

# / Group 17: Cab / Heater / Air-Conditioning System

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# Group 17: Cab / Heater / Air-Conditioning System

## Subgroup 17.30 Auxiliary heating

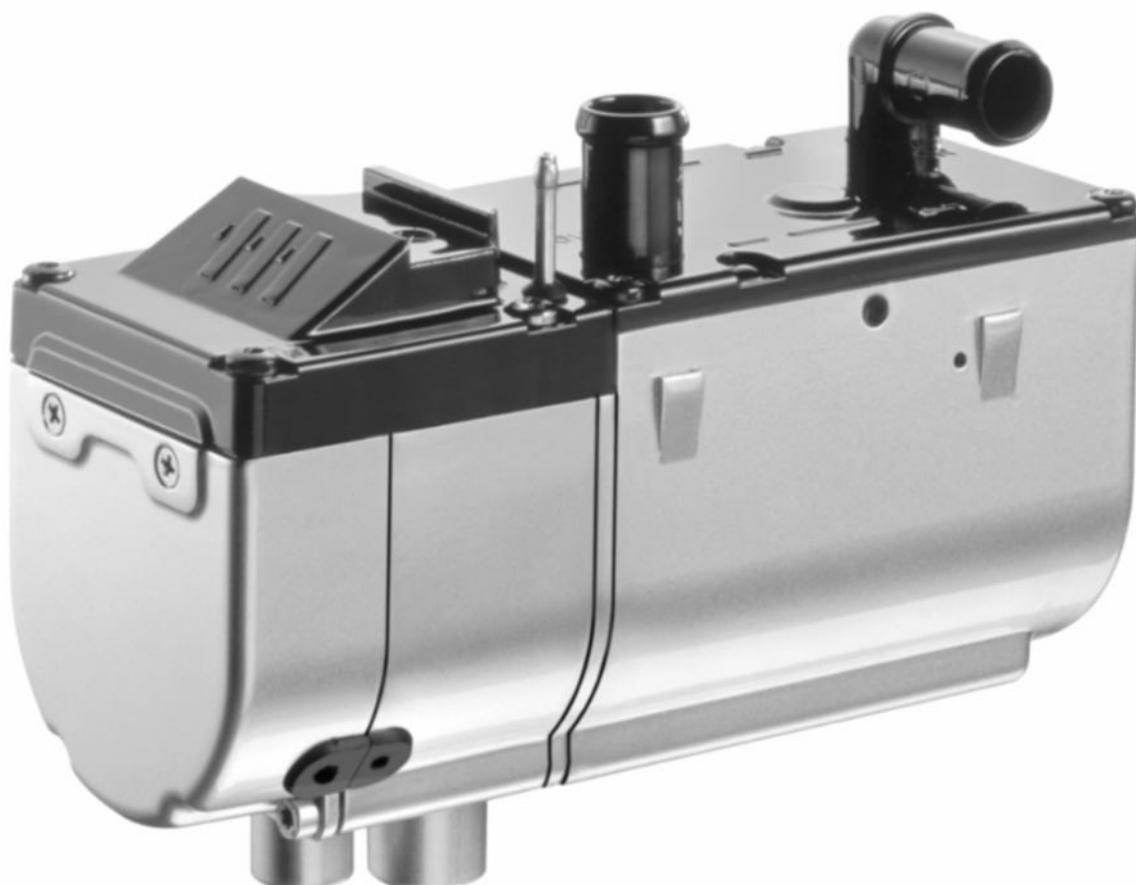
### 1 Job definition

The auxiliary heating functions independently of the diesel engine as a cooling circuit or heating circuit of the warm water heating connected to the diesel engine.

The auxiliary heating heats the interior of the operator's cab through its own ventilation channels; also heats the cooling water of the engine.

This will ensure that the engine, particularly in colder temperatures:

- will start up easily
- will be more energy-efficient
- will be better preserved



**Fig. 1** Heater

## 2 Tasks in general

Machine Onwards of serial number	R 924 B Li. Compact 21034	
Type	D 5 W S	
Heating medium	Water / refrigerant	
Fuel	Commercially-approved diesel (DIN EN 590) PME (DIN V 51606)	
Nominal voltage	24 volt	
Operating range above the voltage limit below the voltage limit	32 volt 20.4 volt	
Regulation of heat flow	High	Low
Heat flow	5000 watts	2400 watts
Fuel consumption	0.62 l/h	0.27 l/h
during operation	37 watts	10 watts
for start-up	110 watts	

Machine Onwards of serial number	R 924 B Li. Compact 21034
in after-run	8 watts
Minimum water flow rate of heater	250 l/h
Minimum water flow rate of water pump against 0.1 bar	950 l/h
Permissible ambient temperature Heater operation Batching pump operation in storage	-40°C to +80°C -40°C to +80°C -40°C to +105°C
Permissible operating pressure	up to 2.5 bar overpressure
Preheating time	approx. 20 - 50 seconds.
After-run time	approx. 130 seconds.
Weight without refrigerant and accessories with water pump and batching pump	approx. 2.3 kg approx. 2.9 kg

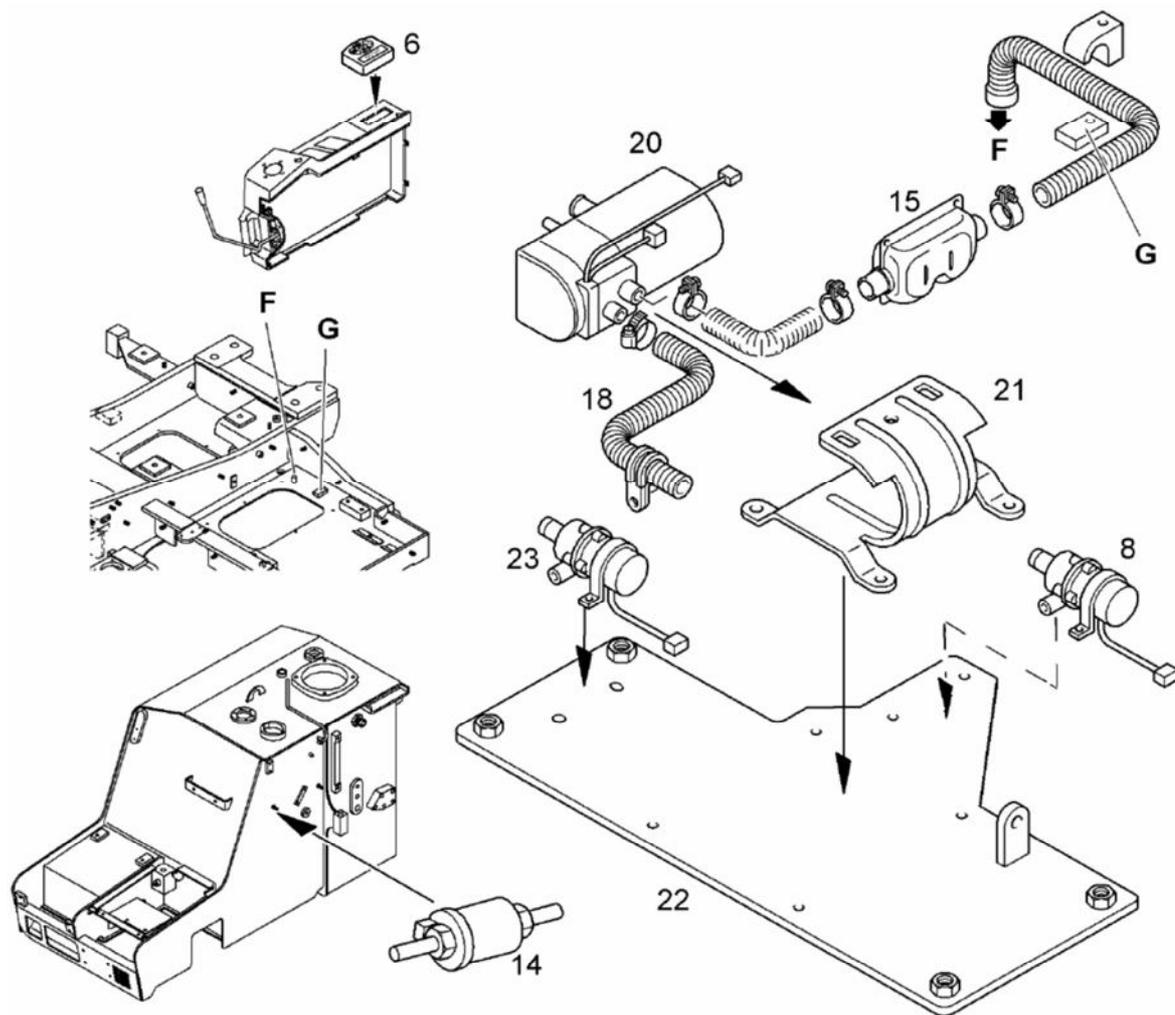
**Tab. 1** Technical data (all data ± 10%)

### 3 System description

The auxiliary heating is comprised of several main parts:

- Mini dial **6**
- Water pump **8**
- Batching pump **14**
- Exhaust gas muffler **15** with exhaust hose
- Combustion air hose **18**
- Heater **20** with retainer **21**
- Console **22**
- Auxiliary water pump **23**

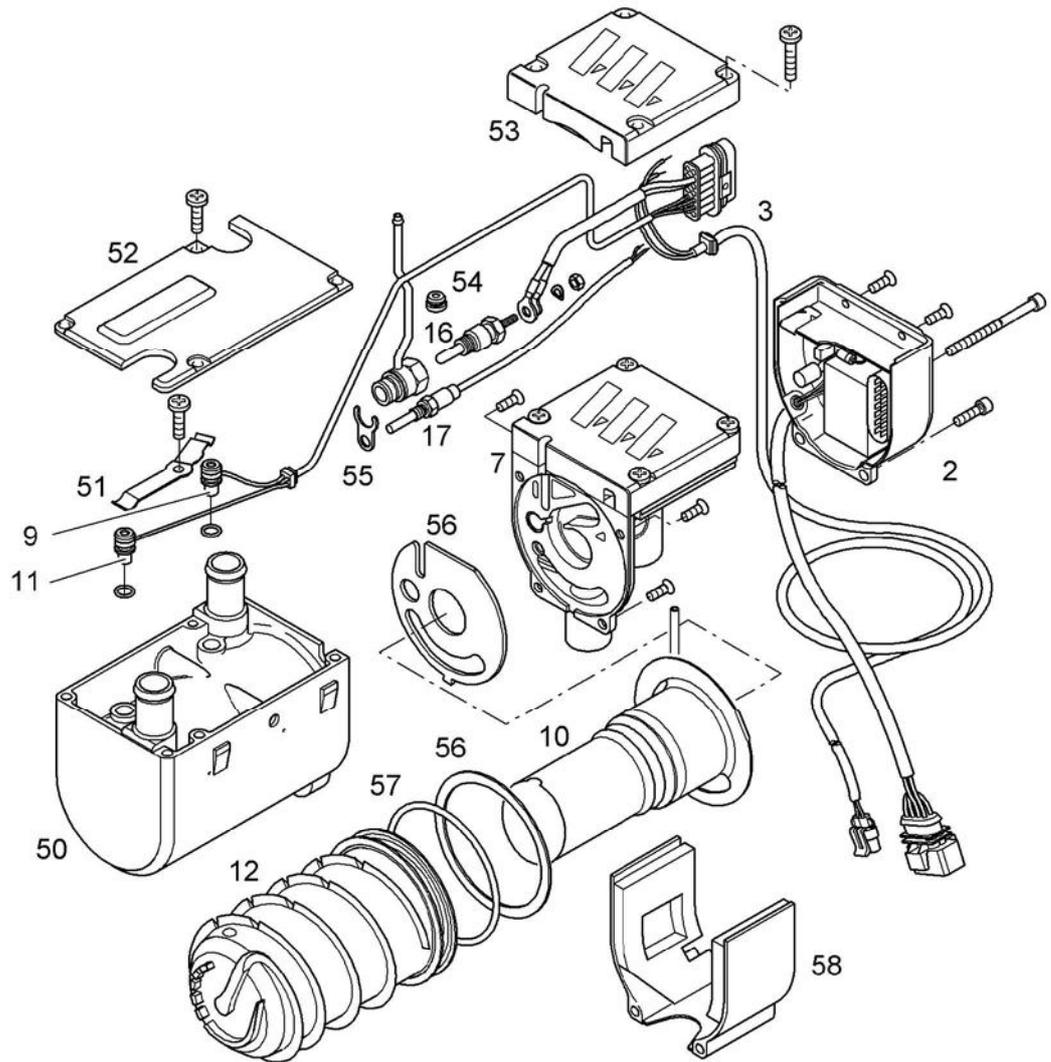
The heating process is initiated by the mini-clock **6** installed in the left-hand console in the operator station. The water pump **8** mounted below the cooler on the console **22**, the auxiliary water pump **23** and the heater **20** are thus activated. Air is drawn in by the combustion air hose **18**. Supply of fuel is resulted directly from the batching pump **14** mounted on the fuel tank, also activated upon start-up. The exhaust gasses are channelled out into the open air via the exhaust gas muffler **15** with exhaust hose.



**Fig. 2** Main parts of the heater

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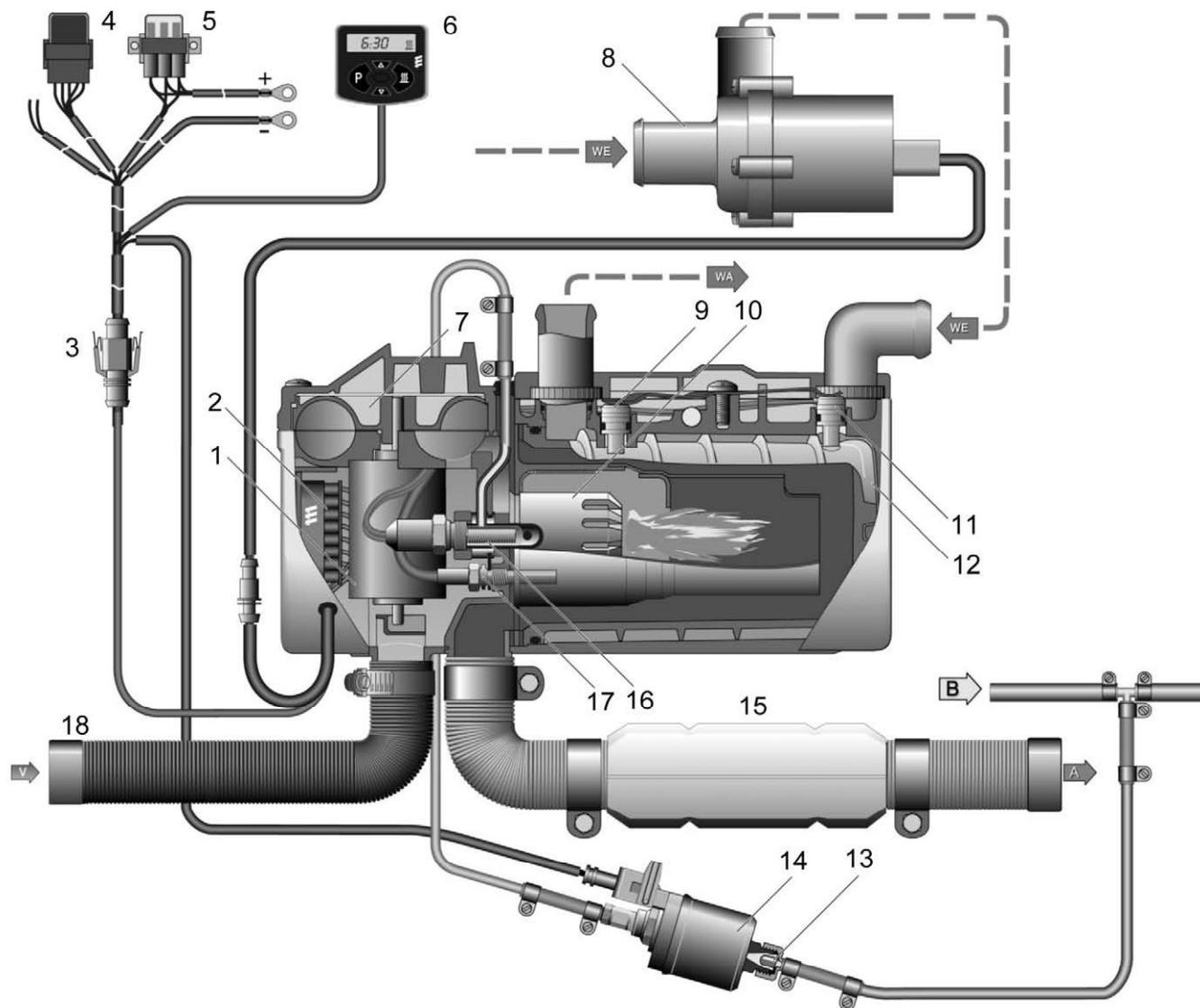
### 3.1 Individual components of the heater



**Fig. 3** Individual components of the heater

- |                         |                                     |
|-------------------------|-------------------------------------|
| 2 Control unit          | 50 Cladding                         |
| 3 8-pin plug connection | 51 Pressure spring                  |
| 7 Combustion air blower | 52 Cover for cladding               |
| 9 Temperature gauge     | 53 Cover for combustion air housing |
| 10 Combustion chamber   | 54 Muzzle                           |
| 11 Overheating gauge    | 55 Retainer                         |
| 12 Heat exchanger       | 56 Sealing kit                      |
| 16 Glow plug            | 57 O-ring                           |
| 17 Flame scanner        | 58 Cover                            |

## 4 Operation and functioning of the auxiliary heating



**Fig. 4** Sectional drawing of the heater

- |                           |                        |                          |
|---------------------------|------------------------|--------------------------|
| 1 Electric motor          | 9 Temperature gauge    | 17 Flame scanner         |
| 2 Control unit            | 10 Combustion chamber  | 18 Combustion air hose   |
| 3 Plug connection (8-pin) | 11 Overheating gauge   | A Exhaust gas            |
| 4 Relay for vehicle fan   | 12 Heat exchanger      | B Fuel                   |
| 5 Main fuses              | 13 Pot sieve           | V Combustion air         |
| 6 Mini-clock              | 14 Batching pump       | WA Water discharge point |
| 7 Combustion air blower   | 15 Exhaust gas muffler | WE Water intake          |
| 8 Water pump              | 16 Glow plug           |                          |

## 4.1 Initial start-up of heater

The following points are to be noted for initial start-up, and following installation or repair:

- ▶ Aerate the coolant circuit and the fuel supply thoroughly.
- ▶ Open the coolant circuit (set temperature gauge to „warm“) prior to carrying out the test-run.
- ▶ During the test-run of the heater check all water and fuel connections for leaks and ensure secure fastening.
- ▶ Check the coolant level in the expansion tank

## 4.2 Notes on safety for heating operation

The following should be noted during operation of the auxiliary heating:

- ▶ Switch off the heater before refuelling.

It is not permissible to use the heater in areas where flammable vapours or dust can accumulate.

The installation room of the heater must remain free.

Under no circumstances may

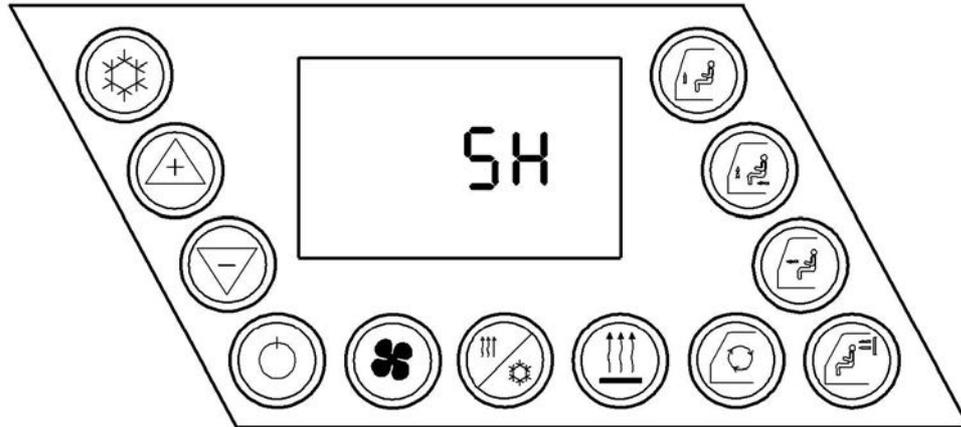
- fuel canisters
- oil nozzles and spray nozzles
- gas cartridges
- fire extinguishers
- cleaning rags
- items of clothing
- paper

be transported or stored on or next to the heater.

## 4.3 Activation, (see Fig. 4)

- ▶ Switch on the auxiliary heating.
  - ↪ If the air-conditioning system is switched on: the text **SH** (auxiliary heating) is displayed for a few seconds, (see Fig. 5 at page 8).
  - ↪ The air-conditioning system switches off and can not be switched on again during operation of the auxiliary heating.
  - ↪ When the auxiliary heating is switched off and the after-run time has expired, the air-conditioning system is once again ready for operation.

Upon activation the indicator lamp in the mini-clock **6** lights up. The water pumps **8** and **23** start and following a specific program involving pre-rinsing and preheating, the combustion air blower, glow plug **16** and combustion batching pump **14** initiate combustion. When a stable flame has formed, the glow plug **16** switches off upon expiry of a predetermined time period.



**Fig. 5** Display on the operating unit for heating and air-conditioning system

## 4.4 Control functions

If the heater does not ignite within 90 seconds of the beginning of fuel delivery, the start procedure is repeated. If the heater does not ignite following a further 90 seconds of fuel delivery, a fault shut-down occurs.\*

If the flame goes out of its own accord during operation, a new start is initiated. If the heater does not ignite within 90 seconds of a renewed fuel delivery or if it does ignite but then goes out again within 15 minutes, a fault shut-down occurs. This can be remedied by switching off briefly and restarting.

If overheating (e.g. water deficiency, poorly aerated coolant circuit) occurs, the overheating gauge is actuated. Delivery of fuel is interrupted and a fault shut-down occurs. After remedying the cause and allowing the coolant temperature to drop below 70°C, the heater can be activated again by switching off briefly and then restarting.

If the upper or lower voltage limit is reached (see Tab. 1 at page 3), a fault shut-down occurs.

With faulty glow plug or interruption of an electrical line to the batching pump, the heater will not start.

The speed of the blower motor is monitored constantly. If the blower motor will not start, if it is blocked or if the speed drops below 40% of the set speed, a fault shut-down occurs after 60 seconds.

\*= Following an impermissible number of unsuccessful start attempts, the control unit becomes blocked.

Releasing this lock or a readout of the faults is only possible with the help of diagnostic equipment (with mini-clock installed), (see "Troubleshooting" at page 14). If a modular dial is installed (optional) readout and releasing of the lock is possible without diagnostic equipment.

## 4.5 Functioning in heater operation

With the heater switched on **20** the heat of the vehicle's own heat exchanger **42** and the diesel engine **40** is supplied.

When the coolant temperature has reached approx. 30°C, the vehicle's fan is activated and the heat is also supplied to the cab interior.

Depending on the heating requirement, the heater is regulated in stages: High - Low - Off (control interval).

Fixed temperature thresholds are also programmed into the electronic control unit.

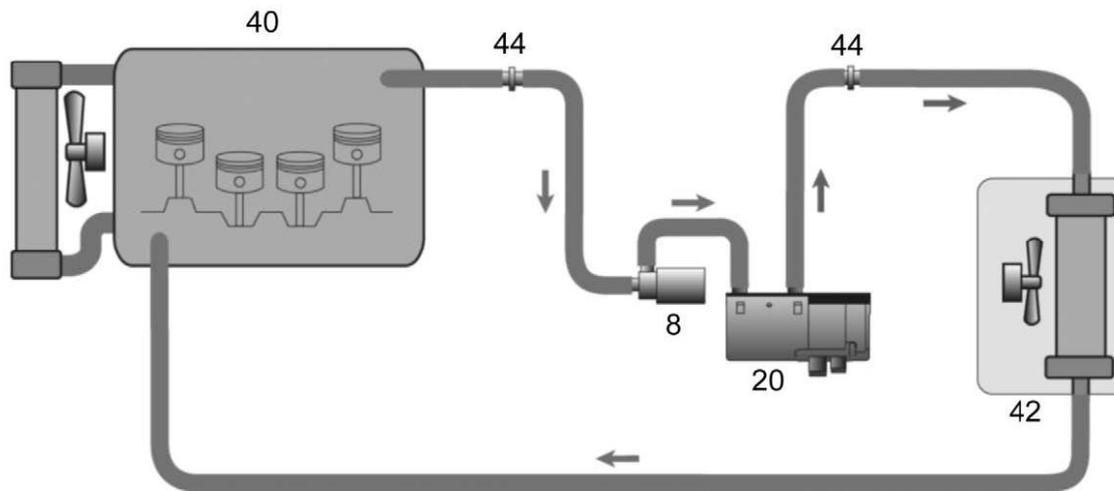
With a control temperature of < 70°C the heater operates constantly in the „High“ stage.

With a coolant temperature of approx. 80°C the heater switches to the „Low“ stage.

If the heating requirement is so insufficient in the „Low “stage that the coolant temperature reaches 85°C, the machine switches to control interval.

An after-run of approx. 130 seconds then follows and then the heater switches off (control interval).

In the control interval, the indicator lamp lights up and the water pump continues running.



**Fig. 6** Connection to the coolant circuit

- 8 Water pump
- 20 Heater
- 40 Diesel engine

- 42 Heat exchanger in the operator's cab
- 44 Connector

## 4.6 Switching off



**Note!**

When switching off, fuel supply is discontinued. The combustion air blower and the water pump continue to run for approx. 180 seconds longer and are then switched off automatically.

Switching off can be resulted in two ways:

- During continuous operation by pressing button **33**, (see Fig. 7 at page 10).
- When the pre-set heating time has expired.

## 4.7 Settings of the mini-clock



**Fig. 7** Mini-clock

<b>30</b> Button for activating the setting options	<b>34</b> Display for time, preselection and heating time
<b>31</b> Button for setting the time forwards	<b>35</b> Symbol for activated preselection time
<b>32</b> Button for setting the time backwards	<b>36</b> Symbol for heating operation
<b>33</b> ON / OFF button for activating / deactivating preselection time	<b>37</b> Symbol for preselection time (1, 2 or 3)



### Note!

- If no button is pressed within 15 seconds, the display switches back to its initial mode (= normal time display).
- When setting the time with buttons **31** and **32**, time adjustment will become quicker if the button is held pressed.

### Initial start-up of the mini-clock

After shutting down the power supply, all symbols in the display **34** begin flashing. The heater can not be started in this condition. The actual time must first be set.

### Setting the time

- ▶ Push button **30** for longer than 3 seconds
  - ↪ The time display starts flashing.
- ▶ Press buttons **31** and **32** until the actual time is displayed.
- ▶ Press button **30** shorter than 5 seconds.
  - ↪ The time is displayed and the double point flashes.



### Note!

If button **30** is not pressed within 5 seconds of setting the time, the clock switches to „Setting heating time“.

### Setting the heating time

- ▶ Push button **30** for longer than 3 seconds

- ↵ The time is flashing.
- ↵ The mini-clock switches to „Setting heating time“.
- ↵ The heating symbol and the heating time start flashing in the display.

- ▶ Set the heating time with buttons **31** and **32** (from 10 to 120 minutes).
- ▶ Press button **30**
  - ↵ The time is displayed and the double point flashes.

### Setting preselection time

- ▶ Press button **30** once, twice or three times.
  - ↵ Preselection time 1, 2 or 3 is called up and indicated in the display (**35** and **37**).
- ▶ Set the preselection time with buttons **31** and **32**.

### Switching on the heater

- ▶ Press button **33**.
  - ↵ The remaining heating time and the symbol **36** are indicated on the display.

### Switching off the heater

- ▶ Press button **33**.
  - ↵ The heater continues to run for approx. 3 minutes, the actual time is indicated in the display.

### Continuous operation

- ▶ Press button **32** and hold it pressed.
- ▶ Press button **33**.
  - ↵ The heater switches on.
- ▶ Press button **33** again.
  - ↵ The heater switches off.

### Activating / deactivating the preselection time



#### Note!

Up to three preselection times can be set and activated for this mini-clock. Each preselection time is deactivated upon conclusion of the heating procedure and must be reactivated for the next heating procedure.

- ▶ Press button **30** once, twice or three times until the desired preselection time appears in the display.
- ▶ Activate the preselection time with button **33**.
  - ↵ Upon activation, the symbol „ON“ **35** appears on the display.
  - ↵ If the preselection time is activated, the symbol (**37**) 1, 2 or 3 appears on the display.
- ▶ Deactivate the preselection time with button **33**.

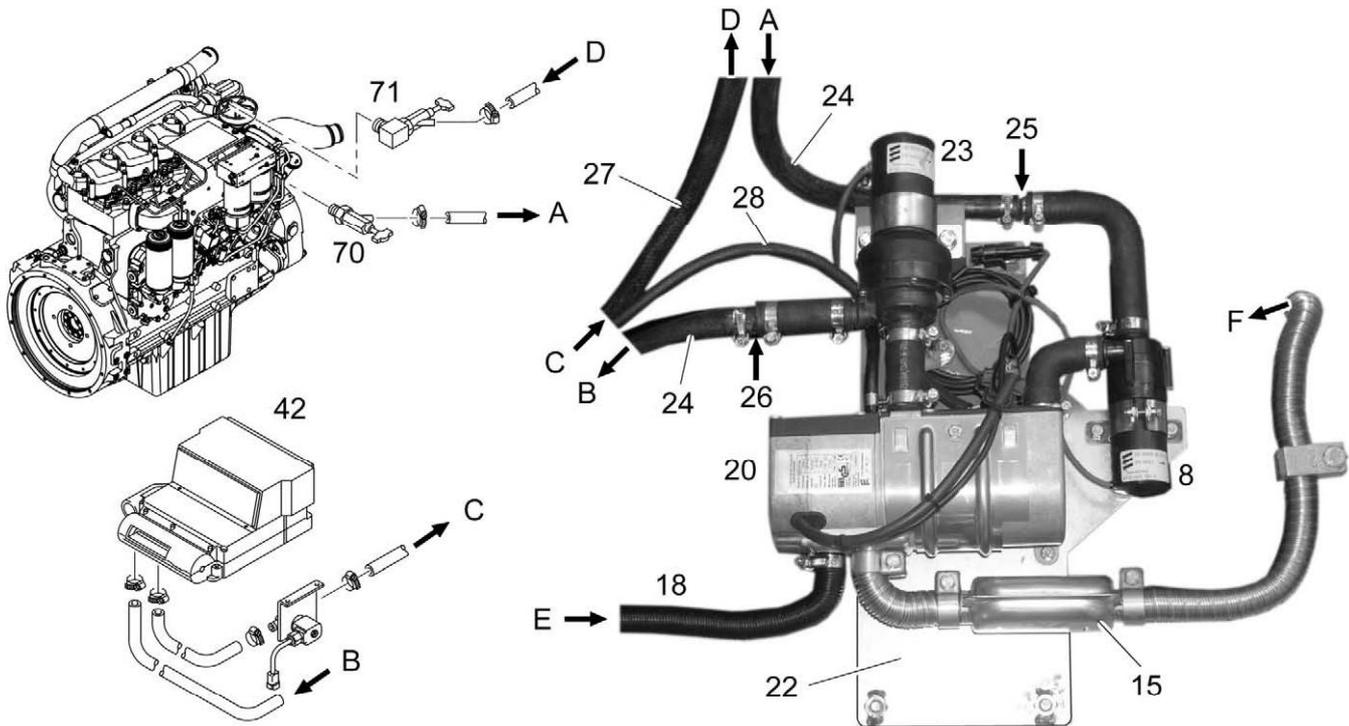
## 5 Subsequent installation of the auxiliary heating



### Caution!

Risk of burns and short-circuits!

- ▶ Before commencing any tasks, switch off the battery main switch or disconnect the vehicle battery.
- ▶ Before working on the heater, switch off the heater and allow components to cool.



**Fig. 8** Installing the auxiliary heating

- |  |   |
|--|---|
| <b>8</b> Water pump                                | <b>28</b> Fuel line   |
| <b>15</b> Exhaust gas muffler                      | <b>42</b> Heat exchanger in the operator's cab                  |
| <b>18</b> Combustion air hose                      | <b>70</b> Shut-off valve water flow to engine                   |
| <b>20</b> Heater                                   | <b>71</b> Shut-off valve water return-flow to engine            |
| <b>22</b> Console                                  | <b>A</b> Water flow from engine                                 |
| <b>23</b> Auxiliary water pump                     | <b>B</b> Water flow to heat exchanger in the operator's station |
| <b>24</b> Water flow hose                          | <b>C</b> Water return-flow from heat exchanger                  |
| <b>25</b> Separation point heater - water flow     | <b>D</b> Water return-flow to engine                            |
| <b>26</b> Separation point heater - heat exchanger | <b>E</b> Air suction  |
| <b>27</b> Water return-flow hose                   | <b>F</b> Exhaust point  |

## 5.1 Installing the auxiliary heating

- ▶ Mount the heating **20** on the console **22**, (see Fig. 8 at page 12).
- ▶ Mount the complete console **22** beneath the cooler.
- ▶ Close the water taps **70** and **71** on the diesel engine, (see Fig. 8 at page 12).
- ▶ Disconnect the water hose **24** (feed at bottom of engine) so that the hose reaches from the diesel engine to the separation point **25**.

At the same time ensure that the water hose does not become kinked and does not scrape against any rotating parts (e.g. fan wheel).

- ▶ Secure the water hose **24** to the separation point **25** using a hose clamp.
- ▶ Disconnect the water hose **24** from the heat exchanger in the operator's station **42** and secure it to the separation point **26** using a hose clamp.
- ▶ Mount and connect the batching pump **14** to the tank, (see Fig. 9 at page 13).
- ▶ Lay out and connect the fuel line **28** from the tank to the heater, (see Fig. 10 at page 14).
- ▶ Fasten the combustion air hose **18** to the slewing platform.
- ▶ Fasten the exhaust gas muffler **15** and the exhaust hose to the slewing platform with a clamp.
- ▶ Open the water taps **70** and **71** on the diesel engine.

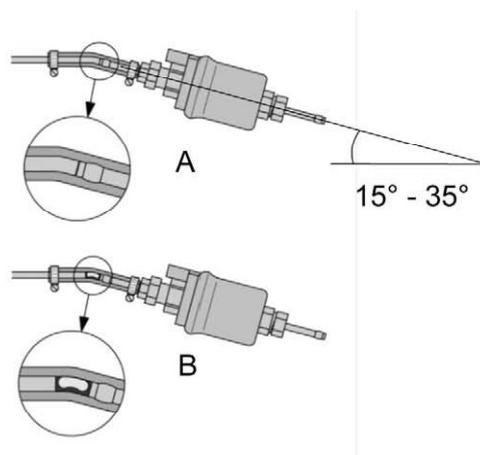
## 5.2 Installing the batching pump



**Fig. 9** Installation position of batching pump

**14** Batching pump  
**61** Plug connection **X98**

**62** Fuel sieve  
**63** Connection to fuel tank



**Fig. 10** Laying of line to the batching pump

**A** correct laying of line

**B** incorrect laying of line

The following must be noted when installing the batching pump and laying the fuel lines:

- Trim the fuel lines and tubes with a sharp knife only. Do not pinch the tube when cutting and cut cleanly ensuring that no burring occurs.
- Never lay or secure fuel lines in immediate proximity to the exhaust gas channels of the heater or the diesel engine.
- Always fix the fuel lines flush to prevent blisters occurring, (see Fig. 10 at page 14).
- Always mount the batching pump with the pressure side pointing upwards. Ensure also that the installation angle is between 15° and 35°, (see Fig. 10 at page 14).

## 6 Maintenance

- Check the fuel sieve **62** of the batching pump **14** for contamination, (see Fig. 9 at page 13).

## 7 Troubleshooting

### Prerequisites:

Ensure that

- there is sufficient fuel in the tank.
- there is no summer diesel remaining in the fuel line in winter.
- the exhaust air and combustion air channels are OK.
- the fuses are OK.

Check the supply voltage **U<sub>Batt</sub>** (**KI. 30**).

- Disconnect the 8-pin plug **X101** (**S1 / B1**) and measure the voltage present in plug **B1** / pin 1 (wire 2.5<sup>2</sup> red) and pin 2 (2.5<sup>2</sup> brown). If a deviation of battery voltage is ascertained, check the fuses, the supply lines, the earth connection and the positive terminal on the battery for a drop in voltage (corrosion / interruption).

Check the actuation signal (**S+**).

- Disconnect the 8-pin plug **X101 S1 / B1** and then press button **33** on the mini-clock. Measure the voltage present in the plug **B1** between pin 7 (wire 0.5<sup>2</sup> yellow) and pin 2 (2.5<sup>2</sup> brown). If no voltage is present, check the supply line (wire 0.5<sup>2</sup> yellow), the 5A fuse at the main fuses **5** and the mini-clock **6**.

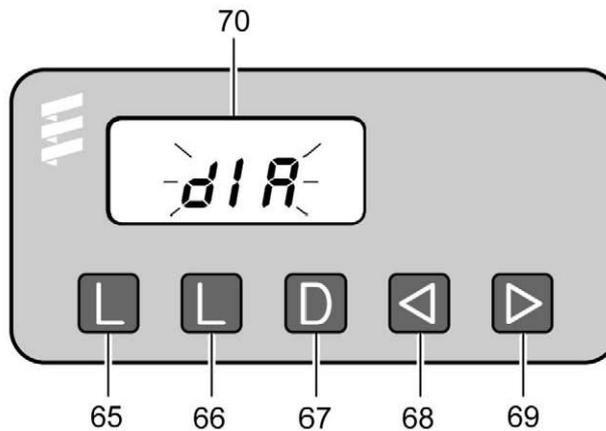
Check the mini-clock.

- Remove plug **X95** at the mini-clock, establish a bridge between wire 0.5<sup>2</sup> red and wire 0.5<sup>2</sup> yellow. If voltage is present in plug **X101** (B1) between pin 7 (wire 0.5<sup>2</sup> yellow) and pin 2 (wire 0.5<sup>2</sup> brown), the mini-clock must be replaced.

## 7.1 Troubleshooting with the diagnostic equipment

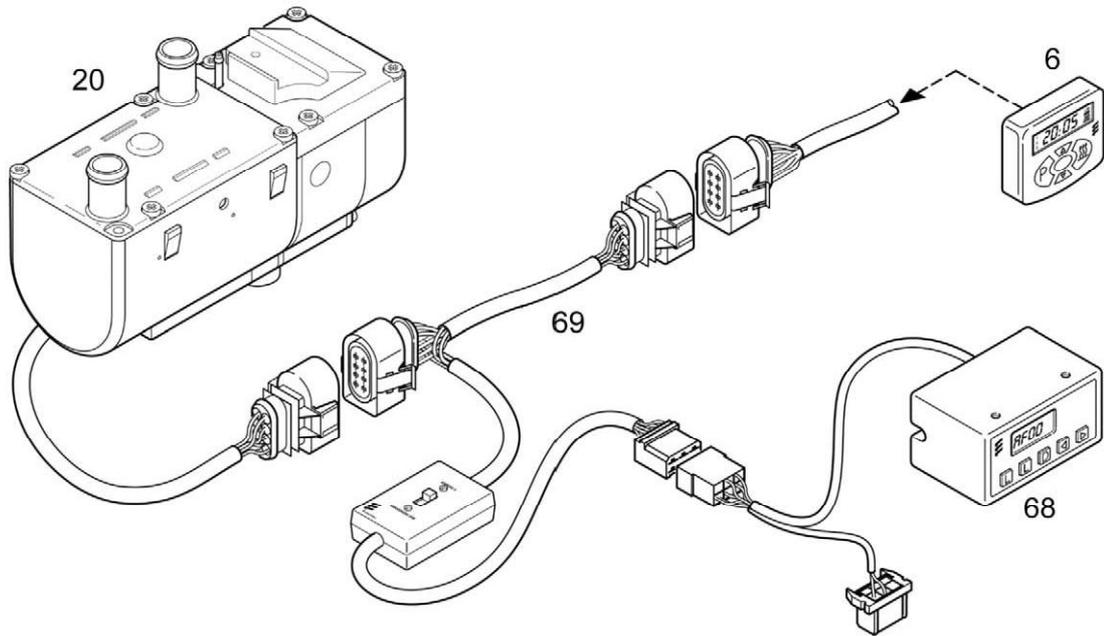
The diagnostic equipment with adapter cable is required for further troubleshooting regarding quing of the error memory and deleting the locking for the control unit, (ID no. see Group 2.01).

The electronic control unit can store up to 5 fault codes which can then be read out and displayed by the diagnostic equipment.



**Fig. 11** Diagnostic equipment

- |  |  |
|--|--|
| <b>65</b> Deleting the stored error      | <b>68</b> Reverse action of errors F5 - F1 |
| <b>66</b> Deleting the stored error      | <b>69</b> Forward action of errors F1 - F5 |
| <b>67</b> Diagnosis - call up fault code | <b>70</b> Display                          |



**Fig. 12** Connection of diagnostic equipment with adapter cable

- |                     |                                |
|---------------------|--------------------------------|
| <b>6</b> Mini-clock | <b>68</b> Diagnostic equipment |
| <b>20</b> Heater    | <b>69</b> Adapter cable set    |

The actual error is displayed as „AF“ and is always written in memory **F1**.

Foregone errors are transferred to memory **F2 - F5**, the content of memory **F5** is overwritten as required.

A faulty current circuit, as well as a faulty component will be displayed in the diagnostic equipment.

**Querying the fault code**

- ▶ Press the button **67**.
  - ↪ „AF“ (=actual error) and a 3-digit number (=fault code) appears on the display.

**Releasing the locking and deleting the fault code**

After remedying the cause of the error:

- ▶ Press buttons **65 + 66** simultaneously for at least 2 seconds.
  - ↪ The control unit is unlocked and the stored errors **F1 - F5** are deleted.
- ▶ Switch off the auxiliary heating and switch back on again.



**Note!**

An additional adapter cable is required for connection of the diagnostic equipment due to poor accessibility of the plug connections, see tools in Group 2.01.

- ▶ Open the cover of the right-hand console.
- ▶ Disconnect the plug of the mini-clock from the cable set.
- ▶ Connect the adapter cable of the diagnostic equipment in between.

## 7.2 Fault codes, error descriptions and remedial measures

Fault code	Error description	Remedial measures
010	Overvoltage: Deactivation	Overvoltage is present for at least 20 seconds without interruption at the control unit ⇔ heater without function ► Disconnect the plug connection <b>X101 (B1/S1)</b> . ► Start up the vehicle engine. ► Measure the voltage in the plug <b>X101 (B1</b> between pin and pin 2). Voltage > 28 volts: ► Check the alternator regulator or battery.
011	Undervoltage: Deactivation	Undervoltage is present for at least 20 seconds without interruption at the control unit ⇔ heater without function ► Disconnect the plug connection <b>X101 (B1/S1)</b> . ► Start up the vehicle engine. ► Measure the voltage in the plug <b>X101 (B1</b> between pin and pin 2). Voltage > 20 volts: ► Check the fuses, the supply lines, the earth connection and positive terminal on the battery for a drop in voltage (corrosion).
012	Overheating (software - threshold value)	Temperature on the overheating gauge > 125°C. Check the water circuit: ► Check all hose connections for leaks. ► Check the direction of throughflow from thermostat and check valves. ► Aerate the water circuit. ► Ensure correct functioning of the water pump. ► Check the temperature gauge and overheating gauge
014	Possible overheating detected (difference evaluation). The heating with the date of manufacture 12.97 features the following values: Difference of temperature values from overheating gauge > 15K. Water temperature at overheating gauge at least 70°C.	Difference of temperature values from overheating gauge and temperature gauge > 25K. Prerequisite for this fault code - display is that the heating active and that the water temperature at the overheating gauge has reached at least 80°C. ► Check all hose connections for leaks. ► Check the direction of throughflow from thermostat and check valves. ► Aerate the water circuit. ► Ensure correct functioning of the water pump. ► Check the temperature gauge and overheating gauge

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Fault code	Error description	Remedial measures
015	Operational shut-down: Permissible number of 10 possible overheatings exceeded.	The control unit is blocked. ► Unblocking of the control unit with the diagnostic equipment. Check the water circuit: ► Check all hose connections for leaks. ► Check the direction of throughflow from thermostat and check valves. ► Aerate the water circuit. ► Ensure correct functioning of the water pump. ► Check the temperature gauge and overheating gauge
017	Overheating detected EMERGENCY-OFF: (hardware - threshold value)	Temperature on the overheating gauge > 130°C. Check the water circuit: ► Check all hose connections for leaks. ► Check the direction of throughflow from thermostat and check valves. ► Aerate the water circuit. ► Ensure correct functioning of the water pump. ► Check the temperature gauge and overheating gauge
020  021	Glow plug - interruption:  Glow plug outlet - short circuit, overload or earth fault (carry out a check with a maximum of 18 volts. The glow plug will become ruined if the value is exceeded. Ensure short-circuit protection of mains power supply)!	Functional check of the glow plug when installed: ► Unplug the 14-pin plug pin 9 (1.5 <sup>2</sup> white) and pin 12 (1.5 <sup>2</sup> brown). ► Establish a voltage of 18 volts ± 0.1 volts at the glow plug. Measure the current strength after approx. 25 seconds. ↳ Current strength = 4.5 amperes ± 1.5 amperes. ↳ Glow plug = OK. If the glow plug is not OK: ► Inspect the drive train of the glow plug for damage. For fault code 021: ► Check assembly of the connector and the waved washer. ► Check the drive train for short circuit.

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Fault code	Error description	Remedial measures
030	<p>Speed of combustion air blower motor outside the permissible range:                      Carry out a check with approx. 15 volt + 0.2 volts.                      Ensure correct connection of lines!                      Brown = +                      Black = -                      (ensure short-circuit protection of mains power supply)!</p>	<p>Blower wheel or combustion air blower motor blocked (frozen solid, contaminated, stiff, drive train scraping against end of shaft...).</p> <ul style="list-style-type: none"> <li>▶ Remedy the blockage.</li> </ul> <p>Measure the speed of the combustion air blower motor:</p> <ul style="list-style-type: none"> <li>▶ Unplug the 14-pin plug pin 14 (0.75<sup>2</sup> brown) and pin 1 (0.75<sup>2</sup> black).</li> <li>▶ Mount the reflective strips on the shaft.</li> <li>▶ Charge the combustion air blower motor with 15 volts</li> <li>▶ Measure the speed with non-contact speedometer.</li> </ul> <p>Speed &lt; 1000 rpm:</p> <ul style="list-style-type: none"> <li>▶ Replace the combustion air blower.</li> </ul> <p>Speed &gt; 1000 rpm:</p> <ul style="list-style-type: none"> <li>▶ Replace the control unit.</li> </ul>
031	<p>Combustion air blower motor:                      Interruption.                      Carry out a check with approx. 15 volt + 0.2 volts.                      Ensure correct connection of lines!                      Brown = +                      Black = -                      (ensure short-circuit protection of mains power supply)!</p>	<ul style="list-style-type: none"> <li>▶ Ensure correct layout of drive train for the combustion blower motor and inspect for damage.</li> </ul> <p>Measure the speed of the combustion air blower motor:</p> <ul style="list-style-type: none"> <li>▶ Unplug the 14-pin plug pin 14 (0.75<sup>2</sup> brown) and pin 1 (0.75<sup>2</sup> black).</li> <li>▶ Mount the reflective strips on the shaft.</li> <li>▶ Charge the combustion air blower motor with 15 volts</li> <li>▶ Measure the speed with non-contact speedometer.</li> </ul> <p>Speed &lt; 1000 rpm:</p> <ul style="list-style-type: none"> <li>▶ Replace the combustion air blower.</li> </ul> <p>Speed &gt; 1000 rpm:</p> <ul style="list-style-type: none"> <li>▶ Replace the control unit.</li> </ul>

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Fault code	Error description	Remedial measures
032	Combustion air blower motor: Short circuit. Carry out a check with approx. 15 volt + 0.2 volts. Ensure correct connection of lines! Brown = + Black = - (ensure short-circuit protection of mains power supply)!	Blower wheel or combustion air blower motor blocked (contaminated, stiff, drive train scraping against the end of the shaft...): <ul style="list-style-type: none"> <li>▶ Remedy the blockage.</li> <li>▶ Measure the resistance.</li> </ul> Resistance < 2 kΩ = earth fault: <ul style="list-style-type: none"> <li>▶ Replace the combustion air blower.</li> </ul> Resistance > 2 kΩ = no earth fault: <ul style="list-style-type: none"> <li>▶ Measure the speed of the combustion air blower motor.</li> </ul> Measure the speed of the combustion air blower motor: <ul style="list-style-type: none"> <li>▶ Unplug the 14-pin plug pin 14 (0.75<sup>2</sup> brown) and pin 13 (0.75<sup>2</sup> black).</li> <li>▶ Mount the reflective strips on the shaft.</li> <li>▶ Charge the combustion air blower motor with 15 volts.</li> <li>▶ Measure the speed with non-contact speedometer.</li> </ul> Speed < 1000 rpm: <ul style="list-style-type: none"> <li>▶ Replace the combustion air blower.</li> </ul> Speed > 1000 rpm: <ul style="list-style-type: none"> <li>▶ Replace the control unit.</li> </ul>
038	Relay control of vehicle blower: Interruption	<ul style="list-style-type: none"> <li>▶ Check the electrical line to the relay.</li> <li>▶ Remedy the interruption.</li> <li>▶ Replace the relay.</li> </ul>
039	Relay control of vehicle blower: Short circuit, overload of earth fault	<ul style="list-style-type: none"> <li>▶ Remove the relay.                          ↳ Fault code 038 appears in the display.</li> <li>▶ Remedy the interruption.</li> <li>▶ Replace the relay.</li> </ul>
041	Water pump: Interruption	Inspect the supply line to the water pump for clear passage: <ul style="list-style-type: none"> <li>▶ Unplug the 14-pin plug pin 10 (0.5<sup>2</sup> brown) and pin 11 (0.5<sup>2</sup> purple).</li> <li>▶ Remedy the interruption.</li> <li>▶ If necessary, replace the water pump.</li> </ul>
042	Water pump: Short circuit, overload, earth fault	<ul style="list-style-type: none"> <li>▶ Disconnect the plug connection in the cable harness „water pump“:</li> </ul> If fault code 041 is displayed: <ul style="list-style-type: none"> <li>↳ Water pump faulty.</li> <li>▶ Replace the water pump.</li> </ul>
047	Batching pump: Short circuit, overload, earth fault	<ul style="list-style-type: none"> <li>▶ Disconnect plug connection in the cable harness „batching pump“:</li> </ul> If fault code 048 is displayed: <ul style="list-style-type: none"> <li>▶ Replace the batching pump.</li> </ul>

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Fault code	Error description	Remedial measures
048	Batching pump: Interruption	<ul style="list-style-type: none"> <li>▶ Inspect the cable harness of the batching pump for clear passage.</li> <li>▶ Remedy the interruption.</li> <li>▶ If necessary, replace the batching pump.</li> </ul>
050	Operational shut-down: Too many start attempts (10 start attempts, additionally a start repeat for every start attempt)	<p>The control unit is blocked.</p> <ul style="list-style-type: none"> <li>▶ Delete the error memory of the control unit with the diagnostic equipment.</li> <li>▶ Unlock the control unit.</li> <li>▶ Check amount of fuel and fuel supply.</li> </ul>
051	Time exceeded: Blowing cold	<p>Upon start-up, the flame scanner registers a temperature 70°C for longer than 240 sec.</p> <ul style="list-style-type: none"> <li>▶ Check exhaust gas and combustion air channelling</li> <li>▶ Check the flame scanner.</li> </ul>
052	Safety time: Exceeded	<ul style="list-style-type: none"> <li>▶ Check exhaust gas and combustion air channelling</li> <li>▶ Check amount of fuel and fuel supply.</li> </ul>
053	Terminating the flame from regulating stage „High“	<p>Warning!</p> <p>The heating initiates a restart upon termination of the flame from regulation stage „High“ or „Low“ as well as permissit start attempts with subsequent start repeats as required! Restart or start repeat = successful ⇨ fault code - displ. is deleted.</p> <p>Fault as no more new start attempts are permissible:</p> <ul style="list-style-type: none"> <li>▶ Check exhaust gas and combustion air channelling</li> <li>▶ Check amount of fuel and fuel supply.</li> <li>▶ Check the flame scanner, see fault codes 064 and 06</li> </ul>
056	Terminating the flame from regulating stage „Low“	
060	Temperature scanner: Interruption	<ul style="list-style-type: none"> <li>▶ Dismantle the control unit and check the connecting cable of the temperature gauge for damage.</li> </ul> <p>Drive train OK, short circuit temperature gauge:</p> <ul style="list-style-type: none"> <li>▶ Plug the 14-pin plug pin 3 into pin 4.</li> <li>▶ Switch on the heating.</li> </ul> <p>If fault code 061 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the temperature gauge.</li> </ul> <p>If fault code 060 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Check the control unit, replace as necessary.</li> </ul>

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Fault code	Error description	Remedial measures
061	<p>Temperature scanner: Short circuit, overload or earth fault</p> <p>The inspection can only be carried out if the heater is still installed in the machine if no test rig is available.</p>	<ul style="list-style-type: none"> <li>▶ Dismantle the control unit and check the connecting cable of the temperature gauge for damage.</li> </ul> <p>Drive train OK:</p> <ul style="list-style-type: none"> <li>▶ Remove the 14-pin plug at the control unit.</li> <li>▶ Unplug pin 3 (0.5<sup>2</sup> blue) and pin 4 (0.5<sup>2</sup> blue).</li> <li>▶ Plug in 14-pin plug at the control unit.</li> <li>▶ Switch on the heating.</li> </ul> <p>If fault code 060 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the temperature gauge.</li> </ul> <p>If fault code 061 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Check the control unit, replace as necessary.</li> </ul>
064	<p>Flame scanner: Interruption</p> <p>The inspection with a bridge in the 14-pin plug can only be carried out if the heater is still installed in the machine or if a test rig is available.</p>	<ul style="list-style-type: none"> <li>▶ Dismantle the control unit and check the connecting cable of the flame scanner for damage.</li> </ul> <p>Drive train OK:</p> <ul style="list-style-type: none"> <li>▶ Change the 14-pin plug pin 1 over to pin 2.</li> <li>▶ Switch on the heating.</li> </ul> <p>If fault code 065 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the flame scanner.</li> </ul> <p>If fault code 064 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Check the control unit, replace as necessary.</li> </ul>
065	<p>Flame scanner: Short circuit, overload, earth fault</p> <p>The inspection can only be carried out if the heater is still installed in the machine if no test rig is available.</p>	<ul style="list-style-type: none"> <li>▶ Dismantle the control unit and check the connecting cable of the flame scanner for damage.</li> </ul> <p>Drive train OK:</p> <ul style="list-style-type: none"> <li>▶ Remove the 14-pin plug at the control unit.</li> <li>▶ Unplug pin 1 (0.5<sup>2</sup> blue) and pin 2 (0.5<sup>2</sup> brown).</li> <li>▶ Plug in 14-pin plug at the control unit.</li> <li>▶ Switch on the heating.</li> </ul> <p>If fault code 064 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the flame scanner.</li> </ul> <p>If fault code 065 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Check the control unit, replace as necessary.</li> </ul>

Fault code	Error description	Remedial measures
071	<p>Overheating gauge: Interruption</p> <p>The inspection with a bridge in the 14-pin plug can only be carried out if the heater is still installed in the machine or if a test rig is available.</p>	<ul style="list-style-type: none"> <li>▶ Dismantle the control unit and check the connecting cable of the overheating gauge for damage.</li> </ul> <p>Drive train OK:</p> <ul style="list-style-type: none"> <li>▶ Change the 14-pin plug pin 5 over to pin 6.</li> <li>▶ Switch on the heating.</li> </ul> <p>If fault code 072 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the overheating gauge.</li> </ul> <p>If fault code 071 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Check the control unit, replace as necessary.</li> </ul>
072	<p>Overheating gauge: Short circuit, overload, earth fault</p> <p>The inspection can only be carried out if the heater is still installed in the machine if no test rig is available.</p>	<ul style="list-style-type: none"> <li>▶ Dismantle the control unit and check the connecting cable of the overheating gauge for damage.</li> </ul> <p>Drive train OK:</p> <ul style="list-style-type: none"> <li>▶ Remove the 14-pin plug at the control unit.</li> <li>▶ Unplug pin 5 (0.5<sup>2</sup> red) and pin 6 (0.5<sup>2</sup> red).</li> <li>▶ Plug in 14-pin plug at the control unit.</li> <li>▶ Switch on the heating.</li> </ul> <p>If fault code 071 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the overheating gauge.</li> </ul> <p>If fault code 072 is displayed:</p> <ul style="list-style-type: none"> <li>▶ Check the control unit, replace as necessary.</li> </ul>
090 092 - 103	Control unit faulty	<ul style="list-style-type: none"> <li>▶ Replace control unit.</li> </ul>
091	External interference voltage	<p>Disruption of control unit due to interference voltages from the onboard power supply from poor batteries, charging equipment, other fault sources.</p> <ul style="list-style-type: none"> <li>▶ Remedy the fault sources.</li> </ul>
Faults which are not displayed by the diagnostic equipment		
Fault description		Remedial measures
Heater will not start		<p>Upon activation of the heater, the water pump and the vehicle blower start immediately.</p> <ul style="list-style-type: none"> <li>▶ Dismantle and check the temperature gauge.</li> </ul>

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### 7.3 Checking the flame scanner

A check of the flame scanner is to be carried out with a digital multimeter. If the resistance value of the flame scanner is outside of the value chart, the flame scanner is to be replaced.

## Checking the overheating gauge and temperature gauge

**7.3.1 Value charts of the flame scanner**

Temp (°C)	-50	0	10	20	30	50	80	90
R (Ω)	803	1000	1022	1062	1097	1194	1309	1347
U (V)	1,407	1,639	1,661	1,719	1,738	1,840	1,948	1,983

Temp (°C)	100	130	150	200	250	300	350	400
R (Ω)	1385	1498	1573	1758	1941	2120	2297	2470
U (V)	2,016	2,111	2,171	2,308	2,432	2,542	2,642	2,732

**7.4 Checking the overheating gauge and temperature gauge**

A check of the overheating gauge and temperature gauge is to be carried out with a digital multimeter. If the resistance value is outside the value chart, the overheating gauge or the temperature gauge is to be replaced.

**7.4.1 Value chart of the overheating gauge and temperature gauge**

Temp (°C)	0	10	20	30	40	50	60	70
R (KΩ)	32,54	19,87	12,48	8,06	5,33	3,60	2,48	1,75
U (V)	4,275	3,960	3,561	3,100	2,611	2,135	1,705	1,339

Temp (°C)	80	90	100	110	120
R (KΩ)	1,25	0,91	0,67	0,50	0,38
U (V)	1,041	0,805	0,622	0,483	0,376

**8 Electrical system****Note!**

The electrical components and connections can be obtained in the circuit diagram of **Group 8**.

# Subgroup 17.48 Heating and air-conditioning system

## 1 Job definition

The operator's cab is fitted with a heating and air-conditioning system as standard. This can be used for heating and air-conditioning, as well as for ventilation of the cab.

It allows the operator:

- to generate the desired room temperature in the cab
- quick dehumidification (reheating) of the cab during "humid seasons"
- regulatory discharge of air via flaps and blower control

### 1.1 Notes in general regarding the air-conditioning system

- The air-conditioning system is only operational if the vehicle engine is running
- During cooling operation, the air humidity is lowered in the vehicle interior. This prevents the windows from steaming up
- The air-conditioning system works most efficiently if the windows and doors are closed. If, however, the interior becomes extremely hot as a result of direct sunlight with the machine switched on, briefly opening the windows / doors will speed up the cooling process
- With high ambient temperatures and high air humidity, condensation will drop from the vapor and forms a puddle of water beneath the machine. This is normal and should not be taken as an indication of leakages
- Contamination is kept to a minimum by the filter in the recirculation grill. Switch over to recirculation mode if the outside air is polluted. The elements of the recirculation grill must be cleaned or replaced at regular intervals in order that output of the air-conditioning system does not become impaired



**Caution!**

For safety reasons we recommend that any interventions or repairs to the air-conditioning system are carried out by **mechanics trained in refrigeration engineering**. For all tasks on the cooling circuit, the safety and accident-prevention guidelines, and in particular the environmental protection guidelines regarding handling of the refrigerant being used, must be observed.

## 2 Technical data

Machine	Unit	R 904 C-Li - R 900 C-Li
Heater and air-conditioning unit	Type	KL 2/4
Operating voltage	Volts DC	24
Refrigerant	Type	R134a
Amount of refrigerant	kg	approx. 1.6 (without cab elevation)
Amount of cooling oil in the circuit	cm <sup>3</sup>	200

Machine	Unit	R 904 C-Li - R 900 C-Li
Quality of cooling oil		PAG SP 10
Vaporiser - cooling output	KW	max. 7.5
Radiator - heating output	KW	max. 9.5
Heat exchanger - air flow	m <sup>3</sup> /h	1165
Heat exchanger - power consumption	A	13,4
Compressor	Type	SD 7 H 15
Compressor weight	kg	5,3
Diameter of magnetic clutch	mm	119
Voltage	Volts DC	24
Pushbutton		
Low pressure deactivation	bar	↘1.5 ± 0.5
activation	bar	↗3.4 max.
High pressure deactivation	bar	↘25.5 ± 0.5
activation	bar	↘18.0 ± 0.5
Defrost thermostat deactivation	°C	↘1.0 ± 1.0
activation	°C	↗5.5 ± 1.0
Pressure control valve 9	bar	32.0 ± 4

**Tab. 1** Technical data

### 3 System description

The air-conditioning system is comprised of 4 main parts connected by hoses:

- **Cooling compressor 1** with electromagnet - clutch **Y20** is powered by the diesel engine via V-belt and is thus situated next to the diesel engine on the fan side
- **The capacitor 2** is mounted at the front on the combined radiator (for engine coolant, hydraulic oil, etc.)
- **The heater and air-conditioning unit 20** is situated in the operator's cab - arranged behind the operator's seat - and forms the low-pressure section of the system. It comprises essentially the heater and vaporiser battery (heat exchanger) **8** and the expansion valve **6**. The vaporiser of the air-conditioning cooling circuit and the heat exchanger of the warm water heating are combined in the heat exchanger **8** to form a battery unit. The defrost thermostat **B43** is mounted on the vaporiser battery **8** and protects the vaporiser battery **8** against icing and shuts down the compressor
- **Dry collection unit 3** is situated in the high-pressure section of the system behind the operator's cab and comprises of the interior filter dryer **4** and inspection glass **5**. The collecting sump **3**, filter dryer **4** and inspection glass **5** are combined in a single unit and may not be replaced individually
- The cooling water of the diesel engine is channelled to the heat exchanger via hoses and represents a separate circuit separate from the air-conditioning circuit

<b>1</b>	Air-conditioning circuit	<b>B255</b>	Temperature sensor / drawn air
<b>2</b>	Capacitor unit	<b>B257</b>	Temperature unit / exhaust air
<b>3</b>	Collecting sump	<b>M13</b>	Engine / vaporiser blower
<b>4</b>	Filter dryer (internal)	<b>M75</b>	Engine / outside air flap
<b>5</b>	Inspection glass	<b>M76</b>	Engine / air flap rear wall
<b>6</b>	Expansion valve	<b>M77</b>	Engine / air flap control console

Notes in general regarding the air-conditioning system

<b>8</b>	Heat exchanger	<b>M78</b>	Engine / air flap for foot area and wind-shield
<b>9</b>	Bypass valve	<b>U37</b>	Control unit / heating and air-conditioning system
<b>10</b>	Dry collector unit	<b>U38</b>	Operating unit
<b>20</b>	Heater and air-conditioning unit housing	<b>Y20</b>	Magnetic clutch / air-conditioning
<b>B43</b>	Defrost thermostat / air-conditioning system	<b>Y46</b>	Solenoid valve / heating system
<b>B44</b>	Pushbutton / air-conditioning system		

# 4 Exploded view of heating and air-conditioning system

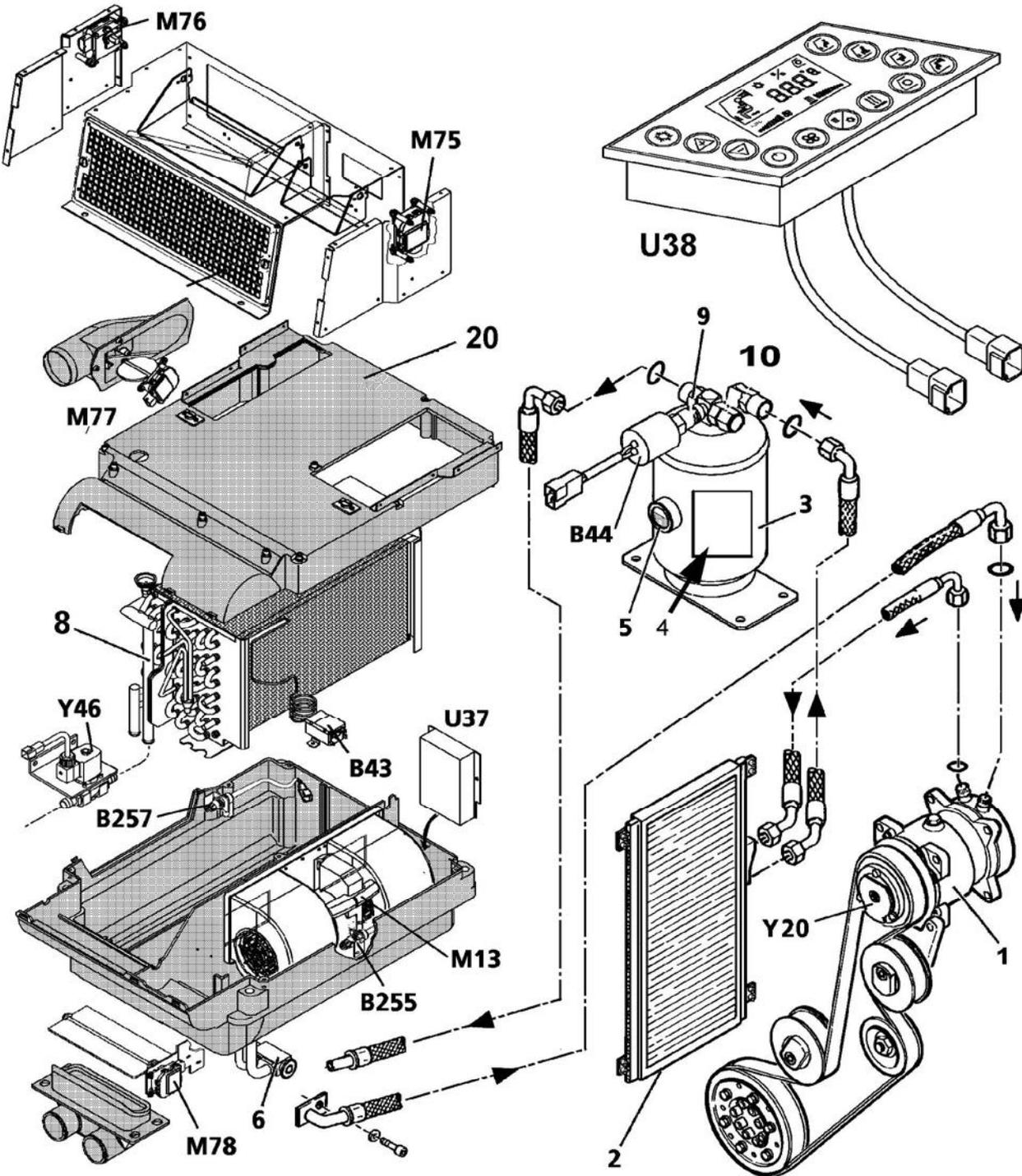


Fig. 1 Heating and air-conditioning system

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