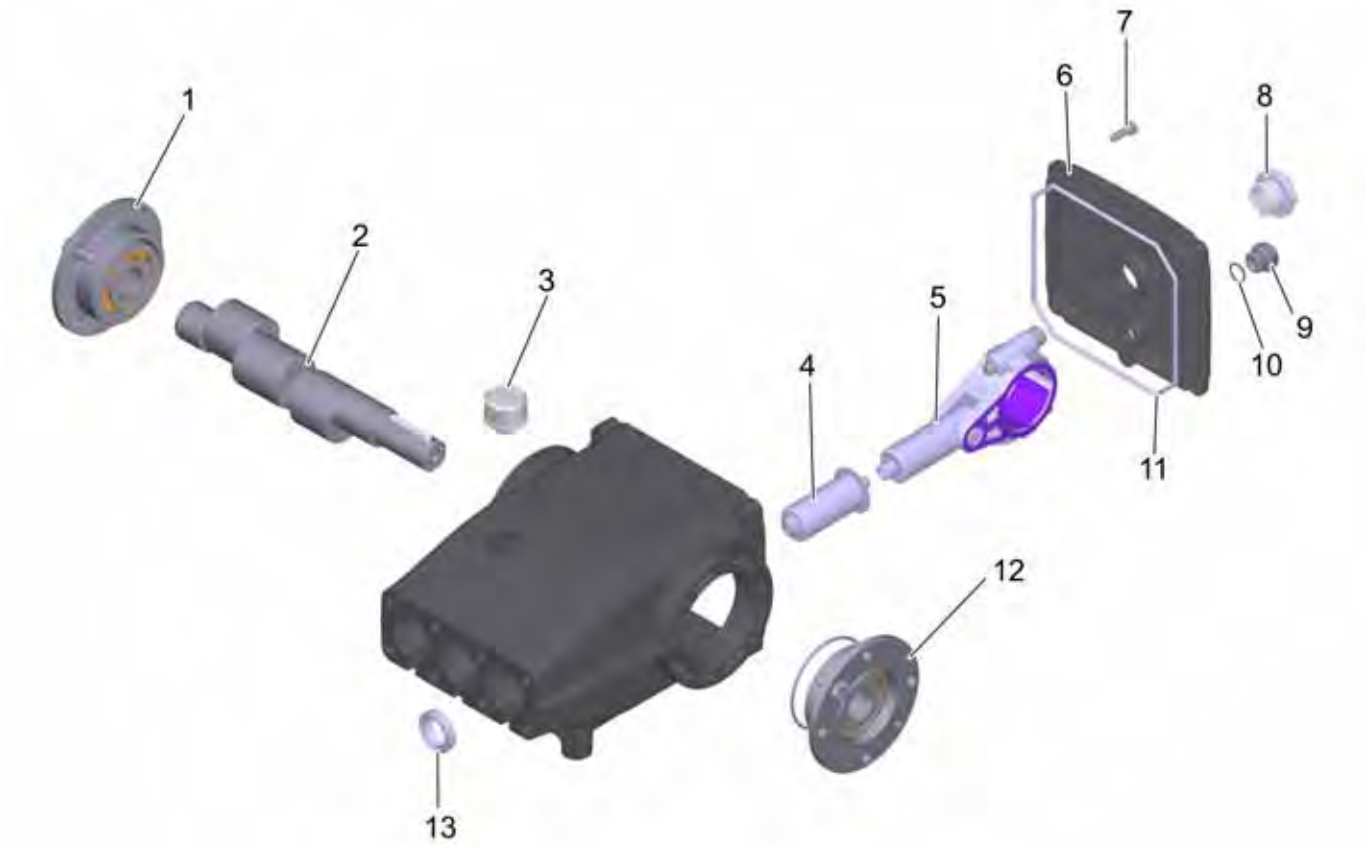


Illustration for pump types 13/20 and 17/20

1 Bearing (closed bearing side)
2 Crankshaft
3 Cover oil filler neck
4 Cover
5 Piston rod
6 Covering lid
7 Screw
8 Oil sight glass
9 Screwed sealing plug
10 O ring
11 Seal casing cover
12 Bearing (open bearing side)
13 Oil seal

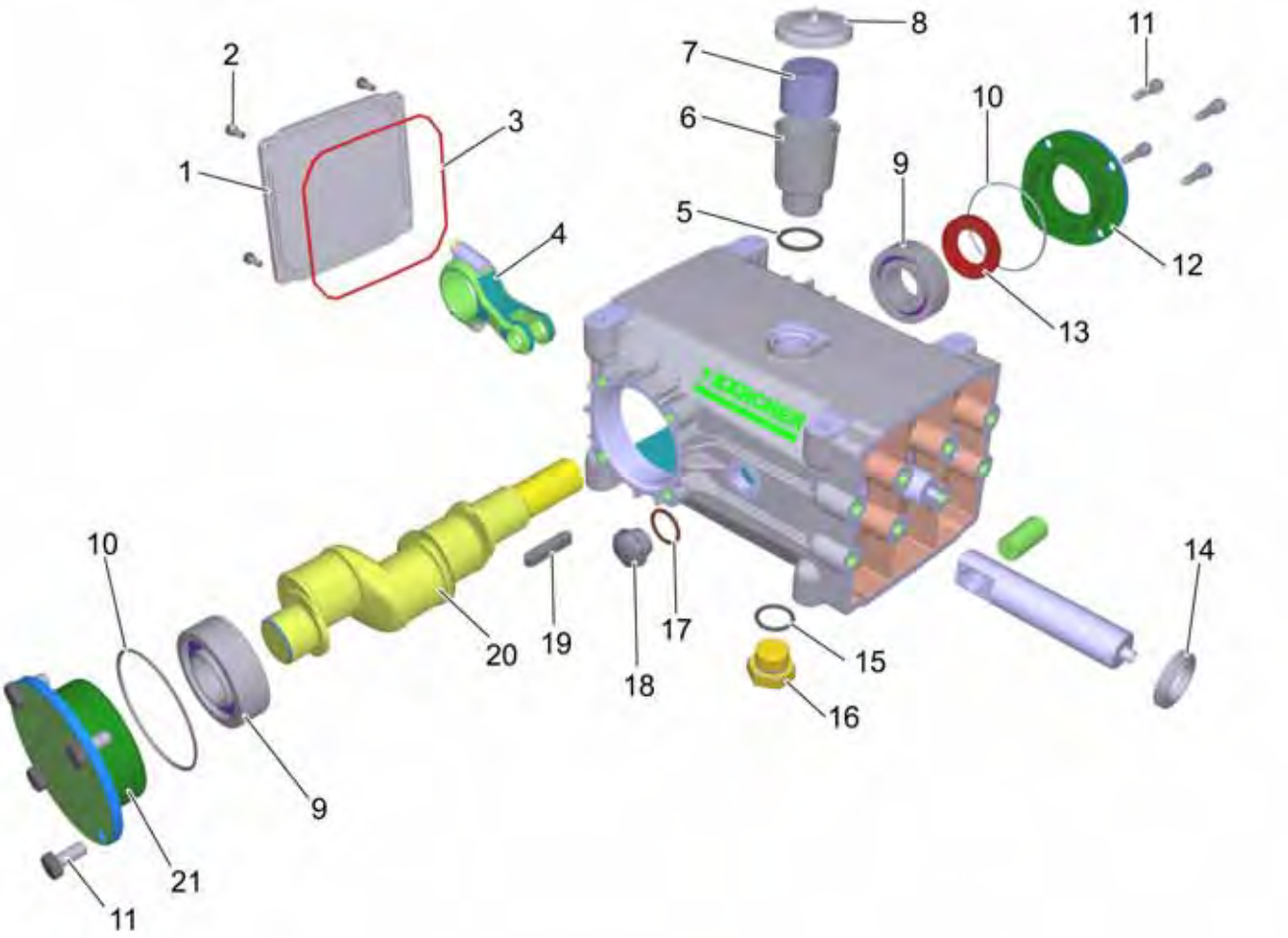


Illustration for pump types 9/50 and 13/35

1 Covering lid
2 Screw
3 Seal casing cover
4 Piston rod
5 O ring
6 Container
7 Stopper
8 Cover oil filler neck
9 Cylinder roller bearing
10 O ring
11 Screw
12 Bearing (open bearing side)
13 Radial seal
14 Shaft seal ring
15 O ring
16 Screwed sealing plug
17 Seal
18 Screwed sealing plug
19 Fitting key
20 Crankshaft
21 Bearing (closed bearing side)

9.14.6 Cylinder head: High-pressure valve and water inlet / piston seals

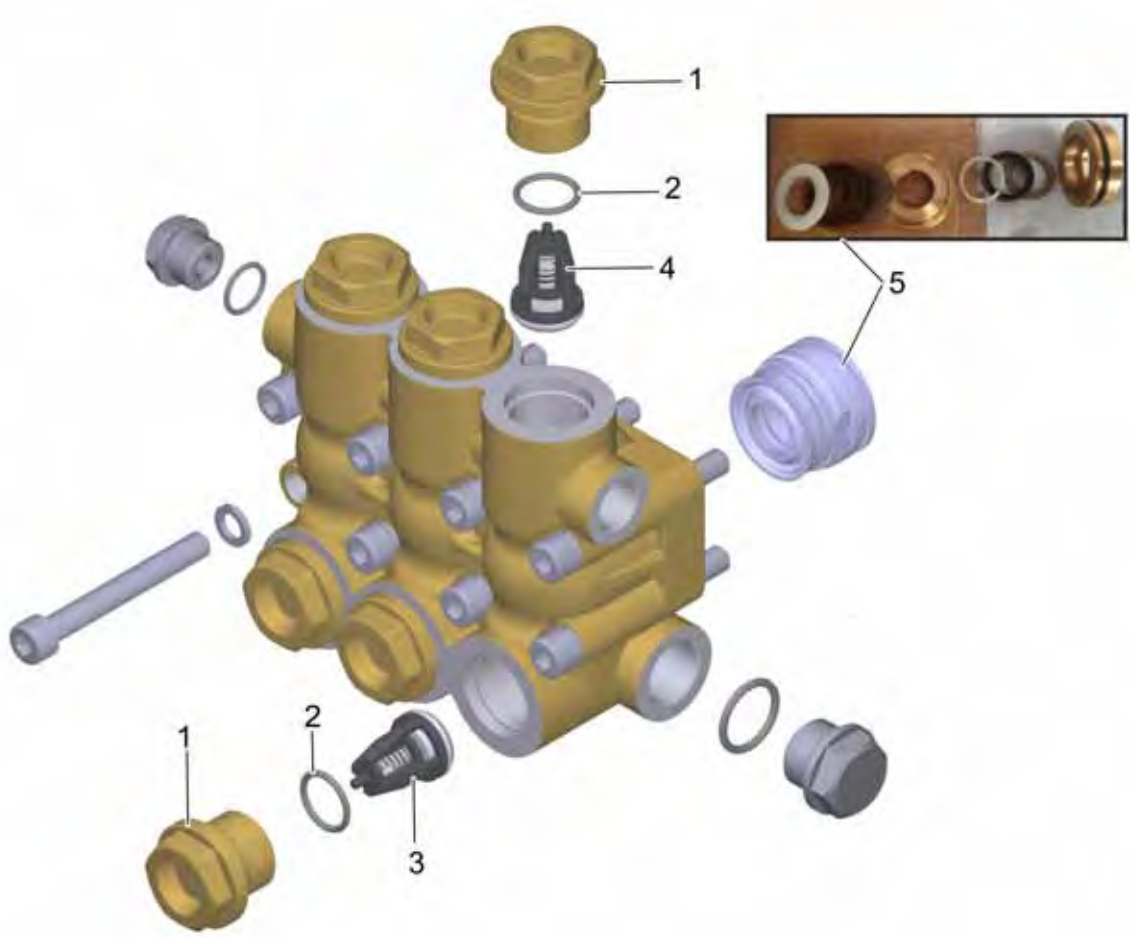


Illustration for pump types 13/20 and 17/20

High-pressure valves and water inlet
1 Valve screw
2 O ring
3 Suction valve
4 Pressure valve
Piston seals
5 Seal kit

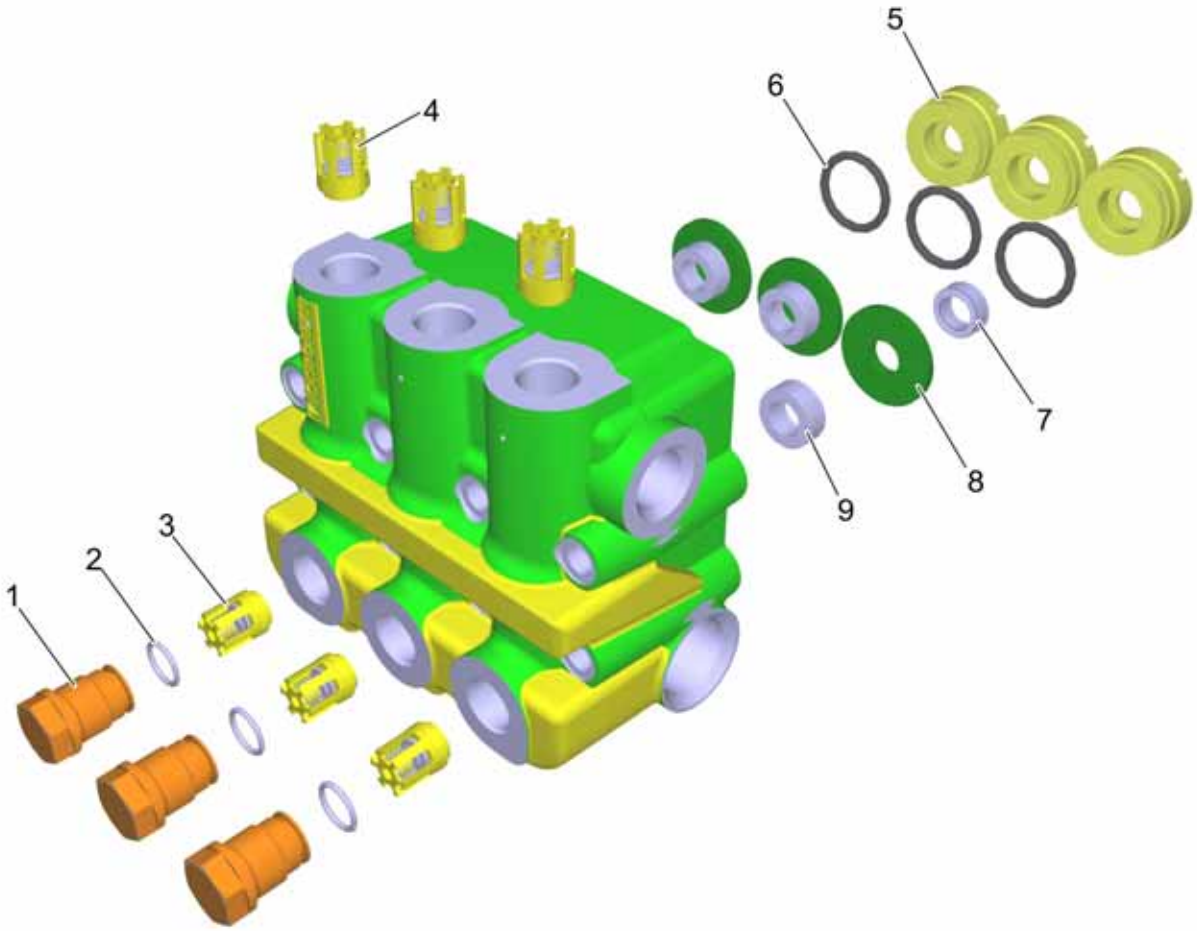


Illustration for pump types 9/50 and 13/35

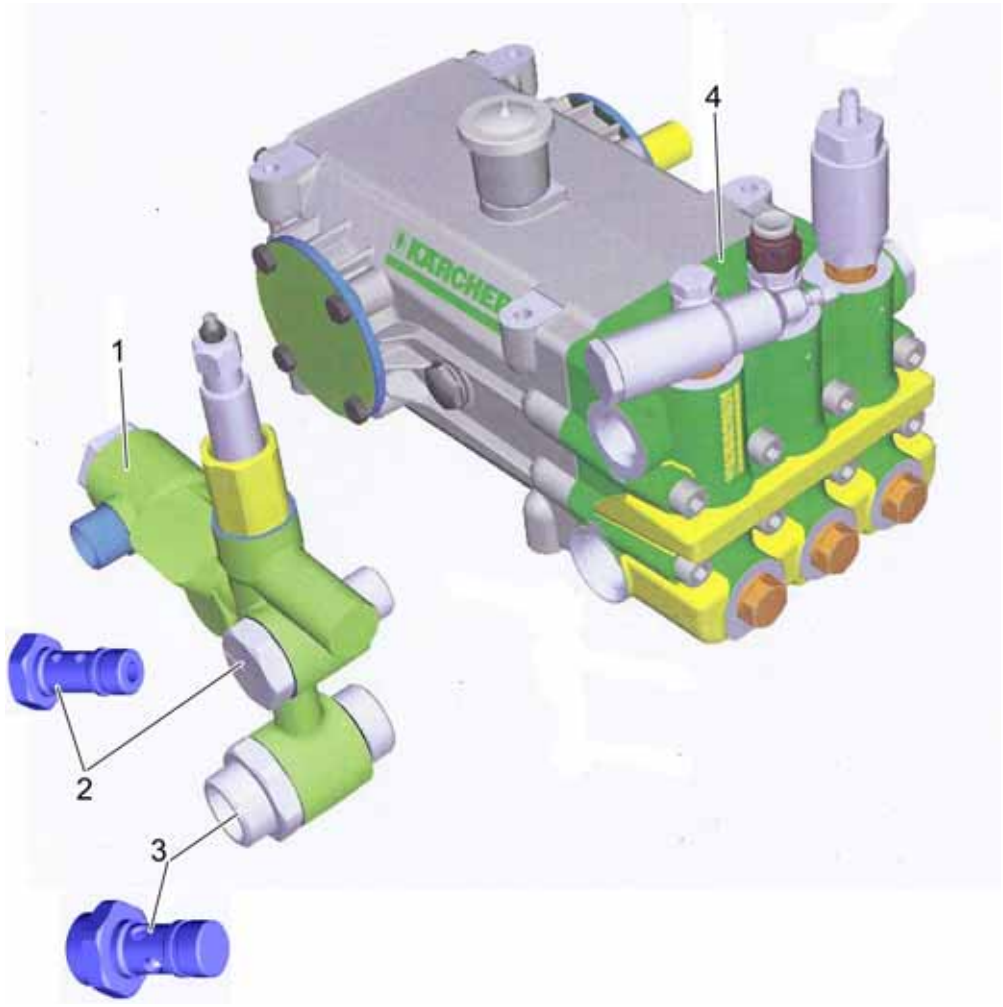
High-pressure valves and water inlet

1 Valve screw
2 O ring
3 Suction valve
4 Pressure valve

Piston seals

5 Screwed sealing plug
6 O ring
7 Seal kit
8 Bushing
9 Seal kit

9.14.7 Cylinder head, overflow valve

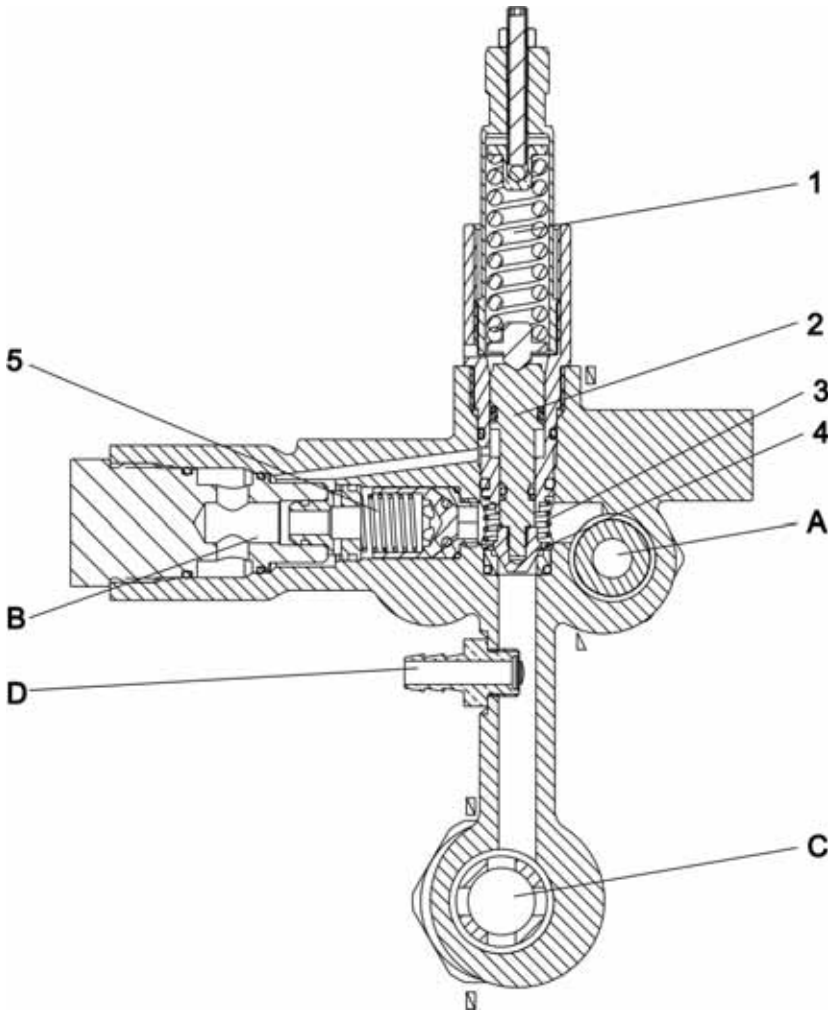


Exemplary illustration for all 4 pump types

1 Overflow
2 Hollow screw
3 Banjo bolt bypass
4 Pump head

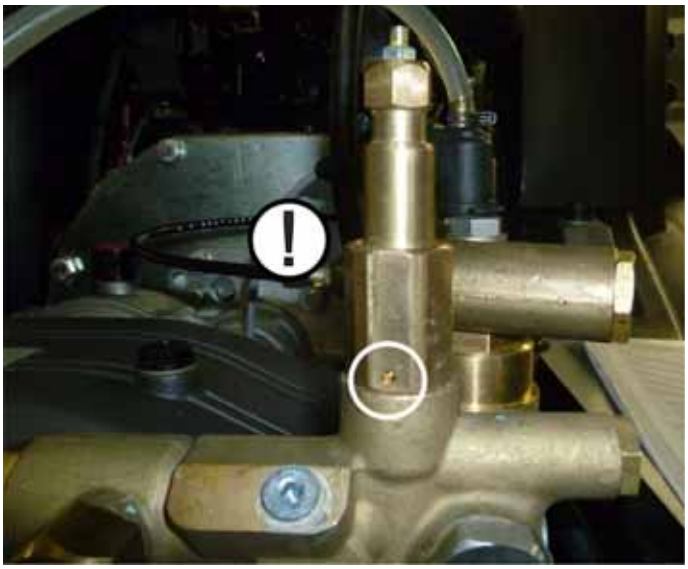
NOTE
Both hollow screws must be loosened or tightened simultaneously while exchanging the knot section in order to avoid damage to the O-rings.
Tightening torque, hollow screw, pressure side: 160 Nm
Tightening torque, hollow screw, suction side: 40 Nm

9.15 Overflow



Exemplary illustration. The overflow valves for the 4 pumps are similarly designed, they differ in the spring force relative to the pressure range.
The overflow valves are permanently set and sealed.

A High-pressure inlet
B High-pressure outlet
C Low pressure return
D Connection of frost protection valve

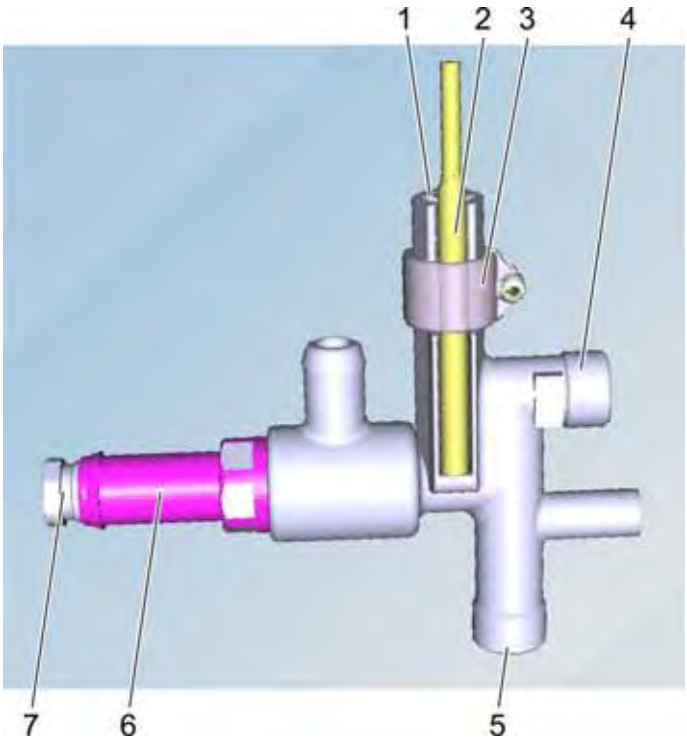


1 Spring
2 Control piston
3 Spring
4 Valve bolt
5 Valve

Function
If the pressure on the high pressure outlet increases, the control piston (2) is lifted up with the valve bolt (4) and the excess pressure escapes to the suction side of the high pressure pump.

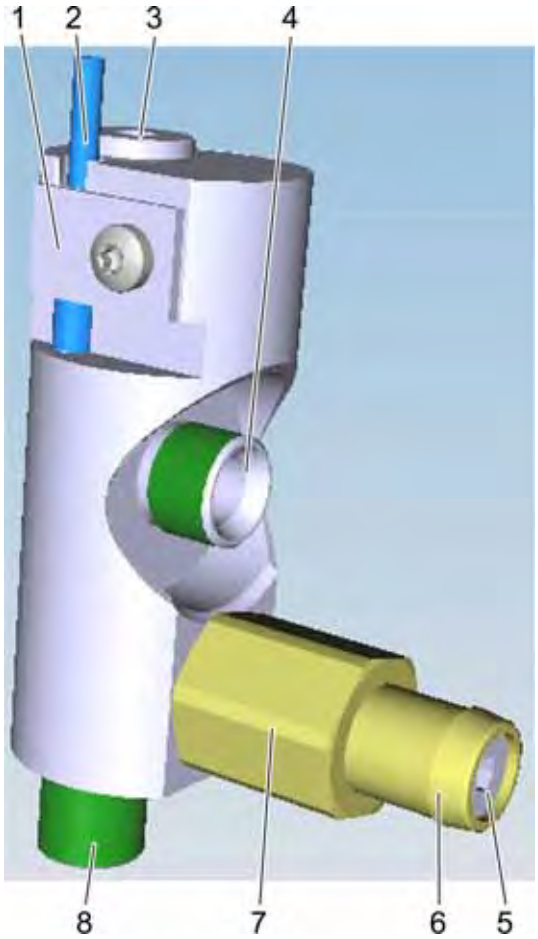
ATTENTION
Risk of property damage! If water or moisture should leak from the component, it must be replaced entirely.
Replacing the O-rings only does not provide a remedy in the long run.

9.16 Safety block



Safety block 200bar
1 Screwed sealing plug
2 Flow switch
3 Clamping bracket
4 High-pressure outlet to the booster heater
5 High pressure input
6 Safety valve
7 Adjusting screw

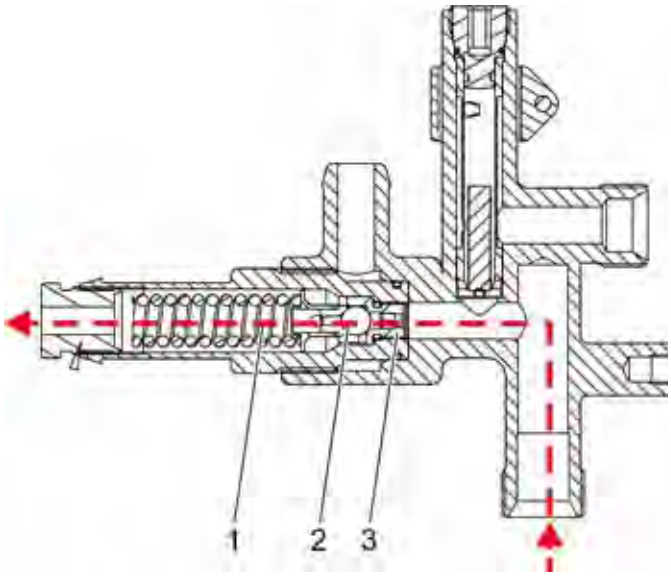
NOTE
The safety valve can be adjusted in the range 185-250bar.
The presetting at 240bar is done in the factory.



Safety block 350/500bar
1 Clamping bracket
2 Flow switch
3 Screwed sealing plug
4 High-pressure outlet to the booster heater
5 Adjusting screw
6 Connection hose
7 Safety valve
8 High pressure input

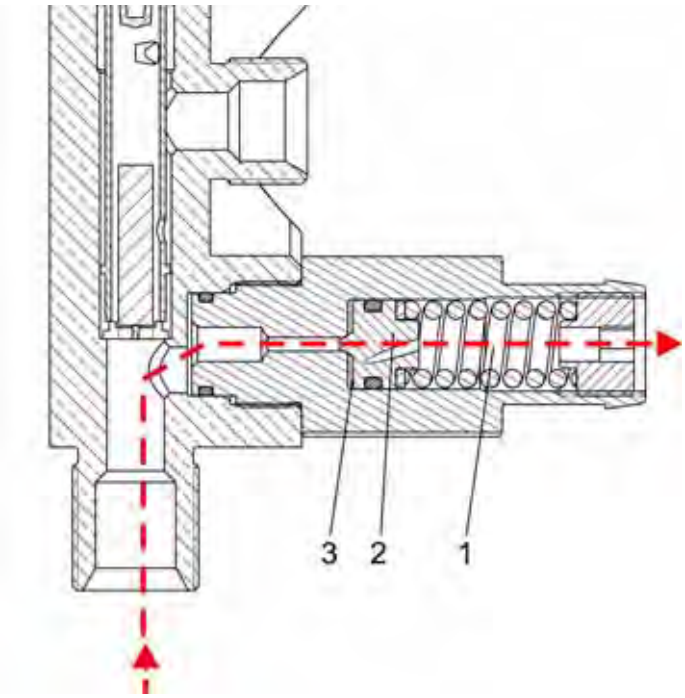
NOTE
The safety valve is permanently set and stamped:
– with 350bar device: Setting 440bar
– with 500bar device: Setting 640bar

9.16.1 Safety valve



1 Spring
2 Valve ball
3 Valve seat

Illustration for pump types 13/20 and 17/20



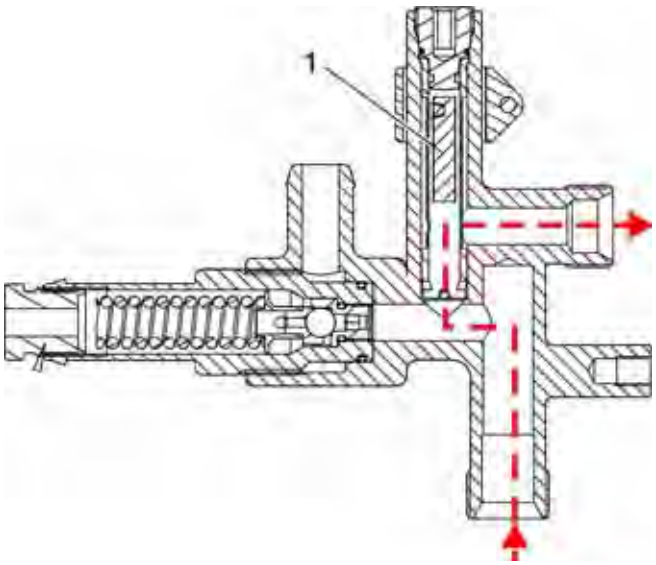
1 Spring
2 Valve disks
3 Valve seat

Illustration for pump types 9/50 and 13/35

If the overflow valve is defective, the safety valve guides the entire flow rate of the pump to the outside and thus protects the device and accessories against inadmissibly high overpressure.
If the gun is open, the safety valve is closed and the entire flow volume of the pump is transferred to the gun at operating pressure.
If the pressure in the high-pressure system rises by approx. 20 bar above the permissible operating pressure, the valve ball or the valve plate (with 350 and 500bar devices) is lifted off the valve seat and part of the flow volume flows to the outside.

For safety valve 200bar only
The opening pressure of the safety valve is adjusted with the adjustment screw.
Rotation to the right increases the opening pressure, rotation to the left decreases the opening pressure.
Normally, the safety valve is preset by the factory. The setting range is between 185 and 250 bar.
NOTE
The safety valve is adjusted via the pressure increase in the system with the burner turned on, so that it limits the pressure increase to the max. permissible value (see Specifications) with the gun closed.
Then seal the settings.

9.16.2 Flow switch



1 Magnetic piston

Illustration for pump types 13/20 and 17/20

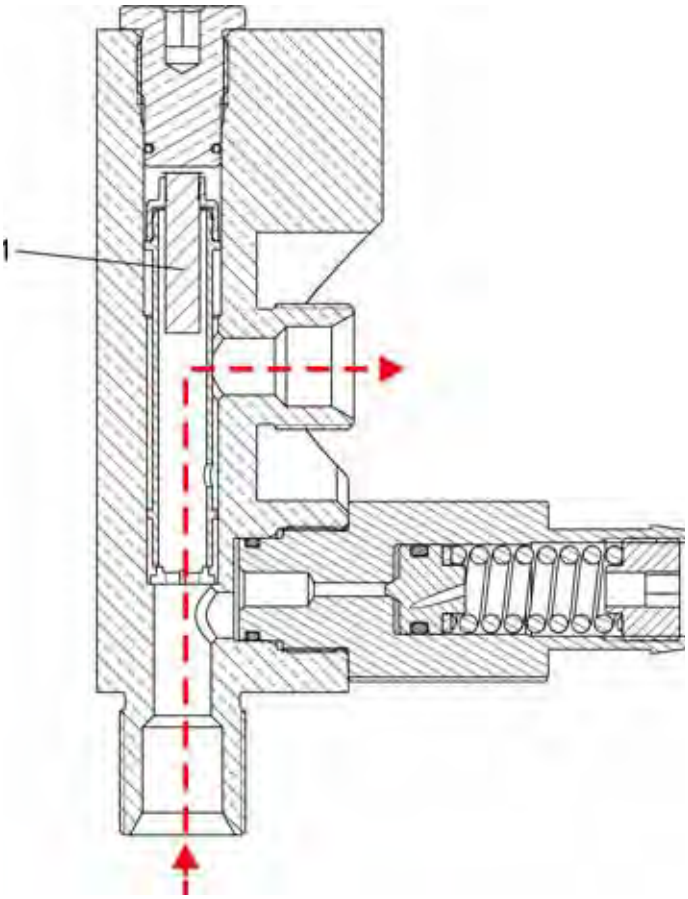


Illustration for pump types 9/50 and 13/35

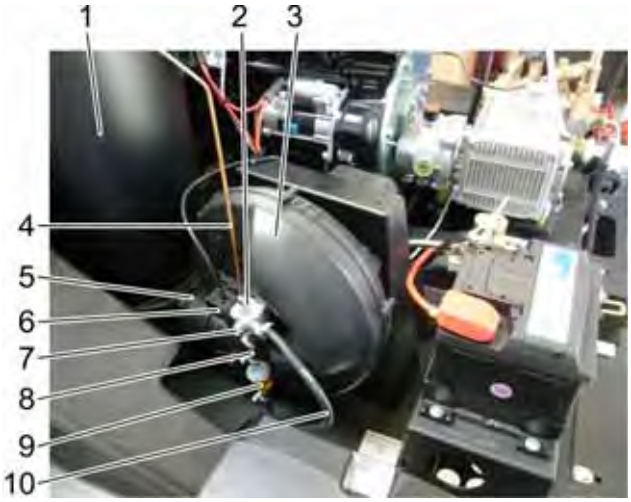
1 Magnetic piston

The flow switch prevents the burner from switching on in case of missing or insufficient water volume and thus protects the booster heater from overheating.
With the gun open and sufficient water flow, the solenoid piston is pushed against the pressure spring.
The solenoid piston closes the contact of the reed switch.
With warm water operation, this opens the fuel solenoid valve and the burner ignites.

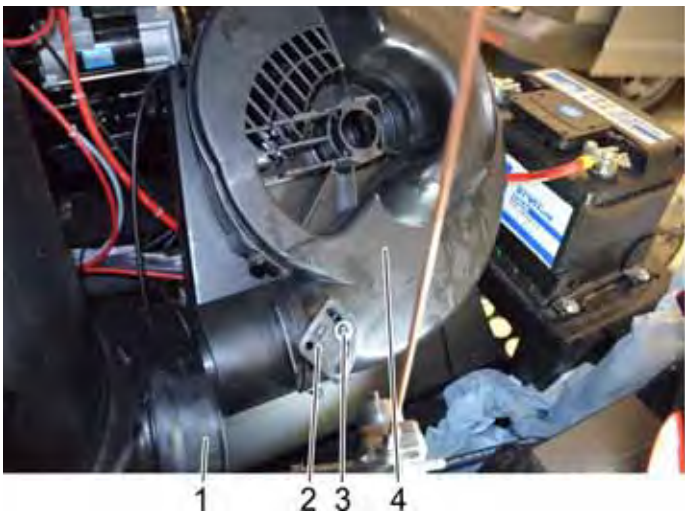
In case of an insufficient water volume, the flow switch immediately switches the burner off in warm water operation and back on if the water volume suffices.

In order to operate the device in normal operation, the flow switch must always work synchronously with the pressure switch. If only one signal is pending, a malfunction occurs.

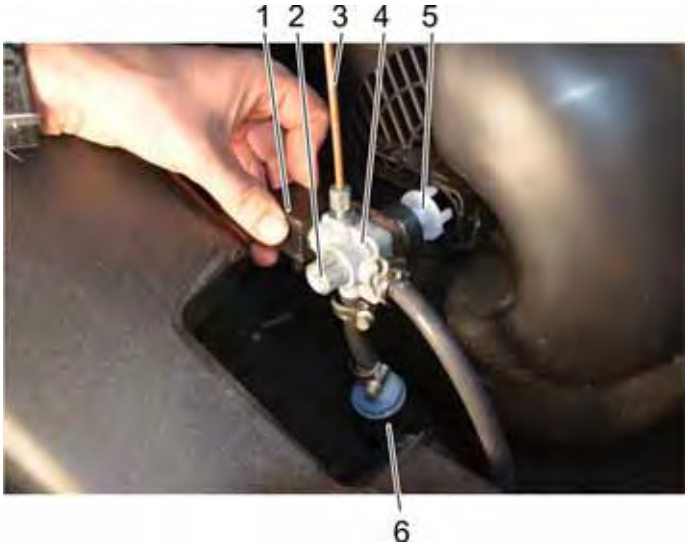
9.17 Burner blower with fuel pump



1 Continuous heater
2 Fuel pump
3 Blower lid
4 Pressure line
5 Rubber collar
6 Solenoid valve
7 Setting fuel pressure
8 Fuel line
9 Filter
10 Return

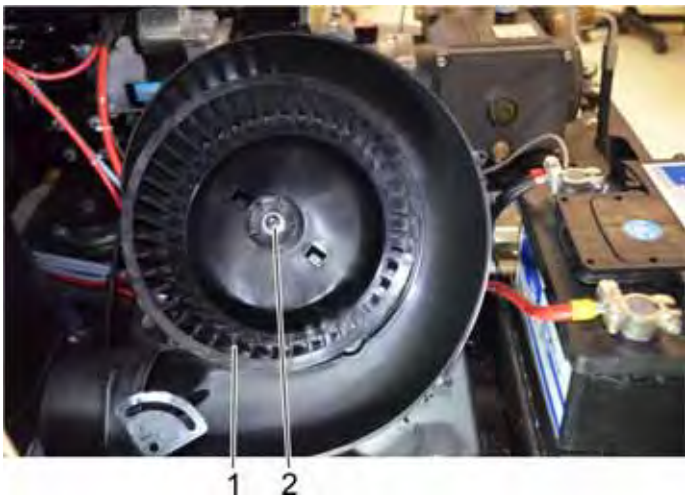


1 Rubber collar
2 Air flap
3 Screw
4 Burner blower



1 Solenoid valve
2 Setting fuel pressure
3 Connection pressure line
4 Fuel pump
5 Coupling unit
6 Filter

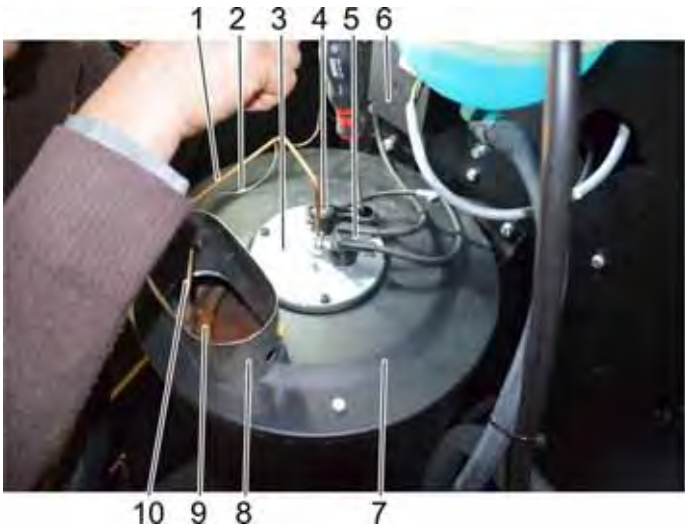
Fuel pump
The fuel pump is connected directly to the motor shaft via the coupling piece and the blower wheel.
During warm water operation, the installed solenoid valve and part of the fuel reaches the burner through the fuel nozzle and is ignited there.
The fuel pressure is adjusted via the central setting screw.
During dry runs, the fuel pump will block.
The coupling piece serves as a nominal breaking point.



1 Blower wheel
2 Fastening screw blower wheel

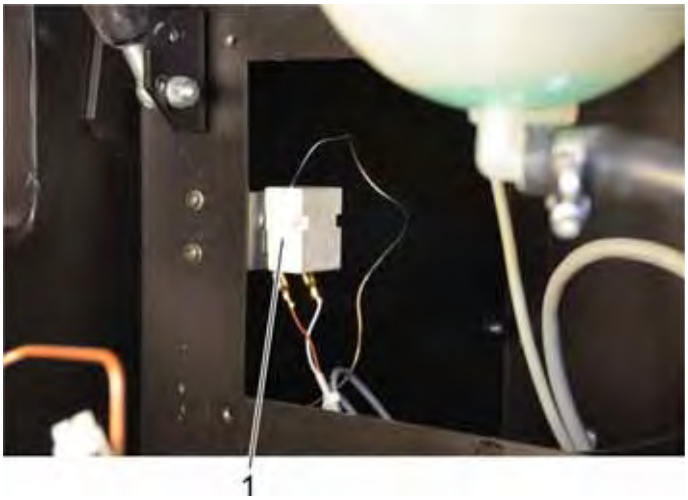
Burner blower
The blower supplies the burner with combustion air.
The air flap is used to adjust the air value to optimised combustion values.
The blower wheel is mounted to the motor shaft by means of 2 feather keys.
The motor of the burner blower only runs in warm water operation.

9.18 Booster heater (with ignition transformer)



1 Fuel line
2 Capillary exhaust temperature monitor
3 Burner cover
4 Flame sensor
5 Ignition cable
6 Ignition transformer
7 Flow-type heater cover
8 Exhaust nozzle
9 Heating coil
10 Exhaust temperature sensor

1 Ignition transformer



View with opened maintenance flap on the right
1 Thermostat switch emission temperature

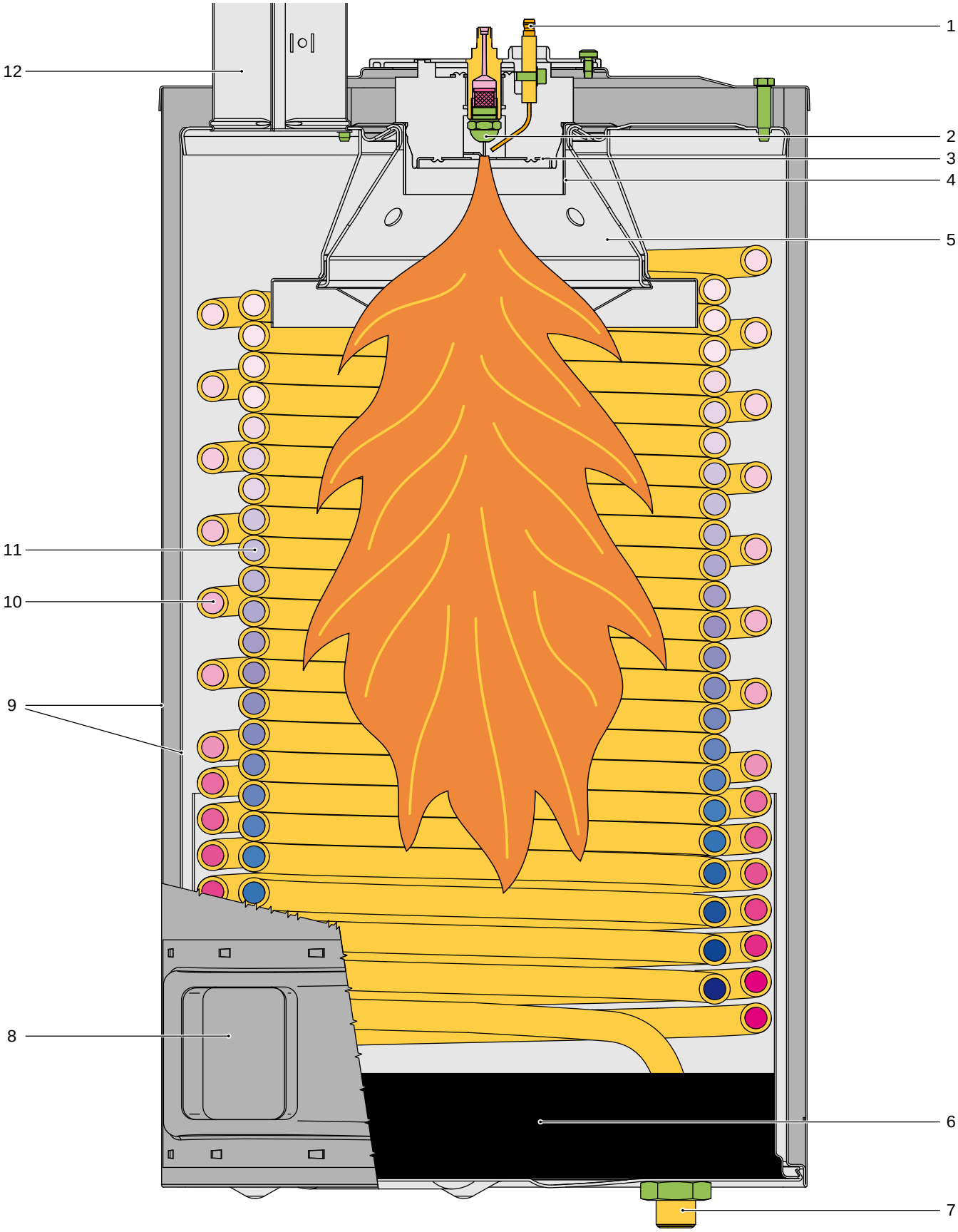
NOTE
When the set emission temperature of 292°C +/-7K is exceeded, the burner switches off automatically.
Restart after a temperature drop by 9 +/-4.5K.

9.18.1 Type plate of heating coil

The type plate of the heating coil can be read through the exhaust stack.

1 Year of manufacture
2 Specifications
3 Part number of heating coil
4 Pressure test passed
5 Continuous plant number

9.18.2 Sectional view (exemplary)



1 Ignition electrodes
2 Fuel nozzle
3 Pressure plate
4 Flame pipe
5 Burning chamber
6 Boiler floor
7 Boiler input
8 Air supply from burner blower
9 Boiler exterior, double-walled
10 Heating coil spiral, exterior
11 Heating coil spiral, interior
12 Exhaust nozzle, on-demand heater

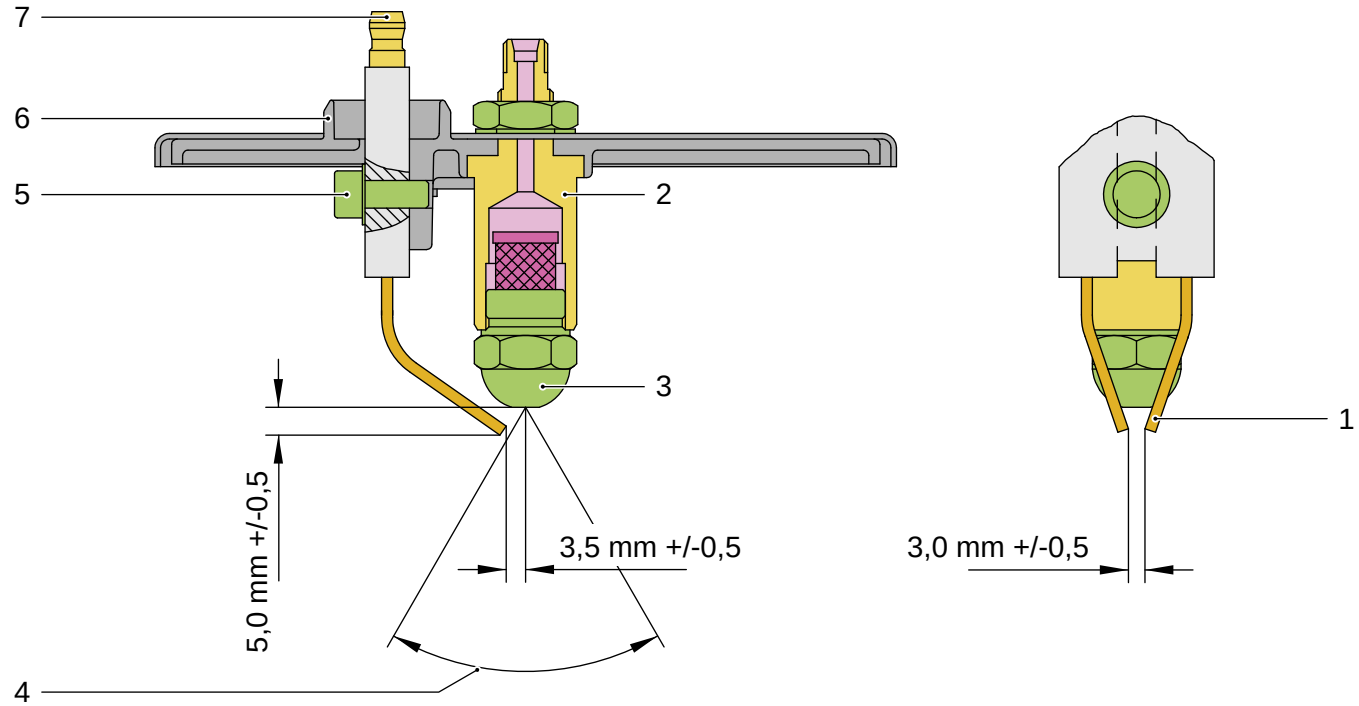
Mode of operation

The water from the high pressure pump enters the interior heating coil spiral, is heated while flowing through and exits to the bottom from the heating coil spiral.
The fuel is vaporised by the fuel nozzle and ignited by the spark of the ignition electrodes.
The combustion air from the blower first flows through the double-walled boiler exterior toward the top, then it flows downward with the flame and is emitted as exhaust through the exhaust stack toward the top into the atmosphere.
The boiler floor is made of fire-resistant insulating concrete. It prevents a radiation of the heat and is used to reroute the flames.
The adjustment of the burner to good exhaust values is achieved via the air flap on the blower (air volume) and with the adjustment screw on the fuel pump (fuel pressure).
The temperature increase with the full water volume is max.:

- with HDS 9/50: 56.5K
- with HDS 13/35: 60.0K
- with HDS 17/20: 52.5K
- with HDS 13/20: 63.0K

When the water volume is reduced by the pressure and volume regulation, the water can be heated to max. 95°C.
An optimal burner performance is only possible if the heating coil is neither full of soot nor other deposits.
Furthermore, the spark electrodes, the amount of fuel and the amount of air must be adjusted properly.

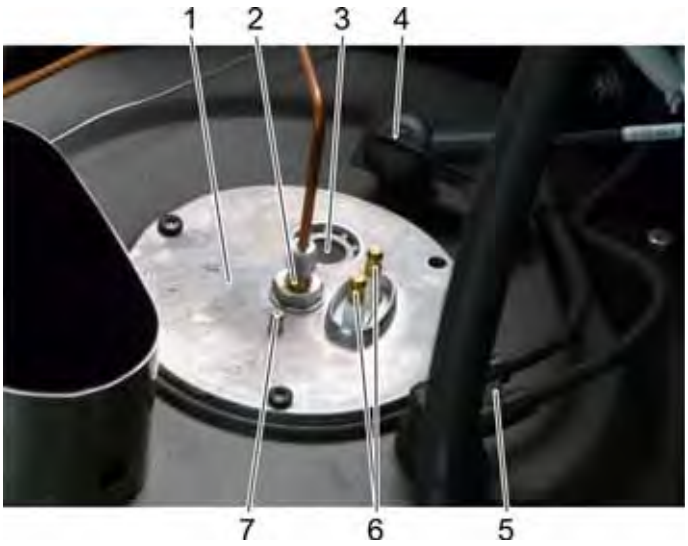
9.19 Burner



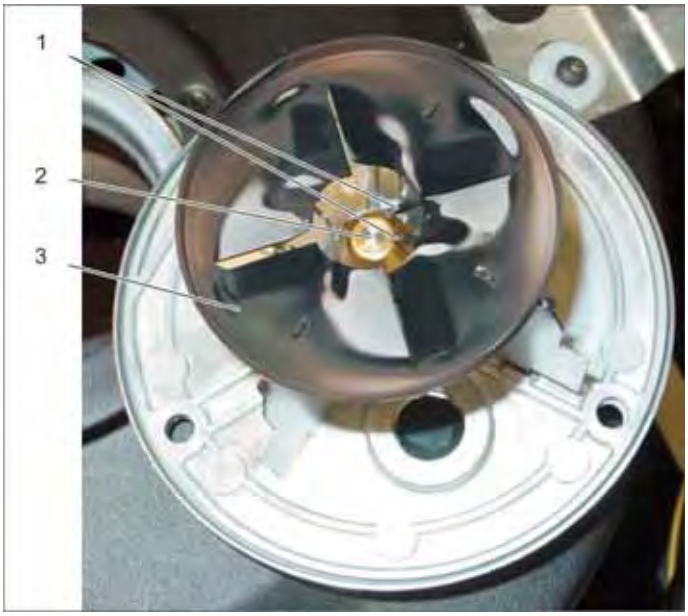
1 Ignition electrodes
2 Fuel nozzle holder
3 Fuel nozzle
4 Spray angle 45° or 60°, depending on the type of appliance
5 Screw
6 Burner cover
7 Connection ignition electrodes

Burner

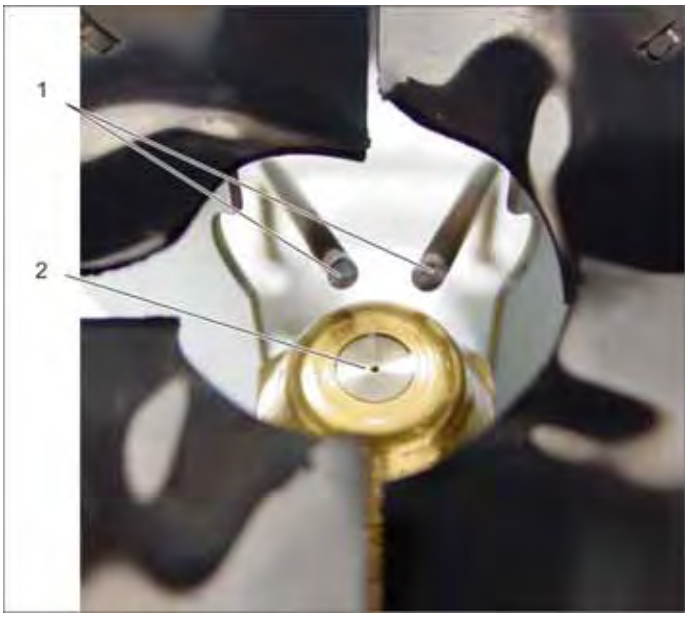
There is a strong spark created between the two ignition electrodes to ensure that the injected fuel will ignite.
The necessary ignition voltage is generated by the ignition transformer.
The exact adherence to the adjustment dimensions is a basic requirement for the proper function of the burner, for good exhaust values and the long idle time of the ignition electrodes.
There is always a ignition spark between the two ignition electrodes, during cold and hot water operation (continuous ignition).
This is a safety measure, so that injected fuel will be ignited in any case and cannot accumulate unburned in the on-demand heater (deflagration hazard).



1 Burner cover
2 Connection pressure line
3 Looking glass
4 Flame sensor (dismantled)
5 Plug ignition electrode (pulled off)
6 Connection ignition electrode
7 Connection for air pressure measurement



1 Ignition electrode
2 Fuel nozzle
3 Pressure plate



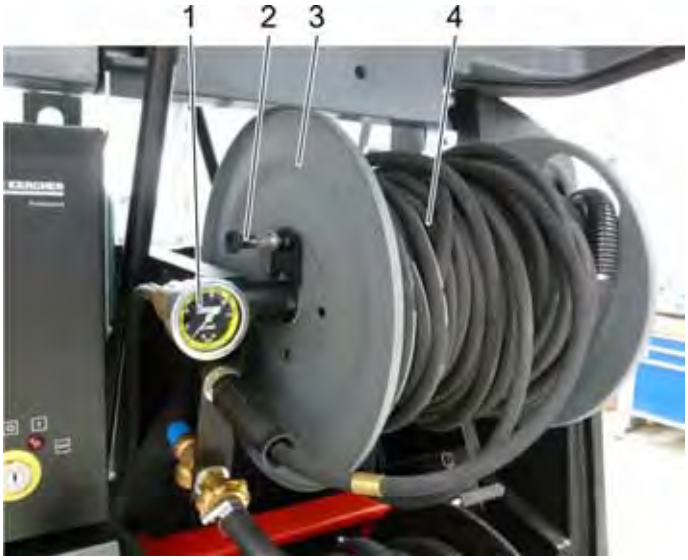
1 Ignition electrode
2 Fuel nozzle

9.20 Output of flow-type heater

View from below
1 Temperature sensor warm water
2 High-pressure line from the booster heater to the high-pressure connection
3 High-pressure line from the safety block to the boiler

NOTE
The temperature sensor measures the warm water temperature after the booster heater and thus regulates the burner operation.

9.21 High pressure connection

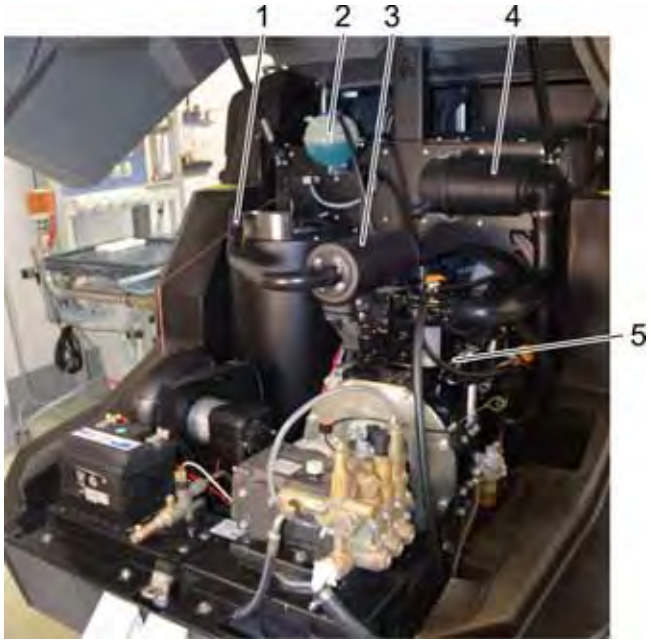


1 Manometer
2 Catch high-pressure hose reel
3 High-pressure hose drum
4 High pressure hose

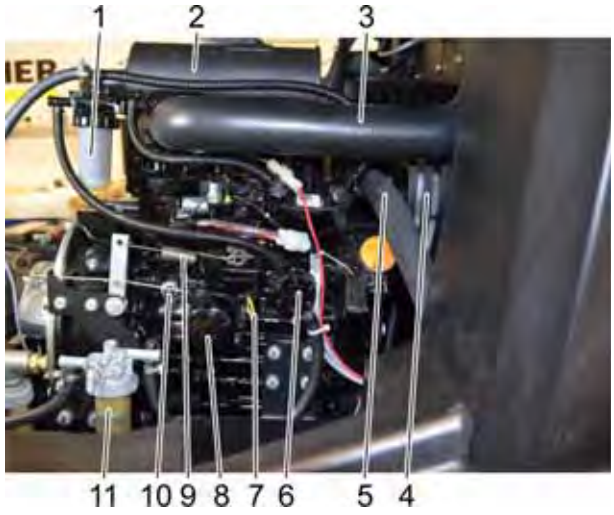
There is also equipment without a high-pressure hose reel. In this case, a separate high-pressure hose is connected to the high-pressure connection in the area of the pressure gauge.
To unroll or roll up the hose, the brake must be released. For this purpose, pull out the catch of the hose reel.
NOTE
Ensure an even distribution of the hose when rolling it up. Finally lock the hose reel by inserting the catch into a hole in the hose reel.

ATTENTION
Never unroll or roll up the high-pressure hose while it is under pressure.

9.22 Motor (water-cooled)

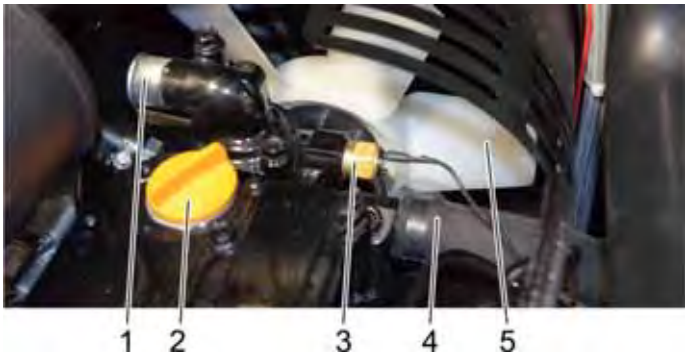


1 Exhaust system
2 Expansion tank motor coolant
3 Exhaust
4 Air filter
5 Diesel engine

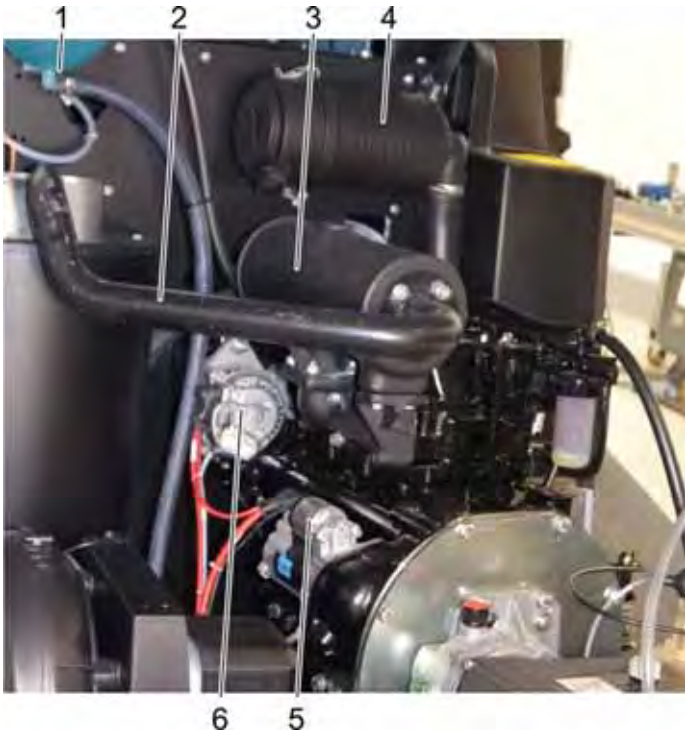


Diesel engine
1 Fuel filter
2 Exhaust
3 Preformed hose from the air filter
4 Cooling fan, motor
5 Coolant hose
6 Fuel pump
7 Oil dip (engine)
8 Oil filter (engine)
9 Speed control (full load / idle mode)
10 Pressure switch
11 Water separator

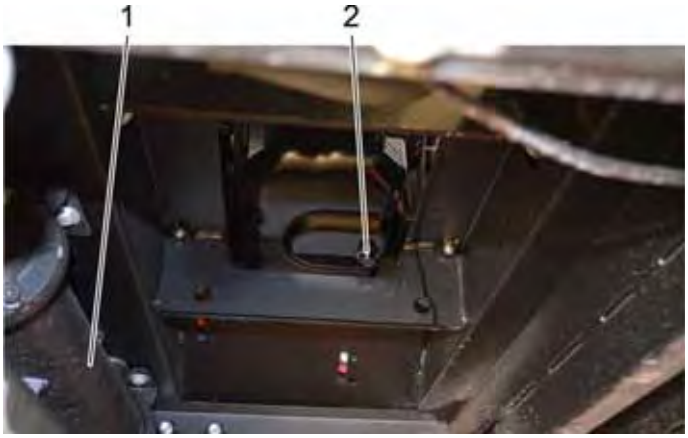
NOTE
The fuel pump is equipped with a manual control. If necessary, this can manually pump the fuel to the motor for the first filling or after the tank has been empty.



Diesel engine
1 Connection coolant hose
2 Filling hole motor oil (top)
3 Thermostat switch motor
4 Connection coolant hose
5 Cooling fan, motor



Diesel engine
1 Expansion tank motor coolant
2 Exhaust system
3 Muffler
4 Air filter
5 Starter
6 Alternator



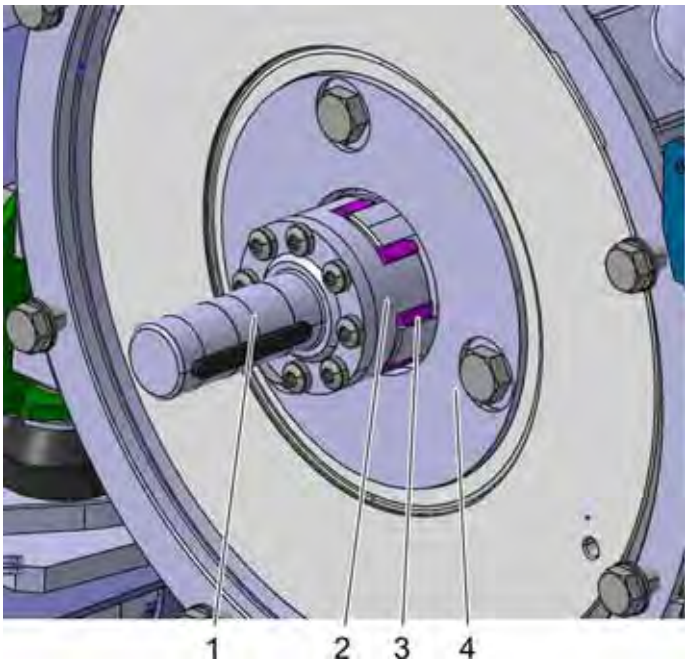
Diesel engine
1 Heat exchanger
2 Oil drain screw engine

The oil drain screw is located on the bottom of the motor casing.

Diesel engine - circuit coolant
1 Connection coolant hose
2 Connection from the expansion tank motor coolant
3 Drain screw coolant
4 Connection from the water distribution
5 Connection to the HP pump

Antifreeze motor

➔ Check the coolant circuit of the motor for sufficient antifreeze, refill antifreeze as needed.

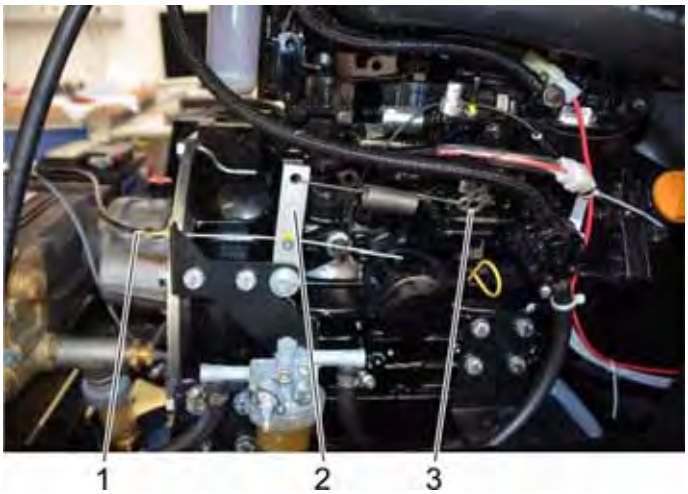


Diesel engine - power transmission
1 Drive shaft
2 Claw clutch
3 Elastomer ring
4 Flange plate

The power transmission from the motor to the intermediate gear takes place by means of a claw coupling.
One half of the claw coupling is screwed onto the rotating flange plate at the motor. Via the elastomer ring that serves for dampening, the torque is transferred to the other half of the claw coupling that is screwed onto the drive shaft. The drive shaft is connected to the intermediate gear by means of a feather key.

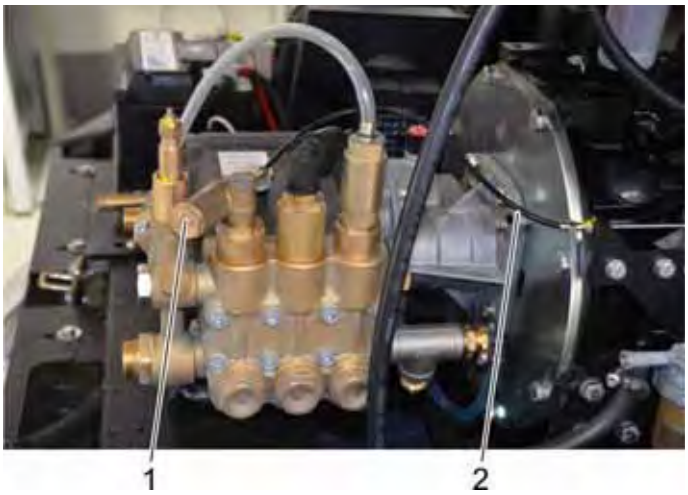
NOTE
The entire motor electrics is integrated in the control cabinet.

9.22.1 Speed control - full load / idling speed



1 Bowden cable speed control from the piston on the high-pressure pump
2 Deflection
3 Speed control motor

The speed control lowers the motor speed when the hand spray gun is closed.

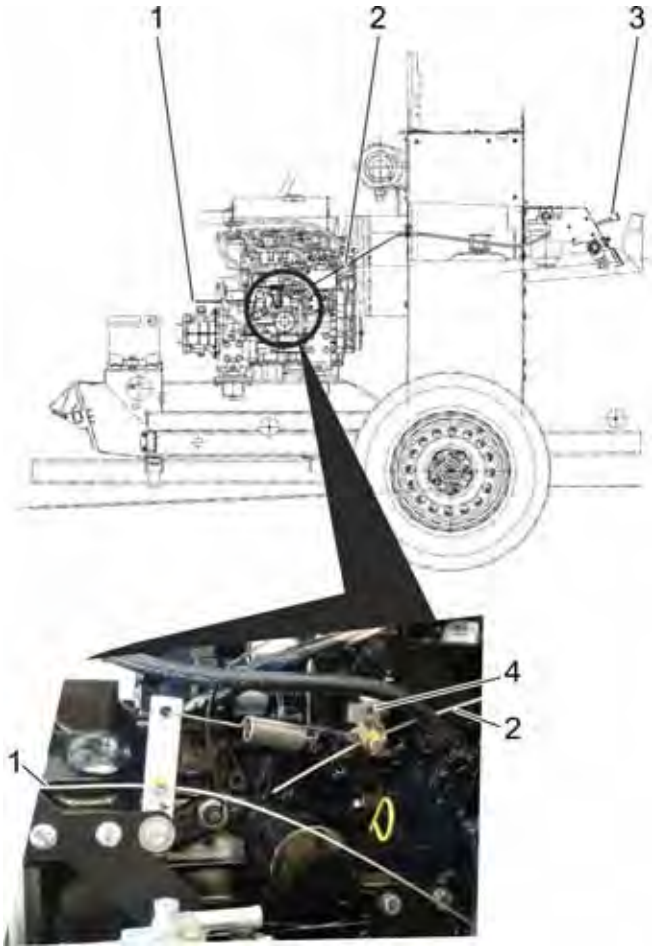


1 Speed control (full load / idle mode)
2 Bowden cable to the motor

9.22.2 Speed control for changing volume and pressure

NOTE

This equipment is only available for HDS 9/50 and HDS 13/35.



1 Speed control (full load / idle mode)
2 Bowden cable from the control lever (limitation max. motor speed for controlling volume and pressure)
3 Control lever for speed control
4 Speed control motor

The Bowden cable from the control lever limits the maximum speed of the motor and regulates the pressure and the volume of the high-pressure pump this way.
This speed control has no influence on the regulation of the speed in the idling mode.

Control lever for the limitation of the max. motor speed for controlling volume and pressure

NOTE

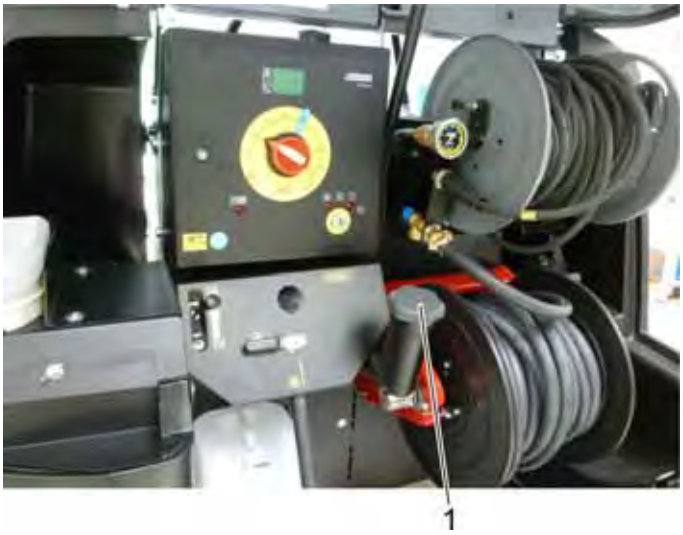
If the motor speed is increased, the operating pressure also rises. This can be read from the pressure gauge.

– Increasing pressure and volume:
➔ Push the lever of the speed control up; the motor speed is increased.
– Reducing pressure and volume:
➔ Push the lever of the speed control down; the motor speed is reduced.

NOTE

The setting of the pressure and the volume with HDS 13/20 and 17/20 is done by turning the pressure/volume regulation on the trigger gun.
Details about the minimum adjustable pressures and water volumes of the different pump types are listed in Chapter 8.14 and 8.1.5.

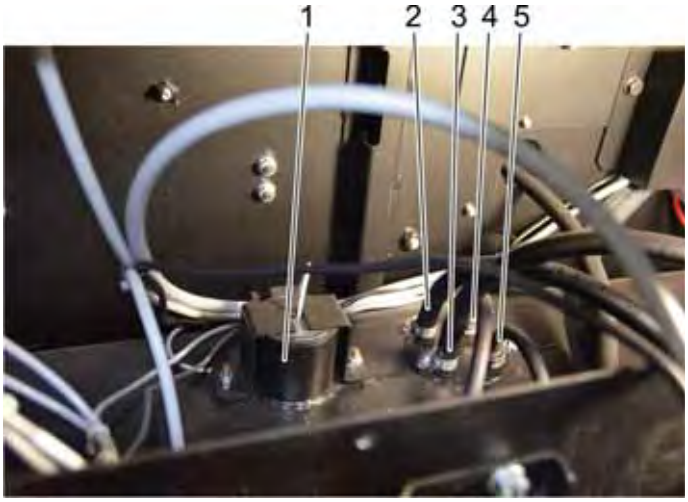
9.23 Fuel tank



1 Tank filler neck with cap

The fuel tank is located in the air casing, which separates the motor compartment from the operator side.

NOTE
If the refuelling is done by means of cans, the accompanying filter sieve should be inserted in the tank filler neck in order to retain potential dirt particles.



View with opened maintenance flap on the right
1 Filling level probe fuel tank
2 Fuel line to the diesel engine
3 Fuel line from the diesel engine
4 Fuel line to the burner
5 Fuel line from the burner

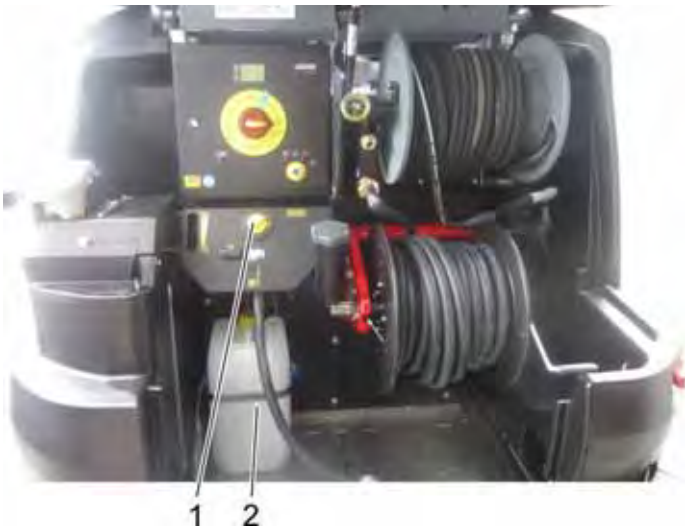
View from below
1 Drain screw fuel tank

The drain screw is located on the bottom of the tank and can be reached from below.

9.24 Detergent dosing unit

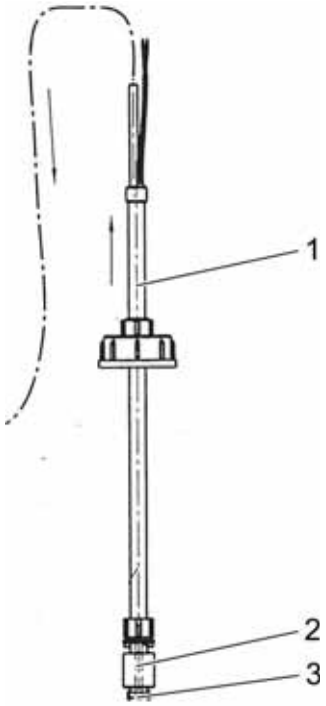
NOTE
This equipment is only available for HDS 13/20 and HDS 17/20.

Detergent is drawn via the dosing valve from the detergent container. The dosing level is adjusted via the dosing valve. With pump operation the solenoid valve before the high-pressure pump opens and injects detergent to the supply water.



1 Dosage valve for detergent
2 Cleaning agent container

By default 20 litre containers are provided.

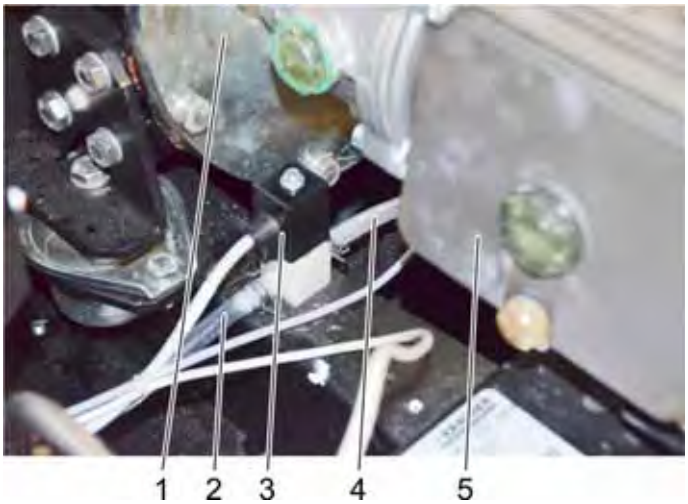


1 Suction lance with screw cap for detergent can
2 Level sensor
3 Suction valve with filter sieve

Level sensor
The level switch contains a reed switch that is operated by means of a magnet in the float.

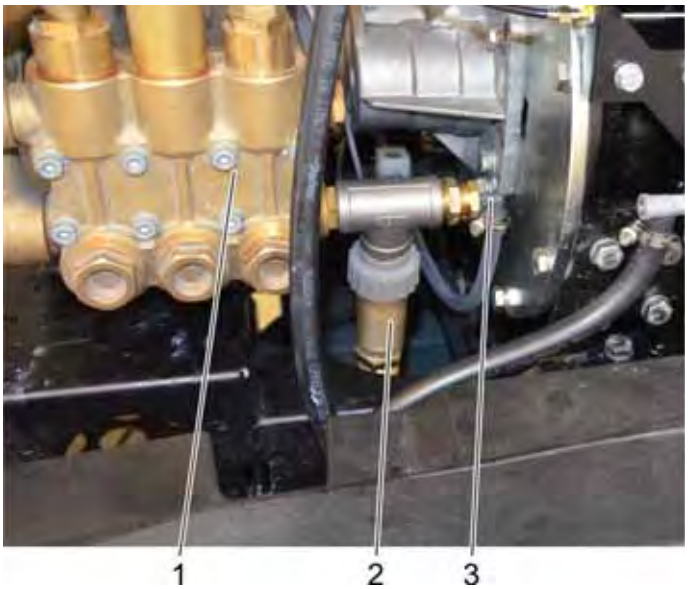
Detergent dosing valve

1 Connection from the detergent tank (labelled with "1")
2 Connection to the pump (labelled with "P")

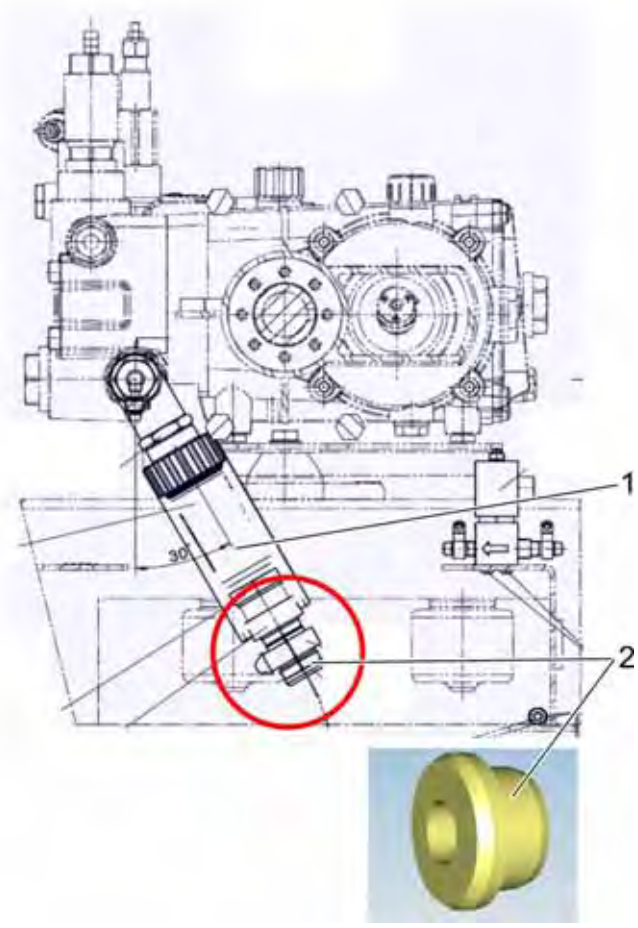


Solenoid valve dosing detergent
1 Motor flange
2 Connection from the detergent tank
3 Solenoid valve
4 Connection to the pump
5 Pump casing

NOTE
The solenoid valves opens subject to the pressure switch of the pump.
If no detergent is desired, the detergent dosing valve must be set to "0".
If the dosing level is too high, foaming in the float container may occur. Reduce the dosing if necessary.



Supply detergent to the high-pressure pump
1 Pump head
2 Supply water with fine filter
3 Injection point detergent



1 Fine filter
2 Aperture

NOTE
In order to improve the suction behaviour of the pump for the detergent, an orifice plate is installed in the inlet to the fine filter.

10 Preparations for service tasks

10.1 Transport

If the trailer needs to be moved for service tasks, this can be done in trailer operation or by means of a crane.

10.1.1 Trailer operation

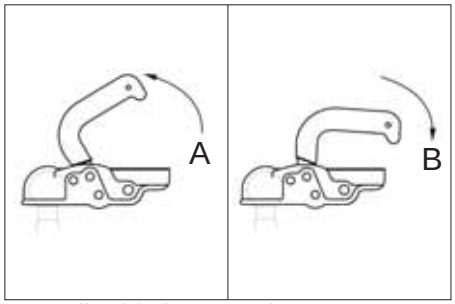
NOTE

The driver, who operates the towing vehicle with trailer on public roads must ensure that he has the appropriate license for this.

⚠ ***DANGER***

When transporting the trailer in public traffic with the water tank half full, the water can swap out or the trailer could even tilt during extreme steering manoeuvers.

➔ Completely fill or empty the water tank. Do not transport with the water tank half full.
➔ Close front and rear cover.
➔ Adjust the height of the drawbar by means of the support wheel to the height of the trailer hitch of the towing vehicle.
➔ Attach the tear-off rope to the towing vehicle.

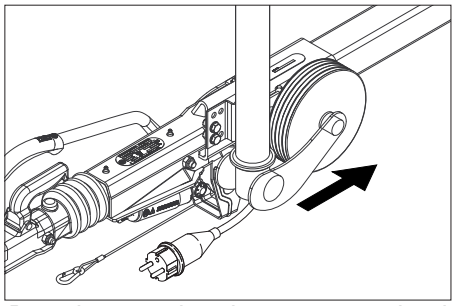


A Trailer hitch opened
B Trailer hitch closed

⚠ ***CAUTION***

Risk of injury and damage! Observe the weight of the appliance when you transport it.

➔ Hitching the towing vehicle: Pull the coupling lever up (open), place the drawbar on the ball, push down the coupling lever (close) until it is horizontal to the drawbar.
➔ Connect the connector of the vehicle lighting.
➔ Rotate the support wheel up by means of the crank.



➔ Make sure that the suppport wheel points in the direction of the trailer when retracted.
➔ Remove the chocks from underneath the wheels and place them in their holders.
➔ Release parking brake.
➔ Check the brake lights, direction indicators, tail lights, and the license plate lighting for proper function.
➔ Check tire pressure (refer to technical data).

NOTE

Local speed limits for vehicles with trailers must be observed and adhered to.

10.1.2 Transport by crane

For lifting it with a crane, the device must be lifted on the lifting eyes.

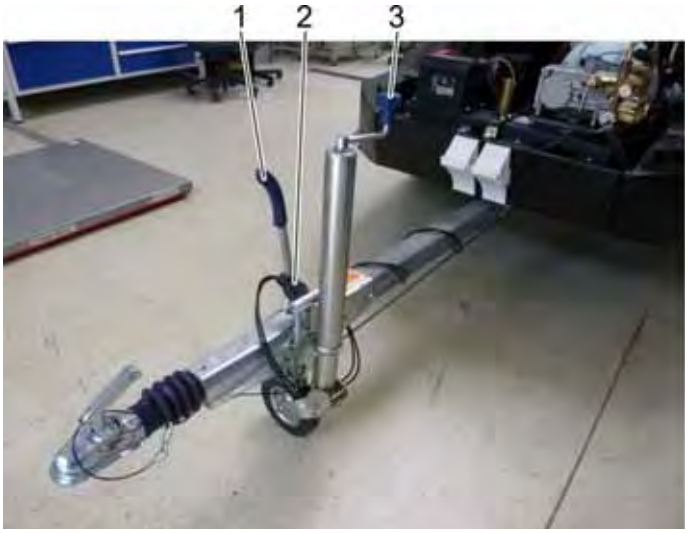
⚠ ***DANGER***

Risk of injury due to machine dropping.

– *Adhere to the local accident prevention guidelines and safety notes.*
– *Check the appliance for crane loading for damage prior to each transport by crane.*
– *Check the lifting unit for damage prior to each transport by crane.*
– *Only lift up the appliance by this mechanism when loading by crane.*
– *Lifting straps and round slings must be at least 2 m long to prevent damage to the appliance hood.*
– *Protect the lifting device from inadvertent load release.*
– *Do not transport any articles on the appliance during the lifting process.*
– *The appliance must only be transported by properly trained crane personnel.*
– *Do stand stand below the suspended load.*
– *Ensure that no persons are present in the immediate vicinity of the crane.*
– *Do not leave the appliance on the crane unattended.*

➔ Check all screws of the appliance for tightness; retighten if necessary.

10.2 Install the device and align it



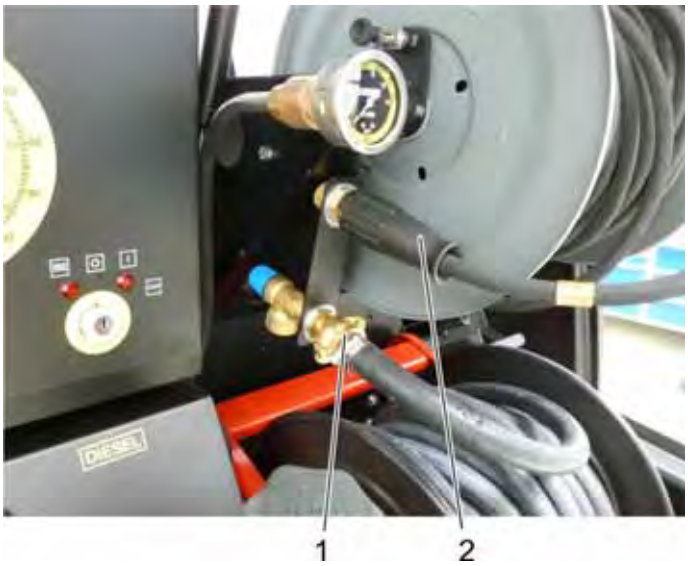
1 Parking brake
2 Plug storage
3 Crank for support wheel adjustment

Choose the installation site in a way that the exhaust gas opening is not covered.

➔ Lock parking brake.
➔ Lower the support wheel by means of the crank.
➔ Remove the tear-off rope from the towing vehicle.
➔ Disconnect the connector from the vehicle lighting and insert it into the plug storage on the drawbar.
➔ Secure the machine with wheel chocks to prevent it from rolling away.
➔ Disconnect the towing vehicle.
➔ Align the appliance horizontally with the support wheel.

ATTENTION

Risk of malfunctions and damages to the appliance. The appliance must be in horizontal position during operation. Place a spirit level on the drawbar for alignment.

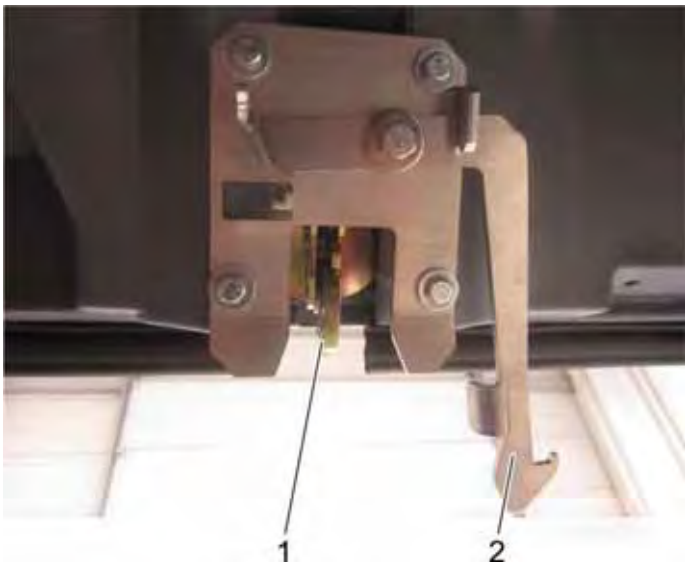


1 Water pipes
2 High pressure hose

For service tasks without lance operation:

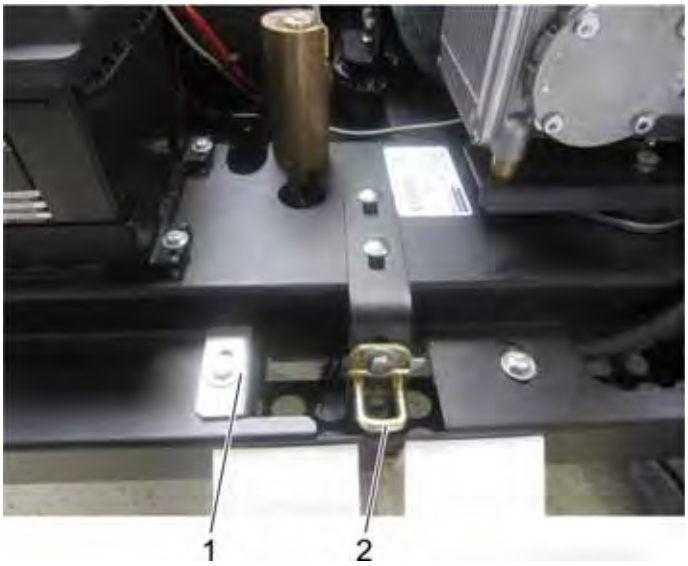
➔ Disconnect the trigger gun from the high-pressure hose.
➔ Connect the high-pressure hose to the frost protection inlet.
➔ Disconnect the water hose from the water supply.
➔ Connect the water hose to the return flow of the frost protection.

10.3 Opening the front cover



View from the inside
1 Lock
2 Catch hook

NOTE
The lock of the front cover is equipped with an additional catch hook in order to prevent unintended opening.
The catch hook must, like with a motorcar, be pushed to the side manually after opening the lock to release the locking mechanism.



1 Angle for locking the catch hook
2 Lock shackle

View with slightly opened front cover
1 Angle for locking the catch hook
2 Catch hook

➔ Open the lock, slightly push down the cover.
➔ Slide the catch hook out of the lock towards the right.
➔ Lift the hood.

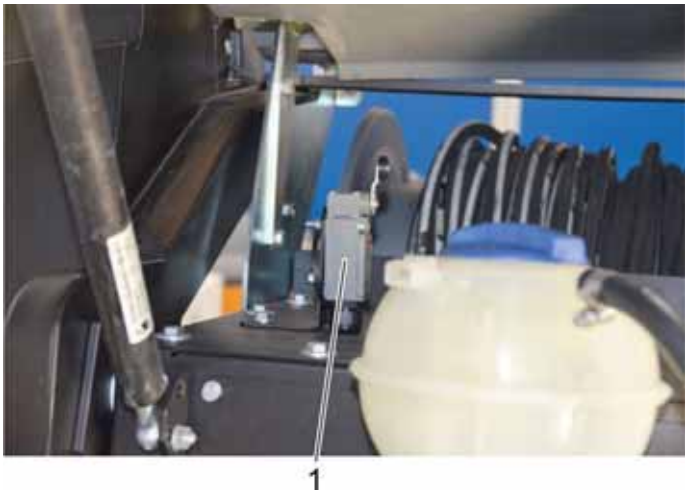
10.4 Service tasks with opened front cover

A safety switch stops the motor upon opening the front cover, starting the motor is not possible when the front cover is open.
In order to still be able to perform maintenance and service tasks while the motor is running, the safety switch must be bridged.

This is necessary, for example, for setting tasks on the burner, for sensor tests, etc.

⚠ ***DANGER***

Danger on account of rotating components, exhaust gas and hot surfaces.
Service tasks with open cover and running motor must only be performed by trained and instructed expert staff!



1 Cover switch (safety switch cover position)

1 Roller switch

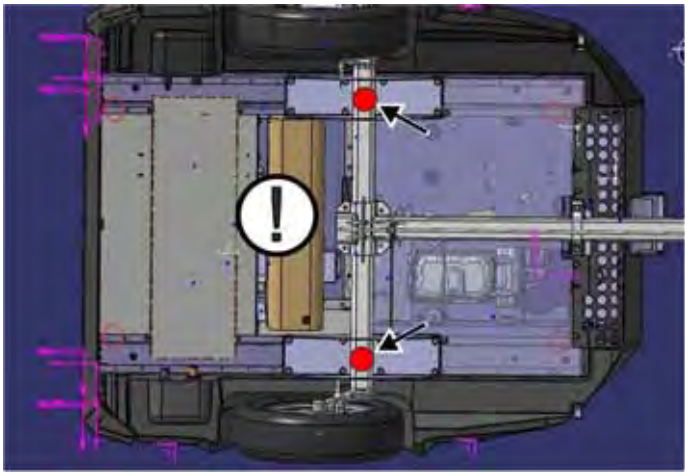
➔ Bridge the roller switch in the "Cover closed" position by means of a cable tie.

10.5 Lifting the trailer from the bottom for maintenance tasks

10.5.1 Lifting with a jack

⚠ DANGER
Danger on account of falling trailer.
When lifting the trailer by means of a jack, ensure that it stands on a solid, level ground!
Ensure that the trailer is secured against rolling away with all wheels that are on the ground.
Ensure that no unauthorised person releases the jack and thus can cause a lowering of the trailer.

NOTE
It is recommended to use an appropriate floor jack as shown.



ATTENTION
Risk of damage to equipment. Use the designated lifting points when lifting the trailer by means of a jack.

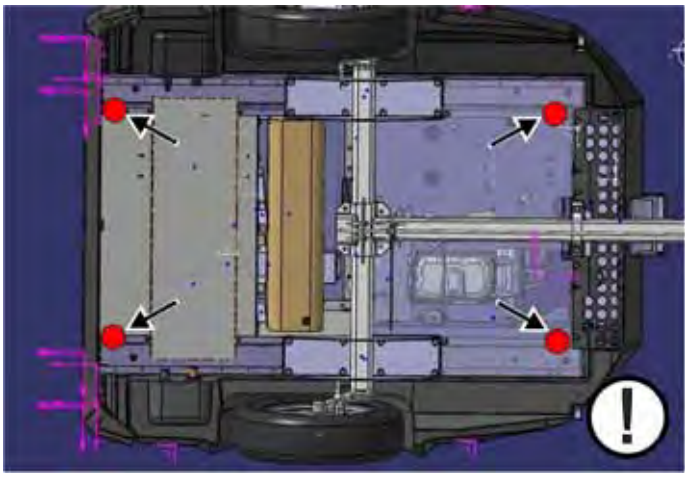
➔ Secure the wheels that remain on the ground against rolling away using wheel chocks.

1 Cross strut of the axle
2 Support point jack

➔ Lift the trailer on the square tube of the cross strut in the area of the suspension.

Exemplary illustration for lifted trailer.

10.5.2 Lifting by means of a car lift



ATTENTION
Risk of damage to equipment. Use the designated lifting points when lifting the trailer by means of a car lift. Ensure that the surrounding plastic parts that are in some cases lower than the frame construction are not damaged! If necessary, equip the lifting arms with secured paddings in order to achieve a necessary height adjustment.

10.6 Dismantling the front plate

For service tasks in the front area of the motor compartment, it may be advisable to remove the front plate in order to enable better access to, for example, the safety block or the fine filter in the pump inlet.

➔ Unscrew the 2 x 3 screws for fastening the front plate at the bottom.

1 Angle for locking the catch hook

➔ Unscrew the 4 screws for fastening the front plate at the top.

NOTE
Mind the angle for the lock of the catch hook, which is secured to the frame by one of the above mentioned screws! Upon installation, slide the angle in the elongated hole all the way to the back and screw it down.

➔ Remove the front plate towards the front.

View with dismantled front plate.

10.7 Dismantling the maintenance flap on the right

The maintenance flap on the right must be dismantled for service tasks on the thermostat switch emission temperature or at the filling level sensor and the fuel lines of the diesel tank.

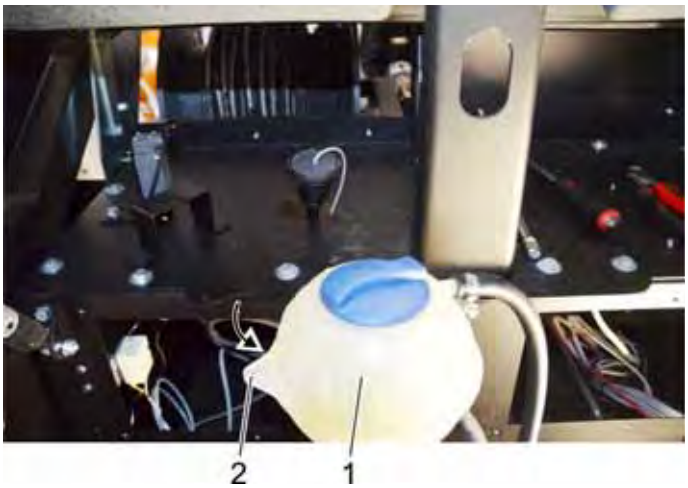
1 Maintenance flap on the right

➔ Pull the cable off the ignition transformer at the burner cover.
➔ Unscrew the 6 screws for the fastening of the maintenance flap on the air casing.

ATTENTION
Risk of damage to equipment. Ensure that the cables are not damaged upon unthreading.

➔ Unthread the maintenance flap.

ATTENTION
Risk of damage to equipment. The exhaust temperature sensor in the chimney is connected to the thermostat switch with a capillary tube. This tube must not be kinked, as otherwise the sensor will be damaged!

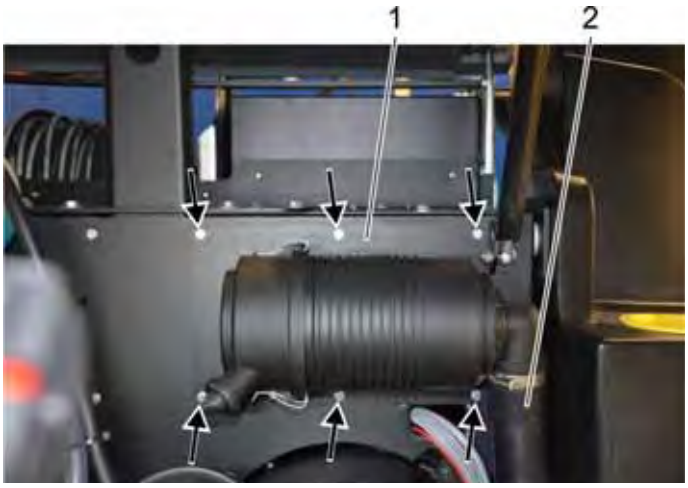


1 Expansion tank motor coolant
2 Screw

NOTE
If necessary, unscrew a screw from the expansion tank und swivel the container away from the maintenance flap.

10.8 Dismantling the maintenance flap on the left

For service tasks on the thermostat switch water temperature or on the inverter, the maintenance flap on the left must be dismantled.



1 Maintenance flap on the left
2 Hose air filter - motor

➔ If necessary, remove the hose from the air filter.
➔ Unscrew the 6 screws for the fastening of the maintenance flap on the air casing.

➔ Unthread the maintenance flap.

ATTENTION
Risk of damage to equipment. Ensure that the hose of the air filter is not damaged.

10.9 Disassembly of the PVC protective plates for service tasks from the bottom

For service tasks from the bottom, the two PVC protective plates must be dismantled.

NOTE

For the oil change of the motor it is enough to remove the left PVC plate.

For the disassembly of the booster heater, it is enough to remove the right PVC plate.

For tasks on the heat exchanger as well as for draining the coolant, both PVC plates must be removed.

1 Screw

➔ Unscrew the 3 screws for the fastening of the PVC plates on the frame.
➔ Carefully pull out the PVC plate.

NOTE

Pay attention to how the PVC plate above the black plate in the centre of the vehicle is inserted, so that it can be re-installed correctly.

Dismantled PVC plate.

10.10 Water connection

For connection values refer to technical specifications

10.10.1 Operation with external water supply

➔ Close stop cock water tanks.
➔ Uncoil the water hose from the hose reel and connect it to the water supply (e.g. tap).
➔ Open the water supply.
The float valves in the supply regulate the filling level in the float container.

10.10.2 Operation with water from the water tanks

➔ Open stop cock water tanks.
➔ Uncoil the water hose from the hose reel and connect it to the water supply (e.g. tap).
➔ Open the water supply.
The water tanks are filled via the float container. When the water tanks are filled, the float valve in the float container closes.
➔ Shut off water supply.
➔ Disconnect the water hose from the water supply.
➔ Coil the water hose onto the hose reel.

10.11 Refill fuel

⚠ ***DANGER***
Risk of explosion! Only refill diesel oil or light fuel oil. Unsuitable fuels, e.g. petrol, are not to be used.
⚠ ***CAUTION***
Please do not allow diesel to enter the environment! Protect the ground in case of spills and clean them up in an environmentally responsible way.

➔ Open fuel filler cap.
➔ Fill in diesel fuel via the filling nozzle of the fuel tank.
➔ Close tank lock.
➔ Wipe off spilled fuel.

NOTE
If the refuelling is done by means of cans, the accompanying filter sieve should be inserted in the tank filler neck in order to retain potential dirt particles.
For this purpose, detach the loss prevention device from the fuel filler cap and insert the filter sieve. After removal of the filter sieve, clip the loss prevention device back onto the tank filler neck.

10.12 Refill detergent

HDS 13/20, HDS 17/20 only:
⚠ ***DANGER***
Risk of injury!
– Use Kärcher products only.
– Under no circumstances fill solvents (petrol, aceton, diluting agent etc.)
– Avoid eye and skin contact.
– Observe safety and handling instructions by the detergent manufacturer.

Kärcher offers an individual cleaning and care appliances program.
Your dealer will consult you gladly.
➔ Refill detergent.

10.13 Refill liquid softener

– The liquid softener highly effectively prevents the calcification of the heating coil during operation with hard tap water. It is dosed into the supply in the float container drop by drop.
– The metering is set to medium water rigidity by the manufacturer

➔ Open filling hole for liquid softener.
➔ Refill liquid softener.
➔ Close filling hole for liquid softener.

NOTE
Even with operation via the two 250l water tanks, the dosing of the liquid softener takes place via the float container. As the tanks are connected to each other, there is still enough liquid softener getting into the water circuit to protect the heating coil.

11 Basic settings and service procedures

⚠ DANGER

Prior to all work on the device that can be performed without the drive running, switch off the key switch and remove the key.

ATTENTION

Risk of damage to equipment. With all service tasks, ensure that no parts fall into the booster heater through the chimney.

11.1 Axle / drawbar

11.1.1 Lubricate the brake on the drawbar

➔ Press lubricant into both lubrication nipples (arrows) using a commercial grease press.

NOTE

The lubrication interval depends on the mileage of the trailer; regular checks of the smoothness are necessary for this purpose.

11.1.2 Lubricating the crank drive of the support wheel

➔ Press appropriate grease into the lubrication nipple (arrow) using a commercially available grease gun.

NOTE

The lubrication interval depends on the general use of the trailer; regular checks of the smoothness are necessary for this purpose.

11.1.3 Replacing wheel

➔ Activate the emergency brake.
➔ Slightly loosen 5 screws.
➔ Lift the trailer.
➔ Unscrew 5 screws, remove wheel.
➔ Tighten new wheel in a crosswise sequence using a torque wrench.

Tightening torque for wheel bolts on steel rims		
Spanner size	Thread	Torque
19	M12x1.5	110-120Nm

NOTE

Only approved tyres/wheel rims that are listed in the registration certificate may be used (type approved pursuant to R48):

– Tyres: 185R14C 104N TL
– Wheel rim: 5.5Jx14 H2 5/66.6/112 ET 30
– Load capacity complete: 900kg/wheel

11.2 Lights

11.2.1 Front light - replacing the lamps

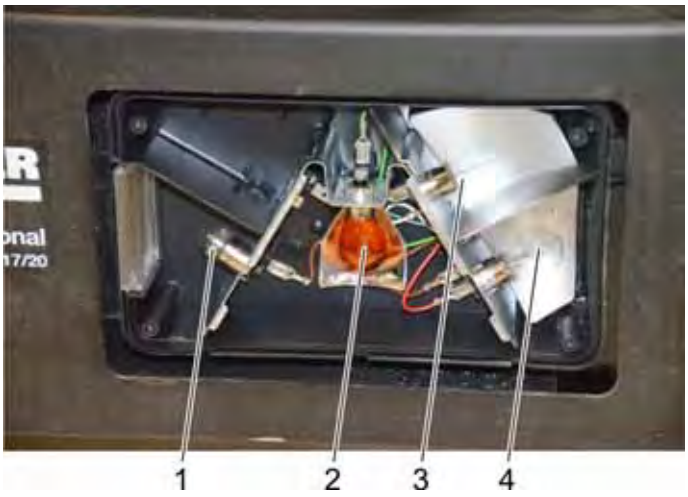
➔ Unscrew 2 screws.
➔ Remove bowl of the lamp.

➔ Change lamp.

Lamp type:
C5W-12V, part number 7.651-009.0

11.2.2 Rear light - replacing the lamps

➔ Unscrew 4 screws.
➔ Remove bowl of the lamp.



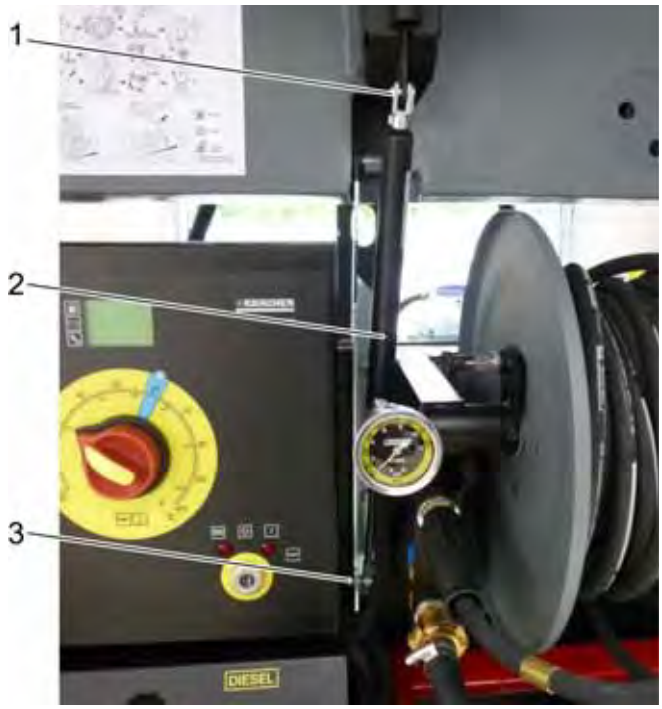
➔ Change lamp.

Lamp type:
1 License plate lights
R10W-BA15s-12V, part number 7.651-006.0
2 Direction-indicator lamp
PY21W-BAU15s-12V, part number 7.651-027.0
3 Reverse light
P21W-BA15s-12V, part number 7.651-014.0
4 Rear light / brake light
P21/5W-BAY15d-12V, part number 7.651-025.0

11.3 Covers

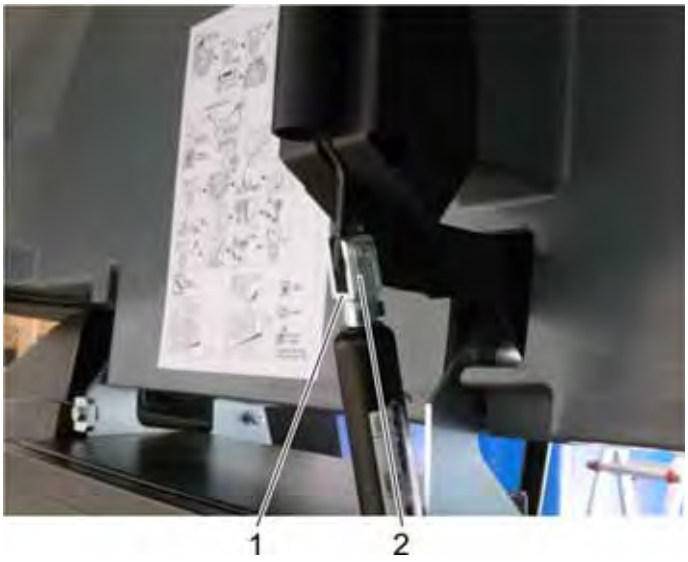
11.3.1 Replace the gas pressure damper

Rear cover



1 Fastening bolt with fork on the cover
2 Gas pressure damper
3 Fastening bolt with ball head on air casing

NOTE
The piston rod is installed towards the cover side.



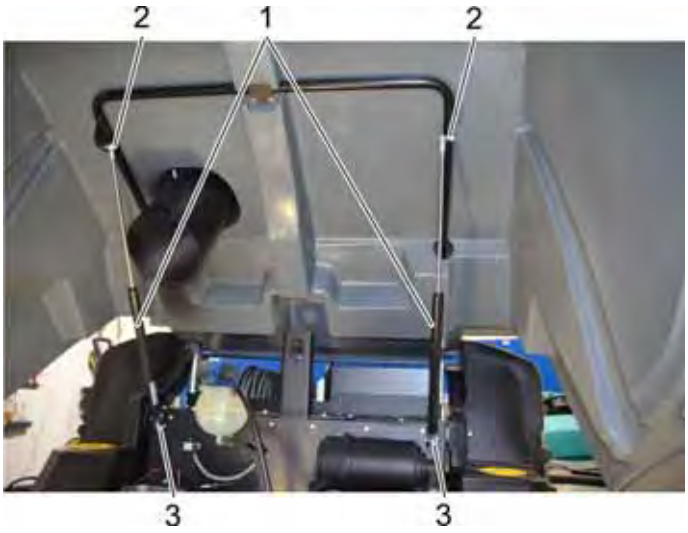
1 Fastening bolt with fork on the cover
2 Splint

⚠ ***CAUTION***
Risk of damage!
Secure the cover against falling shut uncontrolledly!
Do not open the hood too far, this may damage the hood and the appliance. Ensure that the appliance is not lifted up with the hood. The hood fastener is not suitable for this kind of load and can tear.

➔ Fastening at the top (fork): Push the cotter out on both sides, pull out the bolt.
➔ Fastening at the bottom (ball head): Unscrew nut.
➔ Exchange the gas pressure damper.

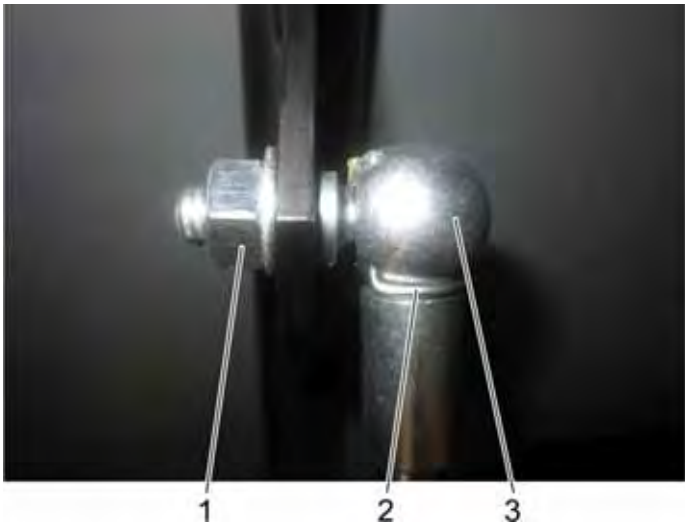
NOTE
Ensure that the gas pressure damper runs in a straight line; if necessary, adjust with lock nut.

Front cover



1 Gas pressure damper
2 Fastening bolt with ball head on the cover
3 Fastening bolt with ball head on air casing

NOTE
The piston rod is installed towards the air casing side.



1 Nut with washer
2 Splint
3 Ball head

⚠ ***CAUTION***
Risk of damage!
Secure the cover against falling shut uncontrolledly!
Do not open the hood too far, this may damage the hood and the appliance. Ensure that the appliance is not lifted up with the hood. The hood fastener is not suitable for this kind of load and can tear.

➔ Pull the cotter out using a pointed object.

➔ Push the ball head out of the retainer by slightly hitting it.
➔ Repeat the same procedure on the opposite side of the gas pressure damper and exchange the gas pressure damper.

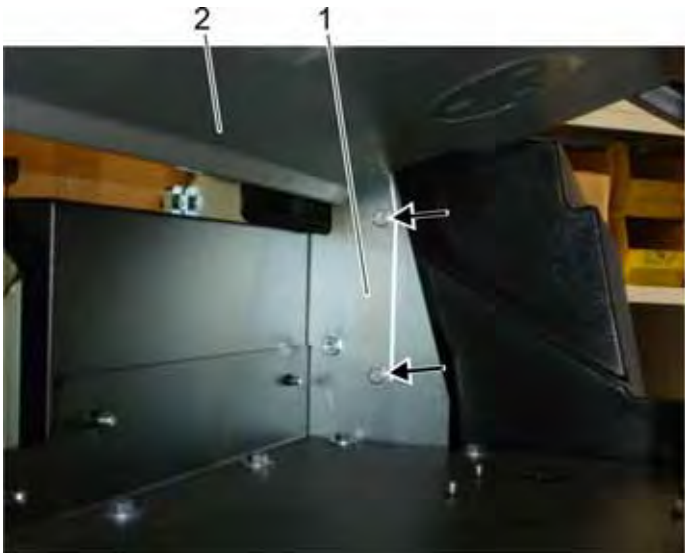
11.3.2 Dismantling covers

NOTE
The disassembly of the two covers is similar and is only illustrated exemplarily based on the front cover.

⚠ ***CAUTION***
Risk of damage!
Secure the cover against falling shut uncontrolledly!
Always have at least two people performing these tasks!
Consider the weight of the covers: Front cover approx. 50kg, rear cover approx. 30kg!

1 Support right
2 Hood

➔ Separate the gas pressure damper from the cover at the top, see previous chapter.
➔ Unscrew the two screws of the holder.



1 Support left
2 Hood

➔ Unscrew the two screws of the holder.

➔ Carefully remove the cover and put it down in a clean, secure place.

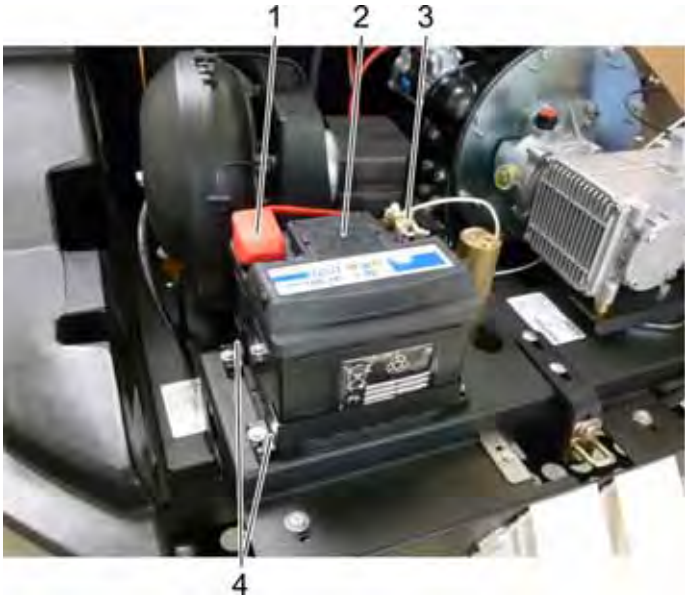
11.4 Battery / inverter

11.4.1 Charge / replace battery / check fluid level

⚠ ***WARNING***
Risk of injury!
Battery acid is very corrosive! Always wear acid-resistant goggles, gloves and an apron when working with battery acid.
Never charge the battery in the vicinity of open flames or igniting sparks.
The battery may only be charged in rooms that are sufficiently ventilated.
Depending on the battery type, the acid level might need to be checked.
The motor must be turned off to charge the battery.

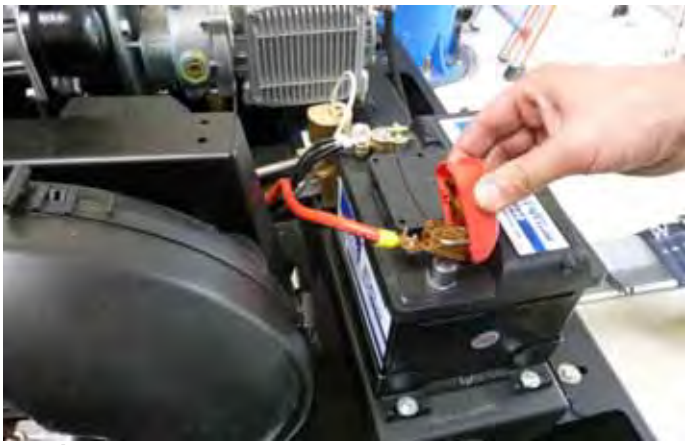
⚠ ***CAUTION***
Risk of damage!
Prior to connecting the charger, the connecting cables to the controller must be disconnected from the battery. Otherwise, the controller could be damaged!

⚠ ***WARNING***
Risk of injury!
Never connect frozen batteries to charge them. Risk of explosion!
Prior to charging, thaw the battery and warm to at least 16 °C.



Battery 12V, 36Ah
1 Battery terminal (+), red protective cover
2 Battery (voltage and capacity, see "Specifications“)
3 Battery terminal (-), black
4 Battery holder

➔ In order to access the connection of the positive terminal, fold up and remove the red protective cover.



⚠ ***CAUTION***
Risk of damage!
Do not place tools on top of the battery if the protective cover has been removed, as this could lead to a short circuit.

Load

⚠ ***WARNING***
Risk of injury!
Risk of explosion due to sparks.
The following sequence of action steps must be adhered to.
Do not transpose the connecting cable. Risk of cable fire!

➔ Disconnect the connecting cable from the battery at the negative terminal.
➔ Disconnect the connecting cable from the battery at the positive terminal.
➔ Connect positive terminal cable from the charger to the positive pole connection on the battery.
➔ Connect the negative terminal cable of the charger to the earth in the motor compartment.
➔ Plug in mains connector and switch on charger.
➔ Charge battery using lowest possible level of charging current.
➔ Disconnect the charger in the reverse order after the charging process is completed.
➔ Connect the connecting cable to the positive terminal on the battery.
➔ Connect the connecting cable to the negative terminal on the battery.

Replace

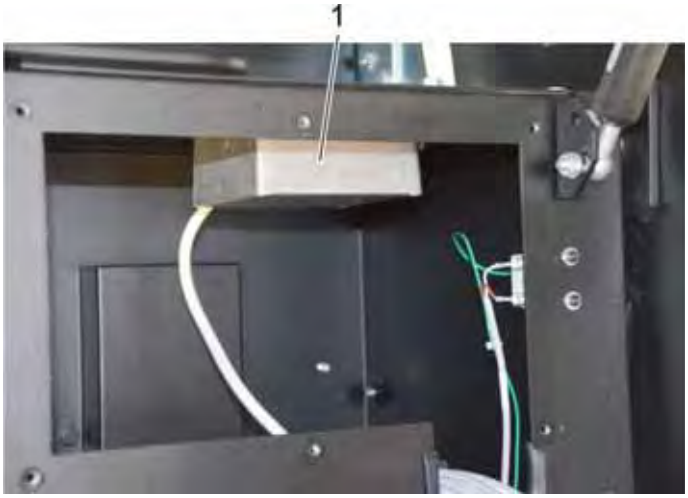
⚠ ***WARNING***
Risk of injury!
Risk of explosion due to sparks.
The following sequence of action steps must be adhered to.
Do not transpose the connecting cable. Risk of cable fire!

➔ Disconnect the connecting cable from the battery at the negative terminal.
➔ Disconnect the connecting cable from the battery at the positive terminal.
➔ Unscrew the battery holder.
➔ Replace batteries.
➔ Screw on the battery holder.
➔ Connect the connecting cable to the positive terminal on the battery.
➔ Connect the connecting cable to the negative terminal on the battery.

Check the fluid level

ATTENTION
Regularly check the fluid level in acid-filled batteries.
➔ Unscrew all cell caps.
➔ Where fluid level is too low, top up cells to the mark provided with distilled water.
➔ Charge battery.
➔ Screw in cell caps.

11.4.2 Replace the inverter



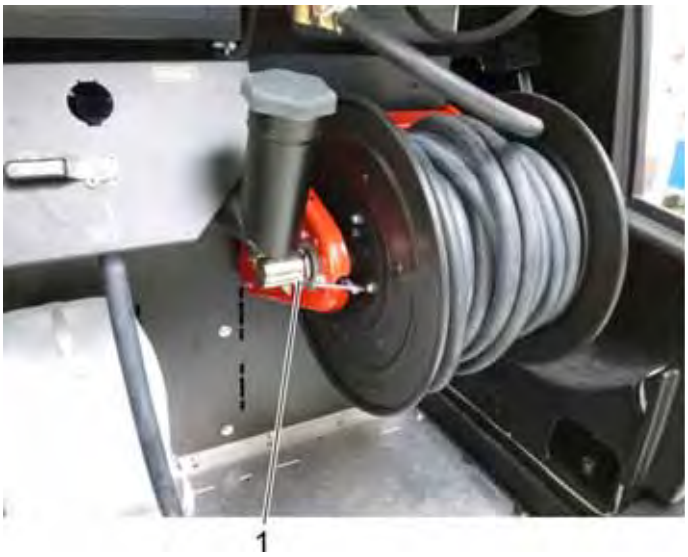
View with opened maintenance flap on the left
1 Inverter

➔ Dismantle the maintenance flap on the left.
➔ Disconnect the supply voltage and connection 24V AC in the control cabinet.
➔ Unscrew 4 screws from the bottom.
➔ Replace the inverter. Observe the cable run with the electrical connection!

NOTE
Mind the correct polarity upon the connection, as the inverter will otherwise be without any function!

11.5 Water inlet

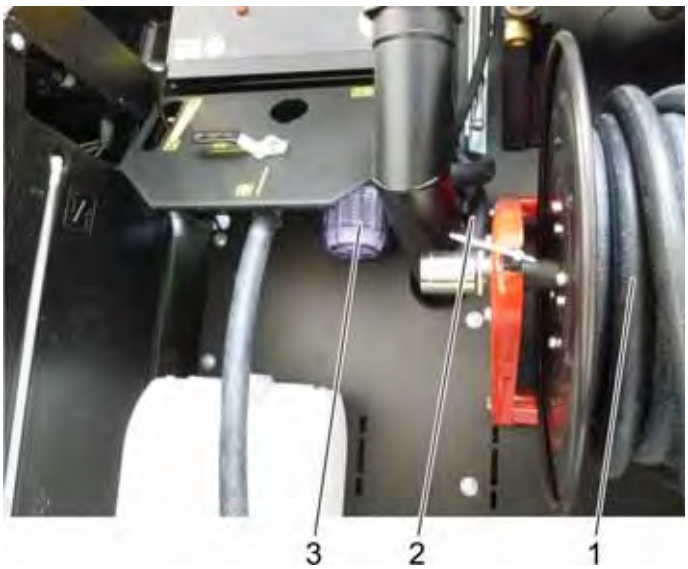
11.5.1 Lubricating the rotating grommet low-pressure hose reel



1 Lubricating nipple rotating grommet

➔ Grease the rotating grommet by means of a commercially available grease gun.

11.5.2 Clean water filter.



1 Low-pressure hose drum
2 Hose water supply
3 Water filter

➔ Disconnect the external water supply from the mains.
➔ Empty the trough area.
➔ Unscrew the filter cup.
➔ Take out the filter inlay.
➔ Clean filter insert or replace if too dirty.
➔ Install the filter cup and hand-tighten it.

NOTE
Check for leaks as soon as water is applied again.

11.6 Liquid softener

11.6.1 Cleaning the level switch

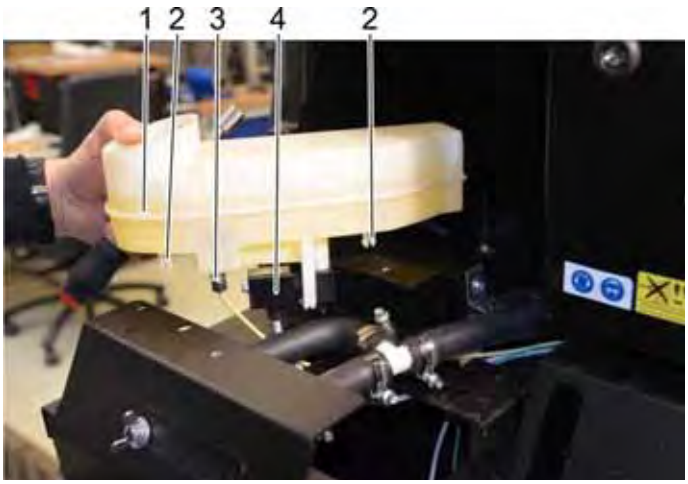
1 Liquid softener reservoir
2 Level sensor

➔ If necessary, clean the magnetic ring of the level switch so that it can easily float on the guide pin.

11.6.2 Exchanging the level switch / dosing valve

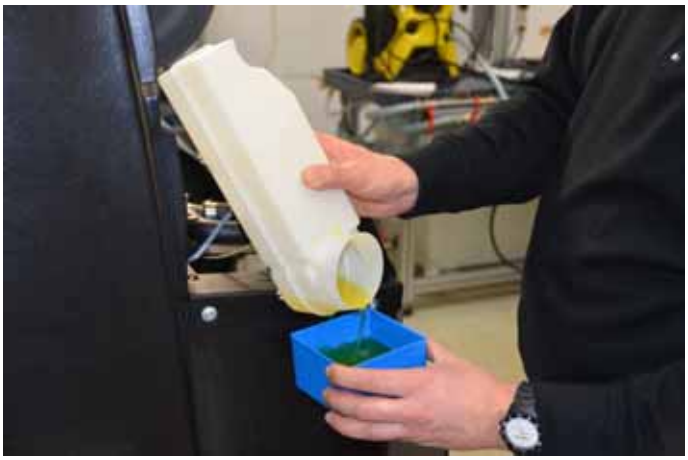
➔ Unscrew the screws.

➔ Remove the console with the cover from the liquid softener container.



1 Container liquid softener
2 Fastening clips
3 Level switch liquid softener
4 Dosing valve

➔ Unclip the container from the anchor.



➔ Empty the container, contain liquid softener.

1 Bracket
2 Dosing valve

➔ Carefully push the support to the side.
➔ Pull the injection unit out of the container bottom.
➔ If necessary, exchange the injection unit. Observe the cable run with the electrical connection!

1 Level switch liquid softener

➔ Pull the level switch out of the container bottom.
➔ If necessary, exchange the level switch. Observe the cable run with the electrical connection!

NOTE
If spare parts are required, the container is available complete with the level switch.

11.7 Swimmer tank

11.7.1 Exchanging float valves

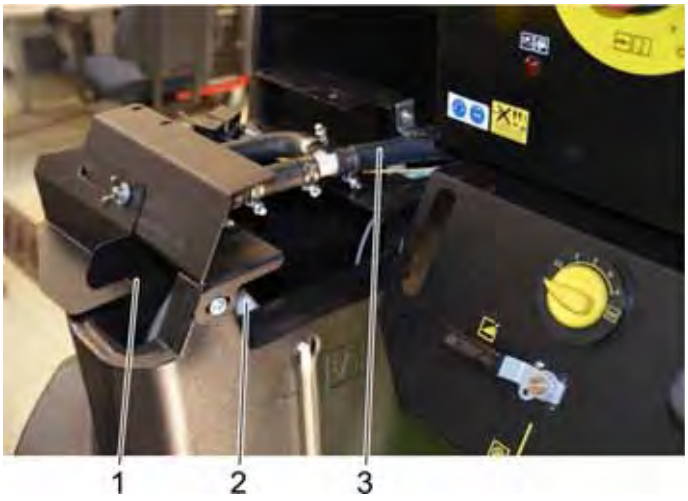
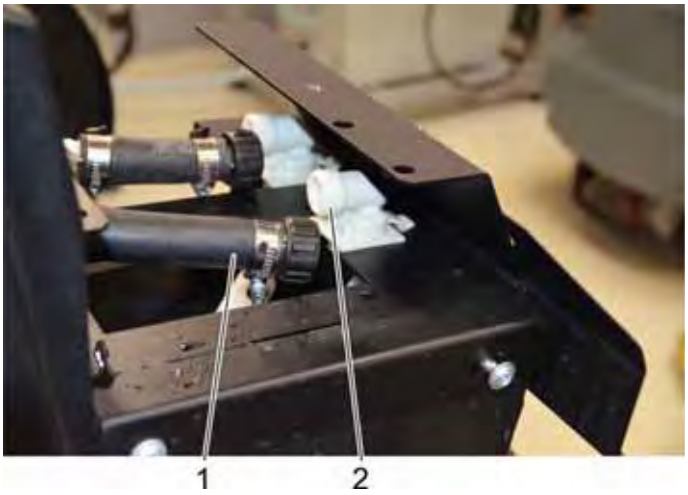


Illustration with dismantled container for liquid softener
1 Filler neck
2 Swimmer ball
3 Water inlet

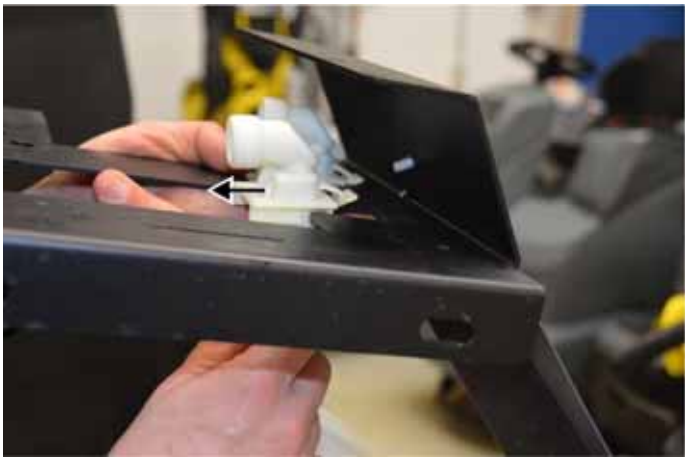
➔ Dismantle container for the softener.
➔ Loosen screws.

➔ Unscrew the screws.



1 Inlet hose
2 Connection float valve

➔ Detach the supply hoses from the two float valves.



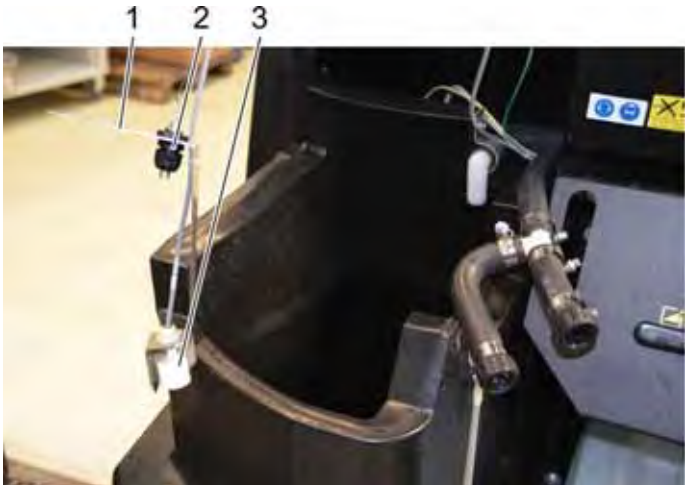
➔ Lift the locking catch on the float valve.
➔ Push out the float valve.

1 Swimmer valve

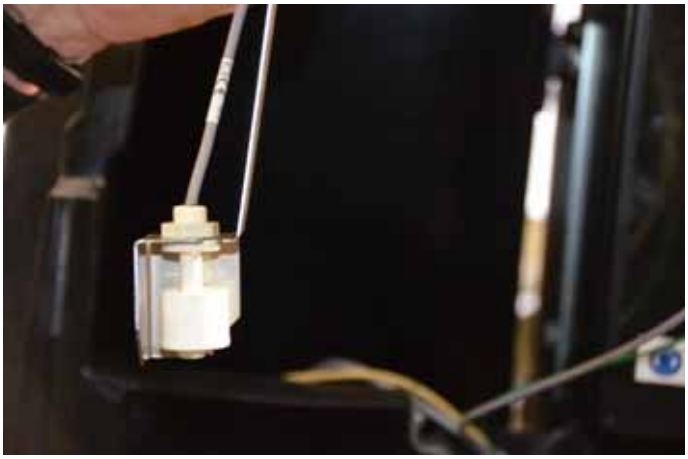
11.7.2 Exchanging the level switch / temperature sensor

Illustration with dismantled float valves.

➔ Unscrew the holder for the temperature sensor and level switch in the lower area of the float container.

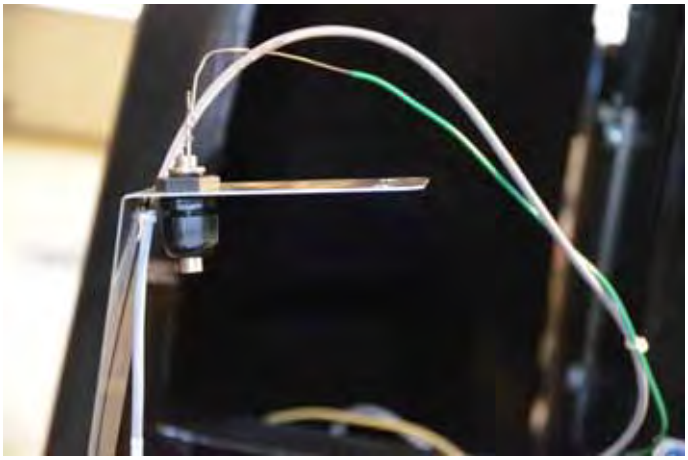


1 Support
2 Temperature sensor water in the float container (green cable)
3 Level switch float container (grey cable)



Level switch float container
➔ If necessary, loosen nut, replace sensor.
➔ Observe the cable run with the electrical connection!

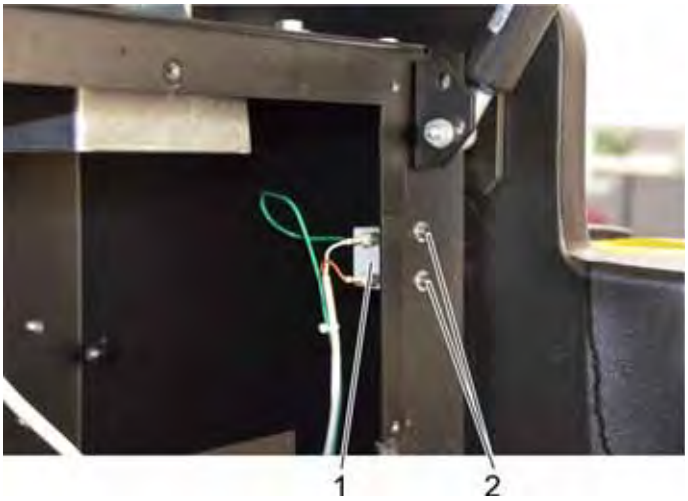
NOTE
Upon installation, ensure that the quadrangular protective casing of the level switch immerses into the recess of the float container.



Temperature sensor water in the float container
➔ If necessary, loosen nut, unscrew the sensor from the screwed cable gland and exchange it.

NOTE
When changing the temperature sensor, it must be disconnected from the thermostat switch first.
Observe the route of the installation!

ATTENTION
Risk of damage to equipment. The temperature sensor in the float container is connected to the thermostat switch with a capillary tube. This tube must not be kinked, as otherwise the sensor will be damaged!



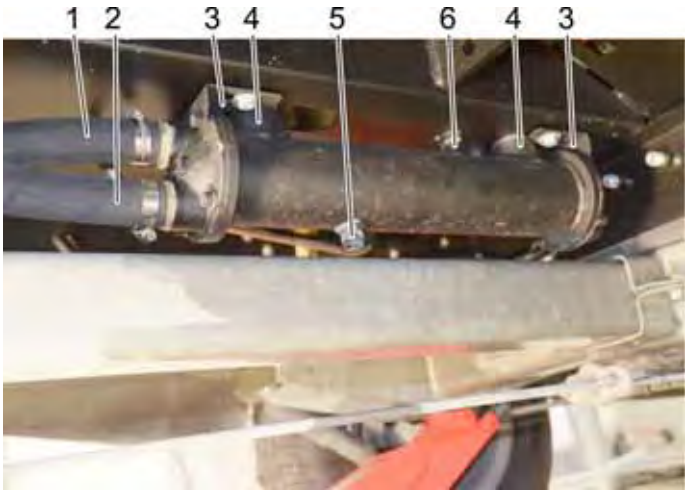
View with opened maintenance flap on the left
1 Thermostat switch water temperature in the float container
2 Screw

➔ Unscrew the maintenance flap on the left.
➔ Upon changing the temperature sensor: disconnect it at the thermostat switch.
➔ Upon replacement with thermostat switch:
Open screws, remove the holder and unscrew the thermostat switch from the holder.
Disconnect the cable connection.

NOTE
Observe the cable run with the electrical connection!

11.8 Heat exchanger (16kW)

11.8.1 Replacing the heat exchanger



1 Supply from the water distribution
2 Supply to the high-pressure pump
3 Support
4 Connection coolant hose
5 Drain screw coolant
6 Connection from the expansion tank motor coolant

➔ Lift the trailer, disassembly of both PVC protective plates at the bottom.
➔ Open the drain screw coolant and drain the coolant into a container.

NOTE
When draining the coolant, observe the necessary environmental regulations, dispose of coolant properly!

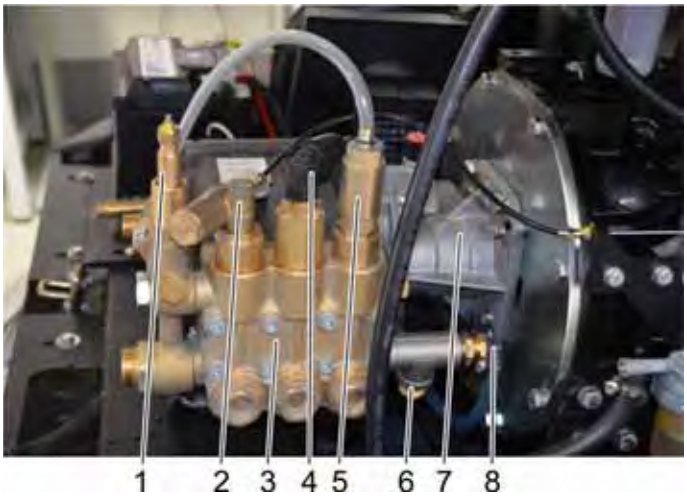
➔ Disconnect all hose connections from the heat exchanger.
➔ Uninstall the high-pressure line from the safety block to the booster heater.
➔ Unscrew the holder of the heat exchanger from the bottom plate.
➔ Unthread the heat exchanger on the side (towards the booster heater).

11.8.2 Clean heat exchanger

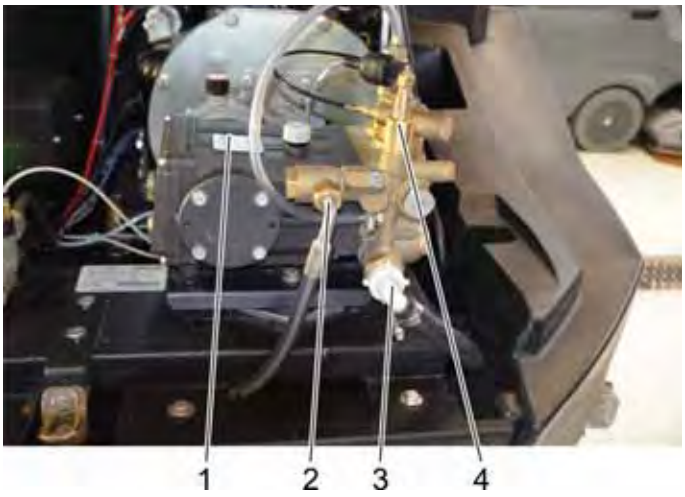
➔ Lift the trailer, disassembly of both PVC protective plates at the bottom.
➔ Uninstall the high-pressure line from the safety block to the booster heater.
➔ Unscrew the holder of the heat exchanger from the bottom plate.
➔ Unscrew the two covers front / back.
➔ Unthread the heat exchanger on the side (towards the booster heater).
➔ Clean the bundle of pipes with compressed air or cleaning sticks.

11.9 High-pressure pump

Overview pump types 13/20 and 17/20



1 Overflow
2 Speed control idle mode / full load
3 Pump head
4 Pressure switch
5 Valve set frost protection
6 Supply water with fine filter
7 Intermediate gear
8 Detergent supply to the pump



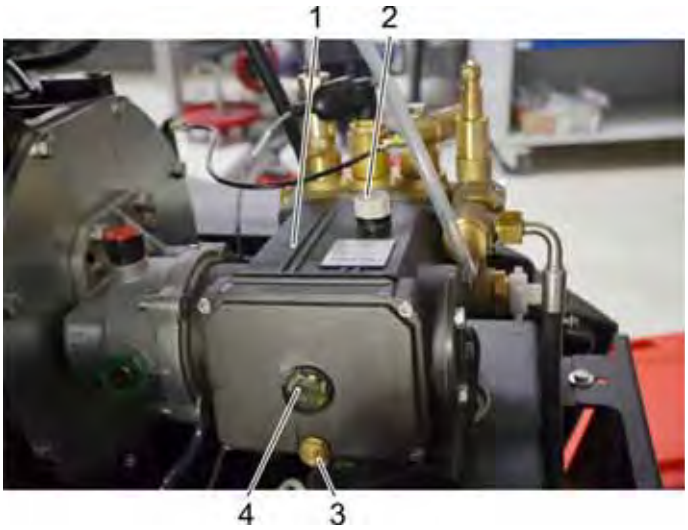
1 Pump casing
2 Outlet high pressure
3 Outlet return line to the float container
4 Overflow

Overview pump types 9/50 and 13/35

1 Pump casing
2 Oil filling nozzle
3 Overflow
4 Speed control idle mode / full load
5 Pressure switch
6 Valve set frost protection
7 Pump head
8 Outlet return line to the float container
9 Outlet high pressure

NOTE
The following pictures apply exemplarily! If the various pump types differ, the relevant shots are illustrated.

11.9.1 Check oil level and refill oil



1 Pump casing
2 Cover filling hole
3 Oil drain screw
4 Oil sight glass

➔ Check the oil level in the oil-level gauge of the pump casing.
➔ If the oil level is below the oil looking glass, add oil.
➔ Fill the appropriate amount of oil into the filling hole.
➔ Check the oil level as described above.
➔ Repeat this procedure as often as necessary until the oil level is in the centre of the oil looking glass.

	prescribed oil grades
Pump gear	350/500bar pump: SAE 90 200bar pump: 15 W40

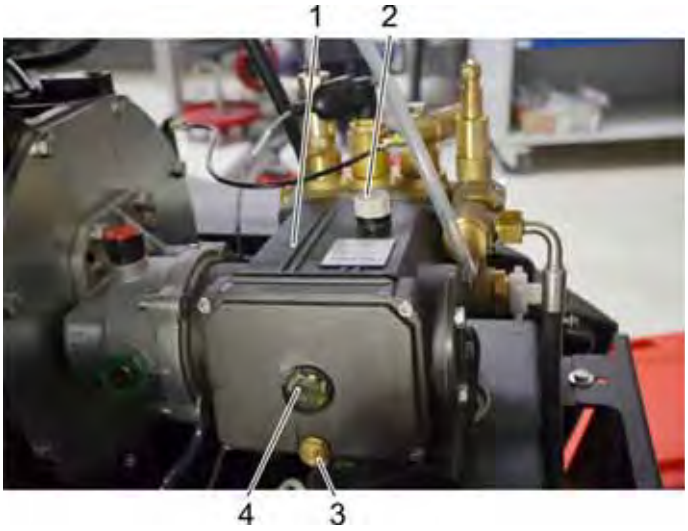
11.9.2 Oil change in high pressure pump

NOTE

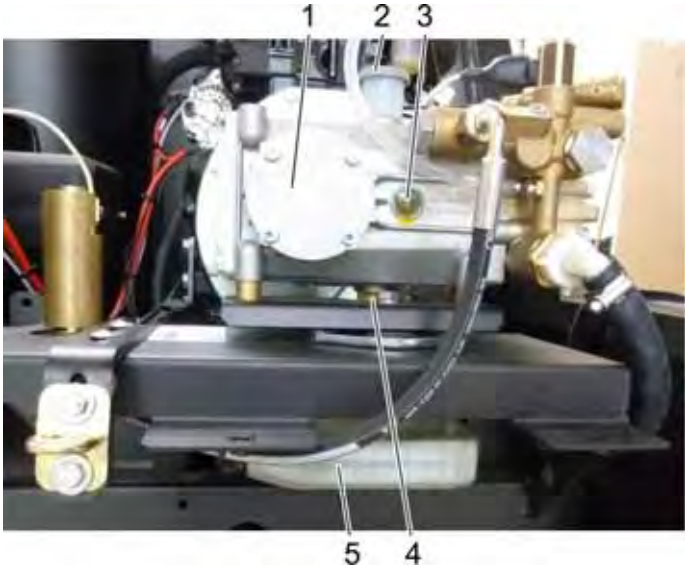
Dispose of the waste oil according to the local provisions.
Replace the oil while the motor has operating temperature.
Align the appliance horizontally prior to the oil change.

⚠ ***CAUTION***

Risk of burns when draining hot oil.



Pump types 13/20 and 17/20
1 Pump casing
2 Cover filling hole
3 Oil drain screw
4 Oil sight glass

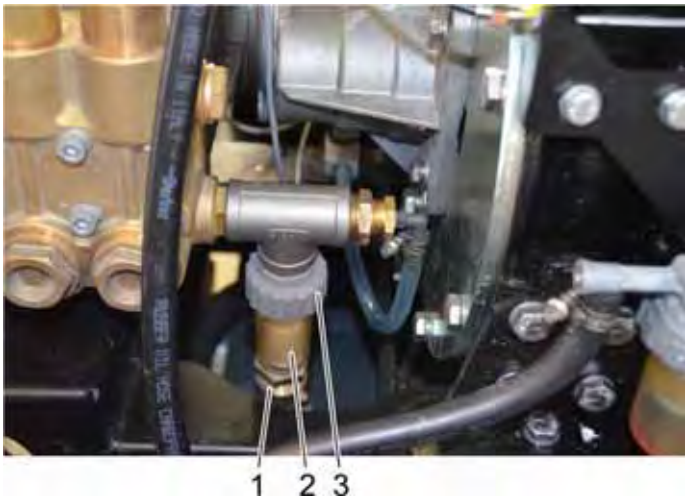


Pump types 9/50 and 13/35
1 Pump casing
2 Cover filling hole
3 Oil sight glass
4 Oil drain screw
5 Oil catch pan

➔ Place a suitable container below the pump gear.
➔ Turn out the oil drain screw.
➔ Connect drain hose.
➔ Drain the waste oil completely.
➔ Remove drain hose.
➔ Screw in the oil drain screw.
➔ Turn the oil fill screw out.
➔ Refill fresh oil.
➔ Check oil level.
➔ Screw in oil filling screw.

	Oil fill volume and type
Pump gear	350/500bar pump: 1.3ltr SAE 90 200bar pump: 1.3 ltr 15 W40

11.9.3 Cleaning the fine filter



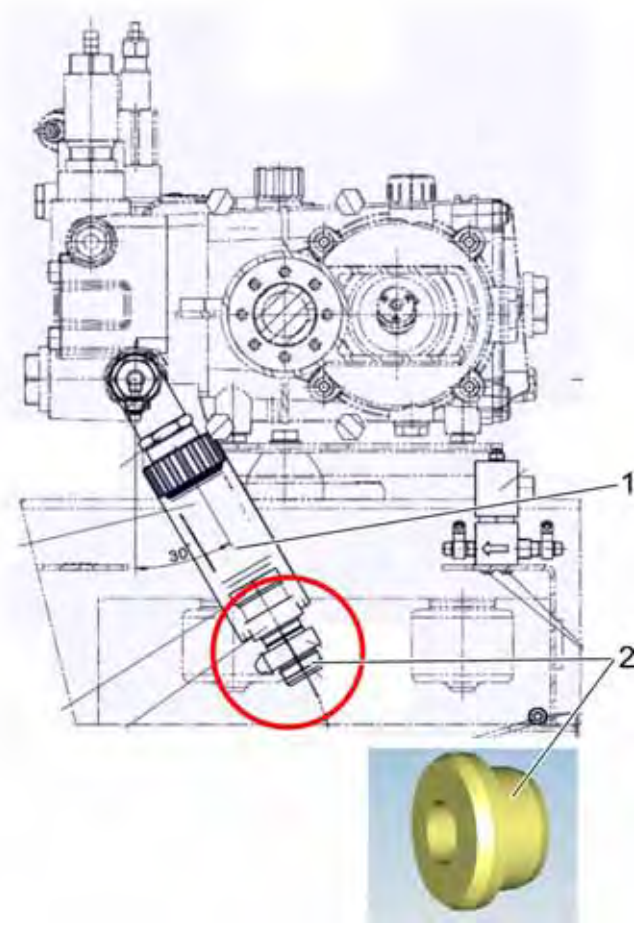
1 Union nut water hose
2 Fine filter
3 Lock nut filter casing

➔ Unpressurize the appliance.
➔ Open the union nut of the water supply, remove hose.

NOTE
It is recommended to dismantle the front plate to provide better access to the lower area of the fine filter.

➔ Unscrew the complete casing, including the lock nut.

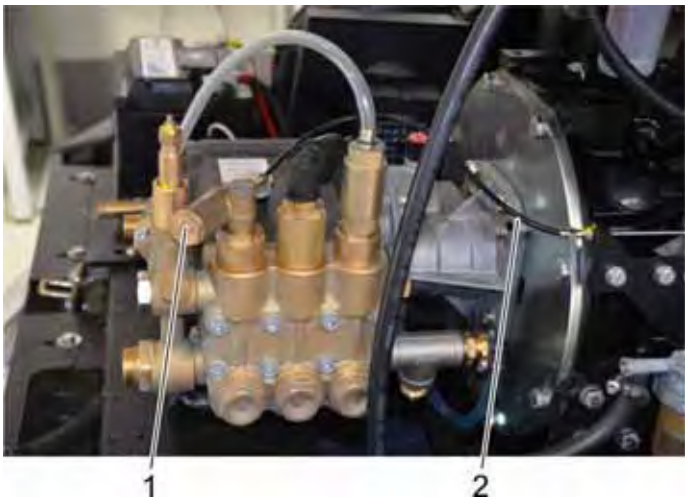
➔ Open the lock nut and remove the filter inlay.
➔ Clean the filter with clean water or compressed air.



1 Fine filter
2 Aperture

NOTE
Make sure not to lose the orifice plate in the inlet of the fine filter!

11.9.4 Check and adjust the speed control full load / idle mode



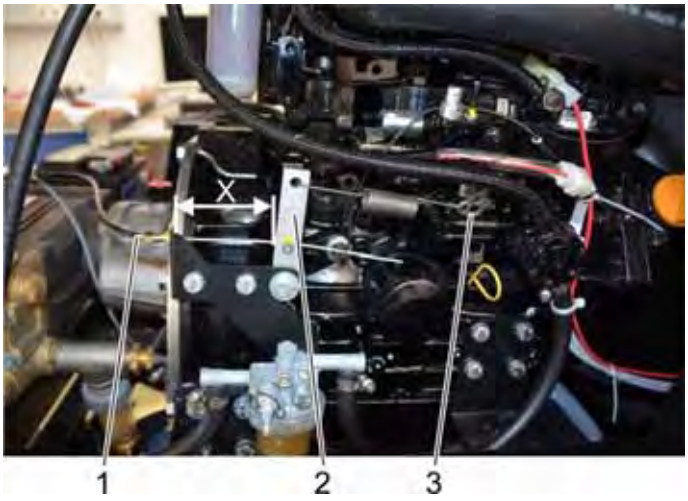
1 Speed control
2 Bowden cable to the motor

➔ Open the screw of the piston.

NOTE
When the screw is loosened, the spring pushes onto the screw head.

➔ Check the piston movement for free run by means of special pliers.

➔ Grease O-rings.



1 Bowden cable from the piston to the high-pressure pump
2 Deflection
3 Speed control motor

➔ If necessary, change the entire unit.
➔ Detach the Bowden cable at the deflection.
➔ Pull the piston with the Bowden cable out of the casing.
➔ Thread new unit through and adjust it in a way that the dimension "X" is approx. 78 mm in the idle state of the motor.

NOTE
Readjusting the Bowden cable is possible at its ends. For this purpose, loosen the lock nuts and turn the adjusting screws.
The adjustment is OK if the spring at the motor is slackened in the idle state and the piston of the speed control is located all the way in the back without play.

11.9.5 Replacing wear parts of the overflow device

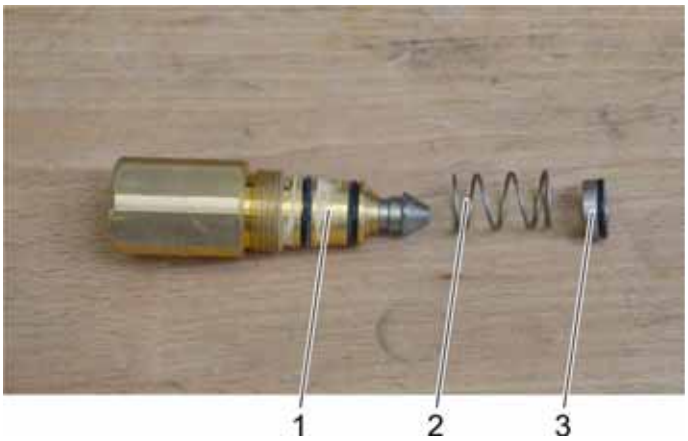
➔ Completely unscrew the upper part of the overflow device, without misadjusting it.

NOTE
This allows a later installation without readjustment work.

1 Casing
2 Spring
3 Valve disks

➔ Unscrew the lower casing part of the overflow device from the pump.

NOTE
Ensure that also the valve seat with the O-ring is removed from the pump casing; remove by means of pliers if necessary.



Wear parts:
1 Casing with taper seat
2 Spring
3 Valve seat with O-ring

➔ If necessary, change the entire unit.
➔ Reinstall the overflow device.

NOTE
When the overflow device is misadjusted, refer to information further back in this chapter.

11.9.6 Changing the valve frost protection

➔ Disconnect the hose from the valve box.

➔ Unscrew the valve box for the frost protection from the pump.

ATTENTION
Risk of damage to equipment. Observe torque of 35-40 Nm, as otherwise the casing can get damaged.

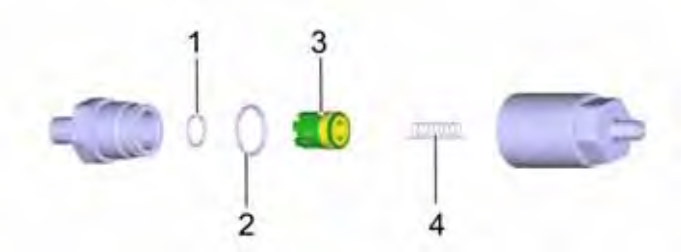
NOTE
Ensure that the valve seat underneath is not unscrewed, too.

➔ Unscrew the casing.

1

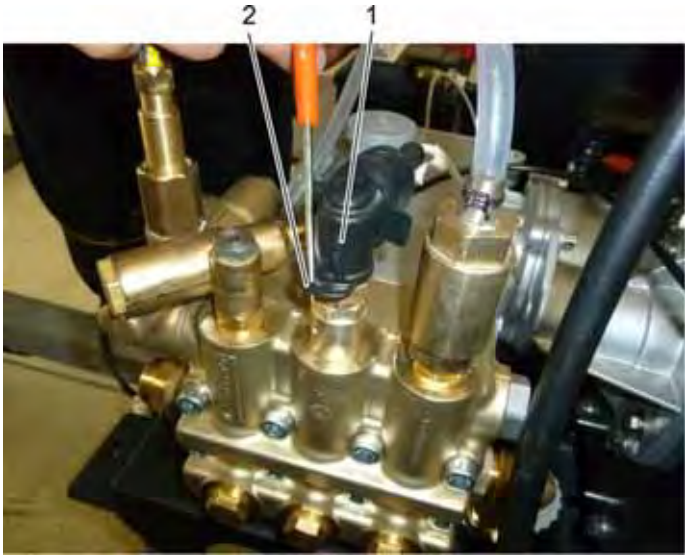
1 Valve

➔ Pull out the valve by means of special pliers and replace it.
➔ Reinstall the frost protection unit.



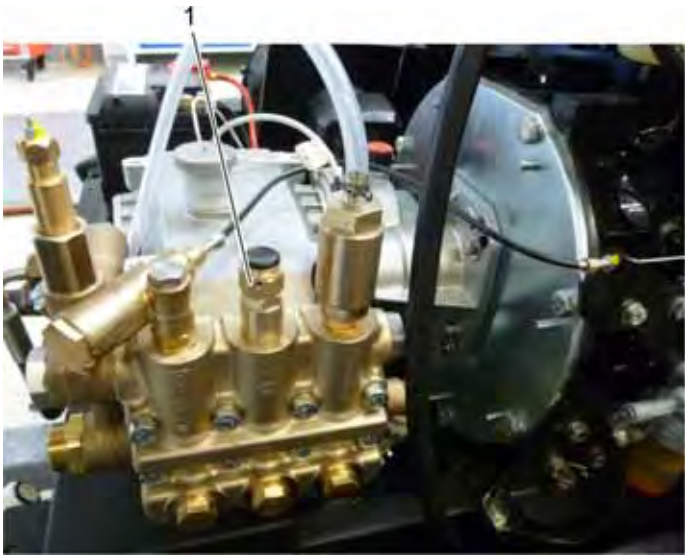
Components in the disassembled condition
1 O ring
2 O ring
3 Valve
4 Spring

11.9.7 Changing the pressure switch



1 Holding bow
2 Pressure switch

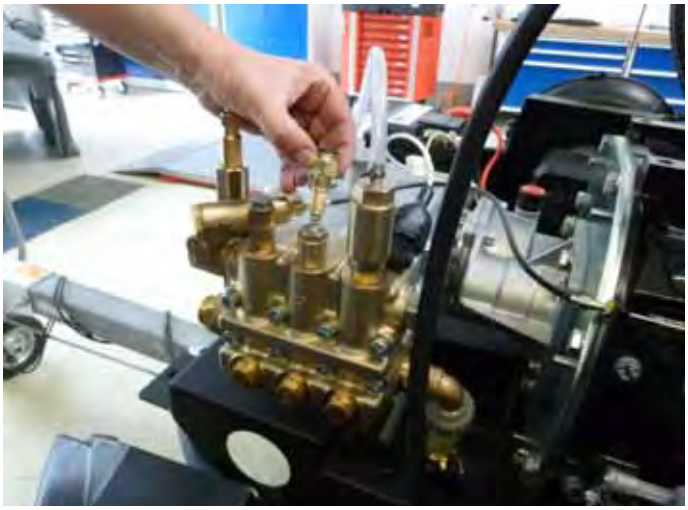
➔ Push the retaining bracket to the front.
➔ Remove the pressure switch towards the top.



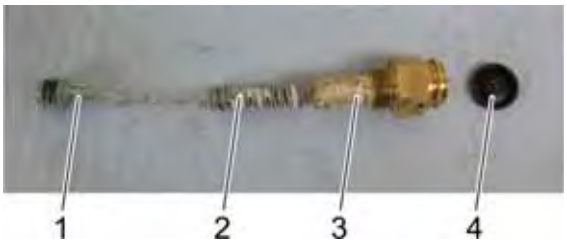
1 Valve casing

➔ Unscrew the valve box of the pressure switch from the pump.

NOTE
Ensure that the valve seat underneath is not unscrewed, too.



➔ Remove the valve from the pump seat.



Components in the disassembled condition
1 Piston with tappet
2 Spring
3 Valve casing
4 Diaphragm

11.9.8 Replace the suction valves.

➔ Switch off the operating mode switch and secure it against restart.
➔ Shut off water supply.
➔ Take the pressure off the high pressure system by opening the gun. Check the pressure ratio of the high pressure system on the pump manometer.

➔ Open the lockscrews of the 3 suction valves and replace the O-rings.

Suction/pressure valve setup

➔ Pull out the suction valves using special pliers (4.901-602.0). If the valve seat gets stuck in the pump head, you can pull it out using the drawing tool (6.815-013.0).

➔ Press in the new suction valves (lubricate the O-rings with silicon grease).

NOTE
Ensure the correct alignment of the valve crosspieces.

➔ Insert the lockscrews of the suction valves and tighten them to 40 Nm (grease O-rings).

11.9.9 Replace pressure valves

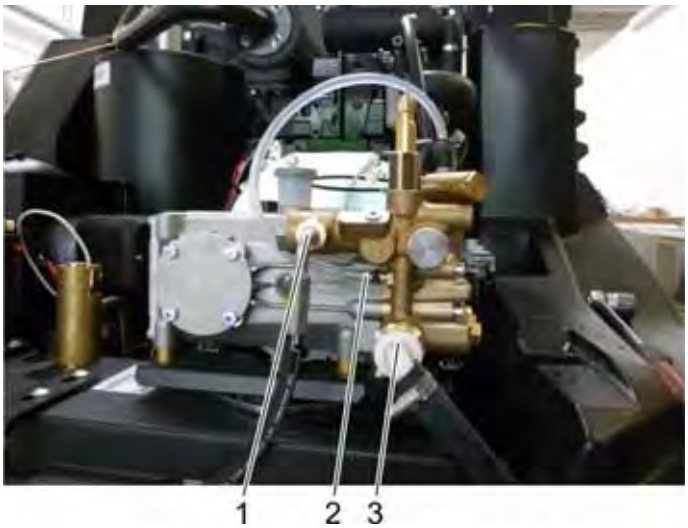
➔ Switch off the operating mode switch and secure it against restart.
➔ Shut off water supply.
➔ Take the pressure off the high pressure system by opening the gun. Check the pressure ratio of the high pressure system on the pump manometer.

➔ Loosen the lockscrews of the pressure valves. Pull the pressure valves out with the pliers 4.901-062.0. Should the valve seat get stuck in the pump head, you can pull it out using the interior driver (6.815-013.0) (cf. removal suction valves).

➔ Press in the new pressure valves manually (grease the O-rings).

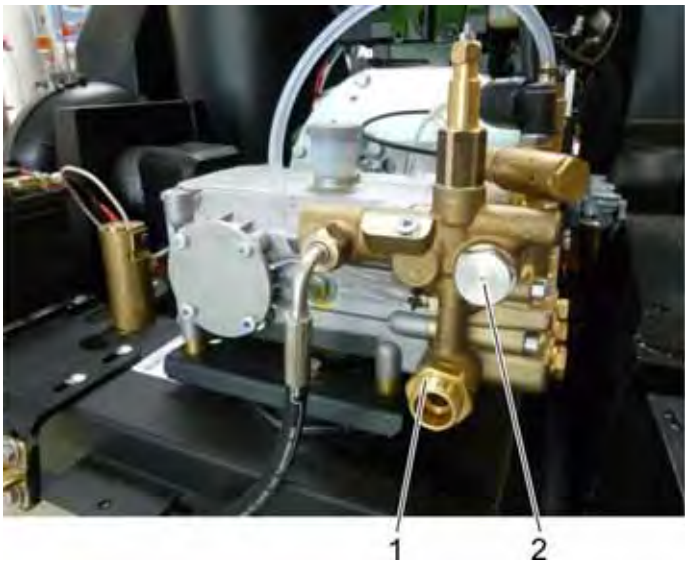
NOTE
Ensure the correct alignment of the valve crosspieces.

11.9.10 Replace the overflow valve



1 Connection high pressure
2 Connection of frost protection valve
3 Connection return flow (bypass)

➔ Disconnect the connections at the overflow valve.



1 Banjo bolt pressure side
2 Banjo bolt bypass

➔ Evenly unscrew the banjo bolts on the overflow valve and remove the overflow valve.

NOTE
The banjo bolts must be loosened or tightened evenly to avoid damage to the O-rings when the overflow valve is replaced.
Tightening torque, hollow screw, pressure side: 50+/-5 Nm
Tightening torque banjo bolt bypass: 50+/-5 Nm

11.9.11 Cylinder head, uninstall

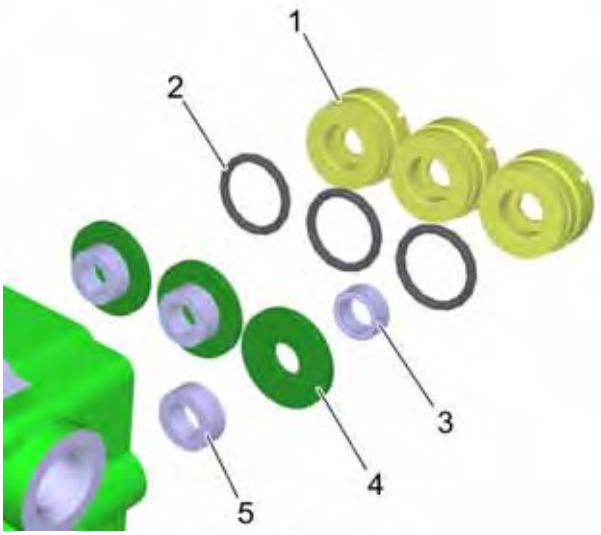
➔ Unscrew the overflow or slightly loosen the hollow screws that secure the overflow.
➔ Unscrew the 8 screws from the pump head.

➔ Carefully pull out the cylinder head using both hands.

ATTENTION
Do not cant during the removal as the ceramic sleeves could break!

➔ Loosen the screw inserts of the stopper bushings using the special tool 6.815-209.0 and take out the seals using the pliers (4.901-062.0).

Pump types 13/20 and 17/20
1 Support ring, high pressure seal
2 High pressure seal
3 Washer (back-up ring)
4 Support disc
5 Support ring, low pressure seal
6 Low pressure seal
7 Washer (back-up ring)
8 Castellated nut with O-ring



Pump types 9/50 and 13/35
1 Screwed sealing plug
2 O ring
3 Seal kit
4 Bushing
5 Seal kit

➔ Insert the new washers into the screw insert.

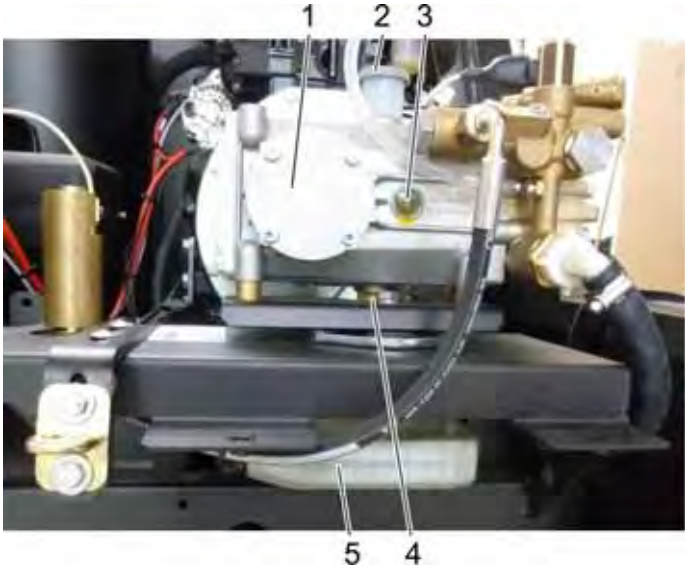
➔ Insert and press in the new seal package into the cylinder head using the installation sleeve and the driver. Observe the sequence.

➔ Tighten the stopping bushings using the special tool 5.511-001.0 to 50 Nm.
➔ Assemble the cylinder head in the reverse sequence.

11.9.12 Replace the oil rings

➔ Disconnect crankshaft casing from the intermediate gear of the diesel engine

NOTE
For details see further back in the chapter.



Exemplary illustration for pump types 9/50 and 13/35
1 Pump casing
2 Cover filling hole
3 Oil sight glass
4 Oil drain screw
5 Oil catch pan

➔ Unscrew the front plate.
➔ Turn out the oil drain screw at the bottom of the pump casing and collect the oil in a suitable container.

➔ Remove the casing lid from the pump casing by opening the four screws.

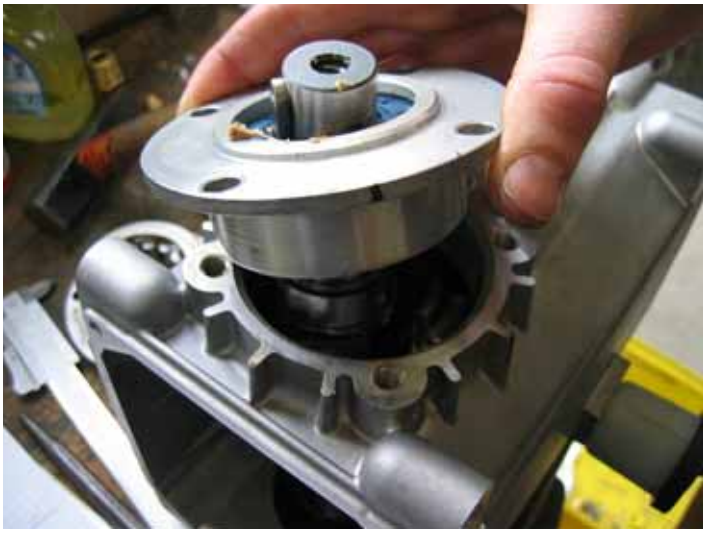
➔ Mark the bearing shells with the piston rod so that they do not get interchanged during assembling.

NOTE

Every bearing cup must later be refastened to the same piston rod with the same alignment. Therefore, mark the components prior to removal.

➔ Loosen the bearing shells of the piston rod and take out the bearing shells.

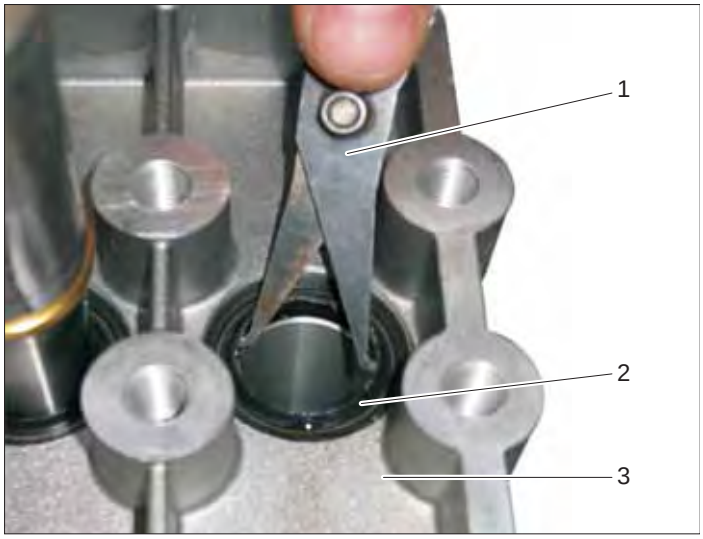
➔ Dismantle both flange bearings on the pump casing; in order to do so, the 4 screws on the flange must be loosened respectively. At the end, you can pull out the flange bearings. Tightening torque 20 Nm.



NOTE
With the 200bar pumps tapered roller bearings are used. The axial load is adjusted on the open bearing side by means of spacer discs (adjustment is performed by the factory!). Ensure that the relevant spacer disc(s) are conclusively reinstalled!

➔ Press the piston rods backwards to the end-position and take out the crank shaft.

➔ Unscrew the piston screws using an Allen wrench and pull out the piston rod from the rear.



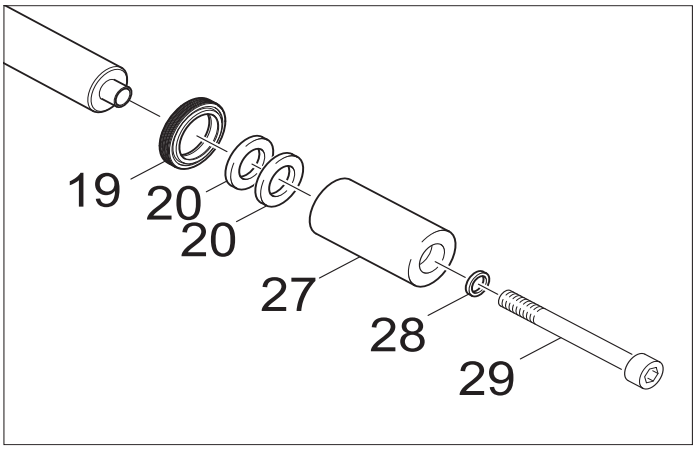
1 Special pliers to remove the oil seal rings
2 Oil seal ring
3 Pump casing

➔ Remove 3 oil seals from the pump housing with the special pliers.

NOTE
Make sure that the boring is not damaged when the oil seal rings are removed.

11.9.13 Replace the piston

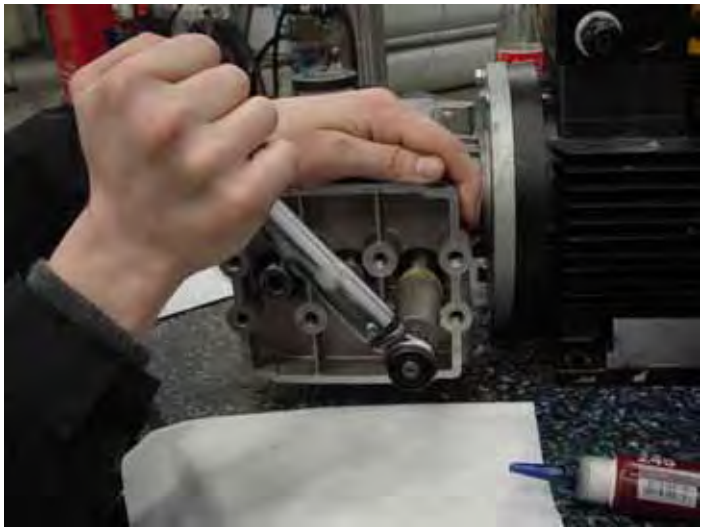
NOTE
The pictures are of a purely informative nature, they do not depict the situation on the mini trailer.

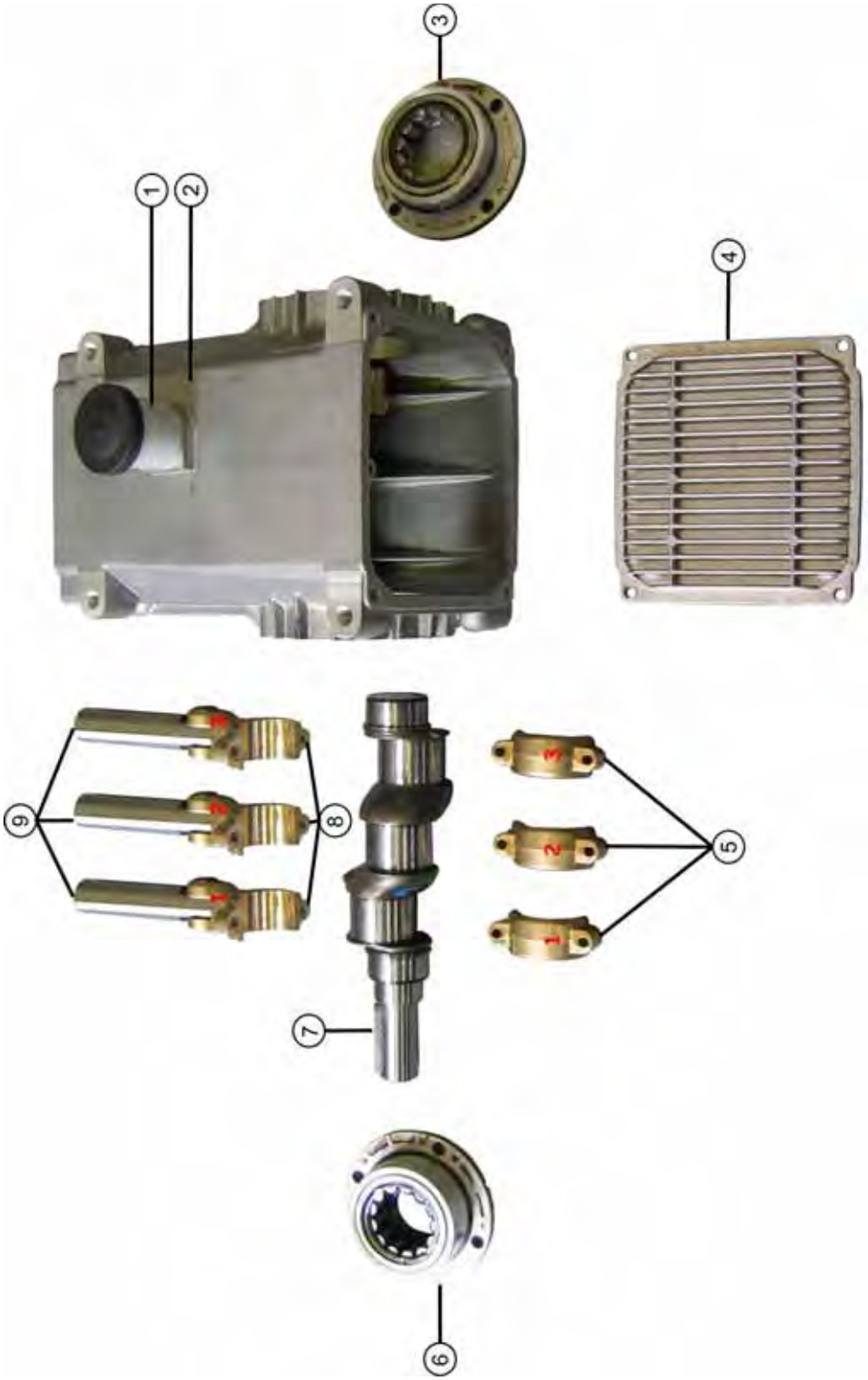


19 Shaft seal
20 Washer
27 Sleeve
28 Copper sealing ring
29 Screw

➔ After replacing the oil groove rings, the piston rod is pushed back into the straight pushing guide and the pistons are screwed on (observe tightening torque, see in the back). Clean the threads before screwing, apply screw securing adhesive (soluble) to the threading of the piston.

NOTE
Ensure the exact centring of the sleeve (item 27) and the copper sealing ring (item 28)!





1 Oil fill container
2 Pump casing
3 Crankshaft bearing cover with crankshaft bearing and O-ring
4 Crankshaft housing cover with O-ring
5 Piston rod bottom parts, marked
6 Crankshaft bearing with flange, O-ring and shaft seal
7 Crankshaft
8 Piston rod top parts, marked
9 Push bar

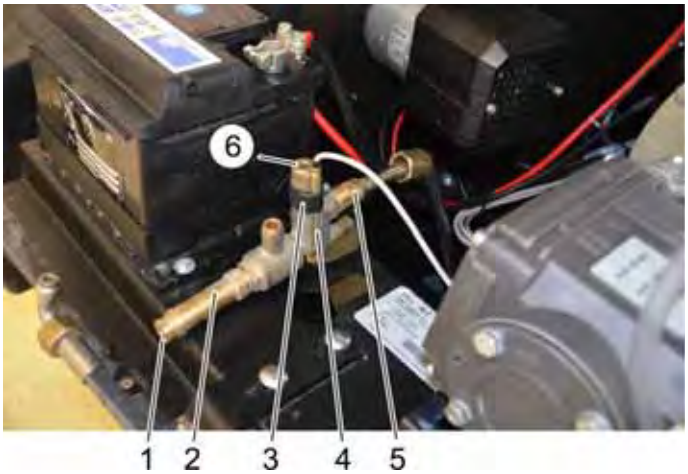
➔ Now, the crankshaft can be put back in. Fixate it with flange bearings. Then screw the bearing cups into the piston rod Nm = 8...9.

➔ Assemble back the parts in the reverse sequence.
➔ Fill in oil up to the sight glass.

	Oil fill volume and type
Pump gear	350/500bar pump: 1.3ltr SAE 90 200bar pump: 1.3 ltr 15 W40

11.10 Safety block

11.10.1 Safety block for 200bar devices



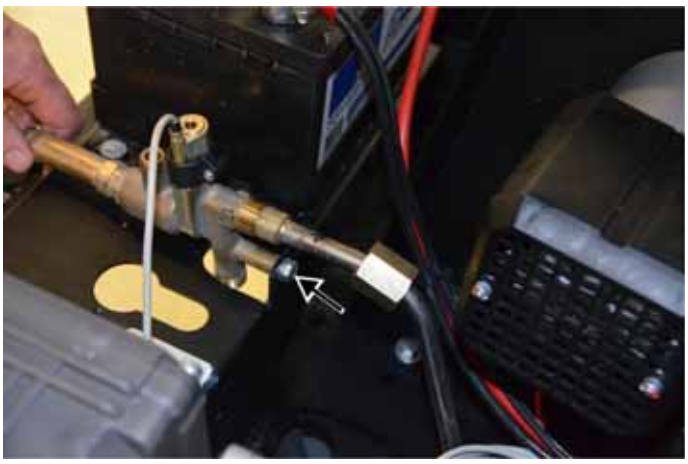
Safety block 200bar
1 Adjustment screw
2 Safety valve
3 Clamping bracket
4 Reed switch
5 High pressure pipe to the on-demand heater
6 Screwed sealing plug

NOTE
Only when changing the safety block, a complete removal is required.
Work on the reed switch and for pressure adjustment on the safety valve can also be performed in the installed condition!
The safety valve can be adjusted in the range 185-250bar. The presetting at 240bar is done in the factory.

➔ Remove front plate.

➔ Disconnect the high-pressure line of the pump from the safety block.

➔ Disconnect the high-pressure outlet to the booster heater.



➔ Unscrew the screw for fastening the safety block form the console, remove the block.

Clean / change the reed switch for flow monitoring

NOTE
Observe the installation position of the reed switch on the casing:
The marking on the reed switch points centrally to the casing!

Clean magnetic pen

1 Reed switch
2 Clips

➔ Open clips, pull out the reed switch for flow monitoring.
➔ Clean reed switch; change in case of a defect.
Observe the cable run when changing the switch!

➔ Loosen screws.

➔ Remove and clean magnetic pen.

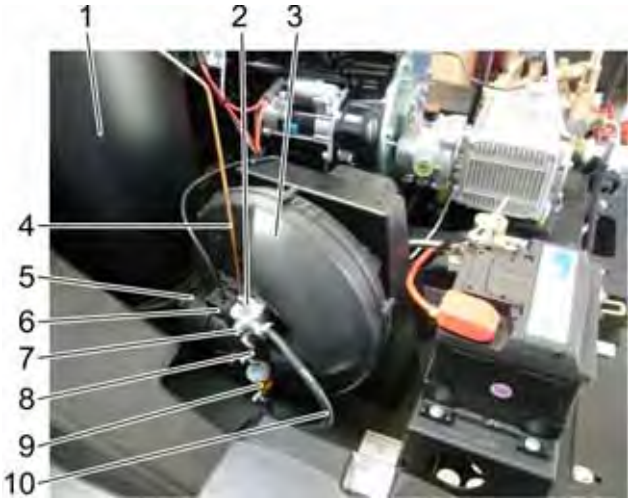
Adjust safety valve
NOTE
The safety valve is adjusted via the pressure increase in the system with the burner turned on, so that it limits the pressure increase to the max. permissible value (see Specifications) with the gun closed.
Then seal the settings.

➔ Block the overflow device (turn to stop).
➔ Set the safety valve to approx. 220-230 bar.
The opening pressure of the safety valve is adjusted with the adjustment screw.
Rotation to the right increases the opening pressure, rotation to the left decreases the opening pressure.
➔ Finally readjust the overflow device.

11.10.2 Safety block for 350/500bar devices

NOTE
The service tasks on the safety blocks are in line with the descriptions of the 200bar safety block, for details see previous chapter.
The safety valves of the two safety blocks cannot be adjusted. These are permanently set and marked.

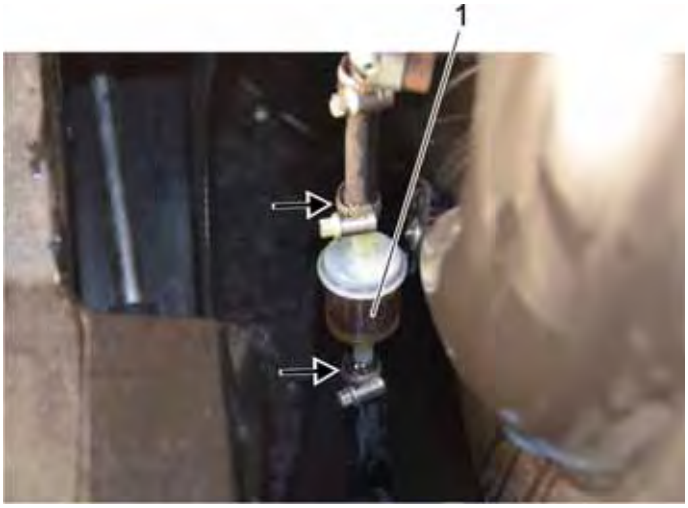
11.11 Burner blower with fuel pump



Overview

1 Continuous heater
2 Fuel pump
3 Blower lid
4 Pressure line
5 Rubber collar
6 Solenoid valve
7 Setting fuel pressure
8 Fuel line
9 Filter
10 Return

11.11.1 Change fuel filter



1 Filter

➔ Loosen the hose clamp before and after the filter, remove hoses.
➔ Change filter.

ATTENTION

Collect the residual amount of diesel from the line and seal the line.
If the diesel tank is not empty, diesel will permanently leak when the line is not sealed!

NOTE

Do not clean the filter, always replace it! Install it in a way that the grey cover points upwards.

11.11.2 Dismantling the fuel pump

➔ Squeeze and pull out the clip.

View with pulled out clip.

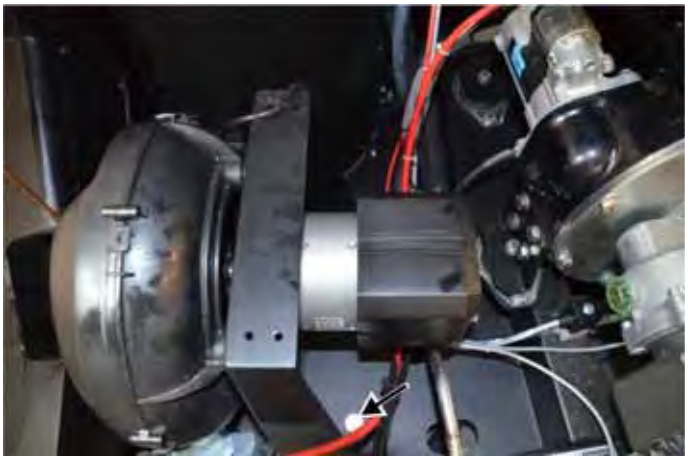
1 Solenoid valve
2 Fuel line
3 Pressure line
4 Fuel pump
5 coupling
6 Return

➔ Remove the pump unit with the coupling from the casing.
➔ Remove magnetic coil.
➔ Remove the connections of the fuel line (supply), pressure line and return, remove lines.

ATTENTION
Collect the residual amount of diesel from the line and seal the line.
If the diesel tank is not empty, diesel will permanently leak when the line is not sealed!

NOTE
Ensure the correct rotation direction with the new fuel pump! Necessary part number: 6.473-006.0.

11.11.3 Dismantling the burner blower

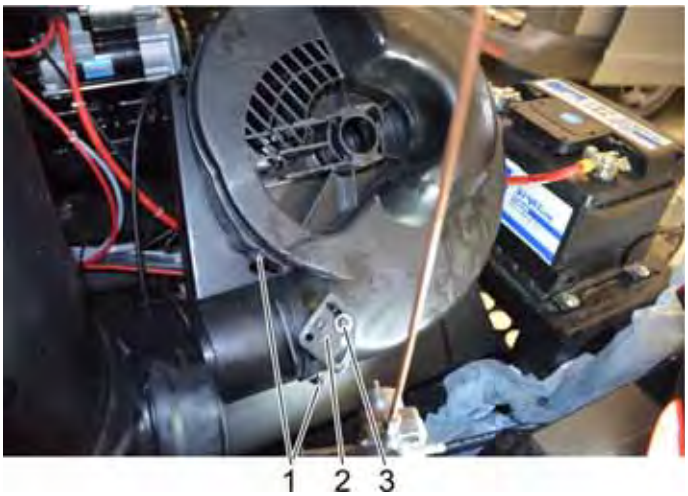


➔ Dismantle the fuel pump.
➔ Unscrew 4 screws of the console.

NOTE
If the connection cable is to be disconnected, the motor must be opened from the back.

➔ Carefully slide the blower unit to the back so that the branch is pulled out of the rubber cuff.
➔ Lift the blower and put it down horizontally.

➔ Mark the position of the air flap.



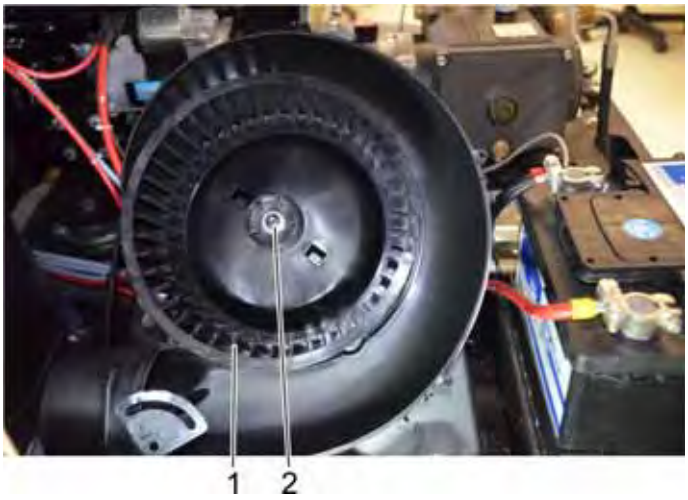
1 Screw
2 Screw for locking the air flap
3 Air flap

➔ Unscrew the screw for locking the air flap.
➔ Open 2 screws of the casing top.

1 Air flap

➔ Position the air flap horizontally.
➔ Remove the fastening clips on the girth of the casing top, remove the cover.

NOTE
If the air flap is in the horizontal position, the adjustment mechanism points upwards.



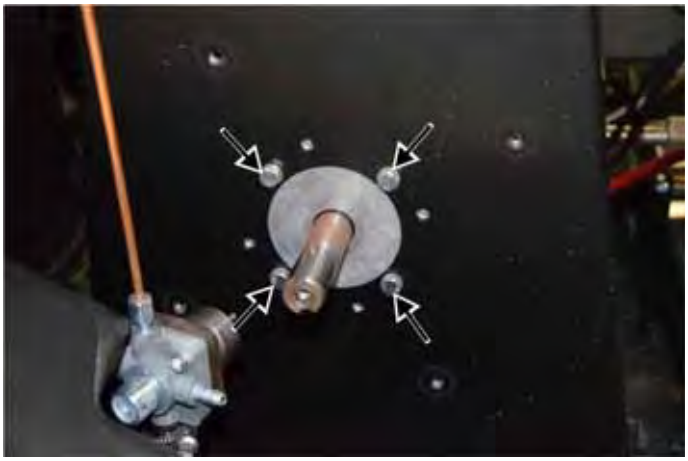
1 Fan wheel
2 Screw

➔ Open the screw at the hub.
➔ Pull the fan wheel off.

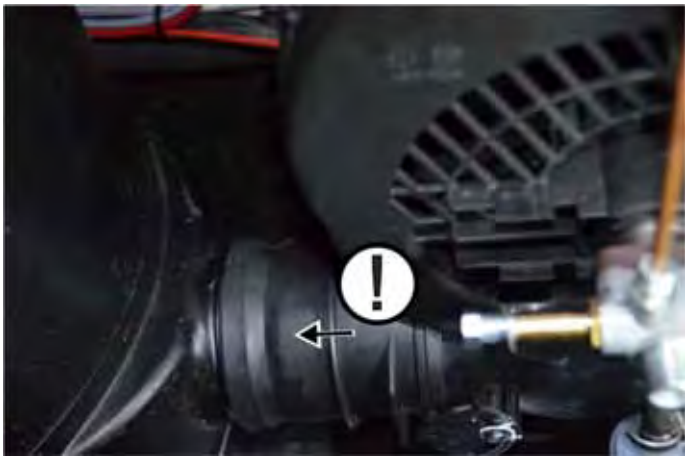
NOTE
Removing the fan wheel requires some force. Carefully wobble the fan wheel all around and lever it out.

1 Fitting key

➔ Remove the two feather keys of the motor shaft.
➔ Unscrew 4 screws.
➔ Remove the bottom part of the blower.



➔ Unscrew 4 screws.
➔ Push out the motor towards the back.



NOTE
When installing the branch, slide it approx. 1 cm into the rubber cuff first, then position the console and screw it down. Finally, slide the cuff approx. 2-3 cm over the branch.

11.11.4 Motor burner blower: Changing the carbons

1 Nut

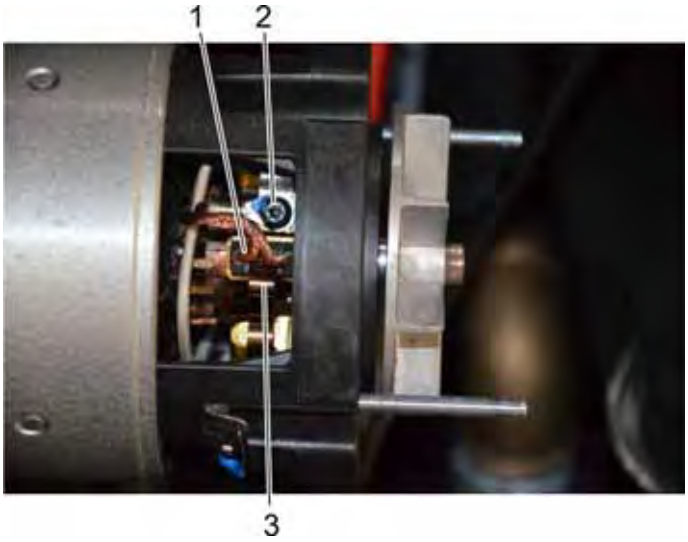
➔ Disconnect battery.
➔ Loosen 2 nuts.
➔ Remove the hood.

NOTE
In the original condition, these are special nuts that fasten the cover. After the first opening, it is recommended to replace them with stop nuts.

1 Tensioning ring

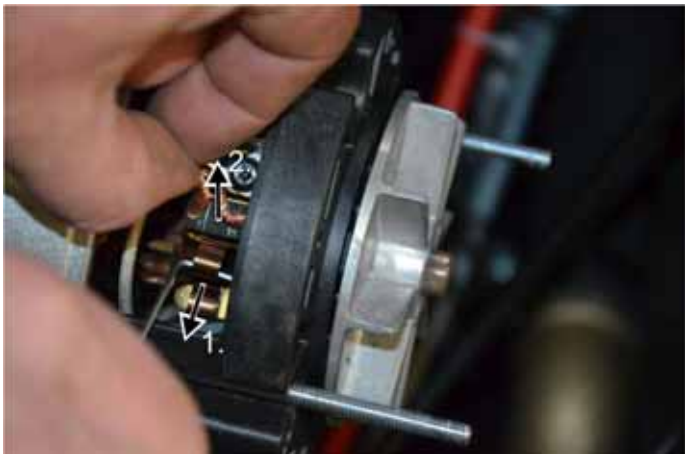
➔ Open and remove the clamping ring.

NOTE
In order to have better access to the 4 carbons later on, it is recommended
– to remove the fuel pump,
– to unscrew the console of the blower unit from the frame and
– to put down the unit horizontally with the motor pointing upwards.

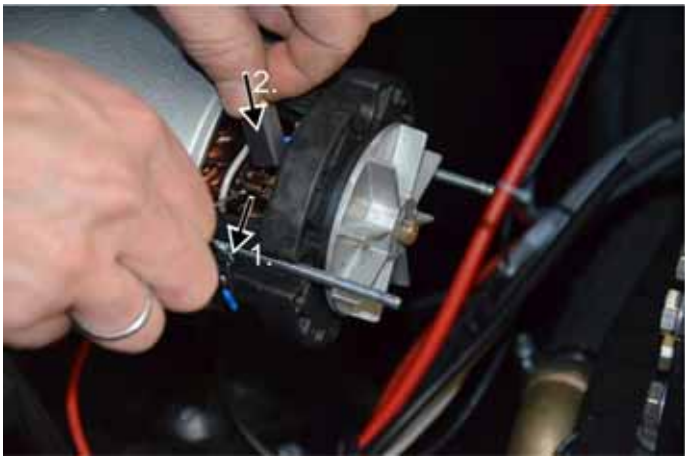


1 Carbon block
2 Connecting cable
3 Retaining spring

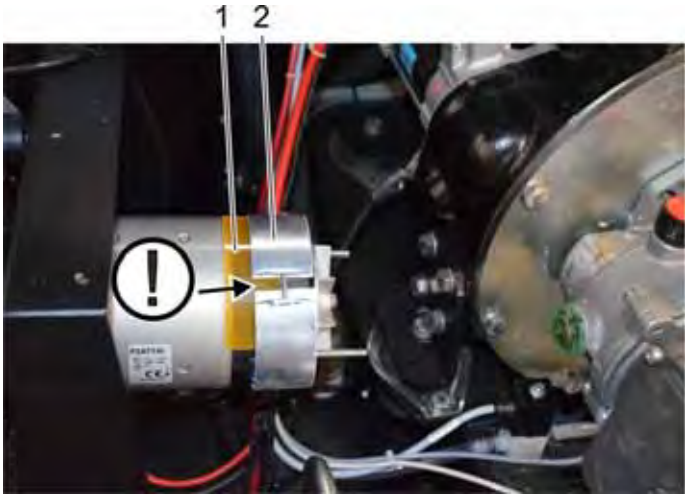
➔ Unscrew the screw, disconnect the connection cable of the carbon block.



➔ Pull back the retaining spring.
➔ Pull out the carbon block towards the top.



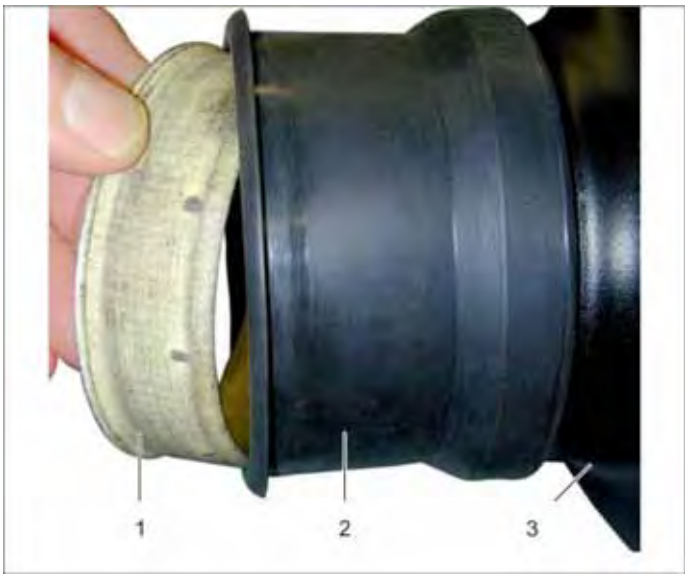
➔ Pull back the retaining spring.
➔ Insert new carbon block and push it in.
➔ Electrically connect the carbon block.



1 Protective element
2 Tensioning ring

➔ Insert the protective element in a way that it is located under the clamping point of the clamping ring.
➔ Slide on the clamping ring and screw it down.

11.11.5 Cleaning the air duct



1 Clamping part
2 Rubber collar
3 Outer jacket on the booster heater

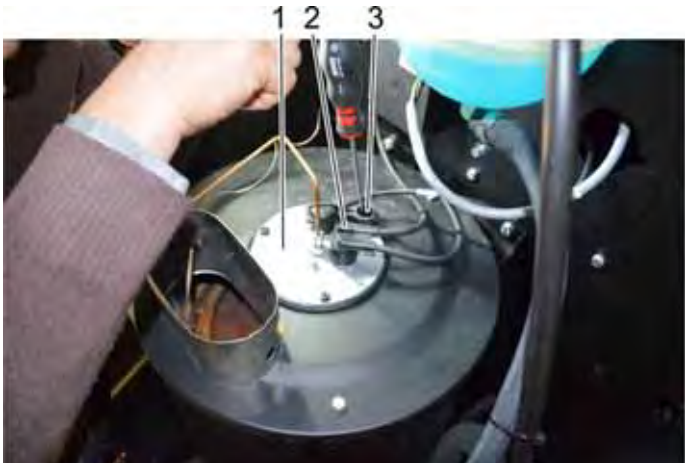
➔ Clean the rubber cuff and the outer jacket in the installation area.
➔ Install the rubber cuff on the outer jacket.
➔ Insert the clamping part with the chamfer towards the booster heater until it noticeably snaps into the rubber cuff.
➔ Grease the clamping part.

NOTE
When installing the outer jacket (booster heater) in the device, the rubber cuff can fall off the outer jacket. This leads to an aggravated installation. An additional clamping part serves as installation aid.

NOTE
Ensure correct seating of the rubber cuff.

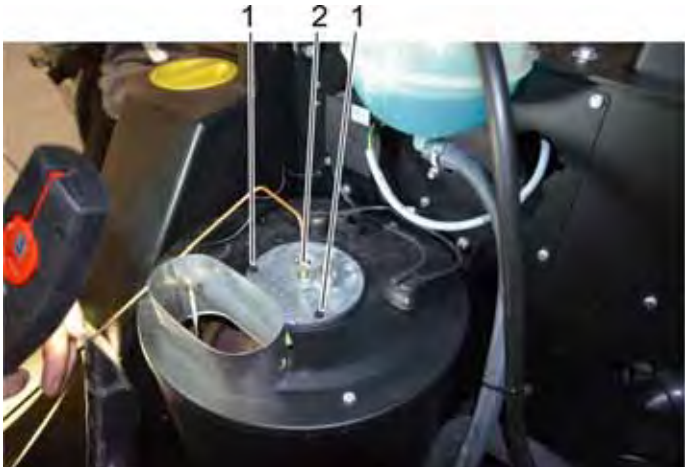
11.12 Booster heater

11.12.1 Dismantling / cleaning the burner cover



1 Burner cover
2 Ignition cable
3 Flame sensor

➔ Unscrew the holder for the flame sensor.
➔ Remove the plug for the ignition cable.

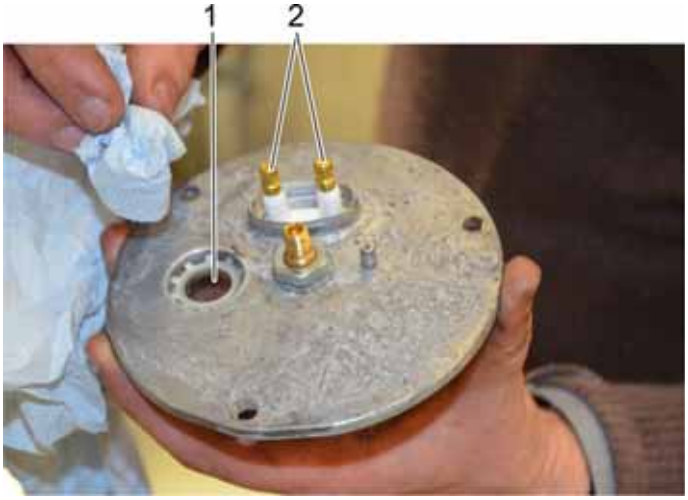


1 Screw
2 Fuel line

➔ Separate the fuel line.
➔ Unscrew 2 screws from the cover.

NOTE
When detaching the connection of the fuel line, pay attention to possibly leaking diesel!

➔ Remove the complete burner unit.



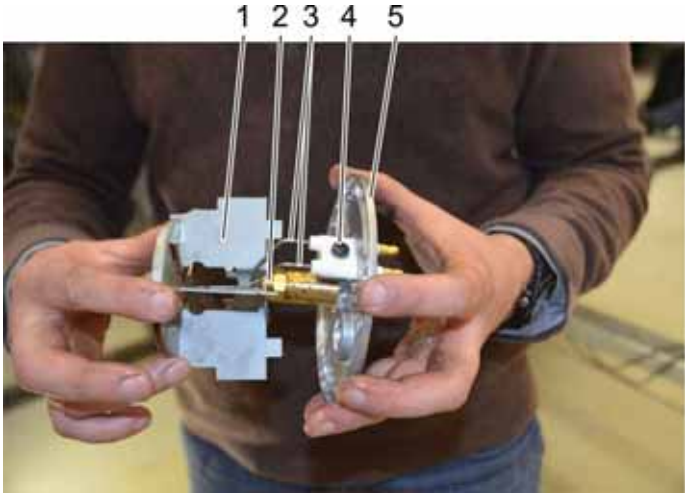
1 Connections ignition electrodes
2 Sight glass for flame sensor

➔ Clean the connections for the ignition electrodes and the sight glass for the flame sensor.

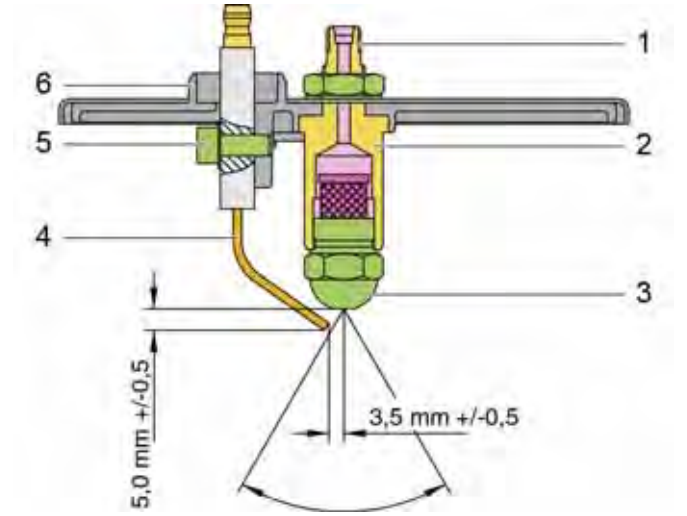
11.12.2 Adjusting the ignition electrodes

-***NOTICE***

You need to carefully adjust the distance between the ignition electrodes to bring about a stronger ignition spark. Replace burnt out ignition electrodes.

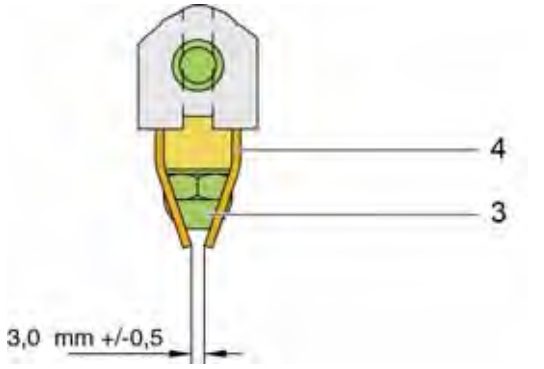


1 Pressure plate
2 Fuel nozzle
3 Ignition electrodes
4 Screw
5 Burner cover

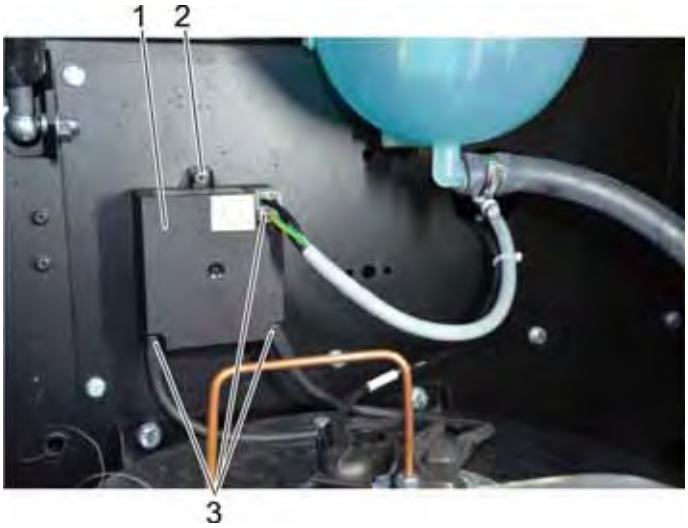


1 Connection fuel line
2 Fuel nozzle holder
3 Fuel nozzle
4 Ignition electrodes
5 Screw
6 Burner cover

➔ Slightly loosen the screw that clamps the ignition electrodes and adjust the electrodes accordingly.



11.12.3 Changing the ignition transformer



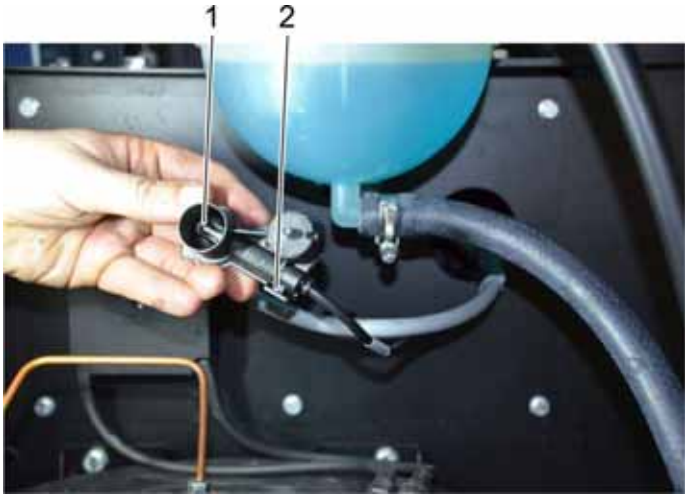
1 Ignition transformer
2 Screw
3 Cable connections

➔ Remove 3 cables from the ignition transformer.
➔ Loosen the screw.
➔ Disconnect the ignition transformer electrically.

NOTE
Observe the cable run with the electrical connection!

NOTE
The two lower cable connections connect the ignition electrodes.
The assignment right/left is not important in this case.

11.12.4 Cleaning / changing the flame sensor



1 Bracket
2 Flame sensor

➔ Unscrew the support from the burner cover.
➔ Unclip the catch, open the support.
➔ Slide out the flame sensor and carefully clean it on the sensor head (transparent part).

NOTE
When sliding the flame sensor into the support, ensure that it is in the correct position. Otherwise the support cannot be closed.

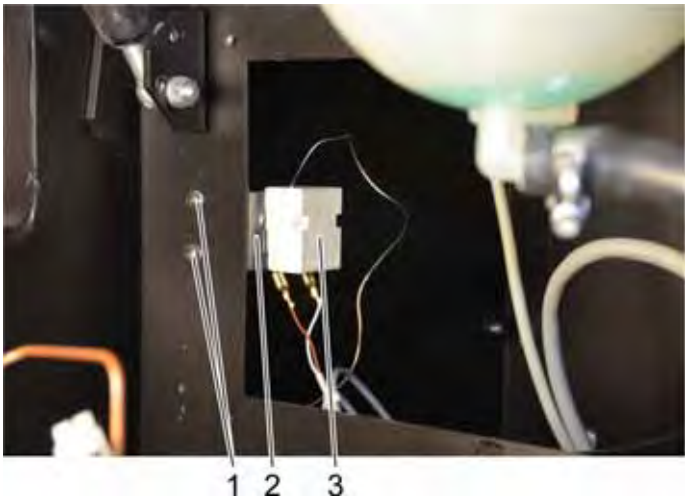
NOTE
When changing the flame sensor, it must be electrically disconnected.
Observe the cable run with the electrical connection!

11.12.5 Cleaning / changing the temperature sensor exhaust gas

1 Exhaust temperature sensor

➔ Push the two nibs into the support, slide out the temperature sensor.
➔ Carefully clean the temperature sensor.

ATTENTION
Risk of damage to equipment. The exhaust temperature sensor in the chimney is connected to the thermostat switch with a capillary tube. This tube must not be kinked, as otherwise the sensor will be damaged!



View with opened maintenance flap on the right
1 Screw
2 Support
3 Thermostat switch emission temperature

➔ Unscrew the maintenance flap on the right.
➔ Upon changing the temperature sensor: disconnect it at the thermostat switch.
➔ Upon replacement with thermostat switch:
Open screws, remove the holder and unscrew the thermostat switch from the holder.
Disconnect the cable connection.

NOTE
Observe the cable run with the electrical connection!

11.12.6 Cleaning / changing the temperature sensor warm water

View from below
1 Temperature sensor warm water
2 High-pressure line from the booster heater to the high-pressure connection
3 High-pressure line from the safety block to the boiler

View from below
1 Bracket
2 Temperature sensor warm water

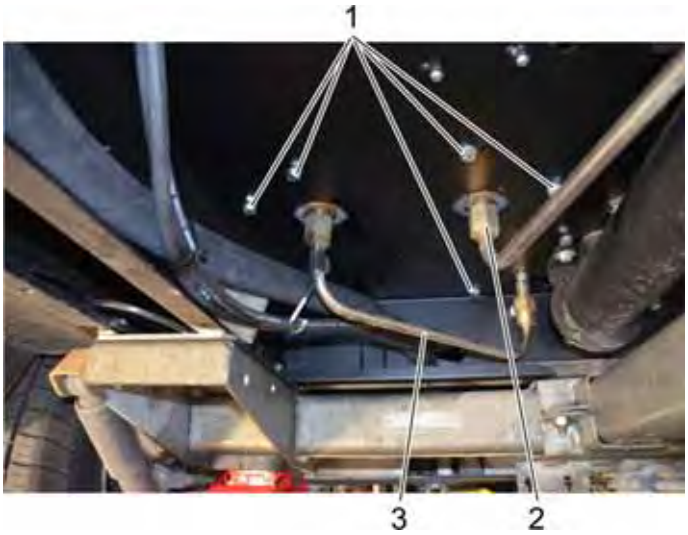
➔ Open support (clips) of the HP pipeline.
➔ Carefully clean the temperature sensor.

NOTE
When changing the temperature sensor, this must be disconnected electrically directly at the control.

11.12.7 Dismantling the booster heater

1 Exhaust

➔ Unscrew the burner cover.
➔ Pull out the temperature sensor emission temperature.
➔ Unscrew the coolant container and ignition transformer.
➔ Unscrew the exhaust pipe from the muffler.
➔ Uninstall the burner blower completely with the console.



View from below
1 Screw
2 High-pressure line from the booster heater to the high-pressure connection
3 High-pressure line from the safety block to the boiler

➔ Dismantle the PVC protective plate on the right.
➔ Remove the high-pressure line from the booster heater to the high-pressure connection.
➔ Detach the connection of the high-pressure line from the safety block.
➔ Unscrew 9 screws on the girth of the booster heater.

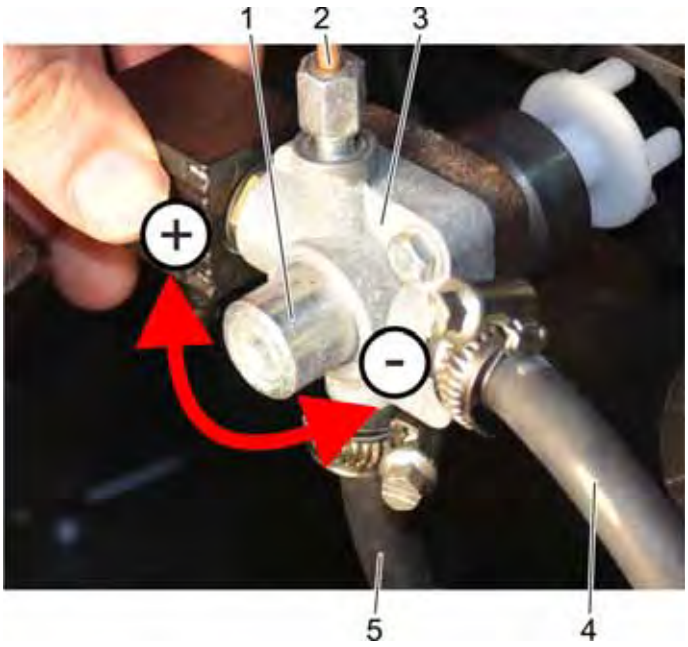
NOTE
This concerns all screws in this area of which the screw heads are visible - no nuts!

➔ Unscrew 2 screws at the air casing.
➔ Lift the booster heater out of the motor compartment towards the front.

ATTENTION
When using lifting gear, ensure that the cover is not damaged.

11.13 Settings, burner

NOTE
An accurate basic adjustment of the burner is only possible if the heating coil was previously thoroughly desooted and the deposits were removed.

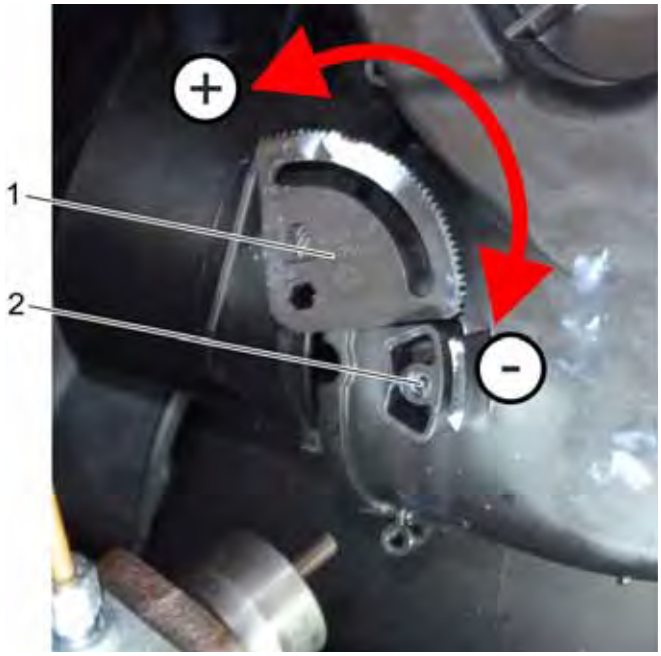


1 Adjustment screw, fuel pressure
2 Pressure line to the burner
3 Fuel pump
4 Return hose to the fuel tank
5 Suction hose, fuel

NOTE
Rotation in the plus direction increases the fuel supply, rotation in the minus direction reduces the fuel supply.

1 Pressure gauge for measuring the pump pressure

Measuring device and connection for measuring the air pressure at the burner cover.



1 Air door, air volume adjustment
2 Stop screw

NOTE
Adjusting the air flaps in the plus direction increases the air quantity, adjustment in the minus direction reduces the air quantity.

Measure water temperature
➔ Install the shut-off valve with thermometer (special tool) on the appliance outlet.
➔ Switch on the burner and bring the appliance to working pressure with full water volume via the shut-off valve.
➔ Let the device run in burner operation for approx. 5 minutes until the maximum water temperature is reached.
➔ Measure the increase in water temperature (water outlet temperature minus water supply flow temperature).
➔ Measure the air pressure on the burner cover (special tool) and adjust it on the air slider.
➔ Measure the soot value, CO2 content and the exhaust temperature (special tools, measuring gauges).

Adjusting the fuel pressure
➔ Set the fuel pressure (and water temperature) via the set screw.

Nominal values		HDS 9/50	HDS 13/35	HDS 17/20	HDS 13/20
Water temperature increase with full load	K	70 - 75	70 - 75	60 - 65	70 - 75
max. air pressure at the burner cover	mmWS	2,5 - 3,5	3,0 - 5,0	3,0 - 5,0	3,0 - 5,0
Soot value		1	1	1	1
CO2 exhaust gas	%	10,0 - 11,5	10,0 - 11,5	10,0 - 11,5	10,0 - 11,5
Emission temperature	°C	100 - 180	120 - 180	120 - 180	140 - 220
Adjustment pressure fuel pump	MPa	1,0 - 1,3	1,0 - 1,3	1,0 - 1,3	1,0 - 1,3

Adjusting the soot value
➔ If the soot value is too high, then the air flap needs to be opened further or the fuel pressure needs to be reduced.

Adjust the CO_2 value
➔ Adjust the CO_2 value by moving the air flap. Open the air flap, the CO_2 content is decreasing.

NOTE
After finishing the basic adjustment, the fuel pump and the air flap must be sealed.

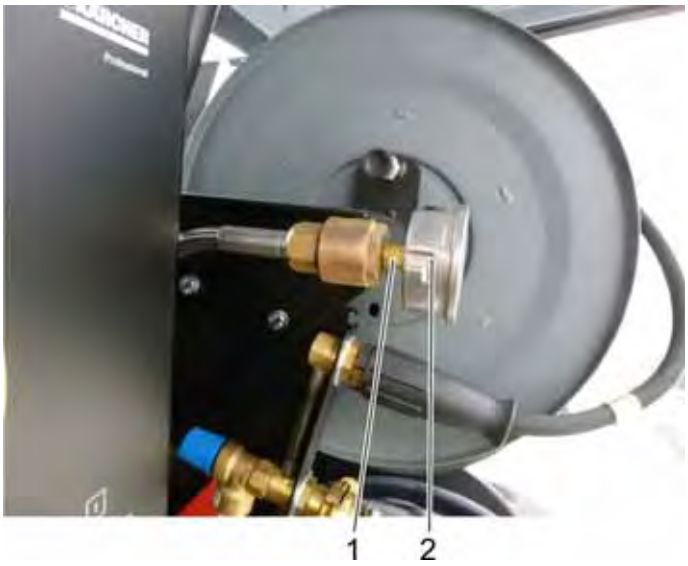
11.14 High pressure outlet

11.14.1 Uninstall / install high-pressure hose

1 High-pressure hose (uncoiled)
2 Hose connection

➔ Unwind the HP hose from the hose reel.
➔ Disconnect the hose at the hose connection.

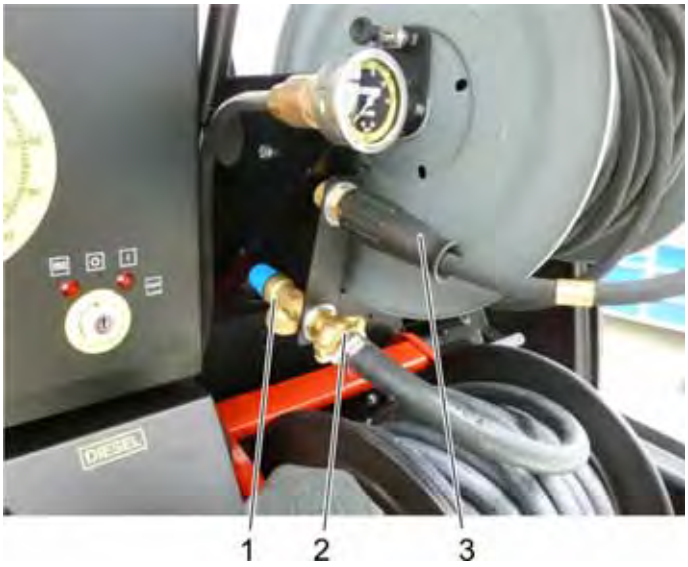
11.14.2 Dismantling the pressure gauge



1 Screw connection
2 Manometer

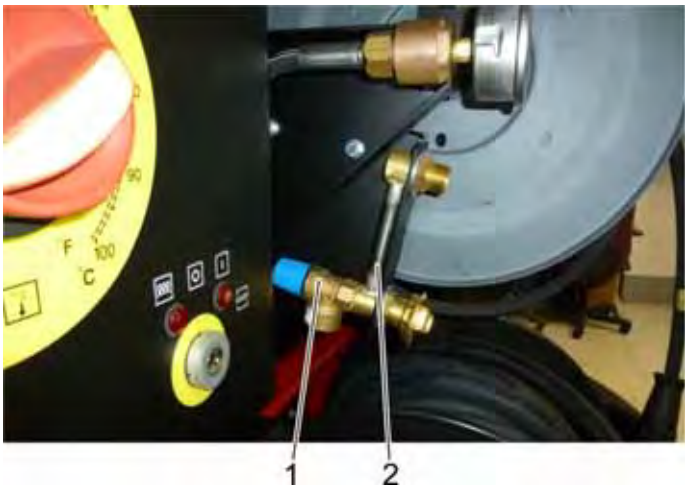
➔ Disconnect the screw connection.
➔ Remove the pressure gauge.

11.14.3 Changing the bypass unit with safety valve



1 Bypass unit
2 Water pipes
3 High pressure hose

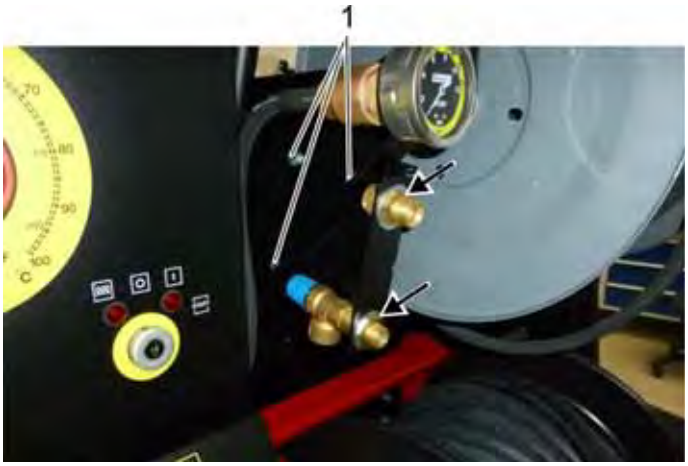
NOTE
The unit is located at a console that must be dismantled to completely unthread the bypass unit!
The following pictures show the situation without the dismantled console.



1 Safety valve
2 Pipe connection

NOTE
The pressure of the safety valve is permanently adjusted to 6 bar and cannot be changed.

➔ Remove both hoses from the plug connection.
➔ Unscrew C-coupling for the water hose.



1 Screw

➔ Open the nuts of the two hose connections.
➔ Unscrew the screws of the console fastening.
➔ Carefully unthread the bypass unit from the console.

NOTE
For mechanical reasons, the two nuts have different spanner sizes.
Upon unthreading, slide out he HP side first and then the side with the safety valve.

Dismantled bypass unit.

11.15 Motor

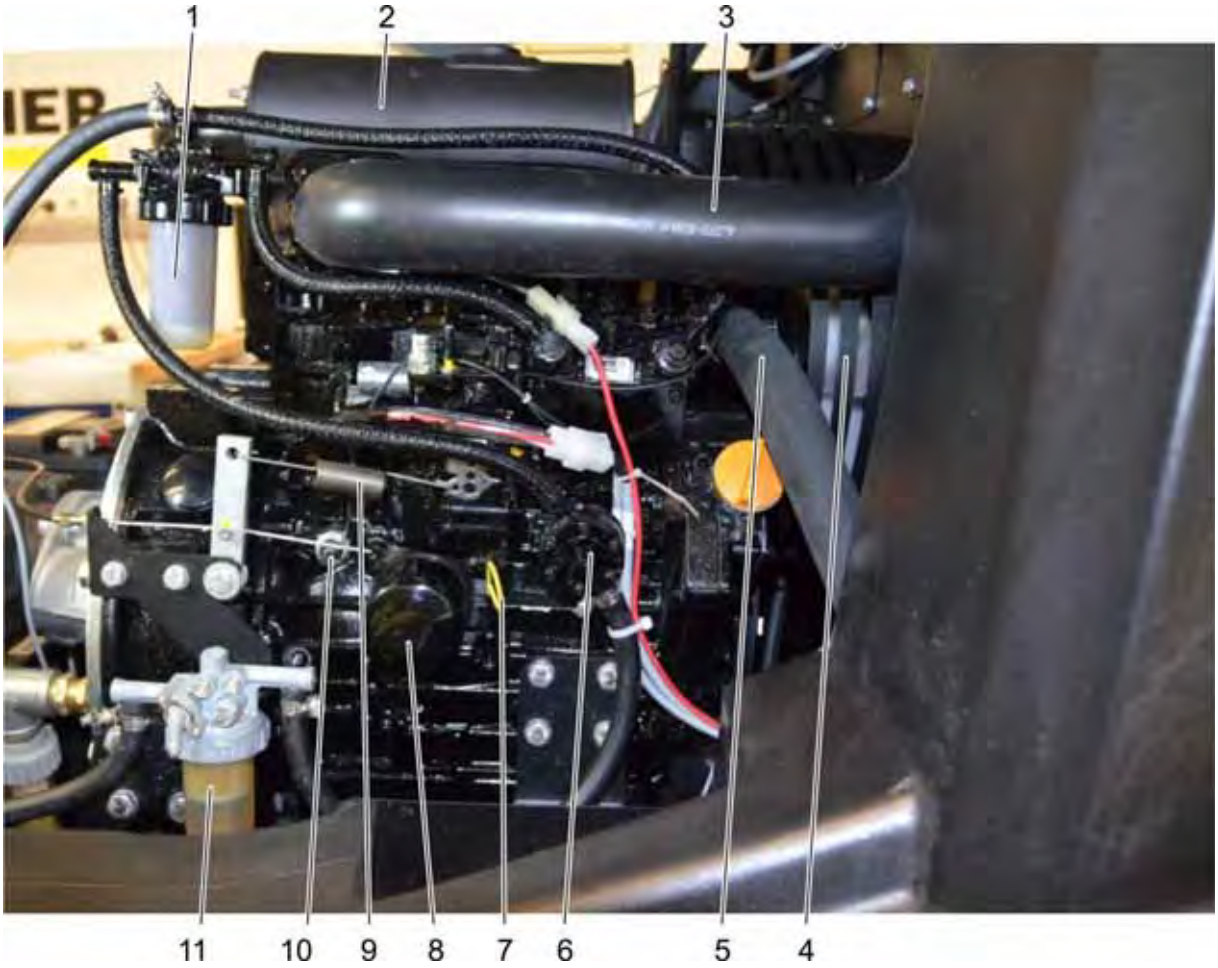
⚠ ***DANGER***

Risk of injury!

Before carrying out any tasks on the machine, switch off the key switch and the battery switch and remove the key. Prevent inadvertent startups of the appliance during Maintenance Procedures via third persons by attaching signs on the appliance and the spray unit.

⚠ ***CAUTION***

Risk of burns. Prior to working on the alternator, make sure the exhaust system has cooled off.

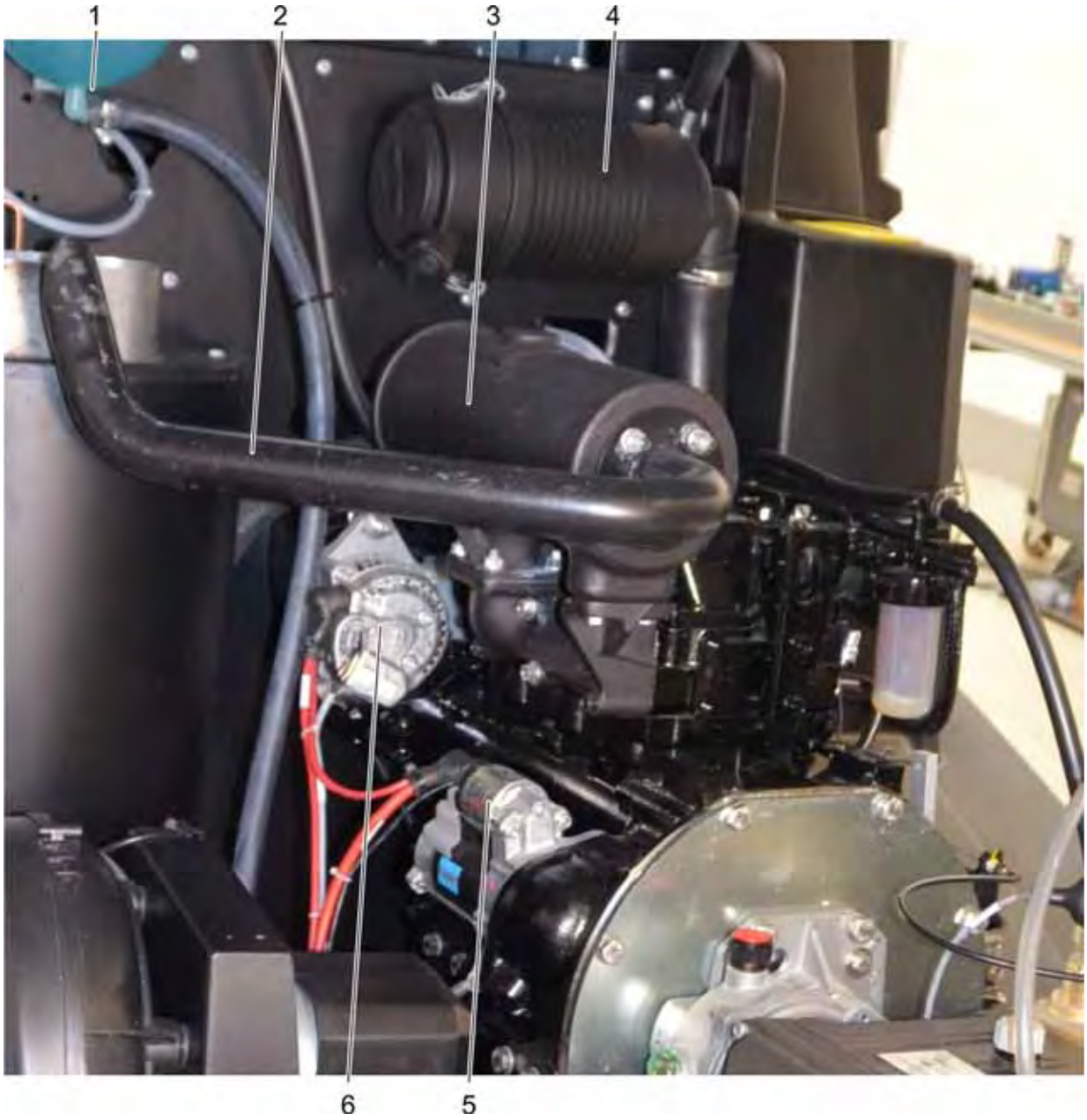


Diesel engine

1 Fuel filter
2 Exhaust
3 Preformed hose from the air filter
4 Cooling fan, motor
5 Coolant hose
6 Fuel pump
7 Oil dip (engine)
8 Oil filter (engine)
9 Speed control (full load / idle mode)
10 Pressure switch
11 Water separator

NOTE

The fuel pump is equipped with a manual control. If necessary, this can manually pump the fuel to the motor for the first filling or after the tank has been empty.



Diesel engine
1 Expansion tank motor coolant
2 Exhaust system
3 Muffler
4 Air filter
5 Starter
6 Alternator

11.15.1 Check and top up coolant

⚠ ***CAUTION***

Risk of damage!

Observe the brand of antifreeze used. The mixture can cause a chemical reaction and hazardous substances can be generated. Do not mix different antifreeze types.

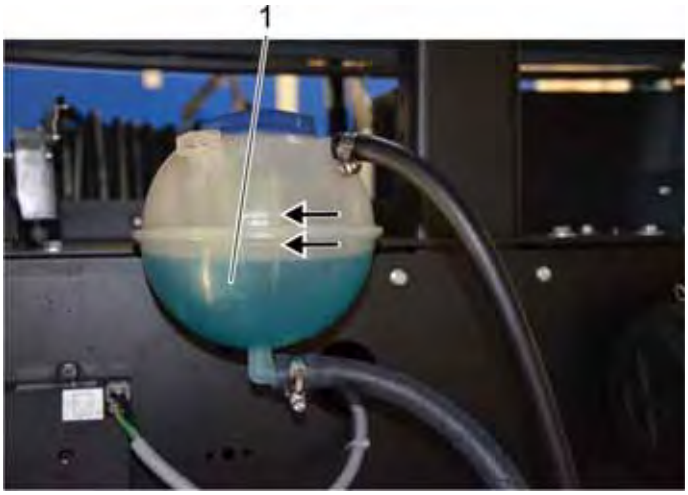
Risk of injury!

The motor can overheat if there is a lack of coolant. Turn the motor off immediately and let it cool down.

If the motor is so overheated, that water vapors escape, immediately turn the motor off and keep a safety distance to the motor until the pressure has decreased.

Danger of burns! Never open the lid on the cooler while the motor has operating temperature. The container is under pressure.

⚠ ***WARNING***



1 Expansion tank motor coolant

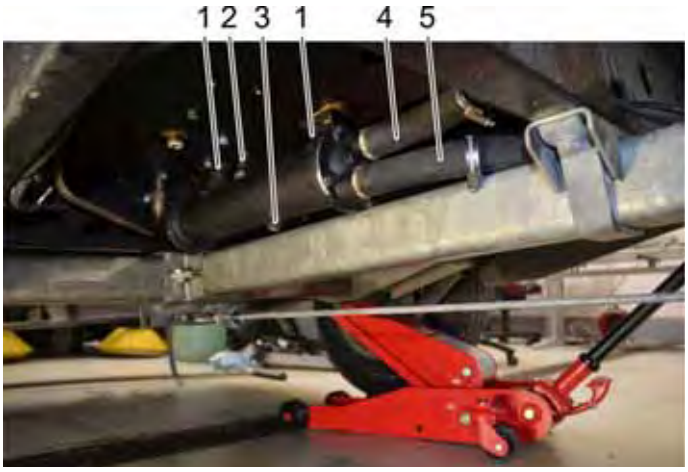
➔ Check the filling level of the coolant in the expansion tank of the motor coolant while the motor is cold. The liquid level has to be between MIN and MAX.

➔ If necessary, refill coolant.
Open the cover on the expansion tank of the motor coolant, fill in fresh clean water and the relevant anti-freeze up to the max marking.

NOTE

Prior to every start-up, the filling level in the expansion tank coolant must be checked.

Due to the space conditions in the filling area, do not use containers of more than 5 litres for refilling.



1 Connection coolant hose (forward and return flow)
2 Connection from the expansion tank motor coolant
3 Drain screw coolant
4 Connection from the water distribution
5 Connection to the HP pump

Change of coolant

➔ Dismantle the protective plates from the bottom.

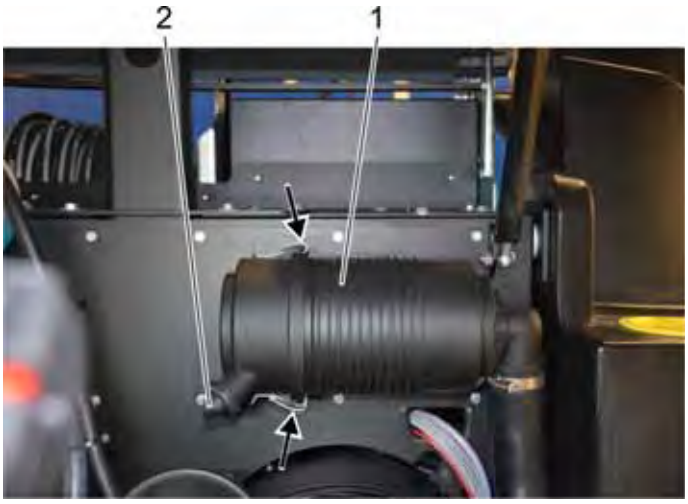
➔ Place tray for collecting the coolant underneath.

➔ Open the drain screw, drain coolant.

NOTE

Coolant quantity total: 5 litres

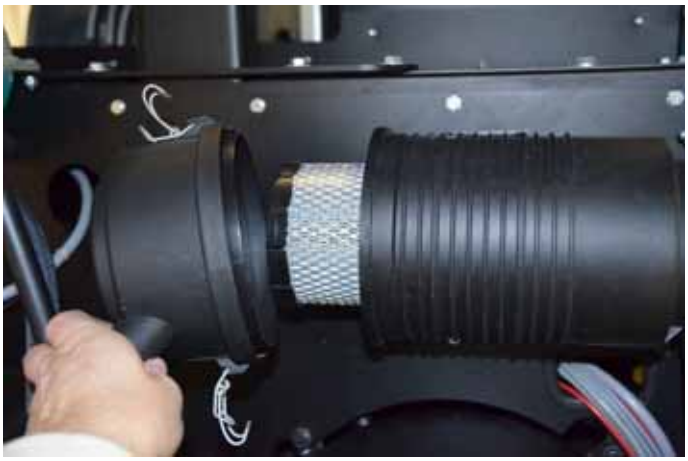
11.15.2 Cleaning/replacing the air filter



1 Air filter
2 Blow-out lip

➔ Loosen the spring tension bracket, remove the cover and eliminate the dust deposits.

NOTE
Severely contaminated or defective filter inserts must always be replaced.



➔ Take out the filter inlay.
➔ Blow out the filter insert with compressed air (max. 2 bar) from the inside.
➔ Clean the inside of the air filter housing with a cloth.

➔ Insert the filter inlay into the air filter casing.
➔ Attach the cover and fasten it by means of the spring tension bracket.

NOTE
Ensure that the opening of the filter inlay points into the casing.
When attaching the cover, ensure that the clamping brackets engage in the recesses on the casing and that the discharge lip points into the motor compartment.

11.15.3 Checking / replacing the V-belt of the alternator

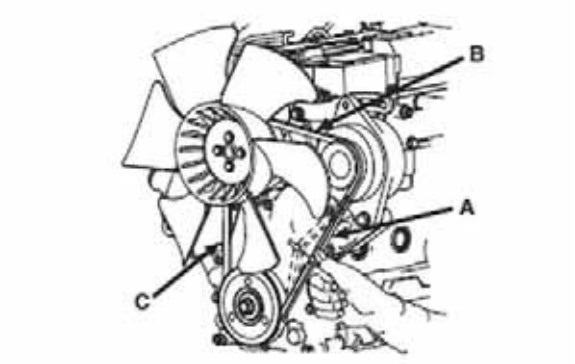
Check the tension of the V-belt

⚠ ***CAUTION***

Risk of damage!

If the V-belt is not sufficiently tensioned, this can cause an overheating of the engine and to an insufficient battery charge.

Defective V-belts must be replaced immediately.



➔ Shut off the motor and remove the key from the key switch.

➔ Press the belt with your thumb to check the V-belt tension.
It should be able to push in the V-belt:
- with position A: 10-14mm
- with position B: 7-10mm
- with position C: 9-13mm

NOTE

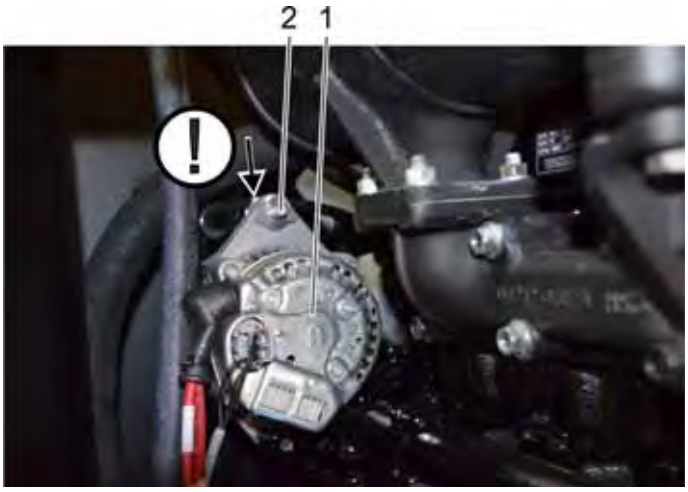
The preferred test position is "B".

Replacing V-belt

➔ Loosen the 4 screws of the protective casing from the fan wheel (do not unscrew completely!)

➔ Turn the protective casing in the counter-clockwise direction until the screws are located over the recesses on the air casing.

➔ Slide the protective casing into the air box so that there is a sufficiently large gap for unthreading the V-belt.



1 Alternator
2 Screw

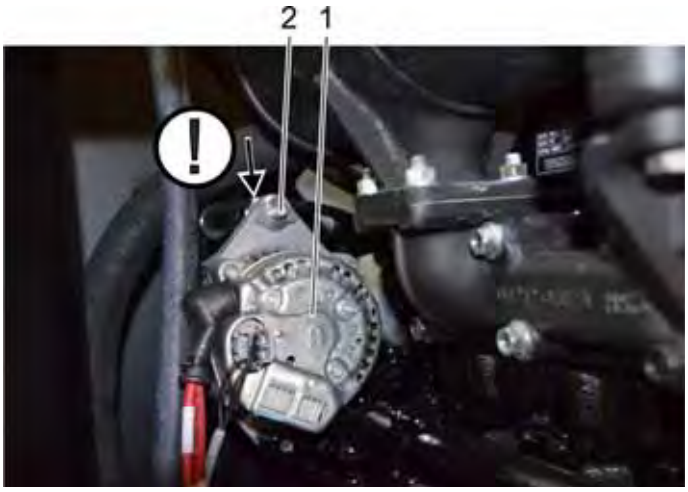
➔ Slightly loosen the screw for fastening the alternator.
➔ Move the alternator towards the motor and slacken the V-belt this way.

1 V-belt
2 Fan wheel

➔ Remove and unthread the V-belt over the fan wheel.

NOTE
When installing the V-belt, position the alternator in a way that the V-belt has the relevant tension again; e.g. indentation depth with position "B" = 7-9 mm, see previous section.
Unscrew the screws of the protective casing sufficiently, pull the protective casing towards the front and bring it in the correct position in the clockwise direction. Ensure that the metal tab is on the inside and the screw with the washer on the outside.

11.15.4 Replace the alternator

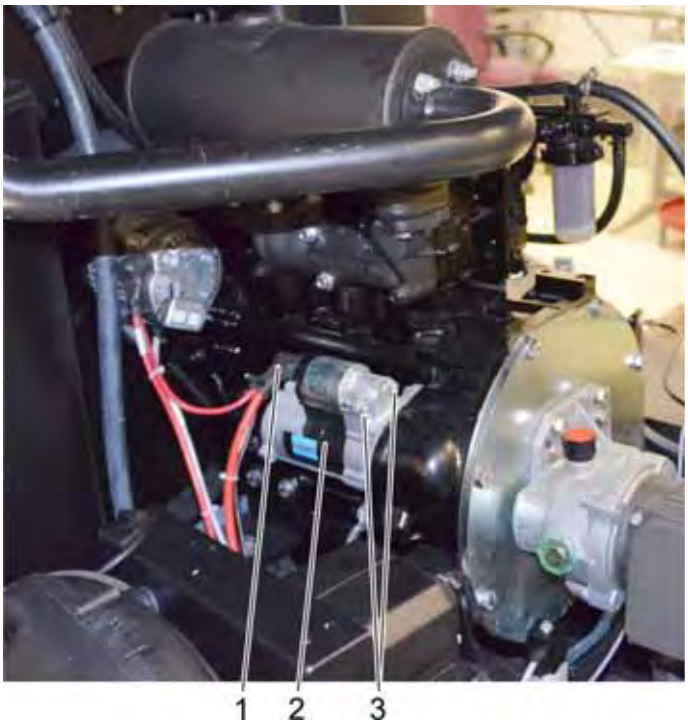


1 Alternator
2 Screw

➔ Disconnect battery.
➔ Mark the position of the alternator on the retainer for orientation.
➔ Slightly loosen the screw for fastening the alternator.
➔ Move the alternator towards the motor and slacken and remove the V-belt this way.
➔ Pull the connection plug off the alternator.
➔ Disconnect the alternator electrically.
Mind the cable run!
➔ Open the screw, remove the alternator.
➔ Install and electrically connect new alternator.
Mind the cable run!
➔ Connect the battery.

NOTE
Upon installation, push the alternator back on the marking for orientation and screw it down so that the V-belt has the appropriate tension again; e.g. indentation depth with position "B" = 7-9 mm, see previous chapter.

11.15.5 Replacing the starter



1 Connecting cable
2 Starter
3 Nut

➔ Disconnect battery.
➔ Disconnect the earth connection and the connection cable from the starter.
➔ Open the nuts, remove the starter.
➔ Install and electrically connect new starter. Mind the cable run!
➔ Connect the battery.

11.15.6 Check the oil level on the motor / refill motor oil

NOTE
Only trained personnel is permitted to add motor, gear and pump oil.
Check the oil level while the engine is warm.
Align the appliance horizontally prior to checking the oil level in order not to get a false result.

⚠ ***CAUTION***
Risk of damage!
When filling the motor oil make sure that no oil lands on hot motor surfaces. Increased risk of fire!

1 Upper cover filling hole
2 Oil dipstick

➔ Remove the oil dip, wipe it and reinsert it.
➔ Remove the oil dip one more time and check the oil level. The oil level is correct if it is within the markings on the oil dip.
➔ If the oil level is below the mark on the dipstick, open the upper cover of the filling hole and fill in fresh motor oil.
➔ Wait five minutes, until the oil has collected in the oil pan.
➔ Check the oil level as described above.
➔ Repeat this procedure as often as necessary until the oil level is between the markings on the oil dip.
➔ After the check, insert the dipstick and close the upper cover of the filling hole.

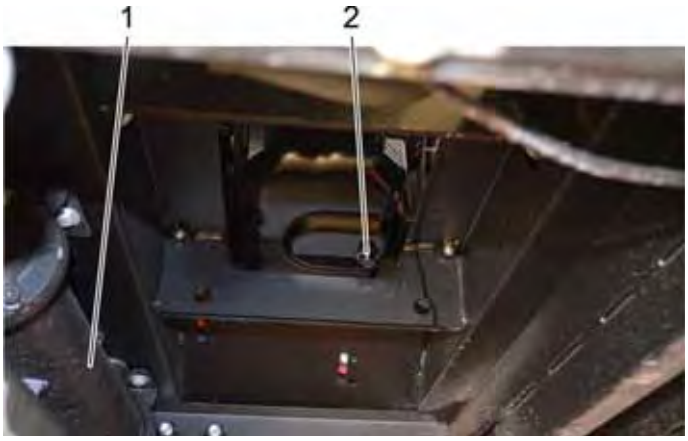
NOTE
Air pockets must be able to leak out.

	Oil grade
Diesel engine	15 W40

11.15.7 Perform oil change / replace oil filter

NOTE

Replace the oil while the motor has operating temperature.
Align the appliance horizontally prior to the oil change.
Dispose of the waste oil according to the local provisions.



View from below
1 Heat exchanger
2 Oil drain screw engine

The oil drain screw is located on the bottom of the motor casing.

➔ Lift the trailer, unscrew the protective plate on the bottom left.
➔ Place a catch pan underneath the oil drain screw.
➔ Open oil drain screw, drain used oil.
➔ Screw the oil drain screw back in.
If the seal is porous or damaged, use a new screw.

1 Oil filter

Oil filter wrench

➔ Remove the oil filter using the oil filter wrench.

1 Seal

➔ Coat the washer of the new oil filter with oil before fitting it.

1 Seal seat

➔ Clean the seal seat and apply oil prior to installation of the new oil filter.
➔ Screw the oil filter in finger tight.
➔ Turn the oil filter another 1/8 turn using the oil filter wrench.
➔ Unscrew the upper cover from the oil filler neck.
➔ Slowly fill 3.5 litres of fresh motor oil (specification see table below) into the oil filler neck.
➔ Screw the lid onto the oil fill neck.
➔ Start the engine and let it warm up.
➔ Check the oil level as decribed in the chapter "Check oil level on engine" and refill if necessary.

	Oil fill volume and type
Diesel engine	3.5 litres, 15 W40

11.15.8 Change fuel filter

NOTE

Collected diesel fuel must be disposed of according to local regulations.

1 Valve tap
2 Fuel filter

➔ As a precaution, place suitable container or absorbing sheets underneath the fuel filter.

➔ Set the valve to "OFF", for this purpose, turn the tap upwards.

NOTE

In the valve position "OFF" leaking of diesel upon opening the filter casing is avoided.

➔ Loosen the lock-union nut.

NOTE

Observe the rotation direction! The casing is screwed down from the bottom!

➔ Unscrew the filter casing.

➔ Clean metal filter inlay.
Replace plastic filter inlay.

➔ Reinsert the filter in the casing so that the opening of the filter inlay points upwards.

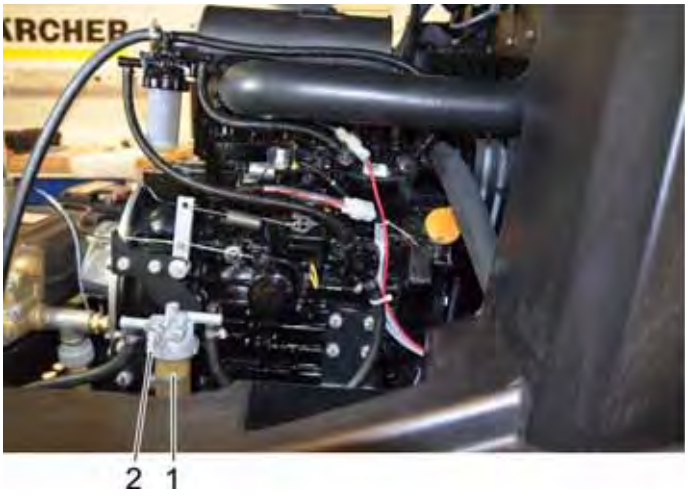
➔ After installation, turn the valve tap down again and set it to "ON".

➔ Manually fill the filter casing with diesel using the manual control on the fuel pump.

11.15.9 Empying the water separator

NOTE

Collected diesel fuel must be disposed of according to local regulations.



1 Water separator
2 Valve tap

➔ As a precaution, place suitable container or absorbing sheets underneath the water separator.

➔ Set the valve to "OFF", for this purpose, turn the tap upwards.

NOTE

In the valve position "OFF" leaking of diesel upon opening the filter casing is avoided.

➔ Loosen the lock-union nut.

NOTE

Observe the rotation direction! The casing is screwed down from the bottom!

➔ Unscrew the casing.

NOTE

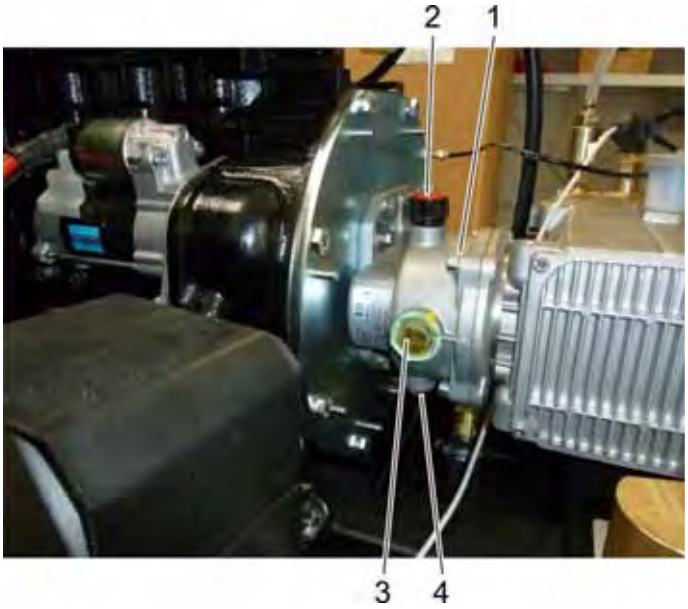
If there is water in the separator, the red ring does no longer lie on the container bottom.

➔ Empty the casing.

➔ Screw the casing back in.

➔ After installation, turn the valve tap down again and set it to "ON".

11.15.10Checking the oil level on the intermediate gear and refilling transmission oil



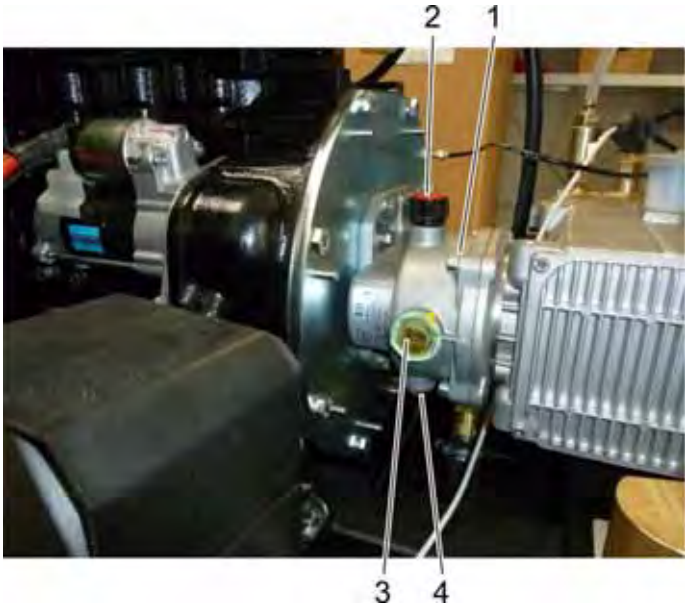
1 Intermediate gear
2 Cover filling hole
3 Oil sight glass
4 Oil drain screw

➔ Check the oil level in the intermediate gear.
➔ If the oil level is below the oil looking glass, add oil.
➔ Fill the appropriate amount of oil into the filling hole.
➔ Check the oil level as described above.
➔ Repeat this procedure as often as necessary until the oil level is in the centre of the oil looking glass.

	prescribed oil grades
Intermediate gear	SAE 90

11.15.11Oil change intermediate gear

NOTE
Dispose of the waste oil according to the local provisions.



1 Intermediate gear
2 Cover filling hole
3 Oil sight glass
4 Oil drain screw

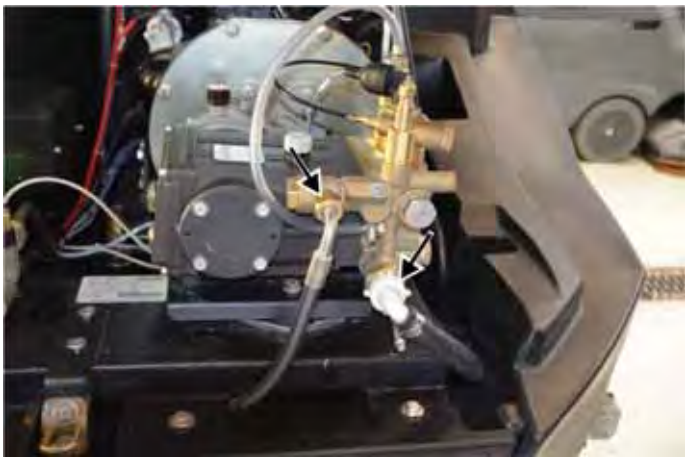
NOTE
Replace the oil while the motor has operating temperature.
Align the appliance horizontally prior to the oil change.

⚠ ***CAUTION***
Risk of burns when draining hot oil.
Let the oil cool down to approx. 40 °C prior to changing the oil.

➔ Place a suitable container below the intermediate gear.
➔ Turn out the oil drain screw.
➔ Drain the waste oil completely.
➔ Screw in the oil drain screw.
➔ Unscrew cover of the filling hole.
➔ Refill fresh oil.
➔ Check oil level.
➔ Screw in the cover of the filling hole.

	Oil fill volume and type
Intermediate gear	0.35 litres, SAE 90

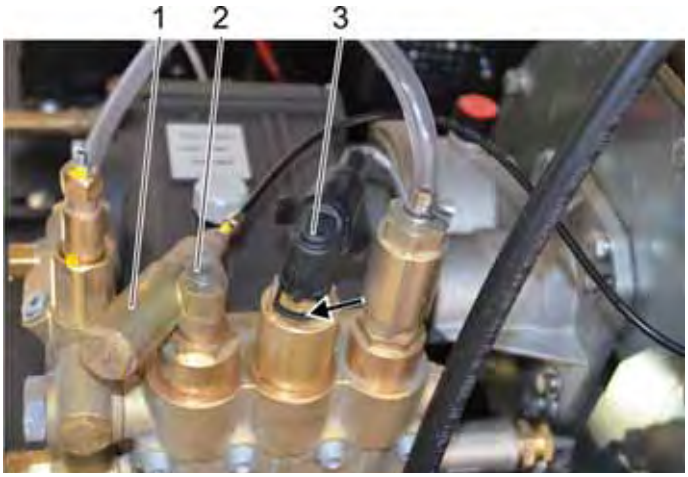
11.15.12 Dismantling intermediate gear with high-pressure pump from the motor / replacing elastomer ring coupling



➔ Disconnect the high-pressure outlet and return line from the pump head.

➔ Disconnect water supply and optionally the detergent connection from the pump head.

NOTE
This detergent connection is only available with the devices HDS 13/20 and HDS 17/20.



1 Speed control
2 Screw
3 Pressure switch

➔ Pull out the clip of the connecting plug of the pressure switch, remove the plug.
➔ Unscrew the screw of the speed control and remove the entire unit of the speed control towards the top.

NOTE
Ensure that no O-rings are lost!

➔ Unscrew 8 screws on the flange between the motor and the intermediate gear.

NOTE
It is recommended to open the bottom screws first and then the upper ones. This is beneficial concerning the available space and the tipping behaviour of the unit.

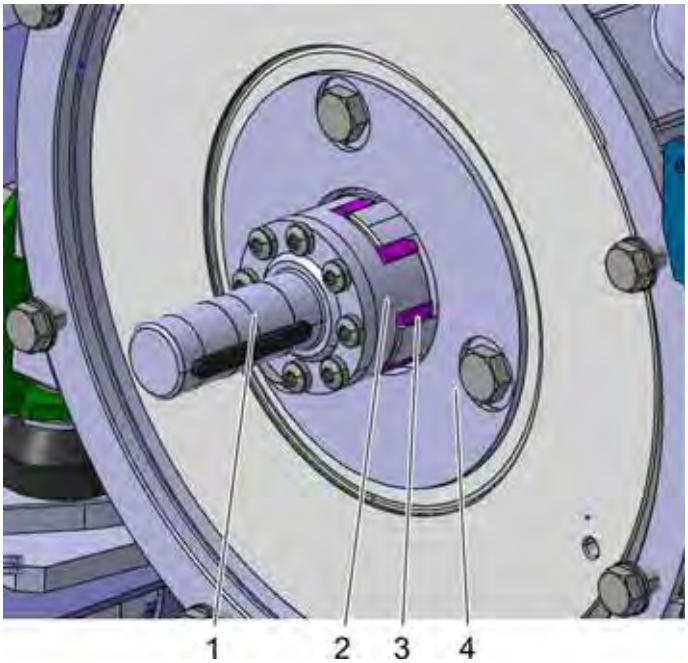
➔ Unscrew the screw of the front rubber buffer support.

NOTE
The structure with the 350/500 bar pumps is similar.

1 Drive shaft

➔ Remove the pump with the intermediate gear from the drive shaft.

NOTE
If necessary, support by levering out in the recesses on the flange area of the motor plate.



1 Drive shaft
2 Claw clutch
3 Elastomer ring
4 Flange plate

➔ If necessary, exchange the elastomer ring. For this purpose, pull out the drive shaft and replace the elastomer ring.

NOTE
If the entire claw coupling must be replaced, the coupling halves of the drive shaft and the flange plate must be unscrewed.
In order to unscrew the coupling half from the flange plate, it must be unscrewed from the motor first.

NOTE
Properly grease the drive shaft prior to installation!
In order to do so, use the lubricating and installation paste, part number 6.869-088.0!

11.15.13Removing the intermediate gear from the high-pressure pump

NOTE

The pictures are of a purely informative nature, they do not depict the situation on the mini trailer.

➔ Drain the oil from the intermediate gear.
➔ Unscrew 4 screws and remove the casing.

➔ Open the safety screw.

➔ Pull off the toothed wheel.

NOTE

Upon installation, push the toothed wheel onto the shaft all the way to the stop.

➔ Unscrew 4 screws and remove the flange from the pump unit.

NOTE
Ensure that no O-rings are lost!

NOTE
After assembly, fill oil (SAE 90) into the oil filler neck while the appliance is in a horizontal position until the oil level reaches the upper edge of the oil level indicator.

11.16 Fuel tank

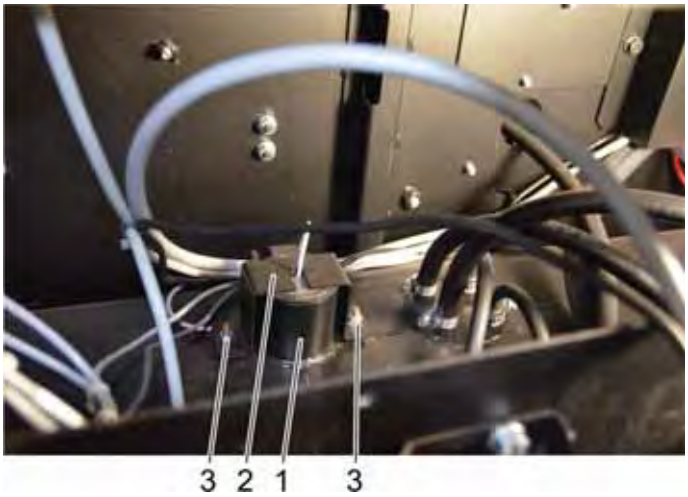
11.16.1 Draining the diesel

Dispose of fuel that cannot be used again in accordance with the local regulations.

View from below
1 Drain screw fuel tank

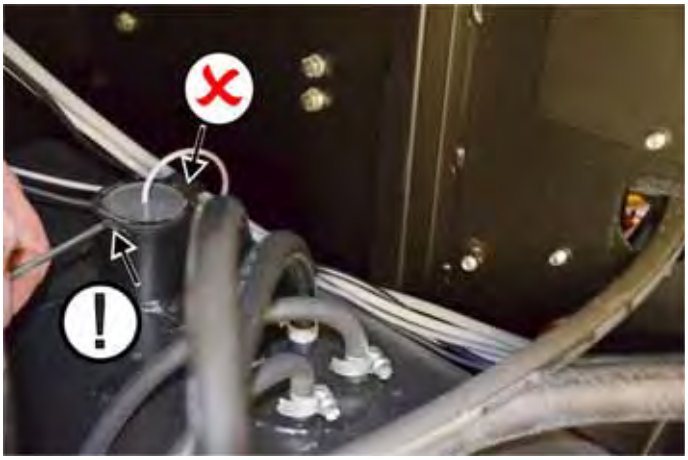
NOTE
The drain screw is located on the bottom of the tank and can be reached from below.
➔ Lift the trailer.
➔ Place a catch pan underneath the drain screw.
➔ Open the drain screw, drain diesel.
➔ Screw the drain screw back in.
If the seal is porous or damaged, use a new screw.

11.16.2 Checking / replacing the level sensor fuel



View with opened maintenance flaps
1 Level sensor for fuel tank
2 Support
3 Nut

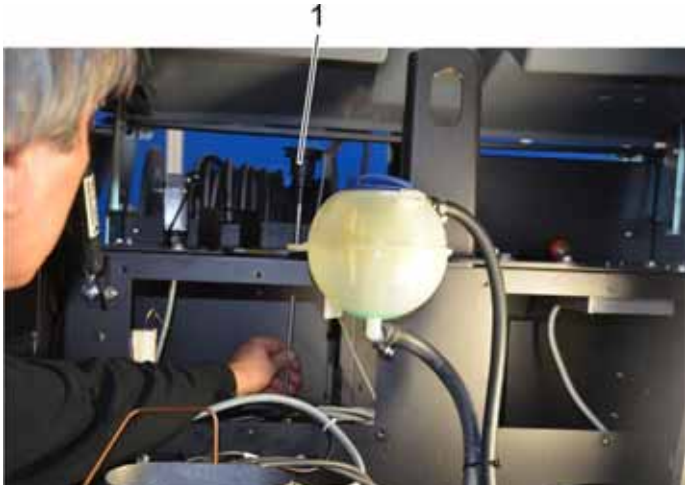
➔ Unscrew both maintenance flaps.
➔ Unscrew 2 nuts.
➔ Unthread the holder, mind the cable while doing so.



➔ Carefully lever out the level sensor at the edge of the upper rubber cuff along the girth of the branch using a screwdriver.

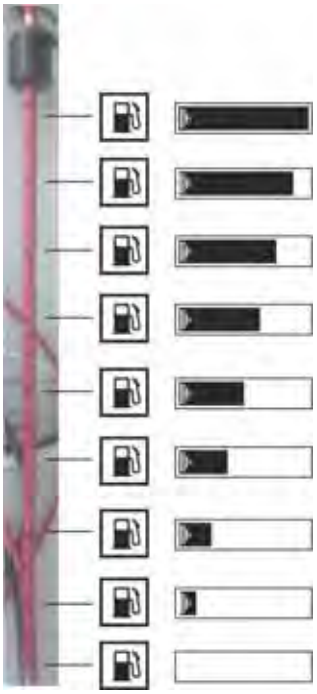
ATTENTION
Risk of property damage! Do not pull the level sensor out on the flap of the cuff, as this can get damaged in the process due to the tight fitting!

➔ Pull out the level sensor from the tank towards the top.



1 Level sensor for fuel tank

➔ Detach the cable tie on the supply line so that there are no constraints by cables upon unthreading.
➔ Push the level sensor up through the opening in the cover of the air casing, then tilt it out towards the motor compartment.
➔ Check the float switch at the sensor end for proper function.
➔ If necessary, electrically disconnect and replace the sensor, observe cable run!

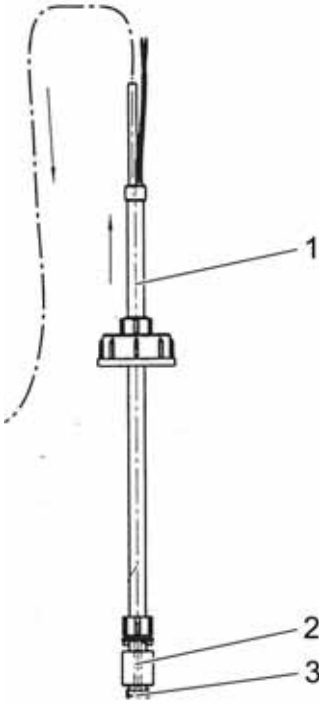


➔ Check level sensor for proper function.
For this purpose, set the float contact to the various filling level positions on the level sensor and match it with the relevant indication on the display.
➔ If necessary, disconnect and replace the level sensor on the control, observe cable run!

NOTE
If no bargraph of the fuel tank is depicted, there is a fault in the level sensor of the fuel tank or it is not properly connected.

11.17 Detergent dosing unit

11.17.1 Clean filter at the detergent suck hose



1 Suction lance with screw cap for detergent can
2 Level sensor
3 Suction valve with filter sieve

➔ Unscrew the screw cap of the detergent suction hose.
➔ Take out detergent suck hose.
➔ Clean filter sieve in water and reinstall it.

11.17.2 Changing the detergent dosing valve

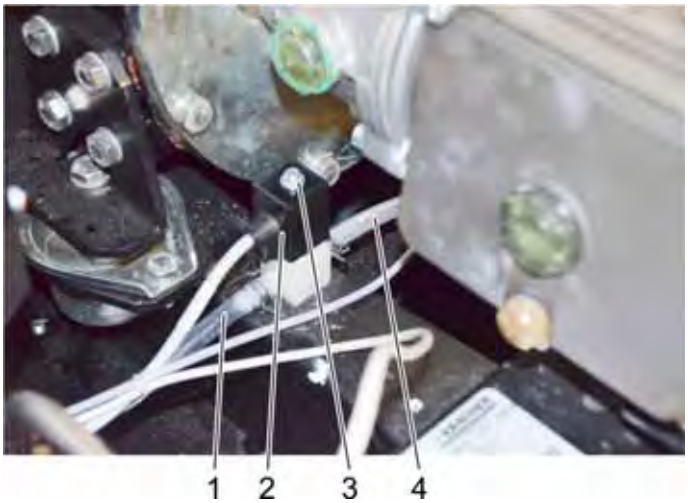
1 Dosage valve for detergent

➔ Detach the hoses on the back of the valve (open clamp by means of pliers)
➔ Slightly push in the catches of the valve from the back and pull off the valve towards the front.

Detergent dosing valve

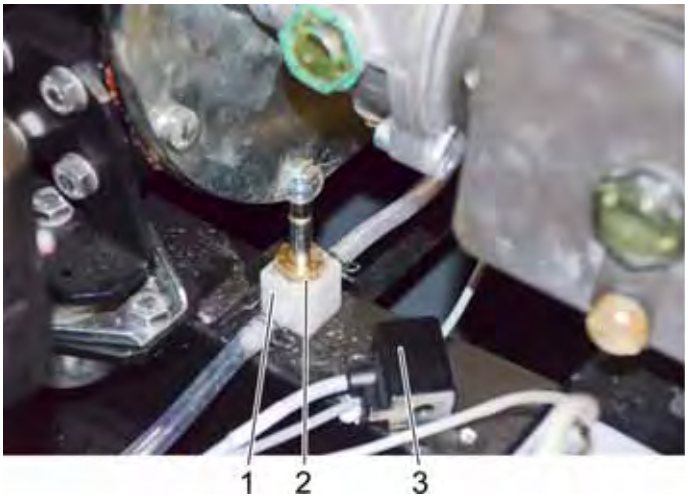
1 Connection from the detergent tank (labelled with "1")
2 Connection to the pump (labelled with "P")

11.17.3 Cleaning / changing the solenoid valve dosing detergent



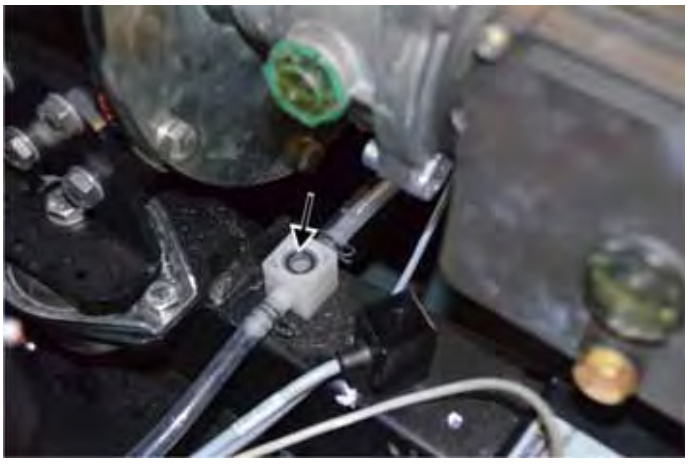
Solenoid valve dosing detergent
1 Connection from the detergent tank
2 Solenoid valve
3 Nut
4 Connection to the pump

➔ Open nut.
➔ Remove magnetic coil from the valve tappet.



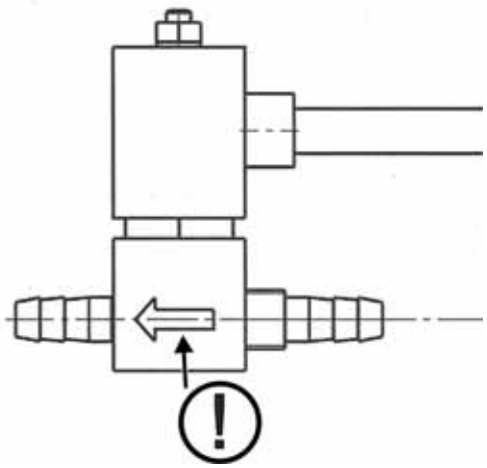
1 Valve body
2 Tappet with hexagon nut
3 Magnet coil

➔ Open the hexagon nut on the tappet.
➔ Pull the tappet out of the valve body.



➔ Clean the valve body.

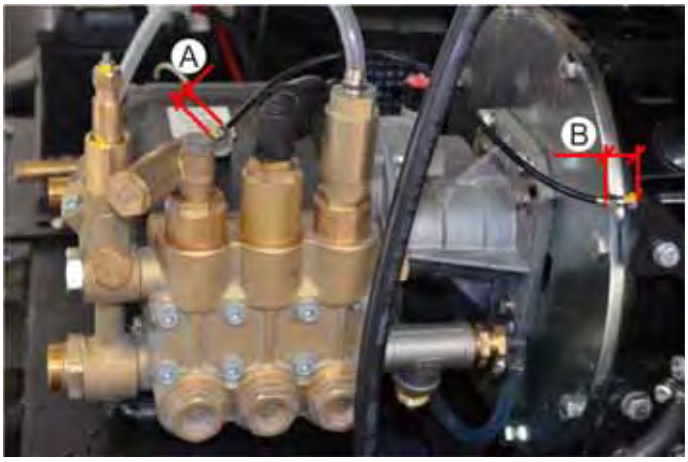
➔ Clean the tappet with a soft cloth if necessary.



NOTE
When changing the complete solenoid valve, the hoses must be disconnected and the valve must be unscrewed from the bottom. Finally electrically disconnect the valve. Observe the cable run with the electrical connection! Mind the flow direction of the solenoid valve (arrow)!

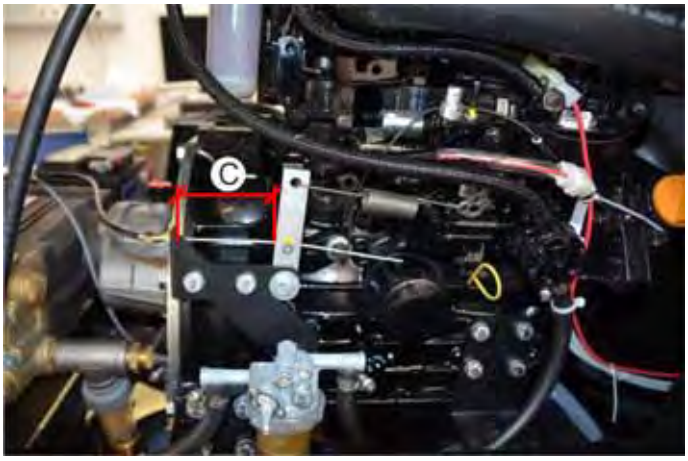
11.18 Adjustment of the working pressure and the water volume in combination with the motor speed

NOTE
The description for adjustment is done jointly for all unit types. Deviations that must be observed with the unit types HDS 13/20 and 17/20 are listed separately.
The technical data required for this is listed in Chapter 15.

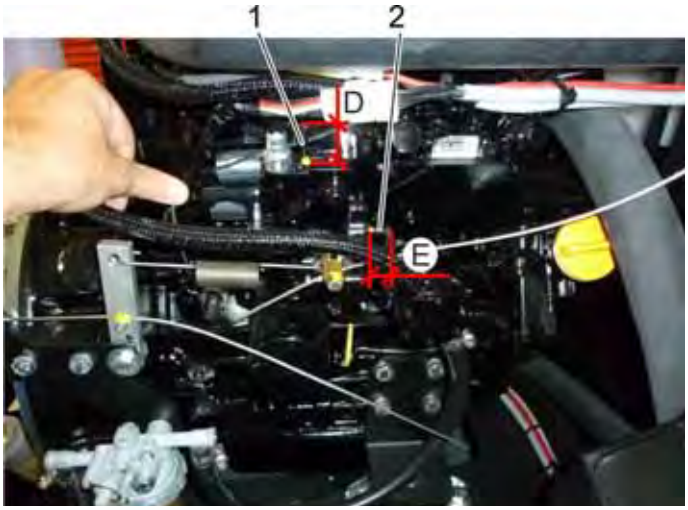


➔ Perform standard settings on the high-pressure pump and the motor.

A = 20mm
B = 20mm



C = 75mm



1 Stop screw full load
2 Stop screw idle mode

D = 27,5mm
E = 18,5mm

Hand throttle lever
➔ Insert test nozzle into the spray gun.
➔ Attach rev counter to the motor.
➔ Start the diesel engine.
NOTE
If the engine does not start, manually fill the engine with diesel by means of the manual control on the fuel pump.

➔ Open gun.
With HDS 13/20 and HDS 17/20: Completely open the pressure and volume regulation on the gun (set to "+").
➔ Set the maximum speed (+/-50 1/min) on the stop screw full load.
➔ Secure the setting by means of a locknut.
➔ Close gun.
➔ Set the minimum speed (+/-50 1/min) on the stop screw idle mode.
➔ Secure the setting by means of a locknut.

NOTE
The check of the motor speed can be performed with the measuring device 6.491-361.0.
The speed is established via the vibrations present on the motor. The rev counter is applied at a suitable spot. Push out the resonance spring until the amplitude with running motor is the largest. Now the speed can be read on the scale.

1 Adjustment screw, high pressure
2 Lock nut, adjustment screw, high pressure
3 Spindle, pressure and quantity regulation
4 Housing, overflow valve

Check setting safety valve
NOTE
The safety valves are preset by the factory.
HDS 13/20 and 17/20: The presetting at 240bar is done in the factory.
HDS 9/50 and 13/35: The safety valve is permanently set and stamped:
– with 350bar device: Setting 440bar
– with 500bar device: Setting 640bar

NOTE
The check of the safety valve is performed by increasing the pressure in the overflow device until the safety valve starts dripping.
The check is done with the test nozzle.

➔ Install the test manometer (special tool) to the high-pressure connection.
➔ Connect the high-pressure hose with gun and rotary regulator to the test manometer.
➔ Open gun.
With HDS 13/20 and HDS 17/20: Completely close the pressure and volume regulation on the gun (set to "-").
➔ Open the lock nut on the overflow device.
➔ Turn the adjustment screw high pressure until the safety valve starts dripping.
➔ Read the pressure on the test pressure gauge, see technical data.

NOTE
If this screw is turned clockwise, the pressure is increased; and if it is turned counter-clockwise, the pressure is decreased.

1 Adjustment screw, high pressure
2 Lock nut, adjustment screw, high pressure
3 Spindle, pressure and quantity regulation
4 Housing, overflow valve

Adjustment overflow device
NOTE
The adjustment is done with the test nozzle.

➔ Install the test manometer (special tool) to the high-pressure connection.
➔ Connect the high-pressure hose with gun and rotary regulator to the test manometer.
➔ Open gun.
With HDS 13/20 and HDS 17/20: Completely close the pressure and volume regulation on the gun (set to "-").
➔ Open the lock nut on the overflow device.
➔ Turn the adjustment screw high pressure until the test pressure on the pressure gauge is reached, see technical data.

NOTE
If this screw is turned clockwise, the pressure is increased; and if it is turned counter-clockwise, the pressure is decreased.

➔ After adjustment, secure the adjustment screw high pressure by means of a lock nut.
➔ With unit types HDS 9/50 and 13/35, install the sheathed cable of the overspeed control in a way that it is no longer slacking at the preselected minimum speed.
➔ Check working pressure and flow rate with the series nozzle.
➔ Seal the adjustment screw for high pressure and the lock nut with safety lacquer.

12 Care

The device must always be kept in a clean condition. Maintenance cleaning must be performed periodically by the operator or service personnel considering the state of cleanliness.
The exterior cleaning can be performed with a high-pressure device, however, a minimum distance of 1-2 metres between the trailer and the high-pressure lance must be kept.

ATTENTION
Risk of damage to equipment. When cleaning the motor compartment, ensure that electrical components, plug connections and the air filter are spared widely. Do not flood the interior!

12.1 Descaling

ATTENTION
Lime deposits in the water system of the high-pressure cleaning system lead to increased pipeline resistance and possibly to the failure of calcified components.!

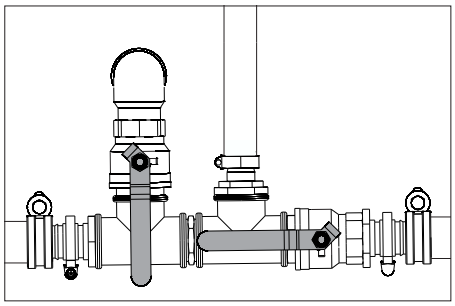
⚠ ***DANGER***
Risk of explosion due to combustible gases! Smoking is prohibited during descaling. Ensure proper ventilation.

⚠ ***DANGER***
Risk of chemical burns on account of acid! Wear protective glasses and protective gloves.
Observe the safety instructions for the detergent!

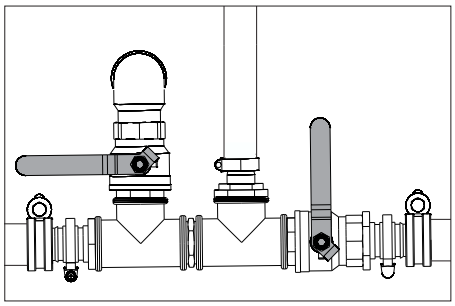
According to statutory requirements, only tested and approved boiler cleansing compounds with a certification mark may be used for removal.
– RM 101 (order no. 6.287-013) removes deposits.

These agents are geared to the materials used in the system. It is recommended to flush the system with an alkaline solution to neutralise the acid residues after descaling (pH-value 7-8).
The application and accident prevention regulations must be observed (concentration in compliance with the specifications on the container label

Descaling of the entire group heat exchanger, pump, booster heater

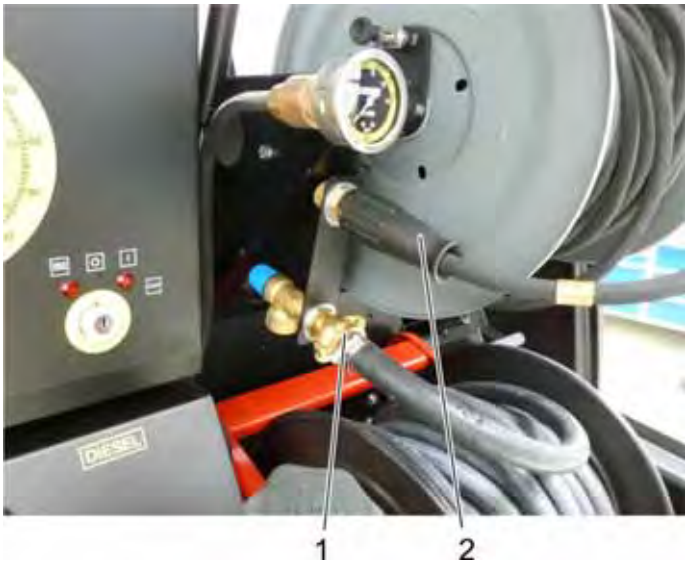


➔ Unpressurize the appliance.
➔ Open the supply tap of the water tanks and the drain tap in order to completely drain the device. The filling level indicator of the water tanks dips completely.



➔ Close the supply tap of the water tanks and the drain tap.

➔ Mix the mixture for descaling:
Mix 18.75 litres of water with 1.25 litres of RM 101 (5-litre can: 6.295-398.0).
➔ Open the filling hole of the float container. In order to do so, loosen the wing screw and push the cover to the left.
➔ Fill up the float container with 20 litres of the descaling mixture.
➔ Set the actuation lever of the ball tap to normal operation (horizontally).



1 Water pipes
2 High pressure hose

➔ Disconnect the trigger gun from the high-pressure hose.
➔ Connect the high-pressure hose to the frost protection inlet.
➔ Disconnect the water hose from the water supply.
➔ Connect the water hose to the return flow of the frost protection.

➔ Set the operating mode switch to the operating mode "frost protection".
➔ With cold engine only:
To preheat the motor, turn the key switch to the left and hold it until the indicator light preheating goes out.
➔ Turn key switch to position "I". The indicator lamp for operational readiness lights up.
The control voltage is switch on and the display shows the operating status "Antifreeze".
➔ Turn the key switch to the right until the motor is running.
➔ The descaling fluid is pumped in the circuit through the device.
➔ Repeat the procedure 3-4 times, then rinse with clear water and, if necessary, some brine; collect the descaling fluid for later environmentally friendly disposal.
➔ The dissolved rejects are filtered in the filter of the water inlet. Finally clean it.

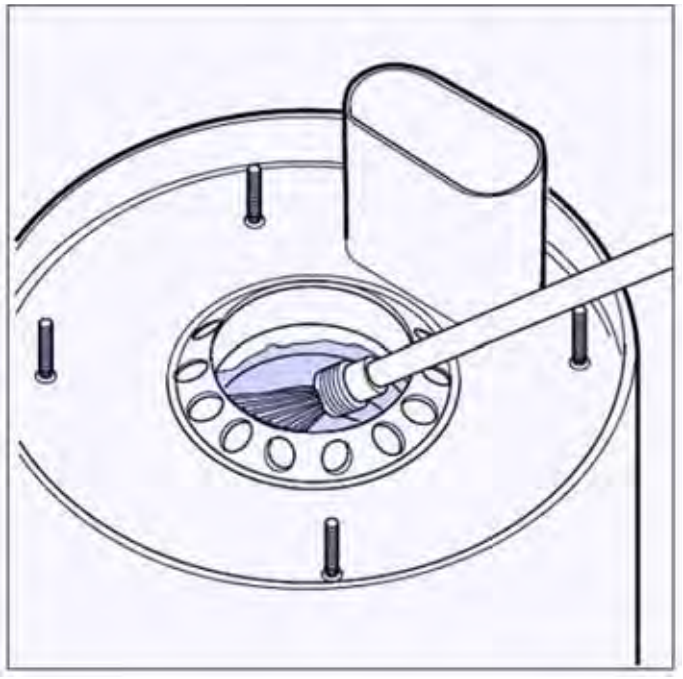
NOTE
In the frost protection mode flow is recognised, however, no pressure. This is OK in this operating mode and does not lead to a fault message!
The fault message "water shortage" is deactivated with the operating mode.
The frost protection mode has a maximum work time of 5 minutes, then the motor is switched off automatically.
In case of a faulty operation that leads to a pressure build-up, the following could happen:
– the safety valve opens or
– the control switches off the diesel engine, as flow and pressure are synchronous. After 5 seconds, the error message ERROR 5 occurs

NOTE
Following the descaling, a maintenance of the pump is recommended.

NOTE
In order to dispose of the descaling water in an environmentally friendly way, it may be necessary to neutralise it.
➔ Dilute the collected descaling water with approx. 10-20 litres of water.
➔ Dip pH indication paper 6.768-006.0 into the descaling water and determine the pH value.
➔ While constantly stirring, add sodium acetate (1 kg: 6.287-172.0) until a pH-value of approx. 7 is reached. The test is done with the pH indicator paper again.
➔ After that, the descaling water can be disposed of via the public sewer system.

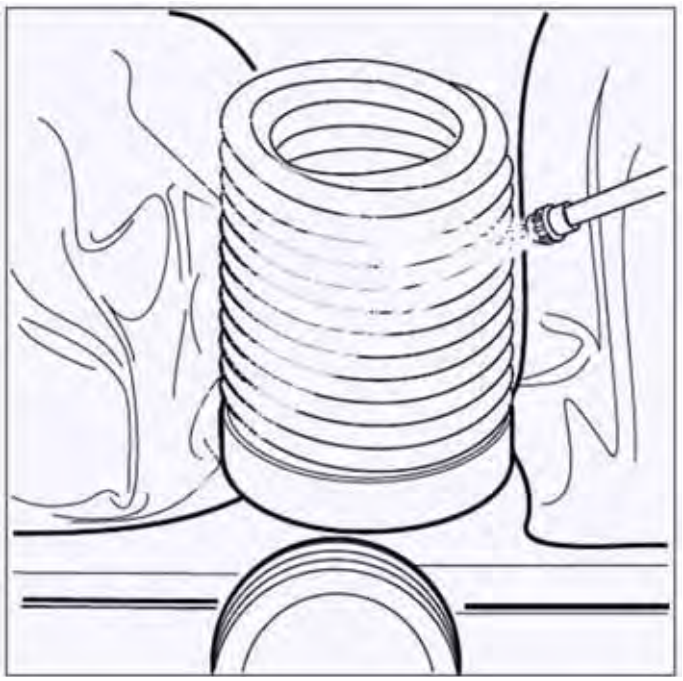
12.2 Removing the soot from the heating coil

⚠ ***DANGER***
Risk of chemical burns from strong brine! Wear safety goggles and protective gloves.
Observe the safety instructions for the detergent!



➔ Let the device warm up in the burner operation, then switch it off.
➔ Depressurise the device by opening the gun.
➔ Unscrew the fuel line, flame sensor and ignition electrodes from the burner cover.
➔ Unscrew the burner cover, remove burner.
➔ Fill the boiler with water just below the upper edge.
➔ Add approx. 0.5 litres of RM 31 and mix well.

NOTE
Use water with a pressure of max. 6 bar to fill the booster heater.



➔ Allow the cleaning solution to react for approx. 15 minutes.
➔ Unscrew the screws from the boiler jacket and remove the boiler jacket towards the top.

NOTE
Collect the leaking water in order to dispose it of in an environmentally sound way!

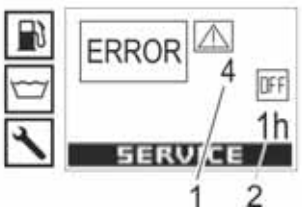
➔ Drain the remaining cleaning solution from the container bottom.
➔ Cover the rest of the device with protective foil so that only the heating coil remains visible.
➔ Switch on the motor and thoroughly spray down the heating coil with cold water.
➔ Drain the residual water in the container bottom.
➔ Reassemble all parts in the reverse order.
➔ After the installation, let the device run in burner operation for approx. 10 minutes for drying.

NOTE
In order to dispose of the cleaning solution in an environmentally friendly way, it may be necessary to neutralise it.

13 Troubleshooting

13.1 Faults with display

The malfunction is shown on the display as follows.



1 Malfunction no.
2 Indication, for how many hours the malfunction has occurred

NOTE
Further information about the test of the sensor technology can be found in Chapter 9.2.1.

Display	Possible cause
ERROR 1 Charging current	Relay K9 defective
	Relay K5 defective
	Motor oil pressure switch defective
	Electronics defective (board A1)
ERROR 3 Coolant or temperature water in the float container	Temperature water in the float container > 50?. Input temperature water too high or the motor runs without water removal for approx. 25-30 minutes.
	Heat exchanger clogged.
	Temperature sensor in the float container defective.
	Temperature coolant too high (>100?).
	Coolant level too low.
	V-belt tension at the motor fan insufficient.
	Motor fan defective.
ERROR 4 Water shortage	Water filter soiled.
	Water supply volume or pressure too low.
	Water tanks (2x250 l) empty or stop cock water tanks closed.
	Float valve soiled / jammed / defective.
	Sensor filling level monitoring in the float container defective
ERROR 5 Flow switch/pressure switch	Normal mode: Flow and pressure switch do not run synchronously.
	Frost protection mode: Flow and pressure switch run synchronously.
	Air in the system.
	Fine filter before the pump is soiled.
	No flow present.
	No pressure present.
	Reed switch flow monitor defective or soiled.
	Pressure switch is defective.
	Overflow device defective.
	Check valve on the high-pressure outlet defective.
ERROR 6 Fuel sensor	Diesel tank empty (bargraph = 0 bars)
	Level sensor not plugged in / no contact / short circuit
	Float of the level sensor jammed.
	Level sensor defective.
ERROR 7 Motor oil pressure	Oil level in the motor low.
	Motor oil has the wrong viscosity grade.
	Oil pressure switch or relay K5 defective
	Relay K9 defective

Display	Possible cause
ERROR 9* Emission temperature	Thermostat switch or temperature switch defective.
	Burner has been wrongly set.
	Heating coil is sooted.
	Check heating coil for internal deposits.
ERROR 10* Temperature sensor booster heater	Sensor defective / cable break / short circuit.
ERROR 11* Flame sensor image bright blind	Nozzle holder is soiled.
	Ignition electrodes are soiled / incorrectly adjusted.
	Flame sensor defective.
	Fuel pump defective / coupling fuel pump defective.
	Solenoid valve fuel is defective.
	Ignition transformer faulty.
	Blower motor defective.
ERROR 12* Flame sensor image dark blind	Flame sensor defective.
	Solenoid valve fuel is jammed, does not close, must possibly be cleaned.
	Solenoid valve fuel is defective.
ERROR 14 Switch-off after 45 minutes continuous break	Switch the device OFF and back ON.
	Deactivate the "continuous break" switch-off.
ERROR 15 Switch-off after 45 minutes continuous operation	Switch the device OFF and back ON.
	Deactivate the "continuous operation" switch-off.

* Cleaning operation with cold water is possible.

13.2 Faults without display on the console

Fault	Possible cause
Water pressure too low / The device does not reach the full pressure	Check / clean the water filter.
	Check water supply volume, increase if necessary.
	Check the water quantity in the two 250 l tanks
	Open stop cock water tanks.
	Bleed device. Check suction line for leaks / clogging.
	Check frost protection valve.
	Check/replace high-pressure nozzle.
	Check the high-pressure hose; appropriate diameter?
	Check safety valve for leaks / replace if necessary.
	Check/adjust/replace overflow valve.
	Check the pressure and suction valves for leaks / replace.
	High and low pressure seals are worn; replace.
	Check / adjust motor speed.
	Check / adjust /grease / replace speed control.
	Coupling motor - check / replace transmission.
	Check / replace intermediate gear.
Water leak between cylinder head and crankcase	Leakiness of 1 drop per minute and piston is acceptable.
	Check / replace high pressure and low pressure seals.
Water is not being heated	Check / correct temperature settings.
	Check / clean / replace flow switch (reed switch).
	Check / refill filling level in the fuel tank (If the bargraph shows < 3 bars, the burner is switched off).
	Check / replace temperature sensor after the boiler outlet.
	Check / replace fuel filter.
	Check / replace the solenoid valve fuel pump.
	Check / adjust setting fuel pump / replace pump.
	Check / replace coupling fuel pump.
	Check / replace blower motor and impeller.
	Check / adjust the setting air flap.
	Check / replace fuel nozzle.
	Check / replace ignition cables.
	Check / replace ignition transformer.
	Check / adjust distances of the ignition electrodes.
	Decalcify the heating coil.
Insufficient or no function detergent	Check / refill the detergent level.
	Check / correct setting of the dosing valve.
	Clean filter detergent on the suction hose.
	Check / replace the solenoid valve detergent.
	Check the orifice plate at the inlet of the fine filter (in the inlet of the HP pump).

Troubleshooting industry engine **YANMAR 3 TNV76**

	Trouble / Cause	Engine does not start	Engine starts but stops soon	Low oil pressure (engine oil)	Overheat (engine coolant)	Low water temperature (engine coolant)	Exhaust temperature rise	Corrective action
Engine	Governor adjusted incorrectly		o					Make adjustment.
Oil system	Incorrect engine oil	o	o	o				Use correct engine oil.
	Engine oil system leakage			o				Repair.
	Clogged engine oil filter			o				Clean or replace.
	Insufficient engine oil level		o	o				Add correct engine oil.
	Overfilled engine crankcase			o				Check engine oil.
Fuel system	Water in fuel system	o						Draining the fuel filter.
	Clogged fuel filter	o	o					Clean or replace.
	Air in fuel system	o	o					Bleed the air.
	Clogged or cracked fuel line	o	o					Clean or replace.
	Insufficient fuel supply to injection pump	o	o					Check fuel tank cock, fuel filter, fuel line and fuel feed pump.
Electrical system	Starting motor defect	o						Repair or replace starter motor.
	Alternator defect	o						Repair or replace alternator.
	Open circuit in wiring	o						Repair open winding.
	Battery voltage drop	o						Inspect and change the battery if needed.
Coolant system	Excessive radiator cooling					o		Replace thermostat.
	Insufficient radiator cooling				o		o	Replace thermostat or check for loose fan belt.
	Insufficient coolant level				o		o	Check water leakage from coolant system.
	Stretched fan belt				o		o	Adjust the belt tension.
	Defective thermostat				o	o		Check or replace
Various	Engine used at high temperatures or at high altitude				o			Study output drop and load matching.
	Clogged exhaust pipe						o	Clean exhaust pipe.

14 Maintenance plans

14.1 Inspection and maintenance checklist

NOTE
The current inspection and maintenance checklist 5.965-663.0 is recorded in the DISIS.

14.2 Maintenance plan trailer

Maintenance schedule for HDS Trailer

o: check ◊: replace

System	Description	daily	every 50h	every 200h	every 400h	every 600h	every 800h
Basic device	Check device cases & covers for function and damages			o			
	Check trailers chassis for damages / grease			o			
	Check tire pressure			o			
	Nameplate present and readable			o			
Water supply	Check water filter, clean if needed (feed water tank)	o		o			
	Check water filter, clean if needed (feed HP pump)	o		o			
	Check float valve(s) for function					o	
	Check float tank for contamination, clean if needed					o	
	Check hoses for tightness, leaks & damages					o	
	Check heat exchanger for leaks & contamination					o	
HP pump	Check oil quantity for gear pump	o					
	Check HP pump for function & tightness. Replace seals if needed.			o		◊	
	Check suction & pressure valves, replace if needed			o		◊	
	Check pressure gauge & operating pressure			o			
	Change the oil in the gear pump		◊ first time			◊ or yearly	
	Check overflow valve for function & greasing, replace complete if needed			o		◊	
	Check non return valve HP outlet, replace if needed			o		◊	
	Check engine speed controller & grease, replace complete if needed			o		◊	
	Check flow switch for function & contamination, clean if needed					o	
	Check pressure switch (pump) for function					o	
	Check safety block for function					o	
Control elements	Check program selector for function					o	
	Check temperature setting for function						
	Check indicator lights (LED) for function					o	
	Chech display for function					o	
	Check service-switch for function					o	
	Check fault list			o			
	Check ignition cable for damages and tight fit				o		
	Check electrode plug for damages and tight fit				o		
	Check ignition electrodes & clean, replace if needed			o	◊		

Maintenance schedule for HDS Trailer

o: check ◊: replace

System	Description	daily	Every 50h	Every 200h	Every 400h	Every 600h	Every 800h
Accessories	Check HP & LP hoses for damages and tightness			o			
	Check spray gun for damages & tightness			o			
	Check spray gun for damages & tightness			o			
	Check HP nozzle, replace if needed			o,◊			
Cleaning agent	Check cleaning agent dosing valve (control element)					o	
	Check solenoid valve for cleaning agent dosing / clean					o	
	Check level sensor for cleaning agent					o	
	Check filter at the cleaning agent suction hose / clean					o	
	Check suction performance for cleaning agent, clean the hose lines if needed					o	
Electric / Electronic	Check oxidation of battery terminals					o	
	Check for right mounting of the battery terminals					o	
	Check for tight seating of screw and plug connections					o	
	Check for oxidation and damages in current conducting cables / contacts					o	
	Check cable connections and plugs on the control electronics					o	
	Check the fuses of the unit					o	

14.3 Maintenance plan Yanmar diesel engine

Maintenance schedule for Industry engine **YANMAR 3 TNV76**

o: Check ◊: Replace •: Contact your authorized YANMAR industrial engine dealer

System	Check item	tdaily	Every 50h	Every 200h	Every 400h	Every 1000h	Every 1600h	Every 2000h
Complete engine	Overall visual check	o						
Cooling	Check and refill engine coolant	o						
	Check & clean radiator fins (???)			o				
	Check & adjust cooling fan V-Belt		o 1st time	o 2nd and after		◊ or every 4 years		
	Drain, flush & refill with new coolantl					◊ or every 1 year		
Cylinderhead	Adjust intake/exhaust valve clearance					•		
	Lap intake / exhaust valve seats (if needed)							•
Electrical Equipment	Check indicators	o						
	Check battery		o					
	Check function and fastening of the starter				o			
	Check the condition of the electric wires at the starter				o			
Engine oil & filter	Motorenöl Füllstand kontrollieren	o						
	Motorenöl wechseln		◊ 1st time	◊ 2nd and after				
	Motorenölfilter auswechseln							
Fuel	Check and refill fuel tank level	o						
	Sieb Kraftstofffüllung reinigen			o				
	Check fuel filter / water separator	o						
	Check fuel piping and hoses for leaks and damage				o			
	Empty the fuel tank. Check and clean if needed.				o			
	Clean water separator				o	◊		
	Replace fuel filter				◊			
	Check pre-heating and glow plugs for function				o			
Emission control	Check, clean, test fuel injectors if needed						•	
	Check crankcase breather system						•	
	Check exhaust system for damages and leaks				o			
Engine speed control	Check and adjust governor lever and engine speed control			o				
	Check operating speed			o				
Air filter	Check / Clean			o				
	Replace				◊			
Hoses	Replace fuel system hoses							• or every 2 years
	Replace cooling system hoses							• or every 2 years

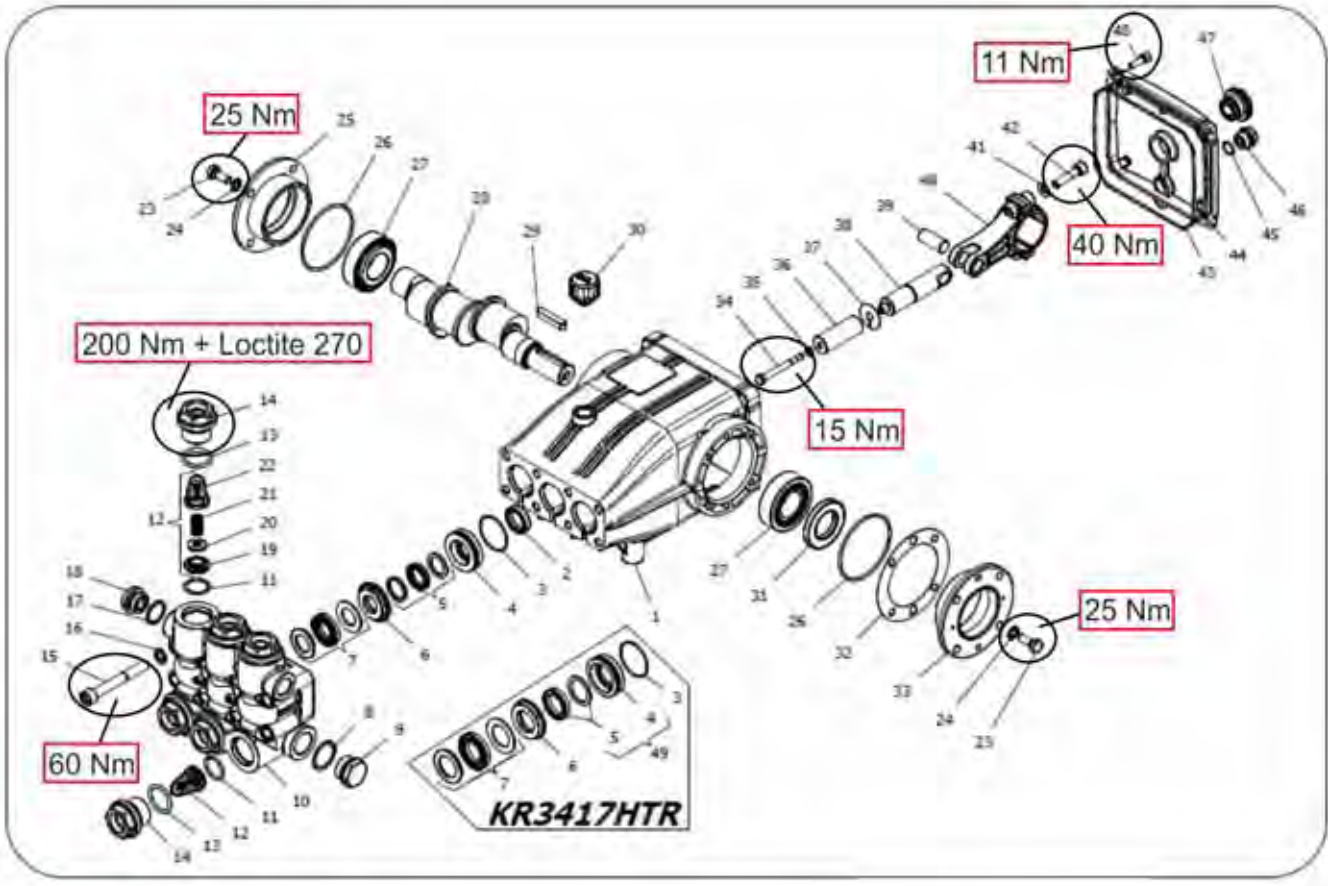
Intermediate gear box	Check oil level			o				
	Check gear for leaks			o				
	Change oil					◊		

15 Technical specifications

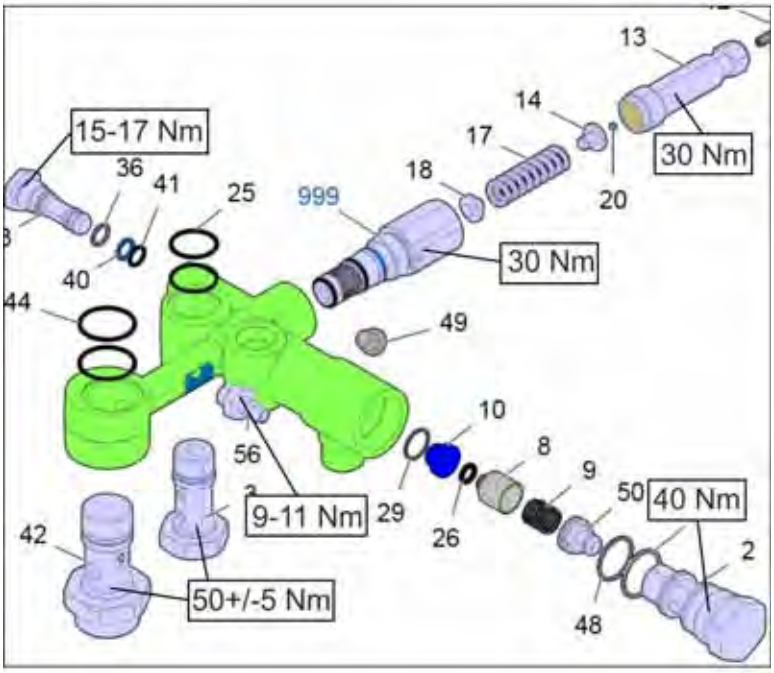
		HDS 9/50 DeTr1	HDS 13/35 DeTr1	HDS 17/20 DeTr1	HDS 13/20 DeTr1
Internal combustion engine					
Idling speed	rpm	1600	1600	1600	1600
Full load speed (gun opened)	rpm	3100	3100	3100	2700
Amount of oil	l	3,5	3,5	3,5	3,5
Oil grade		15 W40	15 W40	15 W40	15 W40
Motor type		3TNV76-CKE	3TNV76-CKE	3TNV76-CKE	3TNV76-CKE
Manufacturer		YANMAR	YANMAR	YANMAR	YANMAR
Cylinder capacity	ccm	1116	1116	1116	1116
Cooling type		Water	Water	Water	Water
Coolant quantity	l	5	5	5	5
Fuel type		Diesel	Diesel	Diesel	Diesel
Consumption diesel	l/h	5,2	5,1	3,7	3,1
Intermediate gear pump					
Reduction ratio		2,176 : 1	2,176 : 1	2,176 : 1	2,176 : 1
Amount of oil	l	0,35	0,35	0,35	0,35
Oil grade		SAE 90	SAE 90	SAE 90	SAE 90
High-pressure pump					
Amount of oil	l	1,3	1,3	1,2	1,2
Oil grade		SAE 90	SAE 90	15 W40	15 W40
Feed pressure water	MPa	0,05 - 1,0	0,05 - 1,0	0,05 - 1,0	0,05 - 1,0
Min. input amount water	l/h	1000	1500	1800	1500
max. water supply temperature	°C	30	30	30	30
Diameter of the inlet hose	DN	19	19	19	19
High-pressure nozzle (series nozzle)	Type	15030	15051	25090	25075
High-pressure nozzle flow (at 8MPa)	l/min	6,12	10,4	18,35	15,29
Flow rate full load, suction water	l/h	840 - 900	1220 - 1280	1600 - 1660	1270 - 1330
Flow volume power press	l/h	-	-	700 - 750	920 - 970
Flow rate partial load	l/h	425 - 475	635 - 695	-	-
Flow rate detergent at full load	l/h	-	-	>55	>45
Pressure full load GA Suction water with test pressure gauge	MPa	49,5 - 50,5	33,5 - 35,0	19,5 - 20,5	19,5 - 20,5
Water pressure with HP hose DN8, 10m Calibration pressure gauge + device outlet	MPa	48,0 - 49,0	32,0 - 33,0	17,0 - 18,0	16,0 - 17,0
Working pressure partial load (Testing manometer)	MPa	13,0 - 14,0	8,5 - 9,5	-	-
Test nozzle / setting Servopress		018	038	038 / controller 3 Controller 3: Servopress > 1100 l/h	038 / controller 3
Pressure full load (Indication on the device pressure gauge)	MPa	50	35	20	20
Safety valve beginning of the opening (Testing manometer)	MPa	64 +/- 0,3	44 +/- 0,3	23,5 +/- 0,3	23,5 +/- 0,3

		HDS 9/50 DeTr1	HDS 13/35 DeTr1	HDS 17/20 DeTr1	HDS 13/20 DeTr1
Safety valve completely opened (Testing manometer)	MPa	<70,4	<48,4	<25,8	25,8
Overflow valve opening pressure (Testing manometer)	MPa	58,5 - 58,5	37,5 - 38,5	21,0 - 22,0	21,0 - 22,0
Water shortage safeguard OFF	l/h	50 - 150	50 - 150	50 - 150	50 - 150
Water shortage safeguard ON	l/h	150 - 250	150 - 250	150 - 250	150 - 250
Burner					
Water temperature increase total, at full load	K	70 - 75	70 - 75	60 - 65	70 - 75
Water temperature increase Burner, at full load	K	57 - 62	60 - 65	52 - 57	63 - 68
Burner nozzle	gph	1,35	2,25	2,25	2,25
Fuel pump, set pressure	MPa	1,0 - 1,3	1,0 - 1,3	1,0 - 1,3	1,0 - 1,3
max. air pressure at the burner cover	mmWS	2,5 - 3,5	3,0 - 5,0	3,0 - 5,0	3,0 - 5,0
Heating output	kW	65	97	105	105
Speed blower full load	rpm	1600	1600	1600	1600
Emissions - exhaust gas values					
Burner exhaust gas temperature	°C	100 - 180	120 - 180	120 - 180	140 - 220
Burner exhaust value CO2	%	10,0 - 11,5	10,0 - 11,5	10,0 - 11,5	10,0 - 11,5
Burner soot number	Value	1	1	1	1
Emission loss	%	<9,0	<9,0	<9,0	<9,0
Weight					
Weight (basic equipment)	kg	945 - 1515	945 - 1515	945 - 1515	945 - 1515
Wheel					
Tyre pressure	MPa	0,45	0,45	0,45	0,45
Tightening torque wheel bolt	Nm	110 - 120	110 - 120	110 - 120	110 - 120

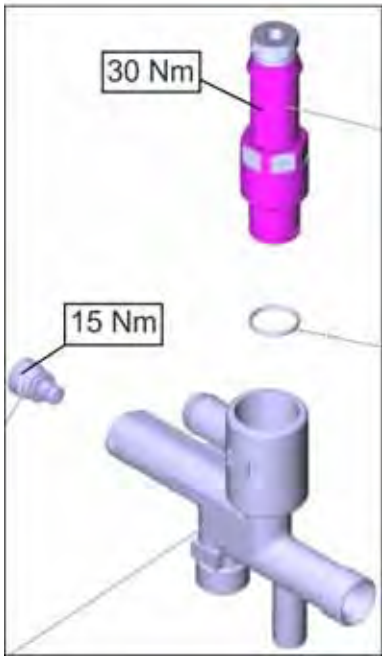
15.1 Tightening torques



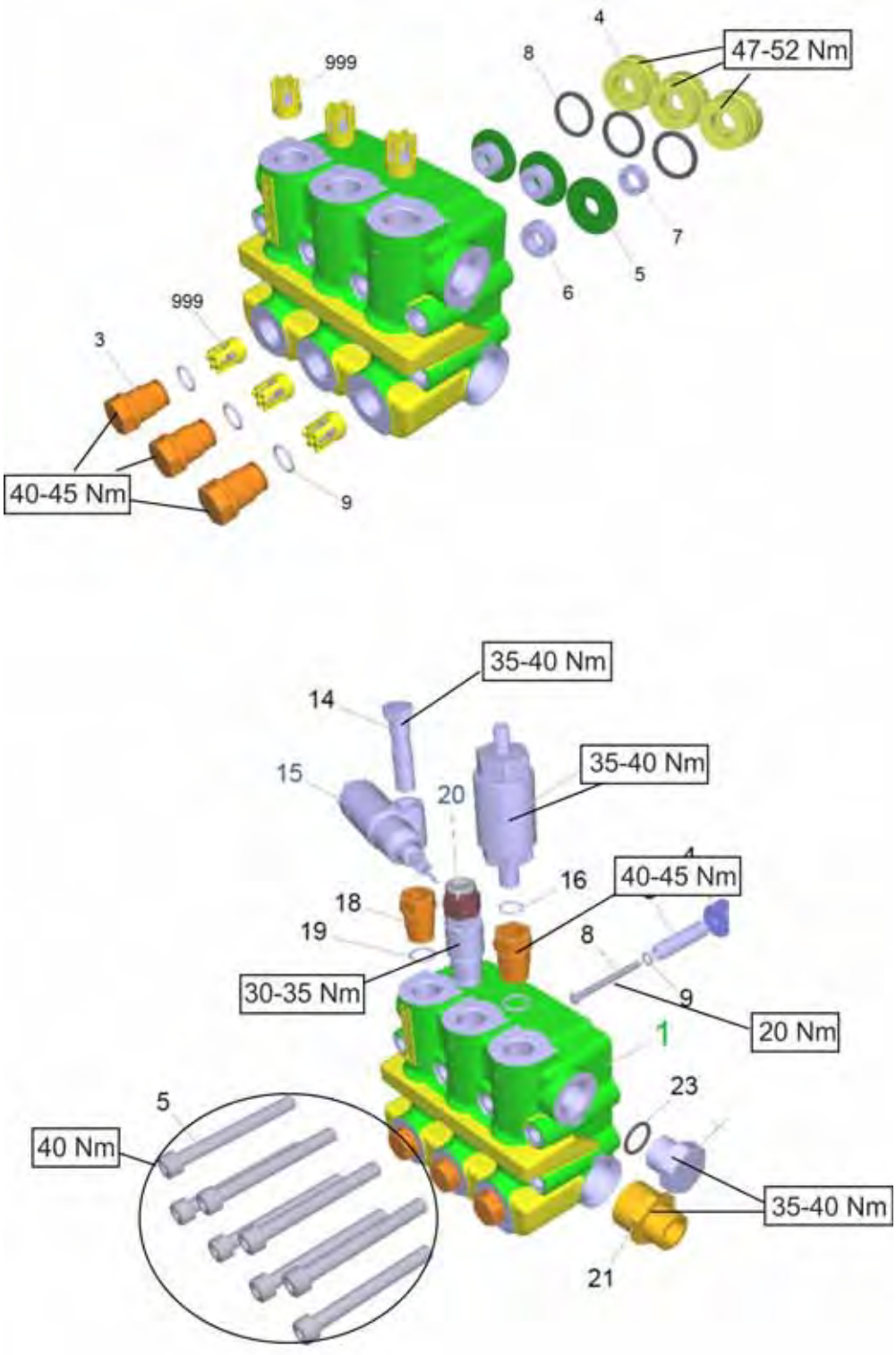
HDS 13/20 and 17/20 - high-pressure pump



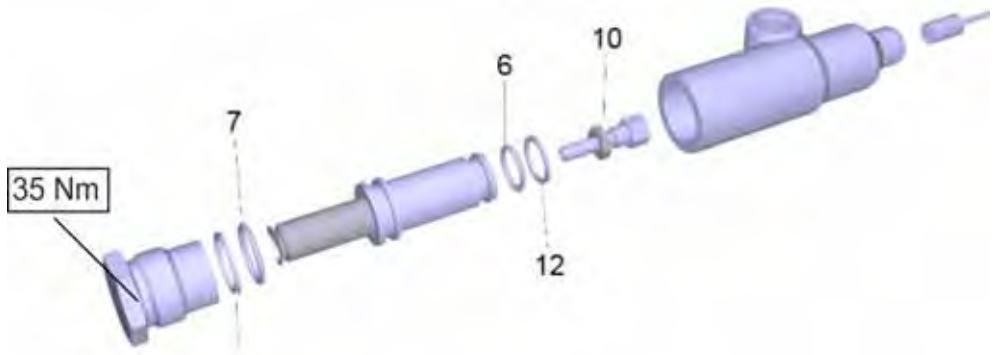
HDS 13/20 and 17/20 - overflow device



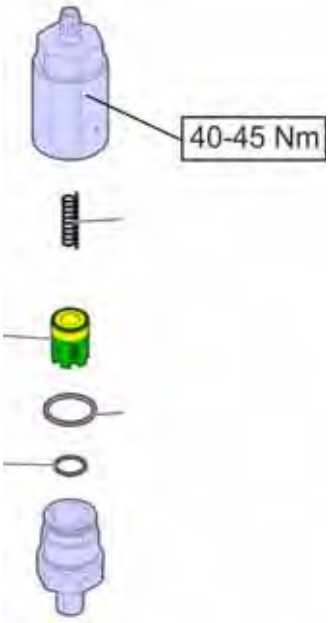
HDS 13/20 and 17/20 - safety block



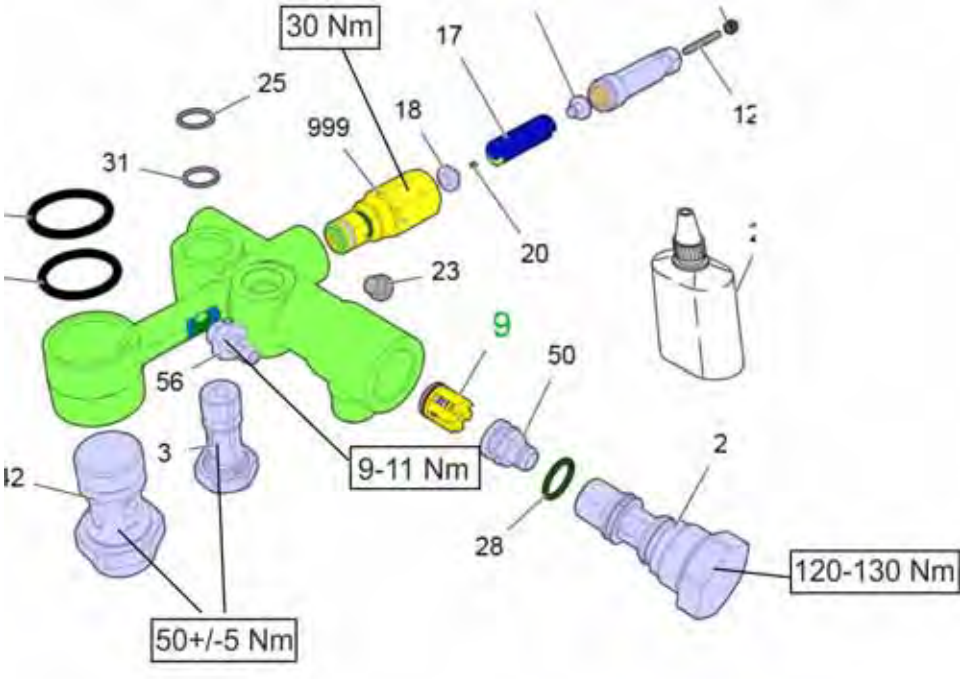
HDS 9/50 and 13/35 - pump head



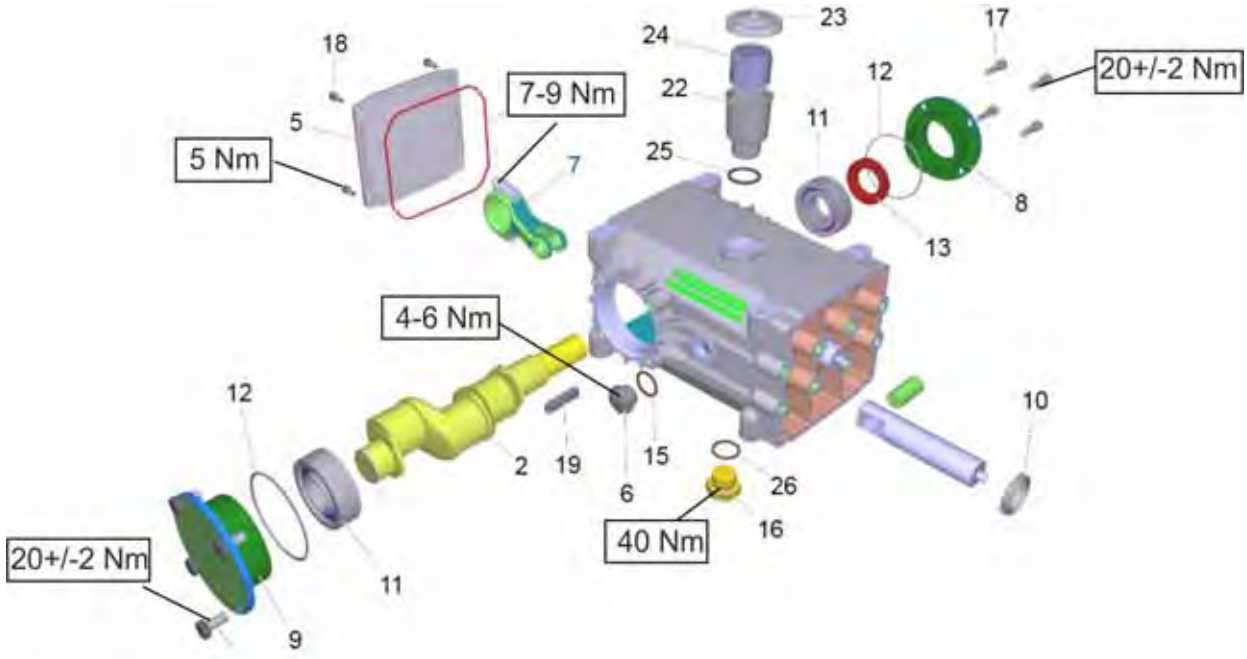
HDS 9/50 and 13/35 - speed control



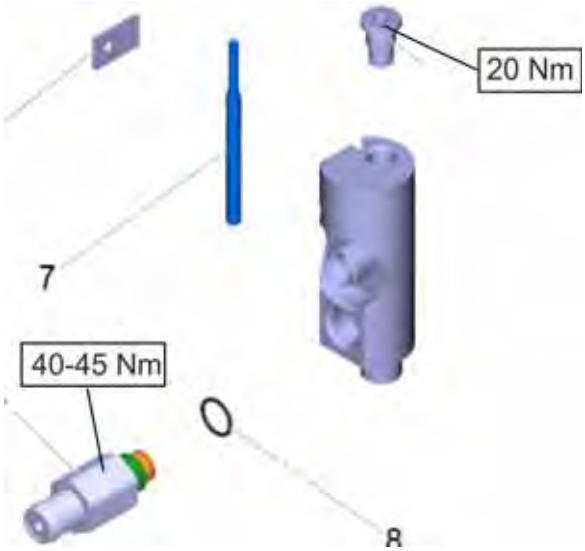
HDS 9/50 and 13/35 - frost protection valve



HDS 9/50 and 13/35 - overflow device



HDS 9/50 and 13/35 - transmission



HDS 9/50 and 13/35 - safety block

16 Special tools

Special tools		
	4.742-025.0	Test pressure gauge 0 - 250 bar (HDS 13/20, HDS 17/20)
	4.742-040.0	Test pressure gauge 0 - 800 bar (HDS 9/50, HDS 13/35)
	4.901-060.0	Pressure gauge fuel pressure for measuring the pump pressure of the fuel pump at the burner cover
	6.775-001.0	Soot pump for measuring the soot number in the exhaust gas
	6.775-002.0	Filter paper for soot pump 6.775-001.0
	6.775-003.0	Comparison table for soot number

Special tools		
 	6.423-029.0	Thermometer exhaust gas measurement for measuring the exhaust gas temperature
		Air pressure gauge at the burner cover no Kärcher part number Recommendation: Testo 510, order number 0560 05610 Hose set: Order number 0554 0448
		Measurement CO2 content in the exhaust gas of the burner no Kärcher part number Recommendation: Testo 320 or Testo 320-2-LL required accessories for both measuring devices: – Power Supply – Device case – Flue gas probe
	4.901-062.0	Removal pliers
	6.815-029.0.0	Interior driver D8 - 12mm (HDS 9/50, HDS 13/35)
	6.815-023.0.0	Interior driver D12 - 16mm (HDS 13/20, HDS 17/20)
	5.314-149.0 6.815-229.0	Installation mandrel for HP/LP seals for piston D14mm (HDS 9/50) Installation mandrel for HP/LP seals for piston D16mm (HDS 13/35)

Special tools		
	5.901-055.0	Installation mandrel for HP seals for piston D20mm (HDS 13/20, HDS 17/20)
  	6.815-258.0	Installation mandrel for oil seals (HDS 13/20, HDS 17/20)
	6.815-209.0	Screw attachment locking screw (HDS 9/50, HDS 13/35) (Crown wrench for brass bush low-pressure seals)
	5.111-128.0 6.815-228.0	Installation sleeve for piston D14mm (HDS 9/50) Installation sleeve for piston D16mm (HDS 13/35)

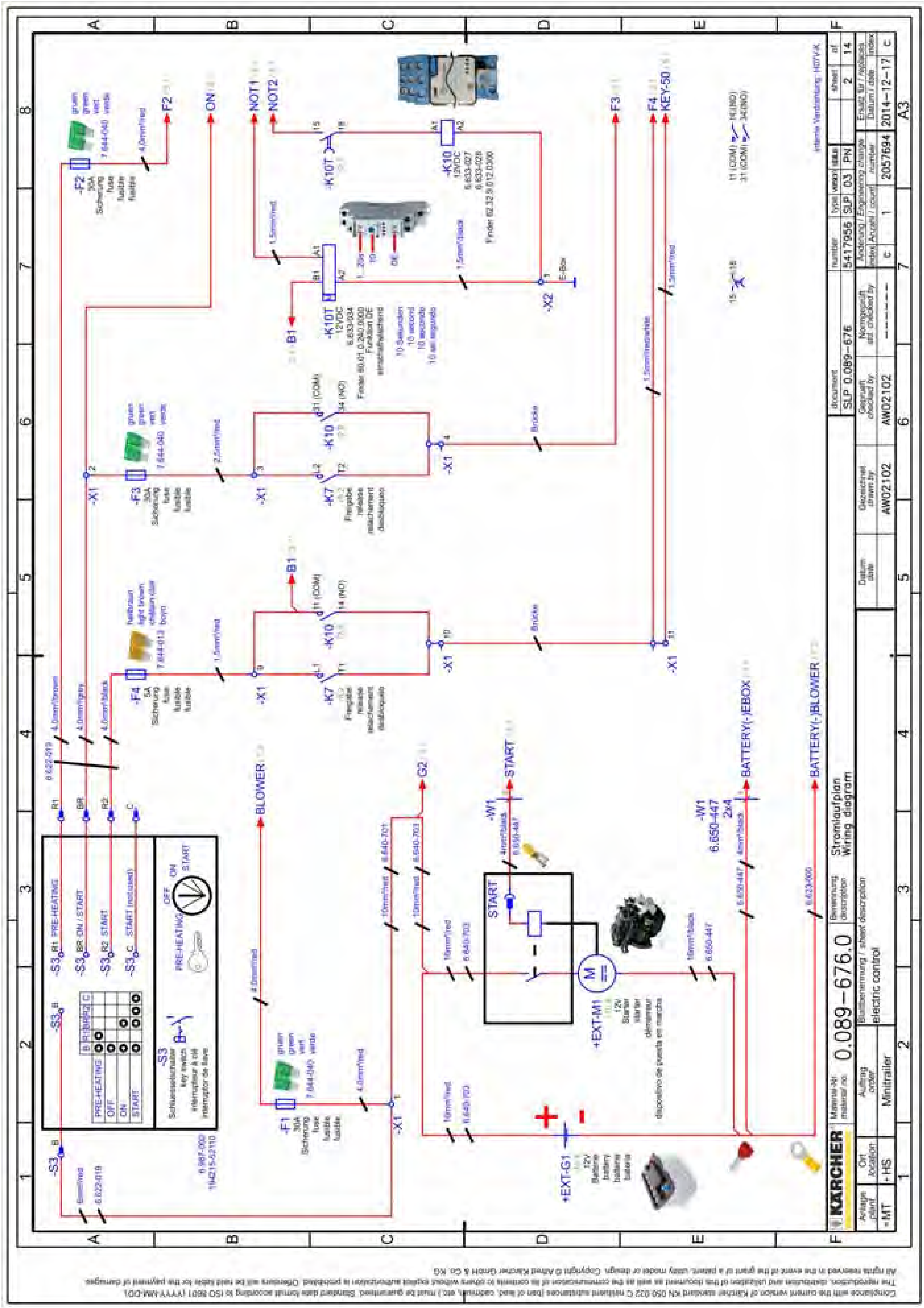
Special tools		
		Oil filter wrench no Kärcher part number Recommendation: Oil filter claw HAZET 2172
	6.491-361.0	Revolution counter for motor speed
	6.803-003.0	Magnetic field tester for the function test of magnetic coils
	6.768-004.0	Hardness indicators for measuring the overall water hardness

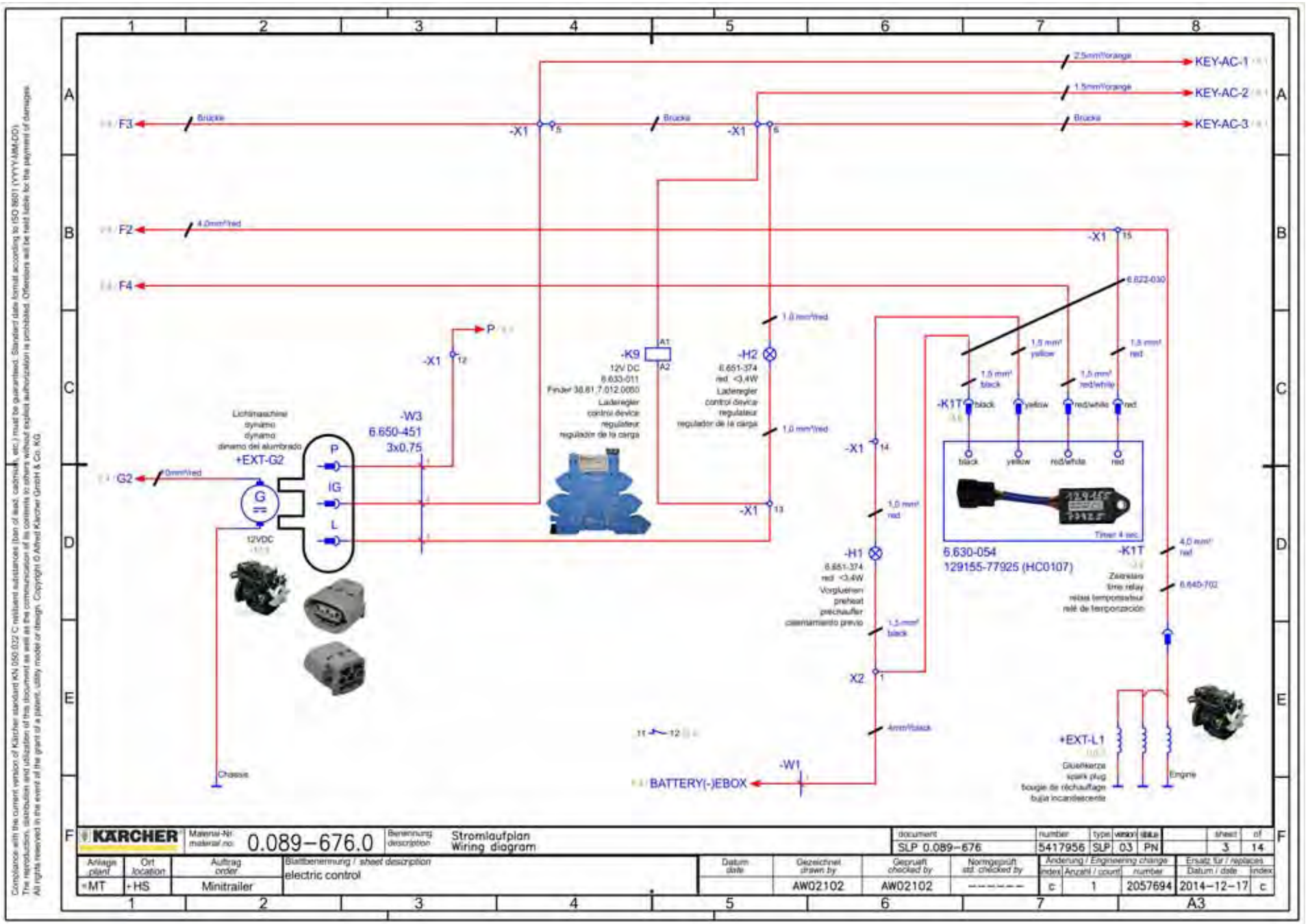
17 Circuit diagram

NOTE

Please use the circuit diagram associated with the machine.

An excerpt of the circuit diagram, version 07/2015, is enclosed for your information.


KÄRCHER
Stromlaufplan
Wiring diagram
0.089-676.0
electric control
Minitrailer



KÄRCHER

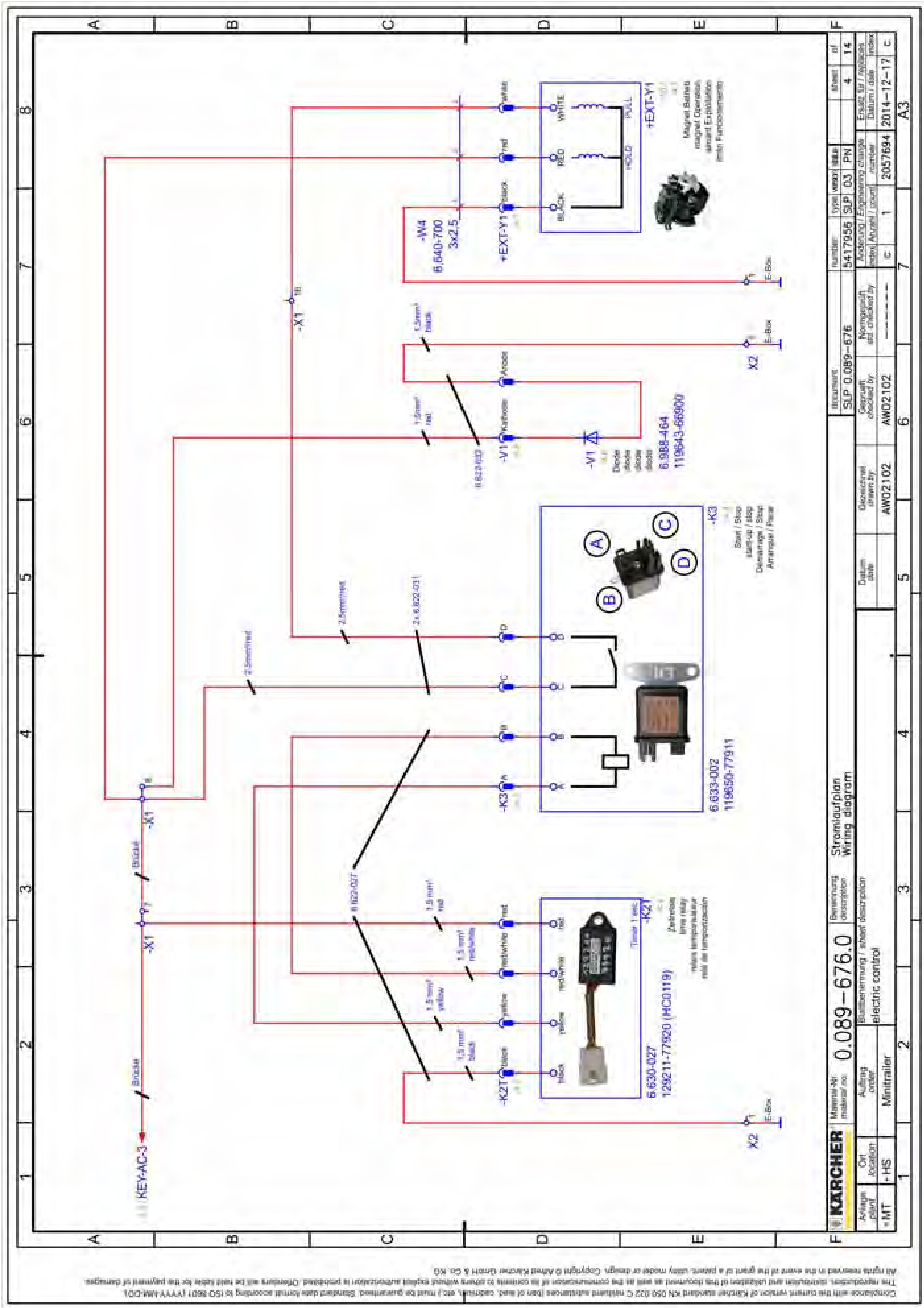
Material-Nr. material no.	0.089–676.0	Benennung description	Stromlaufplan Wiring diagram

document	number	type	version	status		sheet	of
SLP 0.089–676	5417956	SLP	03	PN		3	14

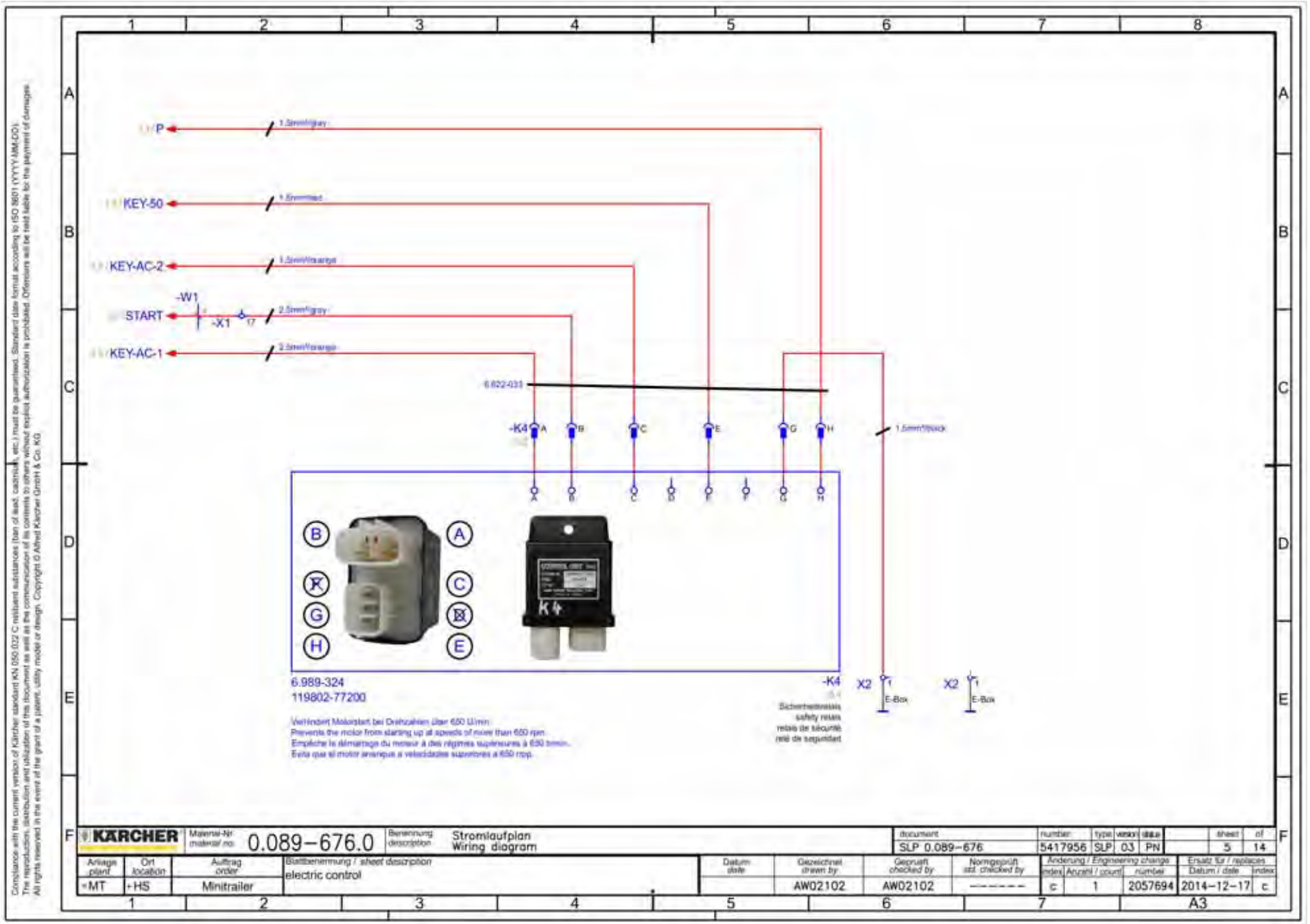
Anlage plant	Ort location	Auftrag order	Blattbenennung / sheet description	Datum date	Gezeichnet drawn by	Geprüft checked by	Normgeprüft std. checked by
=MT	+HS	Minitrailer	electric control		AW02102	AW02102	----------

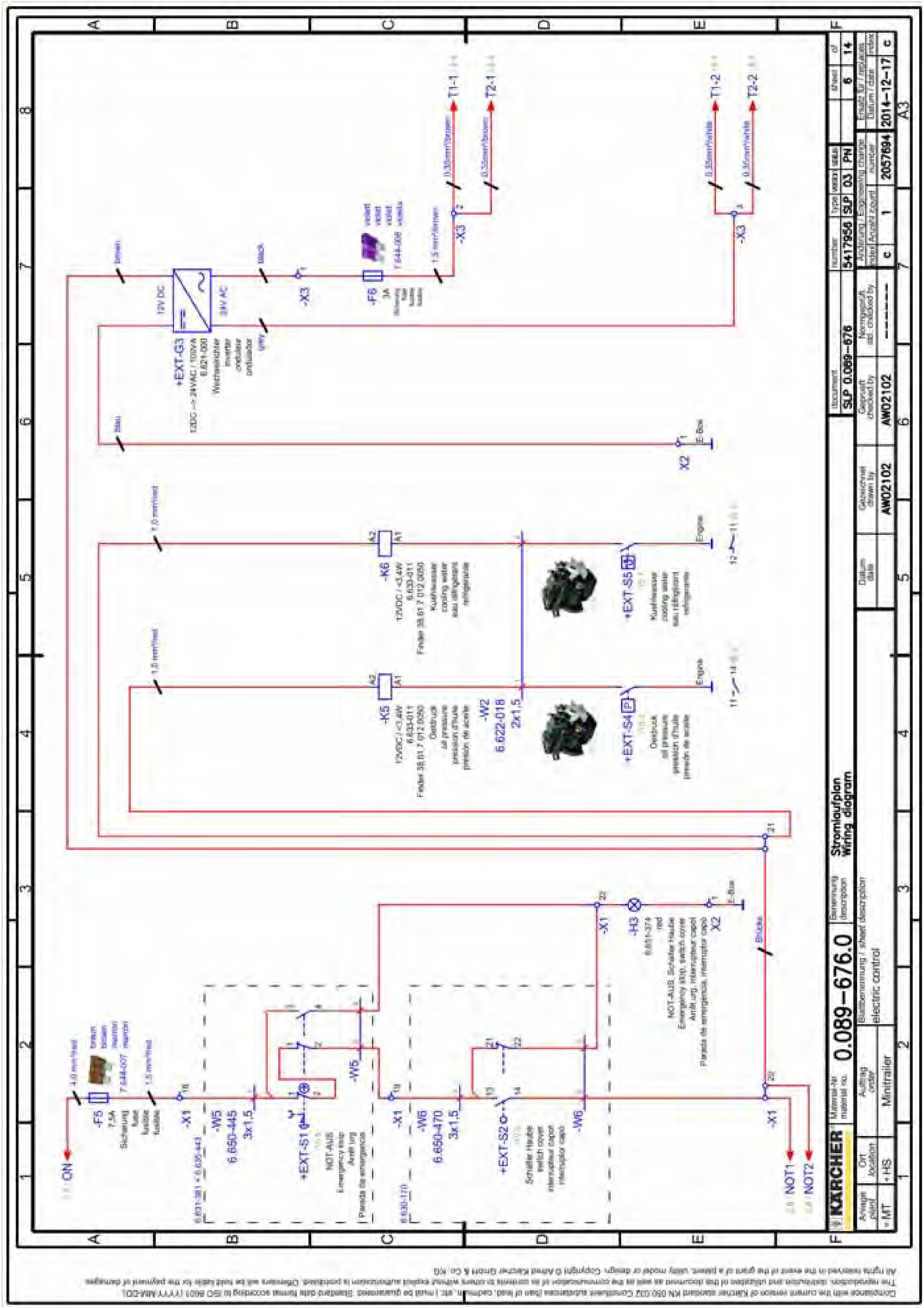
Änderung / Engineering change			Ersatz für / replaces	
index	Anzahl / count	number	Datum / date	index
c	1	2057694	2014–12–17	c

A3

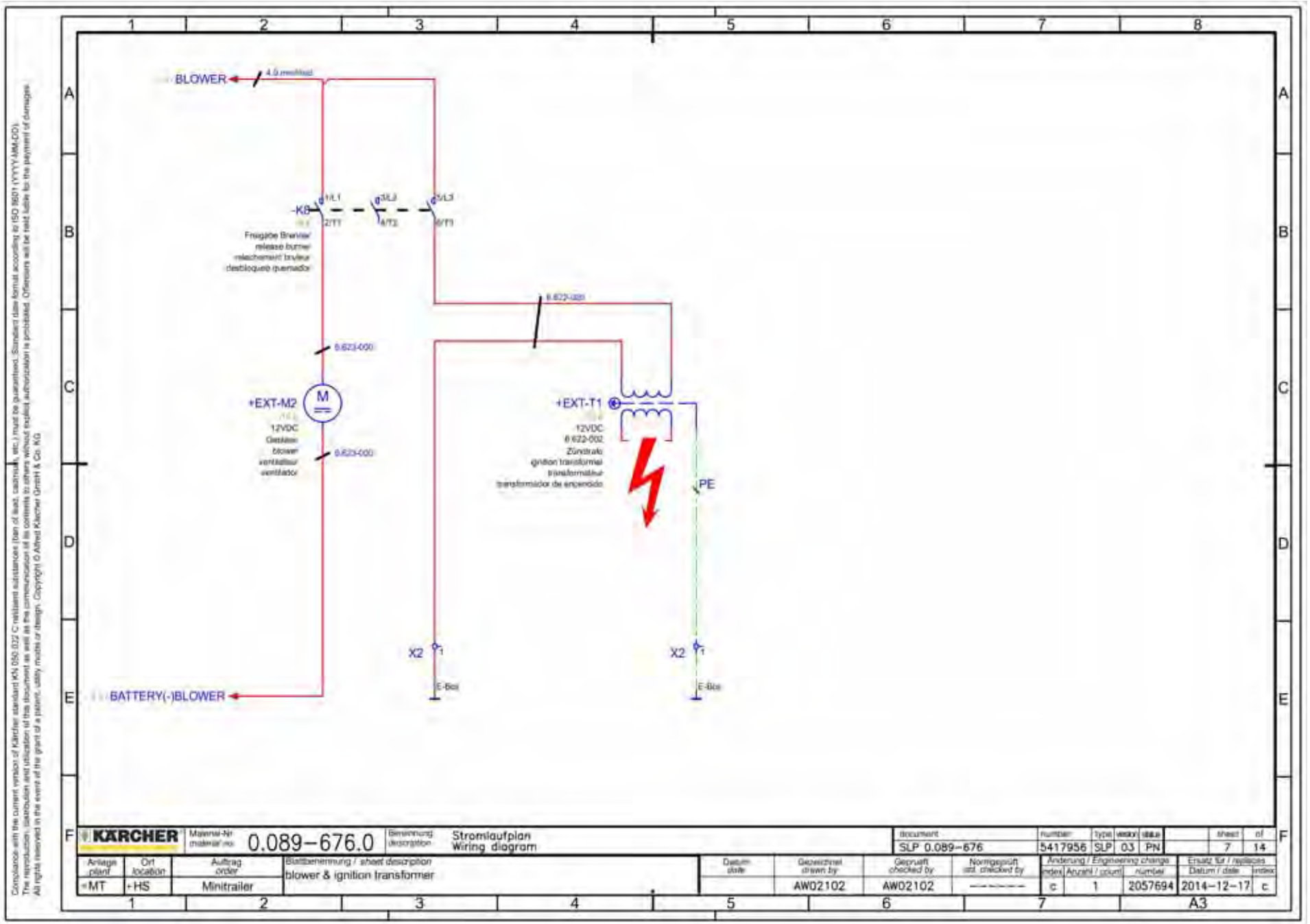


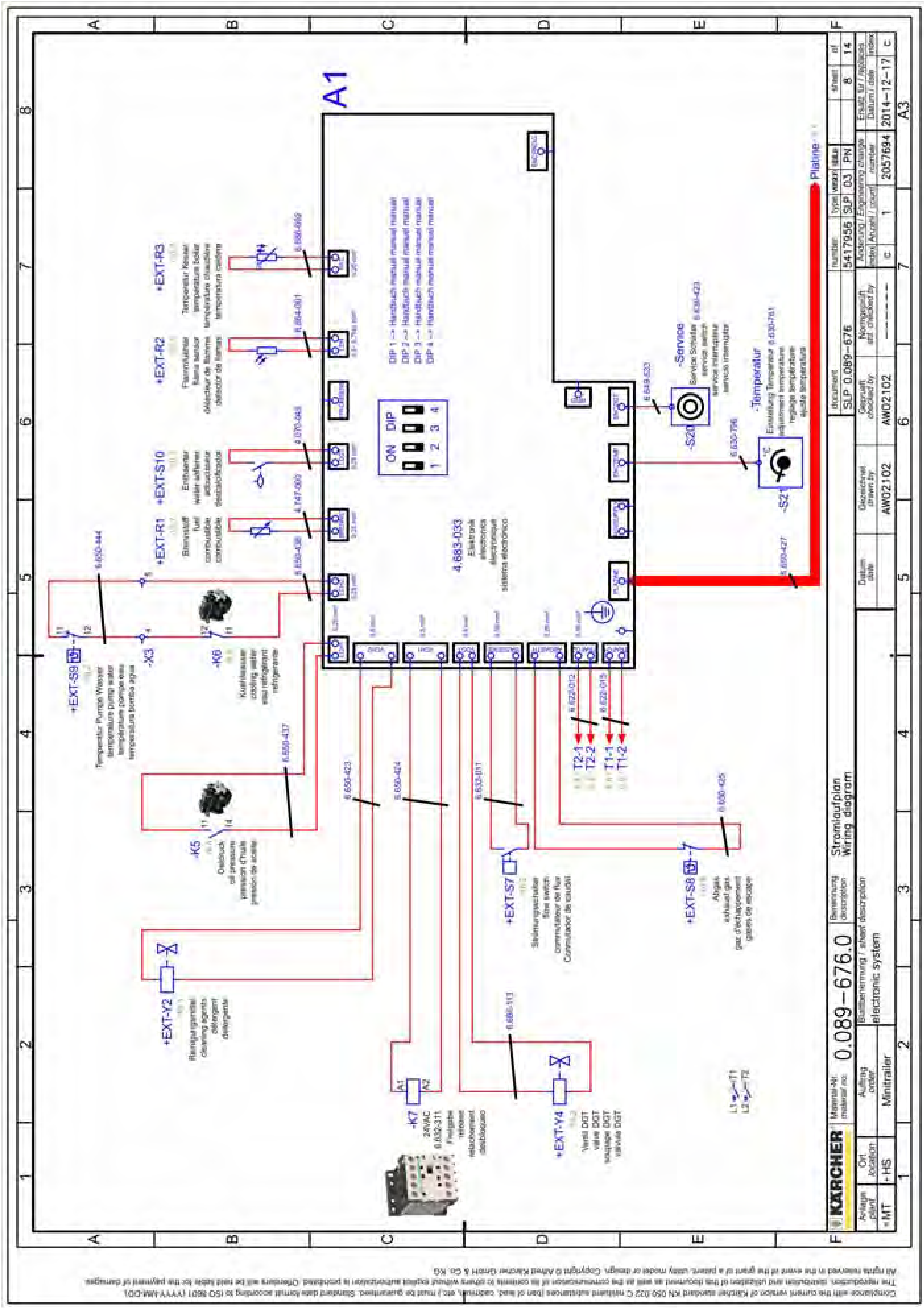
Stromlaufplan
Wiring diagram
0.089-676.0
electric control
Minitrailer
KÄRCHER
KEY-AC-3
-X1
X2
E-Box
-K2T
6.630-027
129211-77920 (HC0119)
-K3
6.633-002
119650-77911
-V1
6.988-464
119643-66900
-W4
6.640-700
3x2,5
+EXT-Y1
BLACK
RED
WHITE
HOLD
PULL
SLP 0.089-676
AW02102
5417956
2057694
2014-12-17
A3

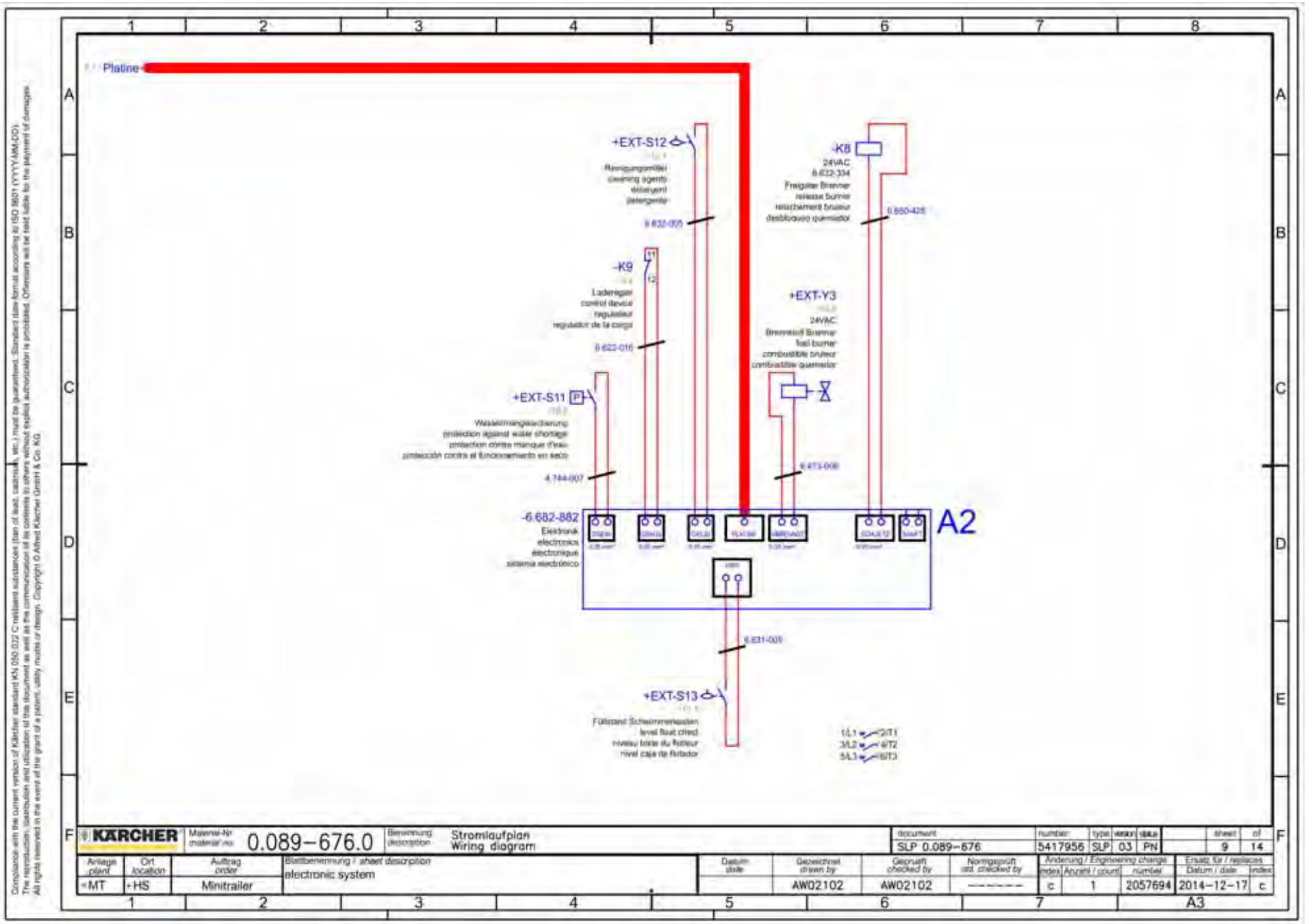


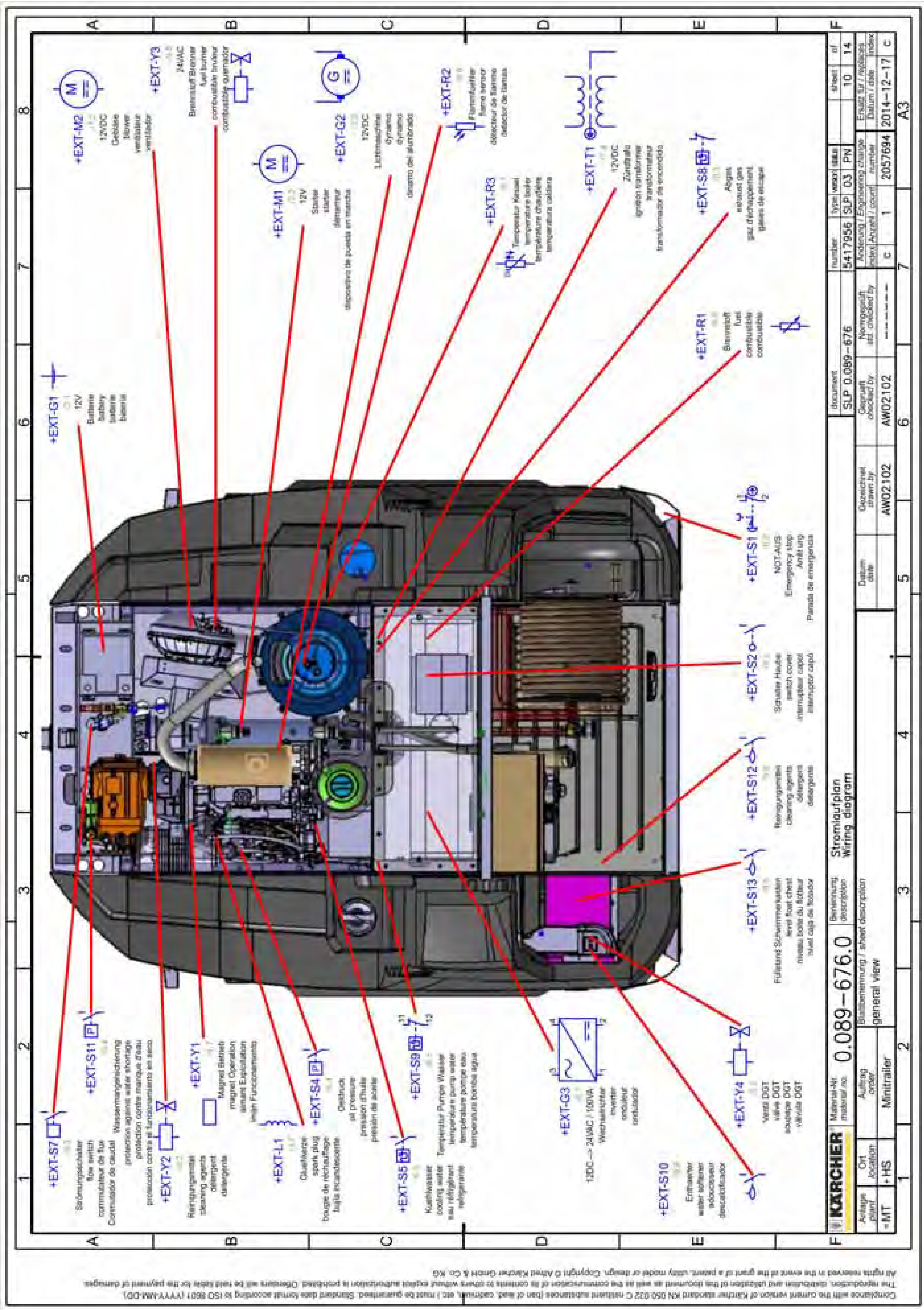


Stromlaufplan
Wiring diagram
0.089-676.0
electric control
Minitrailer
SLP 0.089-676
2014-12-17




A1
4.683-033
Stromlaufplan
Wiring diagram
0.089-676.0
electronic system
Minitrailer
KÄRCHER





KÄRCHER
0.089-676.0
Stromlaufplan
Wiring diagram
general view
Minitrailer
SLP 0.089-676
5417956 SLP 03 PN
AW02102
2057694 2014-12-17 c
10 14
A3
+EXT-G1
+EXT-M2
+EXT-Y3
+EXT-G2
+EXT-M1
+EXT-R2
+EXT-R3
+EXT-T1
+EXT-S8
+EXT-R1
+EXT-S1
+EXT-S2
+EXT-S12
+EXT-S13
+EXT-S7
+EXT-S11
+EXT-Y2
+EXT-Y1
+EXT-L1
+EXT-S4
+EXT-S5
+EXT-S9
+EXT-G3
+EXT-Y4
+EXT-S10