# Workshop Manual

# Thermo Top Pro 50

Water Heater

## English



www.butlertechnik.com

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# 1 General information

## 1.1 About this document

### 1.1.1 Purpose of the document

This workshop manual is designed to assist trained personnel with maintenance of the Thermo Top Pro 50.

The document is part of the product and contains all the information, settings and instructions necessary to maintain the product.

### 1.1.2 Using this document

- Read and understand this workshop manual before repairing the product.
- Read and observe important safety instructions.
- Read and observe Operating instructions.
- Read and observe Installation instructions.

### 1.1.3 Use of symbols and highlighting

**DANGER**
This signal word denotes a hazard with a high degree of risk which, if not avoided, may lead to death or serious injury.

**WARNING**
This signal word denotes a hazard with a moderate degree of risk which, if not avoided, may lead to minor or moderate injury.

**CAUTION**
This signal word denotes a hazard with a low degree of risk which, if not avoided, will lead to minor or moderate injury.

**NOTE**
This signal word denotes a Special Technical Feature or (if not observed) potential damage to the product.

Refers to separate documents which are enclosed or can be requested from Webasto.

✓ Requirements for the following necessary action

## 1.2 Intended use

The water heater Thermo Top Pro 50 is currently approved for the following applications:

- Motor vehicles of EU category **M1**. See also: https://ec.europa.eu/growth/sectors/automotive/vehicle-categories_en.
- Commercial Vehicles

If it is installed in special-purpose vehicles, observe the applicable regulations for this. Alternative applications are possible in agreement with Webasto.

## 1.3 Qualification of the repair personnel

To work on the heater, personnel must have the following qualifications:

- Successful completion of Webasto training.
- Corresponding qualification for working on technical systems.
- Installation instructions, workshop manual and operating instructions as well as the notes it contains must be observed.

## 1.4 Warranty and liability

Webasto shall not assume liability for defects or damage that are the result of the installation and operating instructions, and the instructions in this document, being disregarded. This liability exclusion particularly applies for:

- Maintenance by untrained personnel
- Conversion of the unit without permission from Webasto.
- Improper use.
- Repairs or device replacement not carried out by a Webasto service workshop.

## 1.5 Spare parts

You can find available original spare parts:

- In the Webasto spare parts catalogue.
- In the dealer portal https://dealers.webasto.com.

## 1.6 Abbreviations

| Abbreviation | Meaning |
|---|---|
| DEC | Decimal |
| EOL | End Of Line |
| HD | Heavy Duty |
| HEX | Hexadecimal |

# 2 Safety

The general accident prevention regulations and valid operational safety instructions must be observed. "General safety requirements" that extend beyond the framework of these regulations are specified in the following. The special safety requirements that pertain to this workshop manual are highlighted in the individual chapters and procedural descriptions.

## 2.1 Intended use

## 2.2 General safety information

**DANGER**
**Danger of poisoning and suffocation**
Do not operate the heater in closed rooms that do not have an exhaust extraction unit.
▶ Do not switch on or operate the heater.

**DANGER**
**Danger of scalding from leaking hot coolant**
Scalding on opening the coolant circuit. The vehicle coolant circuit is pressurised.
▶ Allow the coolant to cool before working on the vehicle coolant system.

**DANGER**
Hazardous material vehicles (ADR) must not be switched on or off using a timer control or remote control.

**CAUTION**
**Overheating possible**
A battery disconnector (emergency off switch) may only be actuated in the event of danger since the heater will be switched off without after-running period.
▶ Always switch the heater on and off via the control element.

**CAUTION**

**Overheating**

Insufficient bleeding can lead to a malfunction resulting from overheating in heating mode.

Take care when bleeding the coolant system.

Always bleed:

- Before first commissioning the heater
- After replacing the coolant of the heater

**NOTE**

Correct bleeding can be identified by the fact that the coolant pump is making very little noise.

**NOTE**

**Incorrect handling**

- ▶ Protect the heater against mechanical stress (e.g. dropping, impacts or knocks).
- ▶ Do not stand on the heater.
- ▶ Do not place any objects on top of the heater.
- ▶ Avoid shutting down the heater incorrectly during the after-running period. After switching off via the control element, the fan of the heater continues to run.
- ▶ Always switch off the heater via the control element.
- ▶ Do not disconnect from the power supply until the after-running period has elapsed.

## 2.3 Regulations and legal requirements

The type approvals in accordance with the regulations ECE-R 122 (heating) and ECE-R 10 (EMC) for the Thermo Top Pro 50 heater apply in the area where the European regulation 2018/858 is valid.

## 2.4 Working on the heater

**NOTE**

Before dismantling the heater, disconnect the heater power supply from the vehicle battery or remove fuses **F1** and **F3**.

**NOTE**

Always carry out a visual inspection before starting repair work:

- Check the fuel system for leaks.
- Check the combustion air and exhaust pipe for damage and ensure they are clear.

The main battery power must not be disconnected as long as the heater is operating or after running due the risk of the heater overheating and consequently the overheating safeguard tripping.

**NOTE**

**Replace component:**

Within the warranty period, send in only the defective component (not the entire heater) to Webasto.

**NOTE**

When on-board power supply is applied, never disconnect the connector from the heater.

## 2.5 Working on the vehicle

**NOTE**

The temperature of the heater must not be over 85 °C when switched off. See Technical data.

## 2.6 Heater test run

**NOTE**

Even if you use the timer, the heater must not be operated in enclosed spaces such as garages and workshops without an emissions extraction system.

## 2.7 Checks

Webasto recommends to carry out the following servicing jobs before and after each heating period:

1. Read out the fault code memory.
2. Clean heater exterior (make sure no water gets in).
3. Check the electrical connections for contact corrosion and firm seating.
4. Check exhaust gas and combustion air line for damage and ensure that they are clear.
5. Check the fuel line and filters for leaks.
6. Check hoses for cracks.
7. If fitted and necessary, change the fuel filter.
8. Commission the heater.

# 3 Component introduction

## 3.1 General description

The water heater Thermo Top Pro 50 is used for:

- Heat the vehicle interior.
- Defrost vehicle windows.
- Preheat water-cooled vehicle engines.

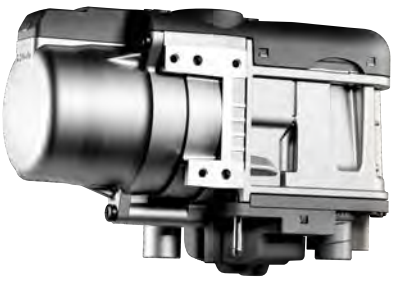

*Fig. 1 Thermo Top Pro 50*

The water heater operates independently of the vehicle engine and is integrated into the cooling system, the fuel system and the electrical system of the vehicle.

Depending on the equipment, the ADR function is provided (for vehicles for transporting hazardous materials).

**Auxiliary Heating**

The water heater works during engine operation and provides thermal assistance to the cooling system. The water heater is integrated into the cooling system, the fuel system and the electrical system of the vehicle. When the engine is switched off, the water heater is not automatically switched off. Automatic shut-off of the water heater when the engine is switched off is only possible in vehicle applications for the transportation of hazardous goods (ADR).

**NOTE**

This workshop manual describes the retrofit version of the heater. In the case of heaters installed directly by the vehicle manufacturer, different control units with different connectors and different software as well as different application parts may be used which are not described in this manual. For these heaters, information is only available in the documentation of the vehicle manufacturer.

The heater operates fully automatically, controlled by the coolant temperature.

The burner output is controlled within the limits between 2.5 and 5 kW depending on the deviation of the current coolant temperature from the setpoint at the coolant temperature sensor.

The Thermo Top Pro 50 heater comprises the combustion air fan unit with control unit, the heat exchanger and the burner unit.

The fuel is supplied externally by means of a fuel pump that is connected to the fuel system of the vehicle.

## 3.2 Combustion air fan unit / control unit

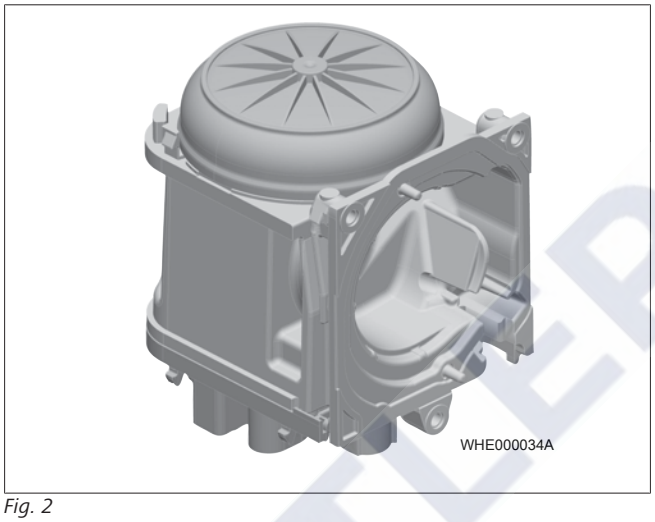


*Fig. 2*

**NOTE**

It is not permitted to dismantle the combustion air fan unit.

The combustion air fan unit comprises:

- The heater type label.
- The connection piece for the combustion air line.
- The control unit with plug-in contacts.
- The motor and the impeller.

The combustion air fan supplies the air required for the combustion process from the combustion air inlet into the combustion chamber.

## 3.3 Burner unit

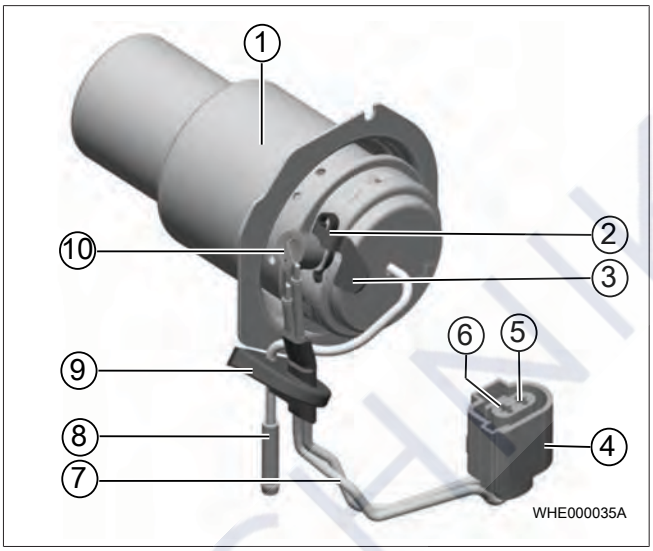


*Fig. 3*

| | | | |
|---|---|---|---|
| ① | Fuel pipe with evaporator holder and evaporator | ⑥ | Pin 1 |
| ② | Spring clip for glow plug | ⑦ | Glow plug cable |
| ③ | Cooling flag for glow plug | ⑧ | Fuel pipe |
| ④ | Glow plug / flame monitor connector | ⑨ | Grommet |
| ⑤ | Pin 2 | ⑩ | Glow plug / flame monitor |

The fuel/air mixture is prepared and the actual combustion takes place in the burner unit. The fuel passes through the fuel pipe to the evaporator where it dissipates and is evaporated with the aid of the glow plug. The air required for combustion is provided by the combustion air fan unit and flows into the combustion chamber via bore holes in the burner.

### 3.3.1 Glow plug / flame monitor

The glow plug / flame monitor is connected to the control unit via an electrical cable with a connector. The glow plug is attached to the vaporiser holder via a spring clip. A cooling flag provides for heat dissipation from the glow plug. It therefore reduces the temperature at the glow plug connection lines.

The glow plug ignites the fuel-air mixture during the start-up phase. The glow plug is switched off when the maximum heating power is reached. It is only used to monitor the flame from this point on. The electrical resistance of the glow plug decreases after the flame is extinguished and no more heat is applied. It is detected by the control unit.

## 3.4 Glow plug

The glow plug is connected to the control unit via an electrical cable with a connector. The glow plug is attached to the vaporiser holder via a spring clip. A cooling flag provides for heat dissipation from the glow plug, and therefore reduces the temperature at the glow plug connection lines. The fuel/air mixture is ignited by the glow plug when the heater is started.

## 3.5 Heat exchanger unit

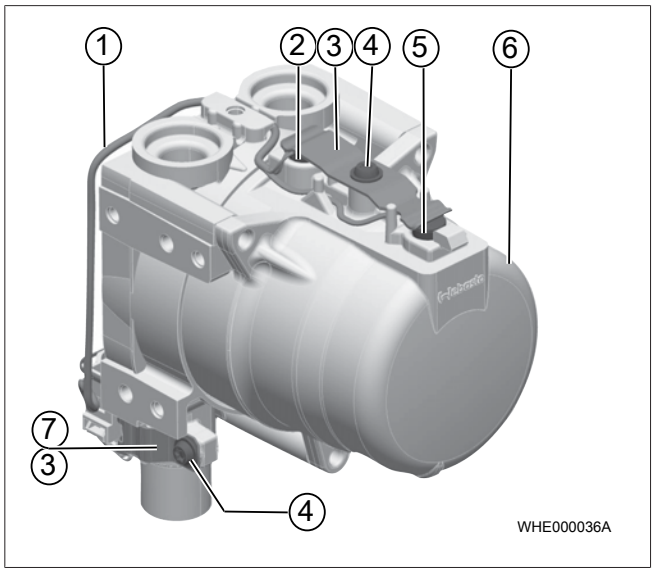


*Fig. 4*

| | | | |
|---|---|---|---|
| ① | Cable temperature sensors | ⑤ | Overheat sensor |
| ② | Temperature sensor | ⑥ | Heat exchanger |
| ③ | Spring clip | ⑦ | Exhaust gas temperature sensor, covered by spring clip |
| ④ | 40x10 self-tapping bolt | | |

The heat exchanger transfers the heat generated in the combustion process to the coolant circuit.

### 3.5.1 Temperature sensor and overheating sensor

The temperature sensor registers the coolant temperature in the heat exchanger of the heater as an electrical resistance. This signal is sent to the control unit, where it is processed. The temperature sensor and the overheating sensor together with the cable and the connector form one unit.

The overheating sensor protects the heater from impermissibly high operating temperatures. The overheating sensor responds at a temperature higher than 125°C and the control unit switches the heater off.

### 3.5.2 Exhaust gas temperature sensor

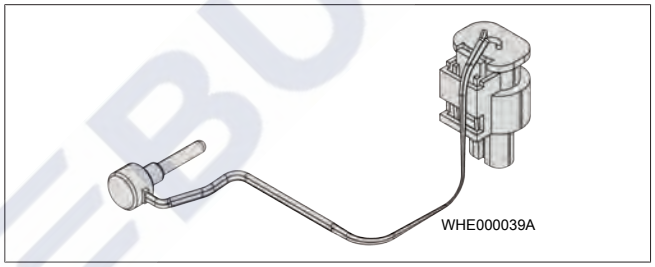


*Fig. 5*

The exhaust gas temperature sensor detects impermissible exhaust gas temperatures.

The cable of the exhaust gas temperature sensor is a high temperature resistant electrical cable with Teflon insulation. The exhaust gas temperature cable:

- can withstand permanent temperatures of up to 185°C
- is sensitive to external mechanical impact.

## 3.6 Temperature sensor and overheating sensor

The temperature sensor registers the coolant temperature in the heat exchanger of the heater as an electrical resistance. This signal is sent to the control unit, where it is processed. The temperature sensor and the overheating sensor together with the cable and the connector form one unit.

The overheating sensor protects the heater from impermissibly high operating temperatures. This triggers the heater's safety shutdown at a temperature of above 125 ± 8°C.

The temperature sensor is a semi-conductor component with a negative temperature coefficient (NTC), i.e. the resistance of the component decreases as the temperature increases.

The overheating sensor is a semi-conductor component with a positive temperature coefficient (PTC), i.e. the resistance of the component increases as the temperature increases.

In contrast to the temperature sensor, the characteristic curve of the overheating sensor does not demonstrate linear behaviour. A sudden increase in resistance is observed at approx. 125 °C.

## 3.7 Exhaust Gas Temperature Sensor

The exhaust gas temperature sensor detects the flame as well as impermissible exhaust gas temperatures.

## 3.8 Coolant pump UP500

The coolant pump UP500 ensures a flow rate of the coolant in the heater and heater circuit of the vehicle. The pump is switched on by the control unit and runs continuously during heater operation. The coolant pump is a centrifugal pump with a brushless EC motor.

The coolant pump has a 3-pin connector socket and is connected to the control unit via a heater wiring harness.

*Fig. 6 Coolant pump UP500*

## 3.9 DP42 fuel pump

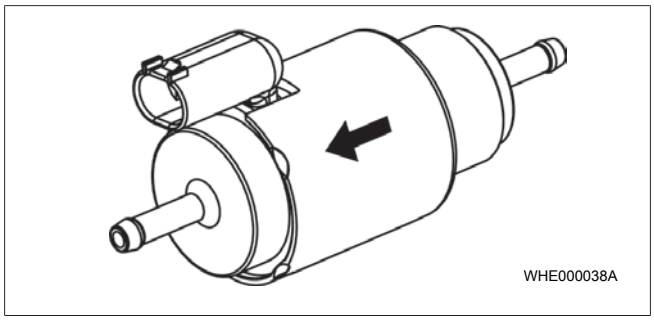


*Fig. 7*

The fuel pump DP42 is a combined delivery, metering and shut-off system. This dry-suction piston pump delivers the fuel via fuel lines from the vehicle tank to the fuel connection piece of the heater. It is normally installed near the tank. The fuel pump does not have a pulsation damper. The fuel pump is connected to the control unit and with an earthing point on the vehicle chassis via the heater wiring harness.

**NOTE**

Only the fuel pump of type DP42 may be used with the heater Thermo Top Evo. Observe the type designation on the component. The $CO_2$ setting should be checked when replacing the fuel pump. See $CO_2$ setting.

## 3.10 Control elements

For suitable control elements, see Webasto Heating catalogue or http://www.webasto.com.

**NOTE**

The heater may only be controlled via the respective Webasto control element.

Failure to do so may result in damage to the heater and peripherals.

# 4 Functional description

## 4.1 Control panel

The control element is used to:

- Switch the heater on and off.
- Reset the heater after a malfunction.
- Display fault codes:
  - Control elements with display: the fault code is shown on the display.
  - Control elements without display: the fault code is indicated by the indicator lamp flashing in defined sequences.
- To activate further functions or modes depending on the control element.

**NOTE**

**ADR operation:**

The heater is in ADR lock-out mode after an ADR shutdown. This mode is cancelled after switching the heater off and on again.

## 4.2 Switching on

The heater is switched on and off by different switch signals. Depending on the system equipment, the switch signals are produced by a switch, control element or a climate control system.

**DANGER**

**Overheating possible**

An emergency off switch may only be actuated in the event of danger since the heater will be switched off without after-running period.

See the operating and installation instructions for the control element.

If the documents are not available, these can be requested from Webasto.

**NOTE**

**Always switch off the heater via the control element**

After switching off via the control element, the heater switches to a short controlled run-on phase. Switching off incorrectly, without after-run, can cause damage to the heater.

The internal components and flame formation are checked during the switch-on routine.

**Start**

With the parking heater, the heater is started via a switch-on signal from the control element.

When the heater is started, the drive motor, the fuel pump and the glow plug are put into operation. The heater starts in a low load level and is slowly ramped up to the required heating power. During this start-up phase, the glow plug is used to check whether a flame has formed.

**Automatic restart**

If no flame is created or the flame fails, an automatic start-up procedure will be repeated. If no flame is created again, the start attempt is terminated. A fault switch-off occurs with an after-run of the combustion air fan. The heater can only be put back into operation after it has been switched off.

**NOTE**

The heater will assume fault lock-out mode after a restart. Briefly switch the heater off and on (for at least 2 seconds) to reset fault lock-out.

## 4.3 Control mode

In control mode, the speed of the combustion air fan and the fuel pump delivery rate are dependent on the heating capacity. The glow plug is switched off.

## 4.4 Control pause

The heater regulates the coolant temperature in a defined temperature range. If the upper temperature limit is exceeded, the heater goes into control pause. If the coolant temperature falls below the lower temperature limit during the control pause, the heater automatically restarts the heating mode. In the meantime, the control element signals "Heating mode".

**NOTE**

Changes to the settings on the control element are implemented by the control unit/heater with a time delay.

## 4.5 Switching off

When the heater is switched off, the indicator lamp on the control element goes out. If no fuel has yet been delivered or if the heater is in control pause, the heater will be switched off immediately with no afterrunning period. If fuel delivery has already begun it will stop immediately when the heater is switched off. The heater is switched off in the same way as the transition from control mode to control pause. The heater is then switched off automatically.

## 4.6 Heater functions in ADR vehicles

Only for Thermo Top Pro 50 heaters that are installed in vehicles for transporting dangerous goods (ADR) and configured for ADR functionality:

Afterunning period will remain unchanged if the heater is switched off at the control element.

A brief afterrunning period (max. 40 seconds) is started automatically when:

- The vehicle's engine is shut down
- A pumping device is placed into operation.

The control unit is in "fault lock-out" mode after an ADR shutdown. The control element must be set to "OFF" before starting up again.

## 4.7 Fault switch-off

The control unit detects faults in individual heater components and malfunctions during start-up and operation. The heater shuts down and assumes fault lock-out when:

- No repeated or faulty start-up
- Overheating sensor interrupted or short-circuited
- Overheating sensor installed incorrectly
- Glow plug interrupted or short-circuited
- Drive motor overloaded or blocked or short-circuited or interrupted
- Fault in electrical circuit of fuel pump
- Undervoltage below 21 V for longer than 20 seconds
- Overvoltage above 32 V for longer than 6 seconds
- Control unit defective

In case of overheating, the fuel feed is interrupted. A run-on is carried out as with manual shut-down. Following the afterrunning period the control unit is in fault lock-out mode if the count of the overheating counter is greater than the value programmed in the data set (currently 20).

- Control element with display: the overheating fault code is shown on the display.
- Control element without display: the overheating fault code is indicated by the operating indicator flashing in defined sequences.

Rectify fault.

Briefly switch the heater off and on (at least 2 seconds) to reset fault lock-out.

### 4.7.1 Resetting fault switch-off

1. Switch on the heater.
2. There is a fault and it is detected by the control unit as a malfunction.
3. The fault code is shown on the control element.
4. If set, cancel fault lock-out (as described in the following).
5. Switching off the heater.
6. Determine cause of fault (e.g. with or without fault code, visual inspection of fuses and plug connectors, ...).
7. Rectify fault.
8. Switch on the heater.
9. Fault lock-out unlocked.
10. The heater assumes control mode.

### 4.7.2 Reset heater lock-out

Certain faults add to the fault count in the fault code memory. The heater assumes heater lock-out mode when the number of faults in the fault code memory exceeds a limit value. The maximum number of fault in the fault code memory and the limit value of the fault code memory is defined by Webasto.

The heater lock-out can be reset:

- with the Webasto System Diagnosis
- or by switching on the heater. Remove fuse **F3** for at least 10 secs. Switch off heater. Re-insert fuse **F3**. Switch on the heater.

## 4.8 External activation of coolant pump

The coolant pump can be controlled separately via the control unit in the heater with the "external coolant control pump" (ECCP) feature but without the heater entering regular operation. As a result, the coolant pump can thus be used purely for pumping the coolant or as additional support for the coolant circuit.

Activation takes place by applying an +24 C signal via pin 3 / connector X1. The coolant pump remains active for as long as the signal is present. The ECCP feature can only be activated from the off state of the heater. Before switching into heating mode the ECCP function must be cancelled by removing the signal.

# 5 Technical data

The technical specifications are provided in the Installation Instructions.

# 6 Malfunctions and troubleshooting

## 6.1 General information

This chapter describes troubleshooting on the Thermo Top Pro 50.

**DANGER**

Troubleshooting assumes detailed knowledge of the design and functional principle of the heater and must only be carried out by specifically trained personnel.

**NOTE**

Troubleshooting is generally restricted to locating faulty heater components.

The following potential malfunction sources are not taken into account and should always be checked to rule them out as the cause of fault:

- ▶ Corrosion or loose connector
- ▶ Corrosion or loose connector at potential equalisation bolts
- ▶ Crimping defect at connector
- ▶ Completeness of the connector
- ▶ Corroded cables and fuses
- ▶ Corroded battery terminals
- ▶ Impermissibly high ambient temperature

**NOTE**

The heater can lock if several faults are registered. To unlock the heater, see Heater unlocking instructions.

All heater components are queried by the control unit. The corresponding component must be checked first when there is a defect. If it is OK, it must be assumed that the control unit is defective.

Carry out a function check of the Thermo Top Pro 50 in the vehicle after rectifying each fault.

## 6.2 Cause of malfunctions

A malfunction is caused when one or more faults occur. Possible faults are:

- overvoltage / undervoltage.
- malfunctions of all components, e.g. due to short-circuit or break.
- the heater overheating.
- unsuccessful starts.
- flame failure.
- impermissible exhaust temperature.

## 6.3 Explanation of terms

**Permanent heater lock-out**

The heater can no longer be switched on. The lock can only be released in a workshop. An error message is stored. Possible root causes for this are:

- A fault switch-off occurs six times in succession without the maximum heating capacity being reached.
- The heater overheats.

**NOTE**

If the fault is an undervoltage switch-off due to a weak battery, no locking occurs.

**Fault switch-off**

- A malfunction will cause the heater to switch off with burnout or prevent the heater from starting. An error message is stored. A restart requires a switch-off signal and a new switch-on signal.
- A malfunction in the power supply or in the control unit results in immediate shutdown of the heater without burnout. No error is entered.

**NOTE**

A fault switch-off with an after-running period occurs at an undervoltage of 21 Volt for more than 20 seconds (burnout).

A fault switch-off with an after-running period occurs at an undervoltage of 32 Volt (measured on the heater) for more than 5 seconds (burnout).

The specified overvoltage or undervoltage depends on the software and is measured at the control unit input.

**Cancelling the fault lock-out**

The cause of the malfunction has been eliminated. The fault lock-out is cancelled by switching the heater off and on again.

**NOTE**

A permanent heater lock-out / overheating lock-out can only be rectified manually (pull the fuse) or with Webasto System Diagnosis. Read out and print out the heater faults stored in the fault code memory with Webasto System Diagnosis.

The heater lock-out can be removed without deleting the fault code memory using the **Delete heater interlock** menu command.

## 6.4 Procedure in the case of fault, malfunction and lock-out

**NOTE**

Always determine the cause of the lock-out first before rectifying the lock-out.

Faults with the heater are detected by the control unit as a malfunction and a fault after-run. Afterwards, the heater remains in the fault lock-out. A fault code is output after detecting a malfunction during the fault switch-off.

The fault code is shown on the control element either by flashing or by a letter combination on the display (depending on the type of control element).

The fault code assists the workshop or Webasto Technical Service in determining the fault.

The heater lock-out can be reset:

- with the Webasto System Diagnosis.
- by switching the heater on at the control element, removing fuse F3 (20 A) within 10 seconds and plugging it in again after 10 seconds.

## 6.5 Instructions for cancelling the fault lock-out

### 6.5.1 Analogue cancelling the fault lock-out

| |
|---|
| Switching on the heater (via control element). |
| ⬇ |
| There is a fault and it is detected by the control unit as a relevant malfunction. |
| ⬇ |
| Heater shuts down due to the fault, i.e. fault switch-off followed by fault lock-out. The fault code is shown on the control element. |
| ⬇ |
| Determine the cause of the fault<br>(e.g. with or without fault code output,<br>visual inspection of fuses and connectors, ...)<br>See also Overview of faults and fault codes. |
| ⬇ |
| Switch off heater. |
| ⬇ |
| Rectify the fault. |
| ⬇ |
| Switch on the heater. |
| ⬇ |
| Fault lock-out unlocked. |

### 6.5.2 Digital cancelling the fault lock-out

| |
|---|
| Connect diagnostic cable to the heater diagnostic plug (next to fuses). |
| ⬇ |
| Switch on the heater. |
| ⬇ |

There is a fault and it is detected by the control unit as a relevant malfunction.

↓

Heater shuts down due to the fault, i.e. fault switch-off followed by fault lock-out.

↓

Determine error cause by reading out the fault code memory. Click on the Fault list button to read out the fault code memory.

↓

**NOTE**
Print out or note the fault code memory.

↓

Rectify the fault.

↓

Clear fault code memory with the command Clear fault code memory or Heater lock-out in the Fault code memory menu.

↓

Switch on the heater.

↓

Fault lock-out unlocked.

**NOTE**
Certain faults add to the fault count in the fault code memory. The heater assumes heater lock-out mode when the number of faults in the fault code memory exceeds a limit value. The maximum number of fault in the fault code memory and the limit value of the fault code memory is defined by the software.

## 6.6 Reset heater lock-out

### 6.6.1 Heater unlocking without Webasto System Diagnosis

- ▶ Switching on the heater (via control element).
- ▶ Remove fuse F3 on-board power supply of the vehicle for at least 10 s within 10 s after switching on.

**NOTE**
When on-board power supply is applied, never disconnect the connector from the heater.

- ▶ Reinsert the fuse.

### 6.6.2 Heater unlocking with Webasto System Diagnosis

See chapter 6.5.2, "Digital cancelling the fault lock-out" on page 9.

## 6.7 Fault codes (fault codes, flash codes)

**NOTE**

The control element can be connected via W-bus or analogue (see wiring diagrams):

-W-bus connection: the HXX fault codes are shown in the display.

- Analogue connection with display: the FXX fault codes are shown in the display.

Analogue connection without display: the fault codes are shown by the number of long flash pulses after the 5 short flash pulses.

A * after the value in the "fault code (analogue)" column means:

✓ The control element switch has an **analogue** connection.

▶ When the indicator lamp flashes, count the long flash pulses after the 5 short flash pulses.

| Fault code (analogue) | Fault code (HEX) | Error message | Possible causes | Recommended action in workshop |
|---|---|---|---|---|
| F00 or 0* | H01 H81 H91 H92 H07 | No component fault | Fuses | Check fuses F1, F2 and F3 |
| | | | Electrical wiring | 1. Check battery connections: + at 12 / - at 9 / + at 3 (switch-on signal), connector X8<br>2. Check control element: check contacts of W-bus cable (yellow) |
| | | | Heater lock-out | Delete heater lock-out |
| | | | Control unit defective / incompatible | Replace control unit |
| F01 or 1* | H4E H02 H82 | No start | Fuel system | 1. Check fuel level<br>2. Check fuel filter<br>3. Check tank extracting device and fuel line for leaks<br>4. Bleed fuel system |
| | | | Combustion air / exhaust line | Check combustion air/exhaust line for foreign objects and clean if necessary |
| | | | Burner unit | 1. Clean burner unit or replace if necessary<br>2. Check glow plug |
| F02 or 2* | H03 | Flame failure | Fuel system | 1. Check fuel level<br>2. Check fuel filter<br>3. Check tank extracting device and fuel line for leaks<br>4. Bleed fuel system |
| | | | Burner unit | Clean burner unit or replace if necessary |
| F03 or 3* | H04 | Supply voltage too high | Power supply | 1. Check battery<br>2. Check electrical connections |
| | H84 | Operating voltage too low | | |
| F04 or 4* | H05 | Flame was detected prior to combustion | The combustion chamber sensor detected a flame before combustion started | 1. Check for fault in air intake and exhaust systems<br>2. Check for fault in the fuel system<br>3. Check the electrical components of the glow plug |
| F06 or 6* | H14 H94 | Temperature sensor | Wiring | 1. Check wiring for damage, break and short-circuit<br>2. Resistance check |
| | | | Temperature sensor failure | Check the operation of temperature sensor and replace if necessary |
| F07 or 7* | H08 H88 | Fuel pump | Wiring | Check wiring for damage, break and short-circuit |
| | | | Fuel pump DP42 faulty | Replace fuel pump DP42 |
| F08 or 8* | H09 H89 H95 | Combustion Air Fan | Combustion air fan blocking guard | Check the operation of the combustion air fan and change the combustion air blower if necessary |
| | | | Combustion air fan defective | Replace combustion air fan |

| Fault code (analogue) | Fault code (HEX) | Error message | Possible causes | Recommended action in workshop |
|---|---|---|---|---|
| F09 or 9* | H8A | Glow plug / electronic ignition unit interruption | Wiring | Check wiring for damage, break and short-circuit |
| | H0A | short-circuit in electrical circuit | Glow plug defective | Check the operation of glow plug and replace if necessary |
| F10 or 10* | H06 | Heater overheated | Heater overheated | 1. Check coolant level, bleed coolant circuit<br>2. Check operation of coolant pump |
| | | | Overheating protection defective | 1. Check wiring for damage, break and short-circuit<br>2. Check operation of overheating protection, replacing if necessary |
| F11 or 11* | H0B H8B | Coolant pump short circuit | Wiring | Check wiring for damage, break and short-circuit |
| | | Interruption | U4847 Econ coolant pump defective | Replace coolant pump |
| F12 or 12* | H16 | Battery disconnector or electronic battery switch short-circuit | Electronic battery switch wiring faulty | Check wiring for damage, break and short-circuit |
| | | | | Check power intake of battery disconnector |
| F13 or 13* | H13 | Vehicle fan short circuit | Wiring | Check wiring for damage, break and short-circuit |
| | | | Vehicle blower relay | 1. Check wiring for damage, break and short-circuit<br>2. Check the operation of vehicle fan relay and replace if necessary |
| F14 or 14* | H1B HAB | Overheat sensor short circuit | Wiring | Check wiring for damage, break and short-circuit |
| | | Interruption | Overheating sensor defective | Check the operation of overheating sensor and replace if necessary |
| F15 or 15* | H2E H22 | The glow/ignition element circuit is defective | Wiring | Check glow plug wiring for damage, break and short-circuit |
| | | | Glow plug defective | Check the operation of glow plug and replace if necessary |
| F16 or 16* | H4F | Exhaust gas temperature too high | Exhaust gas temperature sensor defective | 1. Check wiring for damage, break and short-circuit<br>2. Check operation of exhaust gas temperature sensor, replacing if necessary |
| | | | Heater fouled | 1. Check burner<br>2. Visual inspection with cleaning, replace burner if necessary<br>3. Visual inspection with cleaning and replace the burner if necessary<br>4. Visual inspection with cleaning of inner heat exchanger surface (replace the heat exchanger if necessary) |
| F17 or 17* | H4D H31 | Exhaust gas temperature sensor break or short circuit | Wiring | Check wiring for damage, break and short-circuit |
| | | | Exhaust gas temperature sensor defective | Check operation of exhaust gas temperature sensor and replace it if necessary |

## 6.8 Troubleshooting (fault symptoms)

| Symptom | | Possible cause | Possible troubleshooting |
|---|---|---|---|
| A | Heater does not respond, no component running, operation indicator remains off | Operating voltage | ● Check fuses (F2, F3). Unlock heater, see chapter 6.6, "Reset heater lock-out" on page 10.<br>● Measure supply voltage to heater connector X2, pin 1. |
| | | Operation indicator (control element or ON/OFF switch) | Operating indicator control element:<br>● Check fuse F2.<br>● Measure supply voltage on the switch with function display S4, pin A.<br>● Check continuity against earth on connector with function display S4, pin F. |
| B | Heater will not start, briefly starts up then switches immediately to after-run, operating indicator flashing | DP42 fuel pump | ● Check fuel line connection to fuel pump DP42. Connect Webasto System Diagnosis and evaluate.<br>● Check the clear passage and seating of the flat spring contacts of the fuel pump connector and line.<br>● Measure resistance of fuel pump DP42 (resistance at 22 ± 5°C: 0.8 ± 0.1 ohm).<br>● Setpoints: resistance at 25°C: 4.95 to 5.45 ohm. |
| | | Combustion Air Fan | ● Check exhaust system and air intake system (see symptom C 'Excess smoke from heater during start-up phase'). Connect Webasto System Diagnosis and evaluate.<br>● In the event of short-circuit or break: check fan wiring. |
| | | Coolant pump UP500 | ● Check the coolant level. Connect Webasto System Diagnosis and evaluate. Switch on the component test via Webasto System Diagnosis, touch the pump with your hand, and the pump is operating if a slight vibration can be felt.<br>● Check wiring.<br>● Check self-bleeding position, see section Fig. 12. |
| | | Temperature sensor | ● Check coolant level. Connect Webasto System Diagnosis and evaluate. Check the cold resistance of the temperature sensor.<br>● Setpoints: internal resistance of the coolant pump 20 ± 1 kOhm. |
| | | Glow plug | ● Connect Webasto System Diagnosis and evaluate. Measure the glow plug resistance at the glow plug connector X5. See chapter 10.4.1, "Electrical test of glow plug" on page 24.<br>● Setpoints: cold resistance at 22 ± 5°C: 0.8 ± 0.1 ohm. |
| C | Excessive smoke from the heater during start-up phase | Glow plug | See symptom B, glow plug |
| | | DP42 fuel pump | See symptom B, fuel pump DP42. |
| | | Combustion Air Fan | See symptom B, combustion air fan. |
| | | Fuel connection | ● Check fuel level and fuel supply from the tank.<br>● Check integration in the vehicle's fuel system.<br>● Check fuel lines for leaks, kinks, and clogging, especially in the area of line connectors on the intake side.<br>● Disconnect fuel line from heater, hold hose in a collection container and operate the fuel pump with Webasto System Diagnosis. (measured value fuel delivery rate 115 ml/h*Hz). Fuel should be delivered free of bubbles. |
| | | Exhaust system and air intake system | ● Check lines for blockages.<br>● Rectify any leaks in the intake line and exhaust pipe (no CO2 in intake air).<br>● Make sure that the exhaust line outlet is not located beneath the intake line inlet.<br>● Make sure that the intake line and exhaust line are installed in accordance with the installation instructions, see Thermo Top Pro 50 Installation Instructions.<br>● Make sure that there is sufficient distance from the interior fresh air intake to the vehicle. |
| | | Burner unit | ● Removal and visual inspection. |

| Symptom | | Possible cause | Possible troubleshooting |
|---|---|---|---|
| | | | ● If the fuel pipe to the burner unit is blocked, replace the burner unit. |
| D | Heater goes out prematurely | Undervoltage detection | ● Check fuses (F2, F3).<br>● Webasto System Diagnosis, observe the supply voltage on switched-on heater. Setpoints: The voltage must not fall below 20.0 V for more than 10 consecutive seconds. |
| | | DP42 fuel pump | See symptom B, fuel pump DP42. |
| | | Combustion air fan moves stiffly. | See symptom B, combustion air fan. |
| | | Fuel connection | See symptom C, fuel connection. |
| | | Coolant circuit | ● Check integration into the coolant circuit of the vehicle in accordance with the Thermo Top Pro 50 Installation Instructions. Remove kinks and chafing points.<br>● Check heater, water connection, coolant pump, and hoses for leaks, rectifying if necessary.<br>● Make sure that the coolant circuit is bled correctly.<br>● Check circulation in coolant circuit. |
| | | Exhaust system and air intake system | See symptom C, exhaust system and air intake system. |
| | | Burner unit | See symptom C, burner unit. |
| E | Irregular combustion noise | DP42 fuel pump | See symptom B, fuel pump DP42. |
| | | Burner unit | See symptom C, burner unit. |
| F | Excessive smoke from the heater during the heating phase. | DP42 fuel pump | See symptom B, fuel pump DP42. |
| | | Fuel connection | See symptom C, fuel connection. |
| | | Exhaust system and air intake system | See symptom C, exhaust system and air intake system. |
| | | Burner unit | See symptom C, burner unit. |
| G | Heater running, vehicle interior cold. | Vehicle blower | ● Check fuse F1.<br>● Check coolant temperature (K5 switches at approx. 30 °C).<br>● Check switching signal at relay K5, ground at Pin 85 and positive at Pin 86, (audible, see wiring diagram in Thermo Top Pro 50 Installation Instructions).<br>● Check signal line for coolant temperature (green/white, gr/w), Pin 86 on K5. |
| H | Excessive smoke from heater during after-running period | Exhaust system and air intake system | See symptom C, exhaust system and air intake system. |
| I | Smell of fuel | Fuel connection | See symptom C, fuel connection. |
| | | DP42 fuel pump | See symptom B, fuel pump DP42. |
| | | Glow plug | See symptom A, glow plug. |
| J | Smell of exhaust in vehicle interior | Exhaust system and air intake system | See symptom C, exhaust system and air intake system. |
| K | Coolant loss | Coolant pump UP500 | See symptom B, coolant pump. |
| | | Coolant circuit | See symptom D, coolant circuit. |

*Table 1: Troubleshooting (fault symptoms)*

# 7 Function checks

## 7.1 General information

This section describes the checks conducted on the heater and its components in the installed and uninstalled state.

Even if you use the timer, the heater must not be operated in enclosed spaces such as garages and workshops without an emissions extraction system.

## 7.2 Exhaust gas temperature sensor

**NOTE**

If the cable is damaged, take precautions to protect the cable of the exhaust gas temperature sensor directly, e.g. fitting suitable cover.

If the exhaust gas temperature sensor suffers external mechanical damage, this component can be replaced without the need for additional work.

Additional work (visual inspections) is required if:

- an obvious thermal defect is visible.
- there is an error message (no identifiable mechanical defect).

▶ Carry out the visual inspection of the:

- Burner
- Exhaust lines
- Combustion tube
- Heat exchanging ribs (inner surface).
- Pay attention to soot deposition, fuel residue as well as carbonisation. Clean all affected parts.

If the burner has soot deposits, fuel residue and/or carbonisation, check the burner. The burner must not be deformed. There must be no visible cracks (e.g. welded seam damaged). Replace the burner if necessary.

# 8 Wiring diagrams

Wires or components shown with dashed lines are optional and not included in the scope of delivery or in the wiring harness.

## 8.1 Cable cross-sections

| Graphic | <7.5 m | 7.5 – 15 m |
|---|---|---|
| | 0.75 mm² | 1.0 mm² |
| | 1.0 mm2 | 1.5 mm² |
| | 1.5 mm2 | 2.5 mm² |
| | 2.5 mm2 | 4.0 mm² |
| | 4.0 mm2 | 6.0 mm² |

## 8.2 Cable colours

| Abbreviation | Colour | Abbreviation | Colour |
|---|---|---|---|
| bl | blue | or | orange |
| br | brown | rt | red |
| ge | yellow | sw | black |
| gn | green | vi | violet |
| gr | grey | ws | white |

## 8.3 Legend to wiring diagrams

| No. | Description | Remarks |
|---|---|---|
| A1 | Heater | Thermo Top Pro 50 |
| A2 | Control unit | - |
| ATS | Exhaust gas temperature sensor | PT2000 |
| B4 | Room thermostat | Optional |
| BM | Burner motor | Combustion air fan |
| DP | Fuel pump | Fuel pump for heater |
| F1 | Fuse 20A | Blade fuse DIN 72581-3 |
| F2 | Fuse 1A | |
| F3 | Fuse 20A | |
| FZG | Vehicle blower | - |
| GS | Glow plug | |
| H1 | Symbol on display | |
| H2 | LED (green, blue, white, red) | Operation indicator, Ready indicator, ON indicator, fault list |
| K5 | Relay with freewheeling diode | Vehicle blower |
| P | Smart- / MultiControl | (W-bus) |
| S7 | Battery disconnector (BTS) | Electronically controlled disconnector (max. 500 mA) |
| ÜHS UEHS | Overheating protection | Sensor on heat exchanger |
| UP | Coolant pump | Coolant pump |
| V1 / V2 | Diode | Min. 500 mA (optional, not included in wiring harness) |
| V3 | Diode | For analogue SmartControl/MultiControl connection |
| WTS | Coolant temperature sensor | Coolant temperature in coolant circuit |
| X1 | 4-pin plug connection | Item BM to item A2 |
| X2 | 2-pin plug connection | Item GS to item A2 |
| X3 | | Item DP to item A2 |
| X4 | | Item UP to item A2 |
| X5 | | Item WTS to item A2 |
| X6 | | Item ATS to item A2 |
| X7 | | Item ÜHS to item A2 |
| X10 | 4-pin plug connection | W-bus, Smart- / MultiControl connection, UniControl, Telestart (12 V only), ThermoCall or diagnosis |
| X11 | 2-pin plug connection | at pos. DP |
| X12 | | To item UP |
| X20 | 4-pin plug connection | To item S4 or SmartControl/MultiControl connection, analogue |

## 8.4 Legend for comments

| No. | Remarks |
|---|---|
| ① | D+ signal (vehicle engine ON/OFF) for determining the control temperature.<br>Additional shutdown signal for ADR vehicles, when the generator signal D+ stops. |
| ③ | Fuse for vehicle blower (fuse present in vehicle) |
| ④ | Switch for vehicle blower |
| ⑥ | Wiring harness |

| No. | Remarks |
|---|---|
| ⑨ | Optional extension available (connection to plug connection X10) |
| ⑩ | Smart-/MultiControl connection, Telestart (12 V only), ThermoConnect by W-Bus or diagnosis via W-LIN |
| ⑪ | SmartControl/MultiControl connection or switch (analogue) |

For more connecting possibilities see the combinations matrix control elements: https://dealers.webasto.com

## 8.5 Legend for X1 connector, 16-pin

| Item | Remarks |
|---|---|
| 1 | Auxiliary drive input |
| 2 | LIN / W-bus |
| 3 | External coolant pump control input |
| 4 | Output, fuel pump |
| 5 | Battery disconnector output |
| 6 | Not used |
| 7 | Coolant pump dimensions |
| 8 | Terminal 31 |
| 9 | D+/Terminal 61 |
| 10 | Not used |
| 11 | Input switch-on signal (analogue) |
| 12 | Vehicle blower output |
| 13 | Operating indicator/error code output |
| 14 | Coolant pump control |
| 15 | Coolant pump voltage |
| 16 | Terminal 30 |

## 8.6 Wiring diagrams

**NOTE**
You will find additional wiring diagrams in the installation instructions or on the dealer portal / OnePortal.

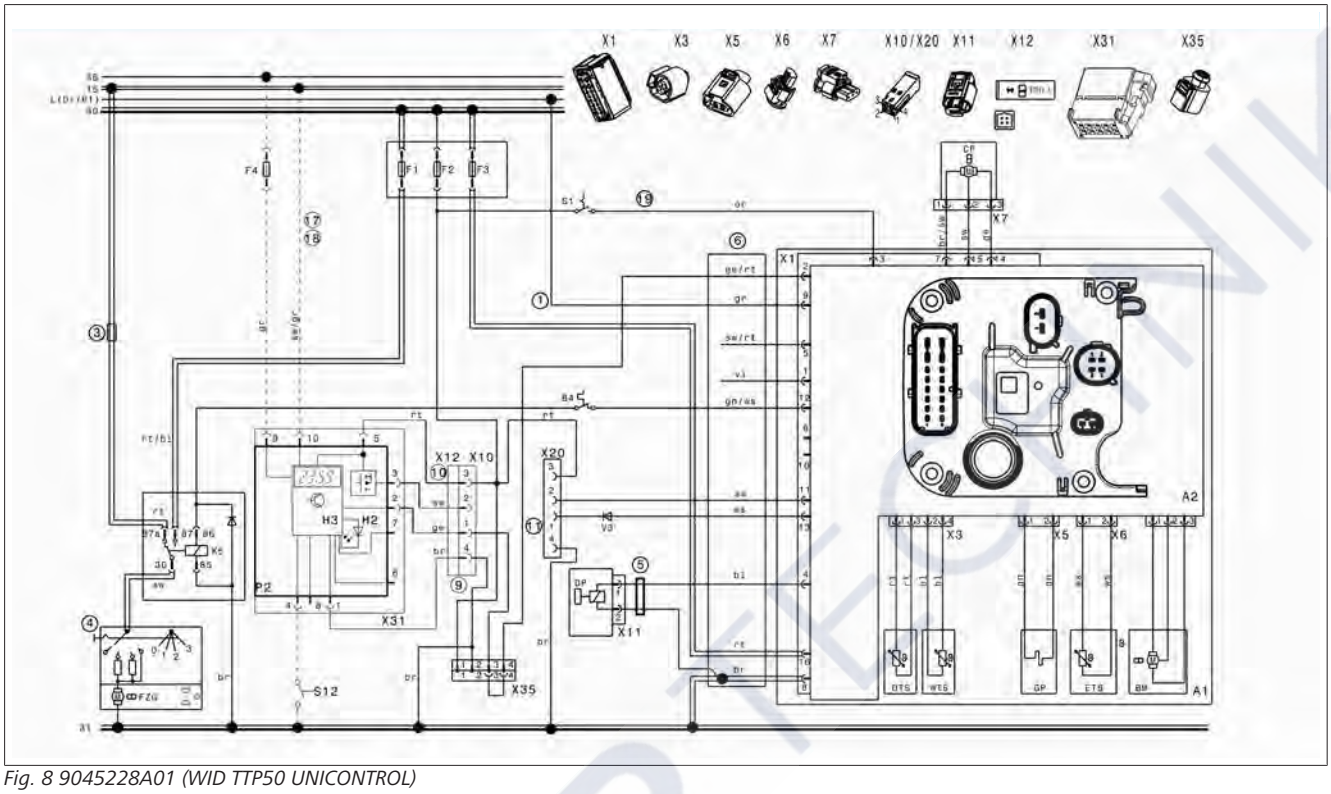


*Fig. 8 9045228A01 (WID TTP50 UNICONTROL)*

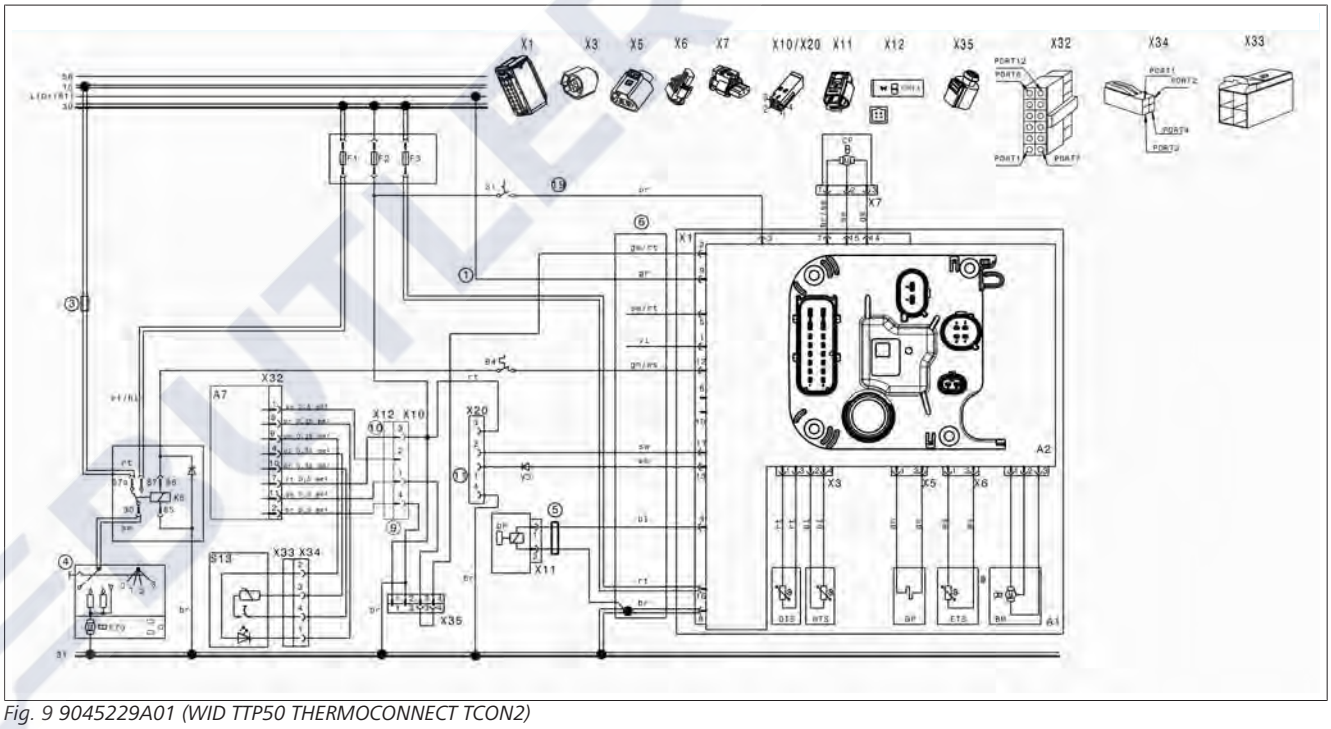


*Fig. 9 9045229A01 (WID TTP50 THERMOCONNECT TCON2)*

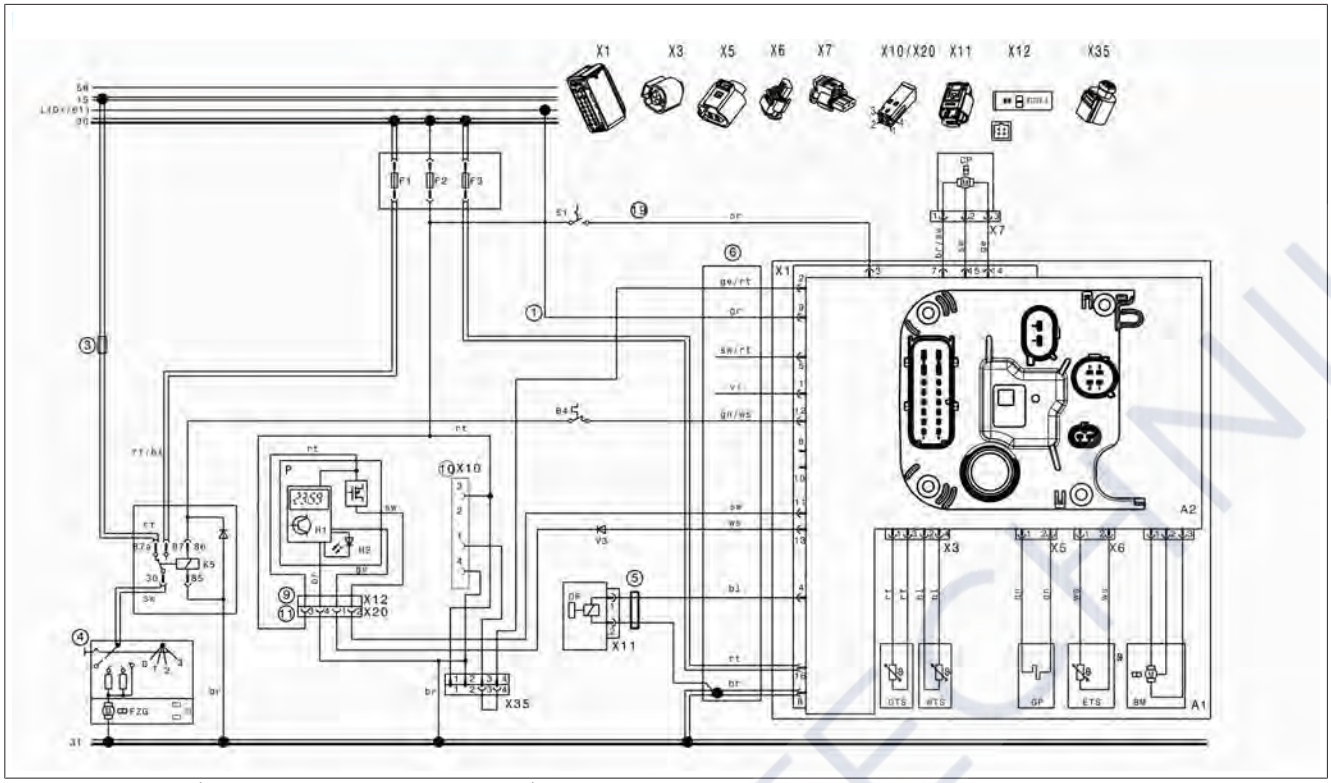


*Fig. 10 9045230A01 (WID TTP50 MULTICONTROL ANALOG)*

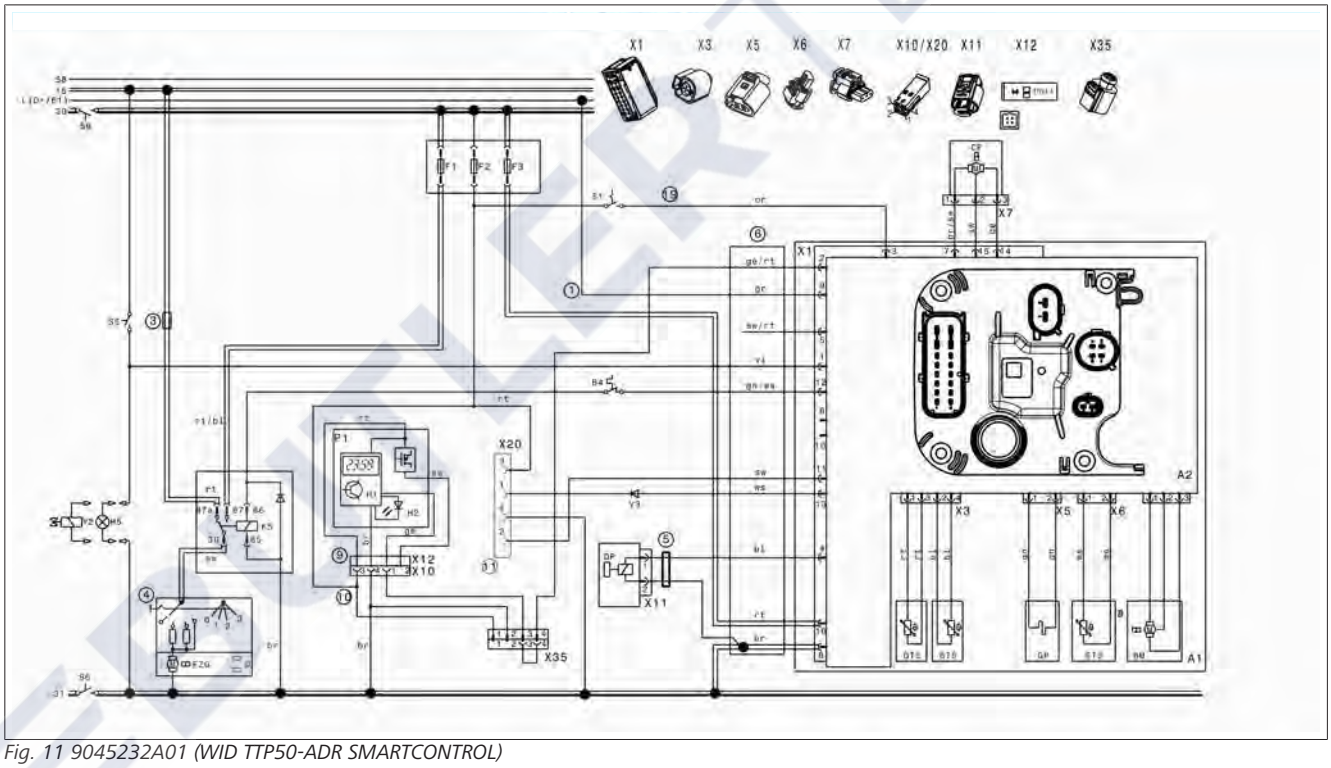


*Fig. 11 9045232A01 (WID TTP50-ADR SMARTCONTROL)*

## 8.7 MultiControl / SmartControl / UniControl

The SmartControl or MultiControl control elements can optionally be connected in analogue or W-bus (Webasto bus system) mode. Two interfaces are provided in the wiring harness for this purpose.

- W-Bus to connector X10.
- Analogue to connector X20.

It is only possible to incorporate multiple control elements in the same mode. Connection of multiple control elements in different modes (W-bus/analogue) is not possible.

# 9 Servicing

This section describes the servicing jobs that can be carried out on the heater and the heater components when installed.

## 9.1 Working on the heater

Always disconnect the power supply before carrying out any work on the heater (remove fuses F1, F2 and F3, see chapter 8, "Wiring diagrams" on page 15).

To prevent damage to components, the power supply of the heater must not be interrupted during operation or after-running.

The heater must be completely removed when carrying out repair work.

Once the heater and all coolant-carrying components have been installed, the entire coolant system should be filled, bled and checked for leaks at the specified system pressure.

Refer to the general installation instructions and the vehicle-specific installation instructions for repairs that require the heater to be installed in a different position.

## 9.2 Working on the vehicle

**ATTENTION**

On no account must a temperature of 125 °C be exceeded in the vicinity of the heater (e.g. vehicle paintwork).

## 9.3 $CO_2$ setting

**NOTE**

After repairing the heater and replacing the fuel pump, check the $CO_2$ setting.

**NOTE**

After changing the fan unit or the control unit, check the $CO_2$ value and reset it if necessary.

**NOTE**

Measure and set the $CO_2$ at the highest heat capacity level (full load / 100% heat capacity = display in Webasto System Diagnosis: "full load" or "Continuous Coolant Temperature Control").

The $CO_2$value can be corrected in selection point 2.7.1. $CO_2$ calibration of the Webasto System Diagnosis.

Measure the $CO_2$ content approx. 20 mm in front of the exhaust outlet inside the exhaust pipe with a $CO_2$ tester (e.g. from MSI).

Adjust the $CO_2$ setting with Webasto System Diagnosis and the $CO_2$ tester prescribed by Webasto.

Commercially available AU multi-gas exhaust gas testers must not be used for adjusting the $CO_2$ level of the heater.

The heater is set in the factory with a $CO_2$ value for ideal operation at heights between 0 and 4000 m above sea level. Continuous operation above 4000 m above sea level can result in heavy smoke and soot. To prevent the device from failing and being put at risk, the $CO_2$ value should be adjusted in consultation with Webasto.

The following table shows the rated $CO_2$ setting at the highest capacity level in accordance with the geodetic height at which the setting is carried out.

| Height [m above sea level] | Rated $CO_2$ setting at 20°C Ambient temperature [vol.-%] 5 kW |
|---|---|
| 0 | 9.4 |
| 500 | 10.2 |
| 1000 | 10.7 |
| 1500 | 11.5 |

*Table 2: $CO_2$ settings*

## 9.4 Coolant pump

Power consumption of UP500 is 12 W with a rated volume flow of 500 l/h and with a counter-pressure of > 160 mbar.

**Electrical test of the coolant pump**

Internal resistance of the coolant pump: 20 ±1 kOhm.

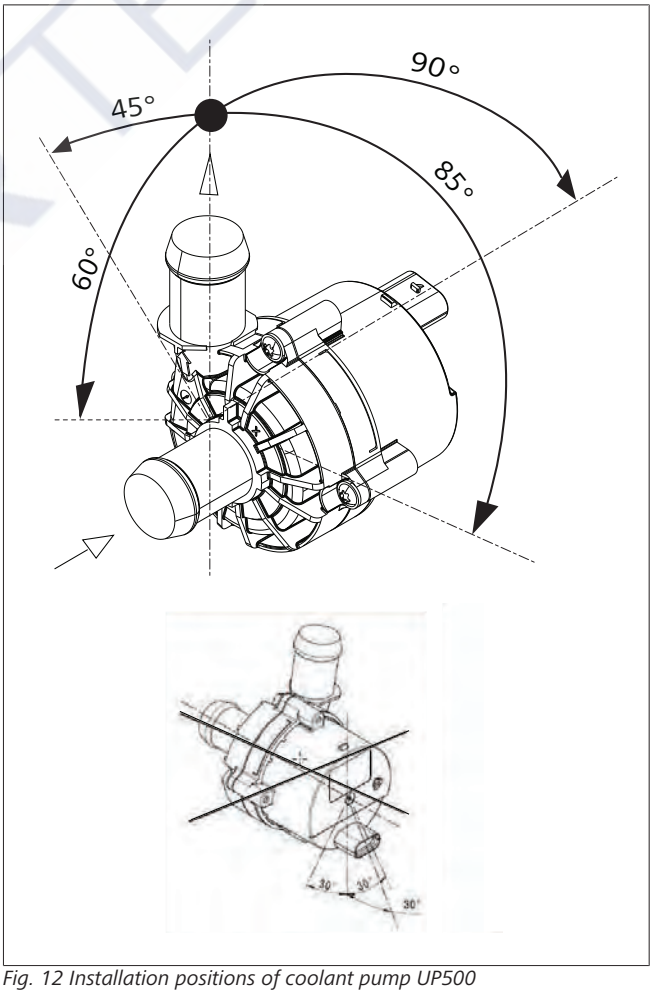


*Fig. 12 Installation positions of coolant pump UP500*

**NOTE**
Pumps that have been dropped are not to be re-used. A fall of the pump may lead to external damage. External damage may lead to leakages of the hose connection pieces. Possible cracks in the plastic part may in extreme cases lead to a leakage between the pump compartment or the environment of the electronic area. This may result in operational failures of the pump due to the ingress of coolant into the electronic area.

**NOTE**
Ensure the direction of flow of the coolant pump (arrow marking) is correct with respect to the vehicle coolant circuit. The installation position of the coolant pump must be selected such that the coolant pump can perform automatic bleeding. The air volume contained in the coolant pump must be able to escape upwards independently via the connection pieces. Incorrect installation may lead to malfunctions of the coolant pump operation.

## 9.5 DP42 fuel pump

Check of the installation positions and installation conditions of the fuel pump in accordance with the general installation instructions for the Thermo Top Pro 50. The Thermo Top Pro 50 heater must only be operated using the fuel pump DP42.

**Electrical test of the fuel pump**

Coil resistance of the fuel pump DP42:

5.20 Ohm ± 5 % at 22 ± 5 °C, test current: < 1 mA.

Perform the function "**Component test of fuel pump**" using the Webasto System Diagnosis.

| Setting | 7 Hz / 60 secs | 7 Hz / 240 secs |
|---|---|---|
| Diesel | 13.4 ml | 53.6 ml |

*Table 3: Fuel pump DP42 delivery rates*

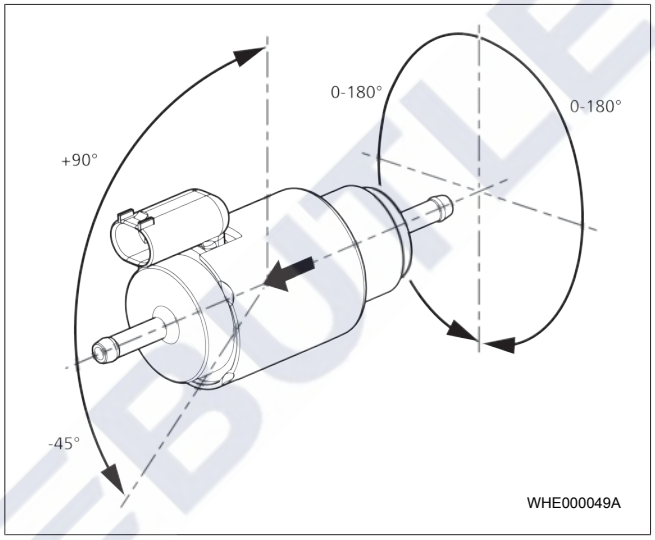


*Fig. 13*

## 9.6 Removing and installing heater

Even if you use the timer, the heater must not be operated in enclosed spaces such as garages and workshops without an emissions extraction system.

**Disassembly**

1. Interrupt power supply of the heater by removing fuses F1, F2 and F3.
2. Detach electric plug connections on heater.

**NOTE**
When on-board power supply is applied, never disconnect the connector from the heater.

**NOTE**
Protect all open plugs and connectors from moisture and dirt.

3. Depressurise coolant system.
4. Release hose clips and detach the coolant hoses from the water connection pieces on the heater. Prevent coolant from dripping out of the coolant hoses.
5. Release and detach combustion air line and exhaust pipe at heater.
6. Release and detach hose clips on the fuel line. Close off fuel connection piece at heater and fuel line with suitable plugs or similar.
7. Detach heater from the bracket, if necessary remove holder from the chassis.

**Installation**

1. Place heater on the bracket in the specified installation position.
2. Carefully manually insert the heater screws into the existing thread and screw them in.
3. Tighten the heater screws with 8 Nm.
4. Connect fuel line and secure with hose clip.
5. Connect coolant hoses and secure with hose clips.

**ATTENTION**
Observe direction of flow of the coolant circuit. Connect coolant hoses to the water connection pieces according to the marking (arrows) on the heater.

6. Reestablish all electrical connections.
7. Connect combustion air line and exhaust pipe.
8. Re-insert fuses F1, F2 and F3.
9. Bleed coolant circuit.
10. Bleed fuel system of vehicle if necessary.

## 9.7 Checks

To maintain the operational reliability of the heater, perform the following service tasks operations every 2 years:

1. Read out the fault code memory.
2. Check the electrical connections for contact corrosion and firm seating.
3. Check electrical wiring for damage.
4. Check exhaust gas and combustion air line for damage and ensure that they are clear.
5. Check the fuel line for leaks.
6. Check hoses for cracks.
7. Check the function of the heater.

## 9.8 Restarting

Carefully bleed the coolant circuit and the fuel supply system after installing the heater. Observe the vehicle manufacturer's specifications.

During the test run, check all coolant and fuel connections for leaks and tight fit. If the heater encounters a fault during operation, perform the troubleshooting procedure to locate the fault (see chapter 6, "Malfunctions and troubleshooting" on page 8).

**NOTE**
To assist bleeding of the coolant circuit, the coolant pump can be operated using the "Component test" function in the Webasto System Diagnosis.
The heater can be put into operation with Webasto System Diagnosis. When the fuel line is completely empty, fill the line with the Webasto System Diagnosis.

# 10 Repair

**NOTE**
Do not reuse removed seals.

## 10.1 Required tools

| Tool description | Amount |
|---|---|
| Torx screwdriver Tx25 | 1 |
| Torque wrench (range covers 5-6 Nm, for Tx25) | 1 |
| Installation tester | 1 |
| EV simulator with rotary field display | 1 |
| Combination pliers | 1 |

## 10.2 Dismantling and assembling the heater

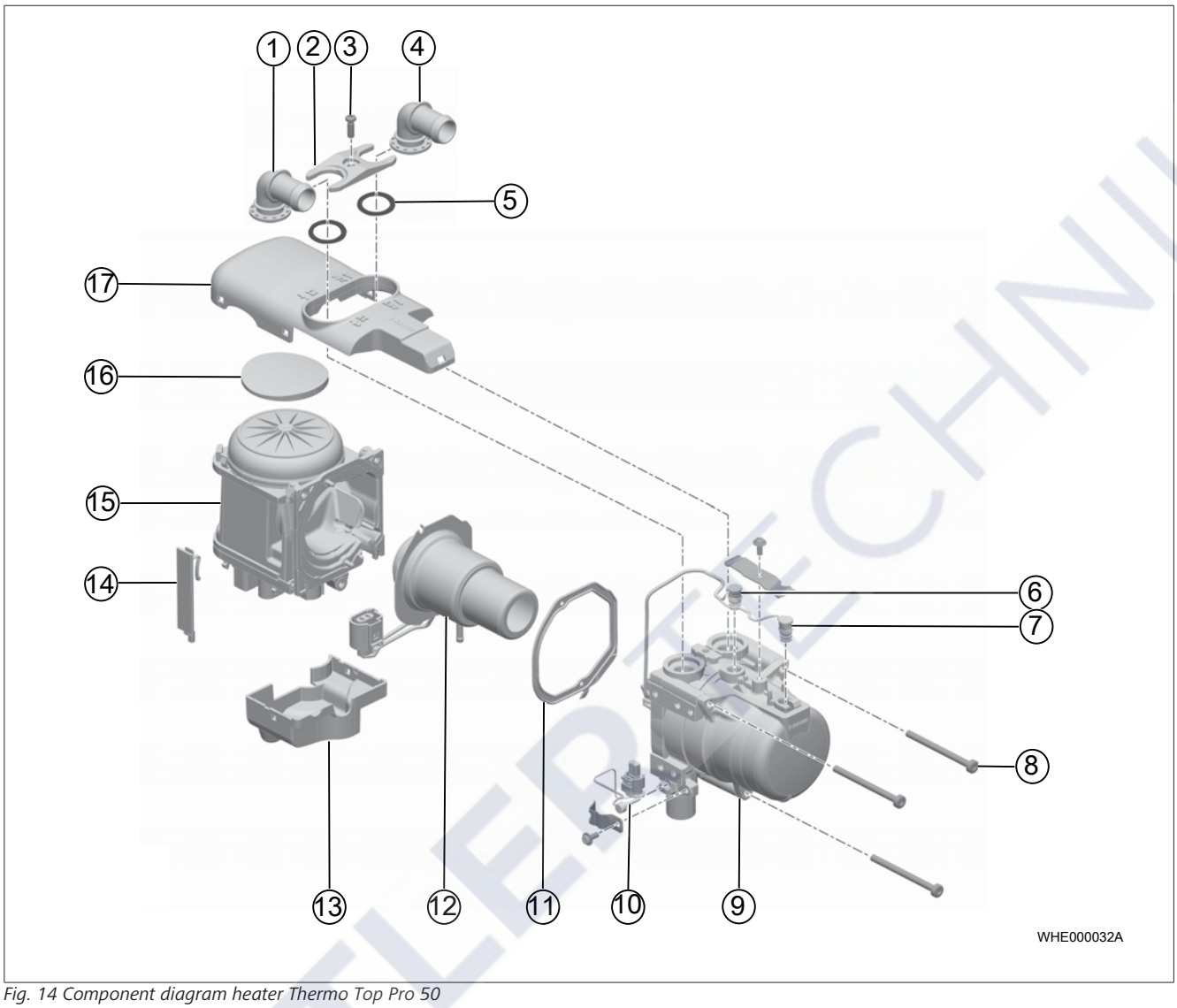


*Fig. 14 Component diagram heater Thermo Top Pro 50*

| | | | |
|---|---|---|---|
| 1 | Water connection piece inlet | 2 | Bracket plate |
| 3 | Screw | 4 | Water connection piece outlet |
| 5 | O-ring | 6 | Temperature sensor |
| 7 | Overheat sensor | 8 | Screw |
| 9 | Heat exchanger | 10 | Exhaust Gas Temperature Sensor |
| 11 | Gasket | 12 | Burner unit |
| 13 | Connector cover | 14 | Cable cover |
| 15 | Combustion air fan unit with control unit | 16 | Damping pad |
| 17 | Heater cover | | |

### 10.2.1 Disassemble heater

For references, see Fig. 14.

1. Undo screw and remove water connection piece with retainer plate and O-ring.
2. Detach heater cover on the side latches of the combustion air fan unit with a screwdriver. Remove the heater cover from the front of the heater.
3. Remove the cable cover from the combustion air fan unit.
4. Detach connector cover on the side facing away from the fuel connection piece by using a screwdriver on the side latches, and remove from the heater.
5. Loosen the connector assembly of the combustion air fan unit (underside) and unplug the connector from control unit.
6. Replace temperature sensors (see chapter 10.7.2, "Remove / install the temperature / overheating sensor" on page 27).
7. Replace defective exhaust gas temperature sensor (see chapter 10.7.3, "Install / remove exhaust gas temperature sensor" on page 28).
8. Undo screws and remove heat exchanger from the combustion air fan unit in axial direction of the screw connection.
9. Remove burner unit (see chapter 10.3.1, "Remove burner unit " on page 23).

**NOTE**

The sensors may be damaged when removed. Sensors which have been removed must not be re-installed. Only new sensors may be used.

### 10.2.2 Assemble heater

For references, see Fig. 14.

1. Install the temperature sensors (see chapter 10.7.2, "Remove / install the temperature / overheating sensor" on page 27).
2. Install the exhaust gas temperature sensor (see chapter 10.7.3, "Install / remove exhaust gas temperature sensor" on page 28).
3. Install the burner unit (see chapter 10.3.2, "Install burner unit" on page 24).
4. Clean interior and exterior of heat exchanger and mount on the combustion air fan unit.
5. Tighten screws to 7 ±0.7 Nm.
6. Insert the temperature / overheating sensor cable into the cable duct (see chapter 10.7, "Sensors" on page 27.
7. Position the cable cover on the combustion air fan unit so that the clips engage correctly.
8. Insert heater cover on the heat exchanger into the heater and lock into place in the locking lugs of the combustion air fan unit.
9. Insert new O-rings into the heat exchanger (see chapter 10.8, "Water connection piece" on page 29).
10. Fasten the water connection piece and the retaining plate with the screw. Tightening torque 7.5 ± 0.7 Nm.

## 10.3 Burner unit

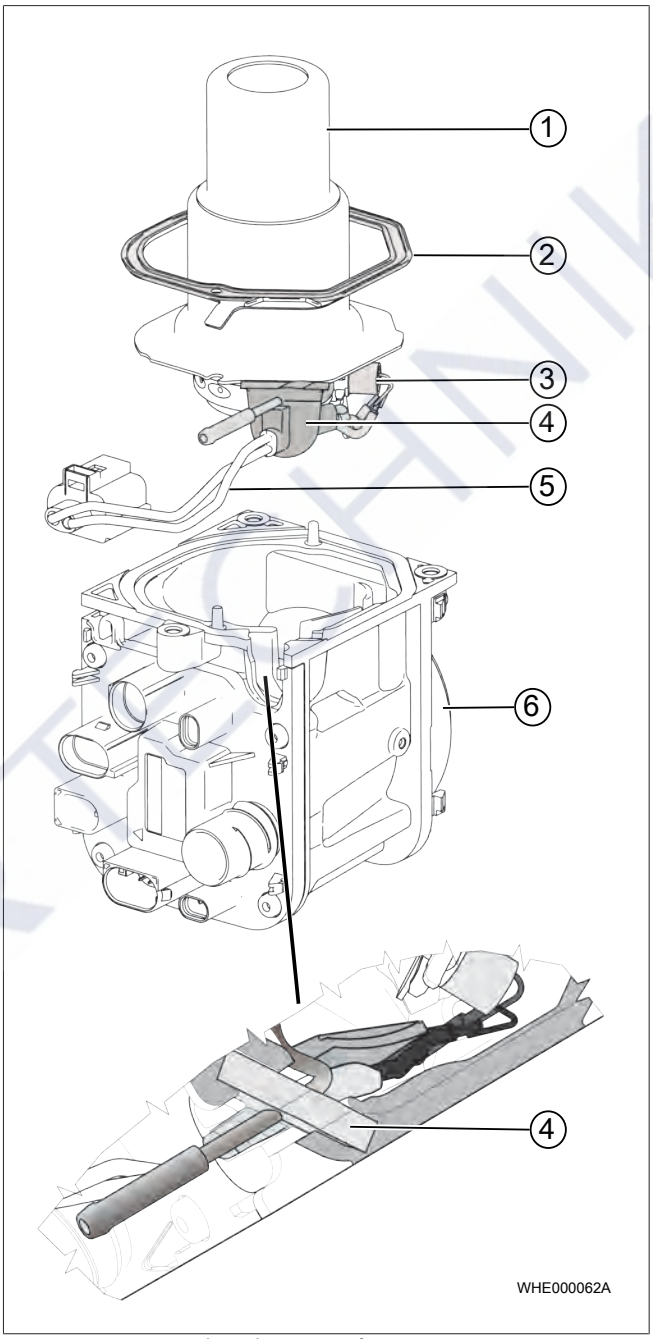


*Fig. 15 Burner unit and combustion air fan unit*

| | | | |
|---|---|---|---|
| 1 | Burner unit | 2 | Gasket |
| 3 | Glow plug / flame monitor | 4 | Glow plug sleeve |
| 5 | Glow plug cable | 6 | Combustion air fan unit |

### 10.3.1 Remove burner unit

**Remove burner unit**

1. Remove heater (see chapter 10.2.1, "Disassemble heater" on page 23).
2. Set the fan down with the burner unit positioned vertically.
3. Remove seal (see Fig. 15).
4. Push the glow plug bush out of the combustion air fan unit with slight pressure on the fuel pipe and lift up the burner unit vertically.

### 10.3.2 Install burner unit

**Install burner unit**

1. Pre-position burner unit with bush in the combustion air fan unit. On assembly, ensure that the glow plug cable and the bush are inserted in the guide provided and the groove of the combustion air blower unit (see Fig. 15). Push the bush into the groove provided until it completely fills the installation space.
2. Place the seal with the flat side facing the combustion air fan unit on the positioning pins of the combustion air fan unit.
3. Assemble heater (see chapter 10.2.2, "Assemble heater" on page 23).

## 10.4 Glow plug

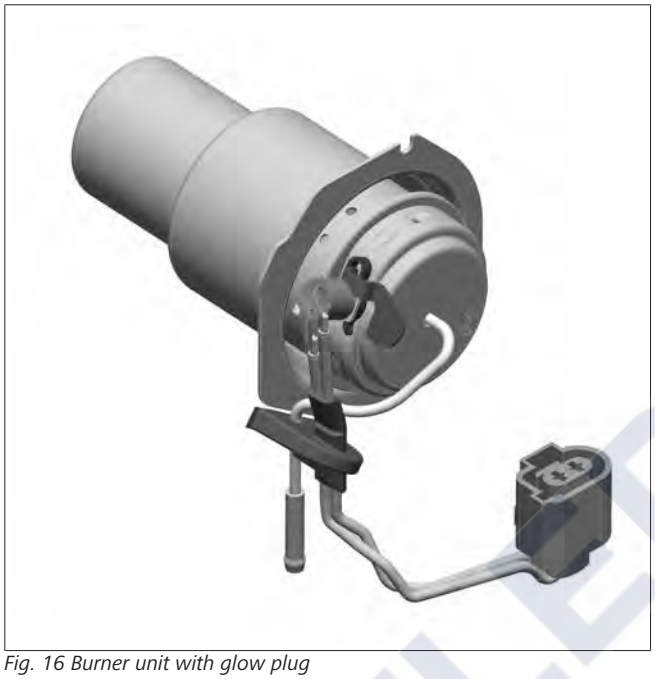

*Fig. 16 Burner unit with glow plug*

### 10.4.1 Electrical test of glow plug

Test the cold resistance by connecting contacts 1 and 2 of the glow plug connector to a multimeter.

Cold resistance at 22 ± 5 °C: 0.780 ± 0.110 Ohms.

Short-circuit test when installed: connect contact 1 of the connector to the combustion air fan unit.

Short-circuit resistance: < 0.500 Ohms.

**NOTE**

Allow the glow plug to cool before testing the cold resistance.

**NOTE**

Perform the measurement with a multimeter. To measure the cold resistance, the temperature of the glow plug must match the room temperature.

### 10.4.2 Remove glow plug

**NOTE**

Removal of the glow plug may involve increased use of force. And may therefore lead to destruction of the glow plug.

1. Remove the spring clip.

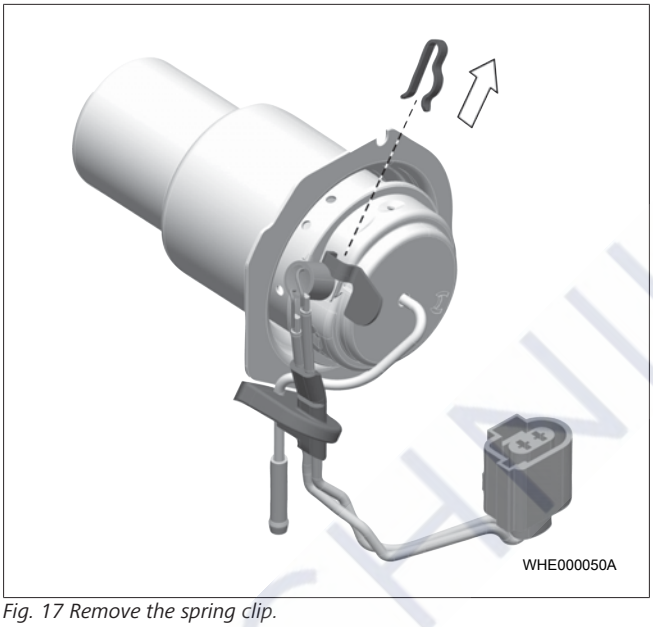


*Fig. 17 Remove the spring clip.*

2. Remove the cooling flag.

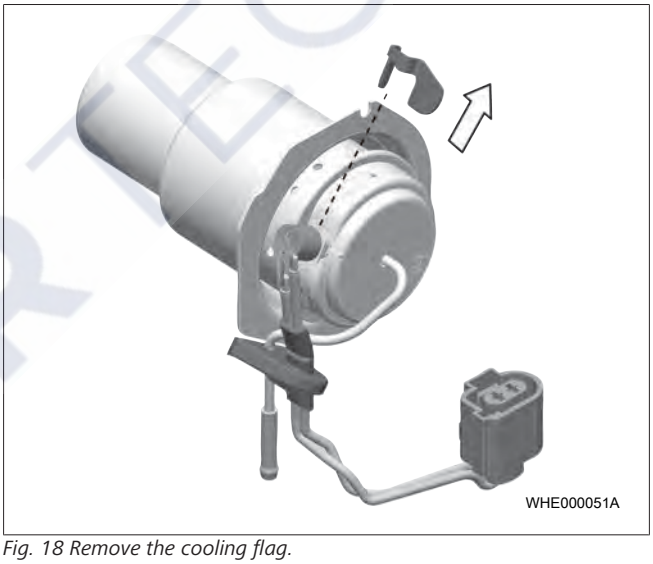


*Fig. 18 Remove the cooling flag.*

3. Remove the glow plug.

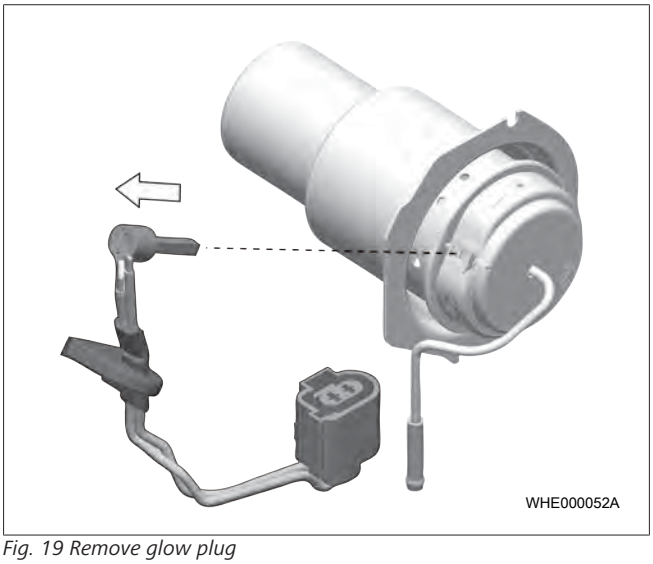


*Fig. 19 Remove glow plug*

### 10.4.3 Install glow plug

**ATTENTION**

On assembly, only a new glow plug must be used. Uninsulated parts of the glow plug cable must not touch each other and must not come into contact with metal parts of the burner unit or of the combustion air housing (risk of short-circuiting).

On assembly, the glow plug must not be twisted or tilted and must be pushed as far as it will go into the guide (risk of breakage).

On assembly of the burner unit, the cable must be routed in such a way that it lies in the groove provided. See chapter 10.3.2, "Install burner unit" on page 24.

1. Position combustion pipe horizontally with evaporator holder towards the rear.
2. Push the glow plug with straight cable into the locating hole of the glow plug mandrel as far as it will go.

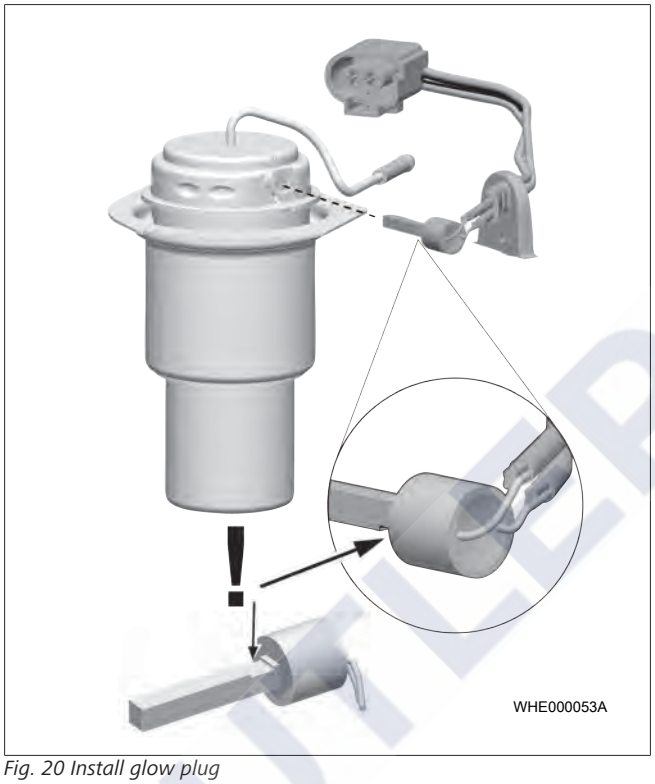


*Fig. 20 Install glow plug*

3. Hold the cooling flag in the groove with your hand on the glow plug mandrel.


*Fig. 21 Insert cooling flag*

4. Push spring clip over cooling flag and glow plug mandrel.

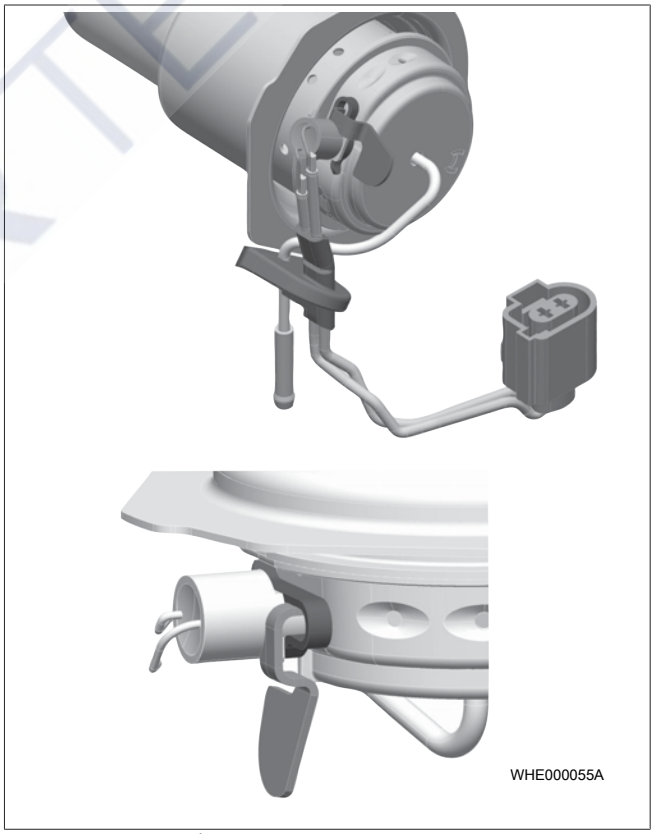


*Fig. 22 Insert spring clip*

5. Push the glow plug into the mounting hole in the combustion tube as far as it will go.
6. Fit glow plug correctly with the groove.

**NOTE**

If the spring clip and the cooling flag do not fit properly, the glow plug must be turned by 90°.

7. Hold the cooling flag in the groove with your hand on the glow plug mandrel.
8. Push spring clip over cooling flag and glow plug mandrel.

**ATTENTION**
The glow plug must be installed in the glow plug mandrel as far as it will go.

9. Route the glow plug cable with a slight bend and push the glow plug cable bush onto the fuel line.

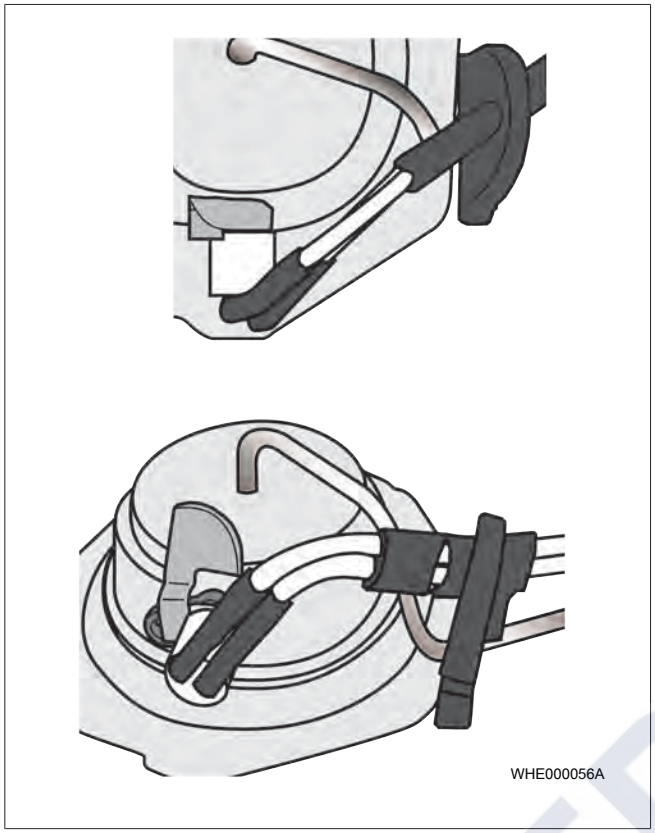


*Fig. 23 Route glow plug cable*

## 10.5 Combustion air fan unit and control unit

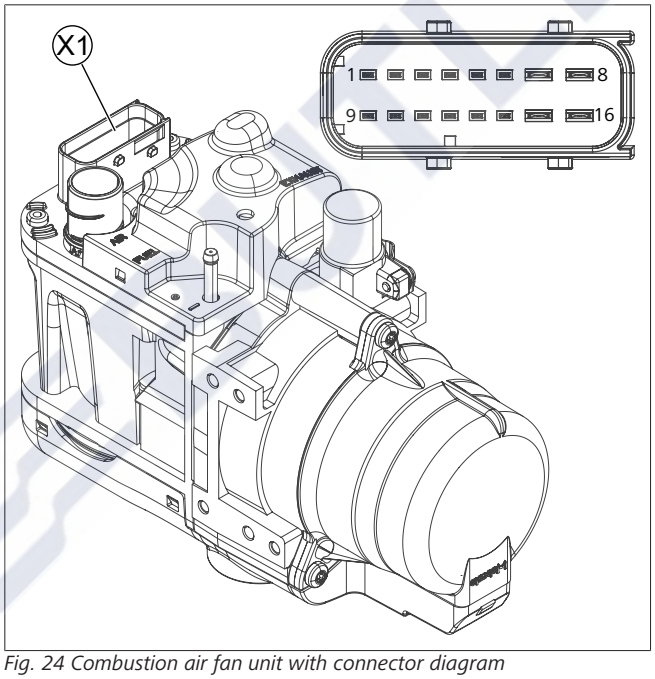


*Fig. 24 Combustion air fan unit with connector diagram*

| Item | Remarks |
|---|---|
| 1 | Auxiliary drive input |
| 2 | LIN / W-bus |
| 3 | External coolant pump control input |
| 4 | Output, fuel pump |
| 5 | Battery disconnector output |
| 6 | Not used |
| 7 | Coolant pump dimensions |
| 8 | Terminal 31 |
| 9 | D+/Terminal 61 |
| 10 | Not used |
| 11 | Input switch-on signal (analogue) |
| 12 | Vehicle blower output |
| 13 | Operating indicator/error code output |
| 14 | Coolant pump control |
| 15 | Coolant pump voltage |
| 16 | Terminal 30 |

**CAUTION**
If there is a fault in the combustion air fan unit or in the control unit, change the combustion air fan unit and the control unit as a complete assembly. Do not disassemble the combustion air fan unit or the control unit into its individual parts.

**NOTE**
When replacing the combustion air fan unit, the $CO_2$ setting must be checked.

**NOTE**
Any dummy connectors are to be fitted on the new control unit.

## 10.6 Heat exchanger

**CAUTION**
If there is a fault in the heat exchanger, replace the heat exchanger as a complete assembly. Do not disassemble the heat exchanger into its individual parts.

**NOTE**
Check sensors and water connection pieces with retaining plate for damage and replace them if necessary.

**NOTE**
Observe direction of flow of the coolant circuit. Connect the coolant hoses to the water connection pieces according to the marking (arrows) on the heater.

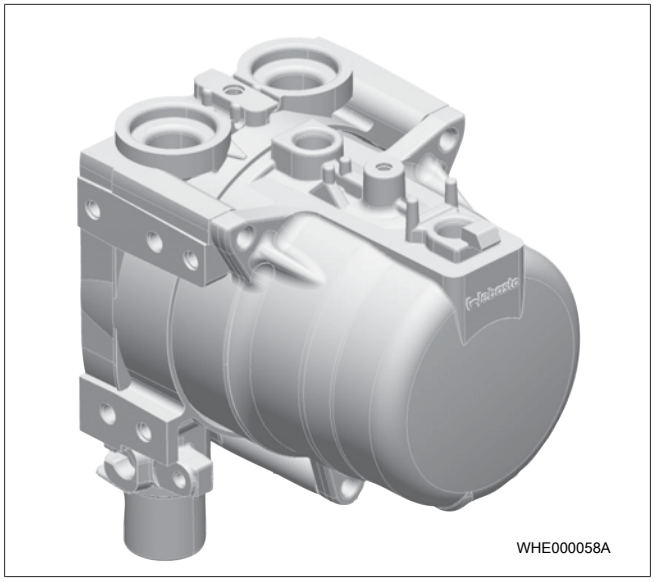


*Fig. 25*

## 10.7 Sensors

**NOTE**
Never reuse removed sensors.

### 10.7.1 Inspection of the sensors

**NOTE**
Do not remove sensors for testing.

When checking the cold resistance, a distinction is to be made between the two versions of sensors W5 and W6 (see next table). For this purpose, the contacts of connector X3 of the sensors are contacted with a multimeter and the resistance is measured (test current: < 1 mA).

| Probes | Contacts on connector X3 | Cold resistance at 22 ± 5 °C [Ohms] | |
|---|---|---|---|
| | | Min. | Max. |
| W5 | 2 and 4 | 2296 | 5047 |
| W6 | 1 and 3 | 30 | 250 |

*Table 4: Resistance values of sensors*

▶ Check:

- Short-circuit to earth to the metal housing.
- Pinching of lines.
- Deformations of the plastic cap of the sensors.

### 10.7.2 Remove / install the temperature / overheating sensor

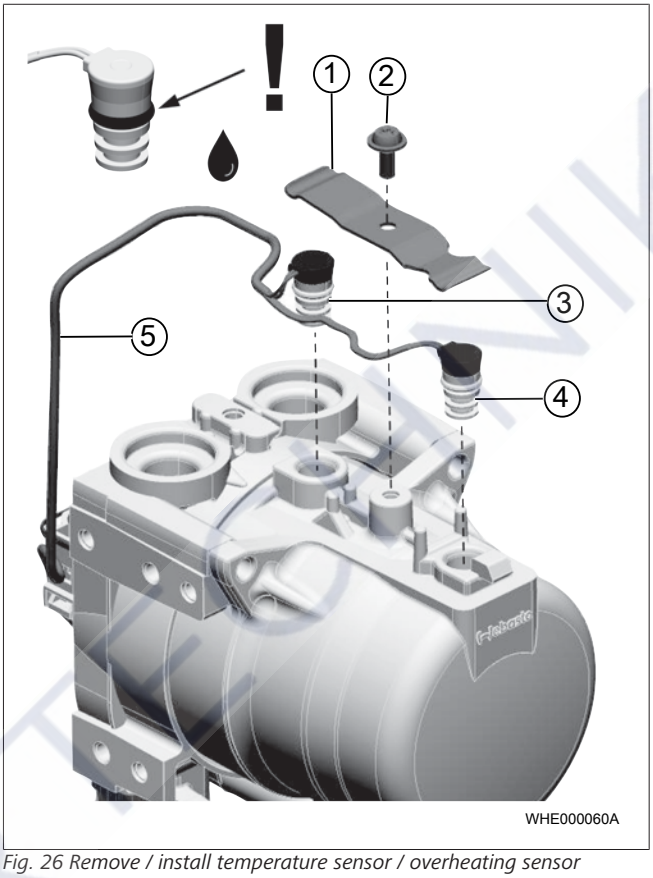


*Fig. 26 Remove / install temperature sensor / overheating sensor*

| | | | |
|---|---|---|---|
| 1 | Retaining plate | 2 | Screw |
| 3 | Temperature sensor | 4 | Overheat sensor |
| 5 | Sensor cable | | |

**Removal**

**NOTE**
Remove / install the temperature sensor / overheating sensor as a combined unit.

**NOTE**
The sealing O-ring of the sensor can get stuck after some period on the housing and as a result obstruct removal.

1. Remove the heater covers.
2. Disconnect the connector for the temperature / overheating sensors.
3. Pull the connector for the temperature / overheating sensors out of the control unit.
4. Loosen the bolt.
5. Remove the spring clip.
6. Pull the sensors out of the heat exchanger.

**Installation**

**CAUTION**
**Excessive tightening or repeated tapping can damage the thread.**
Carefully manually insert the screw into the existing thread and screw it in.

**NOTE**
The seals of the sensors must be wetted with suitable lubricant before being inserted.

**NOTE**
Note cable routing and position of sensors.

1. Wet the seals.
2. Press the sensors vertically into the heat exchanger.
3. Position the sensor line.
4. Position the spring clips.
5. Mount the screw by hand.
6. Tighten screw (4 ±0.4 Nm).

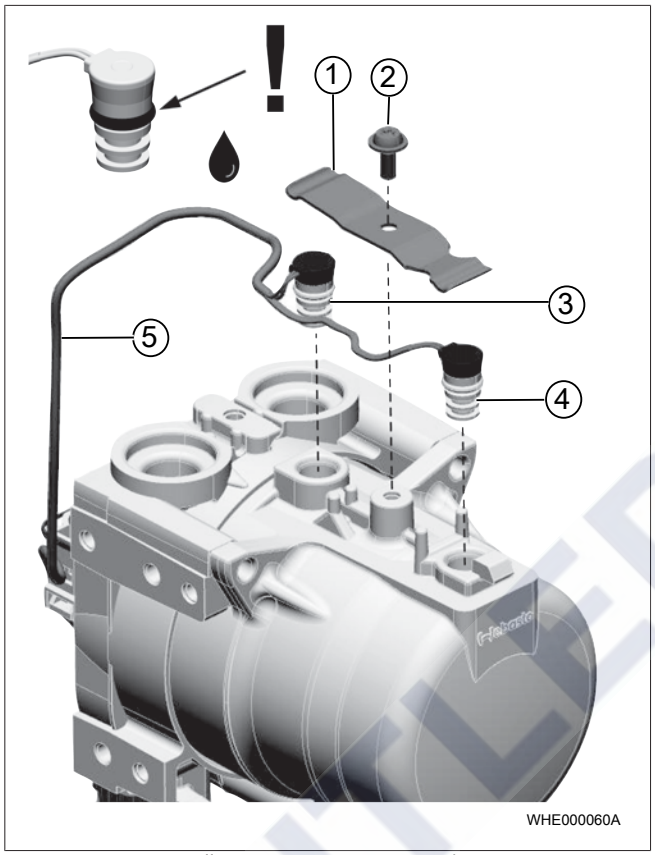


*Fig. 26 Remove / install temperature sensor / overheating sensor*

| | | | |
|---|---|---|---|
| 1 | Retaining plate | 2 | Screw |
| 3 | Temperature sensor | 4 | Overheat sensor |
| 5 | Sensor cable | | |

### 10.7.3 Install / remove exhaust gas temperature sensor

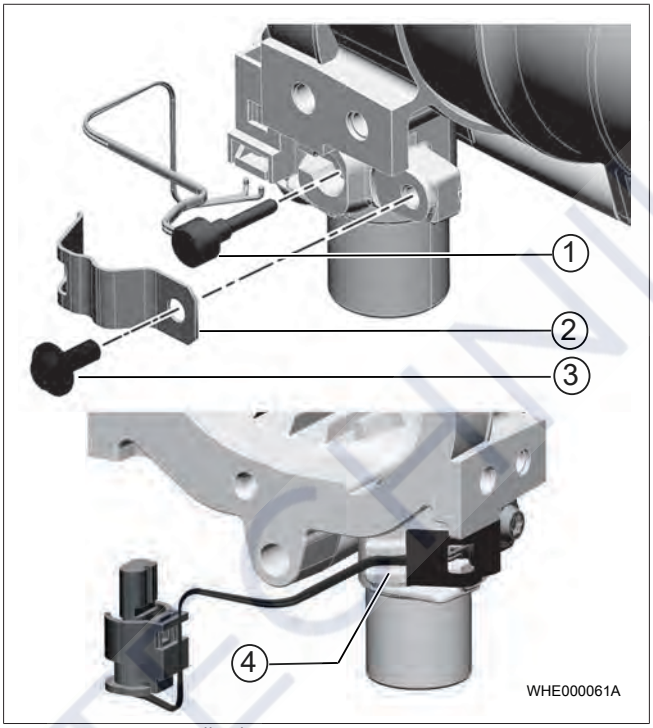


*Fig. 28 Remove / install exhaust gas temperature sensor*

| | | | |
|---|---|---|---|
| 1 | Exhaust Gas Temperature Sensor | 2 | Spring clip |
| 3 | Screw | 4 | Groove |

**Removal**

Follow these steps:

1. Remove the connector cover.
2. Loosen the exhaust gas temperature sensor plug lock.
3. Pull the exhaust gas temperature sensor plug out of the control unit.
4. Loosen the bolt.
5. Remove the spring clip.
6. Pull the exhaust gas temperature sensor out of the exhaust gas pipe on the heat exchanger.

**Installation**

**CAUTION**
**Possible cable break**
- ▶ Do not bend the cable on the exhaust gas temperature sensor.
- ▶ Do not pinch the exhaust temperature sensor cable between the cover and heater.

**CAUTION**
**Excessive tightening or repeated tapping can damage the thread.**
- ▶ Carefully manually insert the screw into the existing thread and screw it in.

1. Insert exhaust gas temperature sensor into the hole on the exhaust pipe of the heat exchanger.
2. The screw is to be inserted carefully by hand into the available thread and screwed in.
3. Insert cable into the groove on the exhaust pipe.
4. Fasten spring clip with screw. Tightening torque 4.0 ± 0.4 Nm.
5. Connect the connector onto the connector board on the control unit.
6. Fit the cover.

## 10.8 Water connection piece

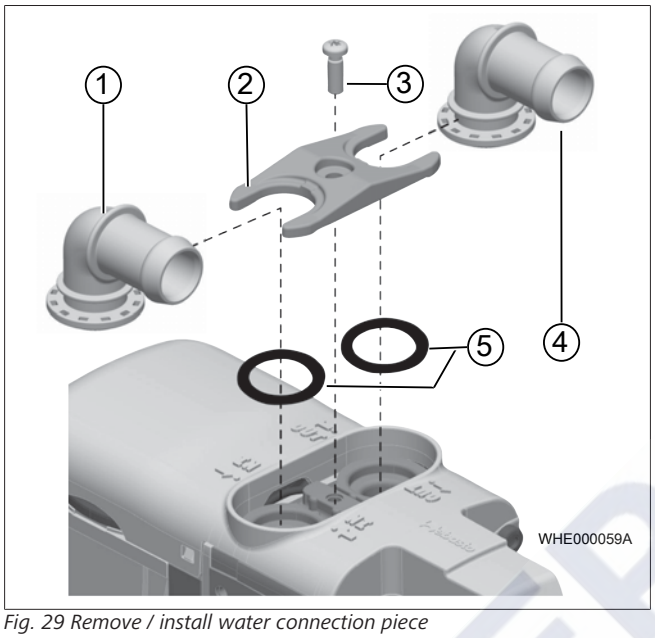


*Fig. 29 Remove / install water connection piece*

| | | | |
|---|---|---|---|
| 1 | Water connection piece inlet | 2 | Retaining plate |
| 3 | Screw | 4 | Water connection piece outlet |
| 5 | O-rings | | |

**Removal**

1. Loosen the bolt.
2. Remove the water connection piece and retaining plate as an assembled unit.
3. Remove the O-rings.
4. Clean the contact surfaces of the O-rings in the heat exchanger and check for damage.

**Installation**

**NOTE**
The contact surfaces of the O-rings in the heat exchanger must be clean and must not show any signs of damage.

**CAUTION**
**Excessive tightening or repeated tapping can damage the thread.**
Carefully manually insert the screw into the existing thread and screw it in.

1. Wet new O-rings.
2. Insert O-rings into the heat exchanger openings.
3. Fix the water connection piece in the retaining plate.
4. Fix the water connection piece and retaining plate and position as an assembled unit in the heat exchanger.
5. Align the water connection piece for the connection of the coolant lines.
6. Insert the screw into the hole and carefully insert it by hand into the existing thread and screw it in.
7. Screw the screw with 7.5 ±0.7 Nm.

# 11 Packaging / storage / shipping

## 11.1 Preferred position for storage and transportation

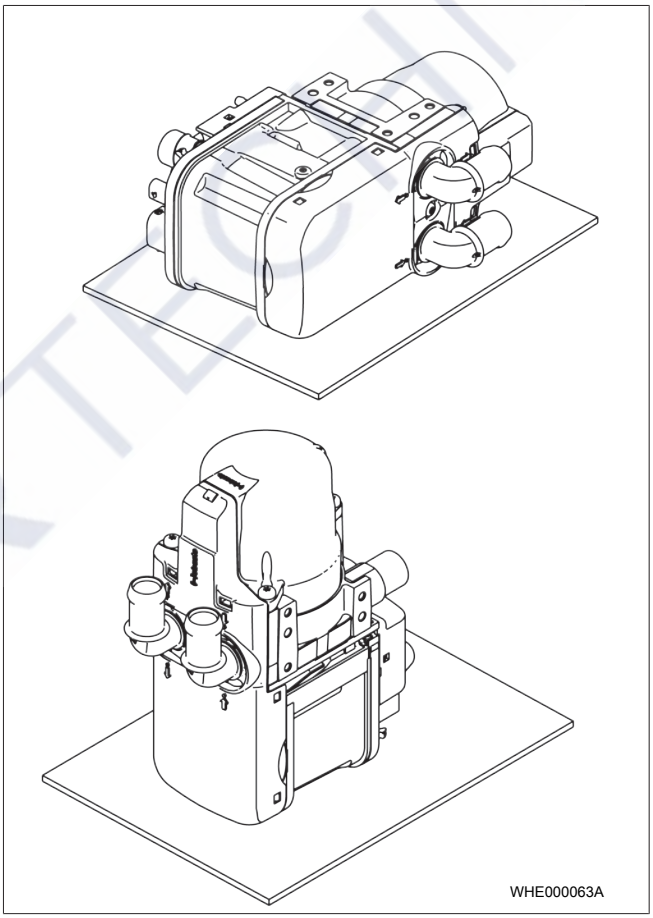


*Fig. 30*

## 11.2 General storage

The heater and/or its external components that are being sent to Webasto for testing or repair must be cleaned and packaged in such a way that they are protected from mechanical damage, soiling and environmental influences during handling, transportation and storage.

## 11.3 Storage and transportation

**CAUTION**
**Possible health / environmental damage**
If a complete heater is returned:
- The heater must be completely drained of fuel.
- When packing or shipping, ensure that fuel or coolant residues cannot escape.
- Seal the coolant connection pieces and the fuel connection with dummy plugs.

Recommendations for:

**Sending in the heater:**

- ▶ The heater must be completely empty.

**Packaging and shipping:**

- ▶ Make sure that the remaining coolant cannot leak out. Close off the coolant connection pieces with protective caps.

**Storage and packaging:**

- The heater can be stored in any position.
- Cover the heater and protect the heater against dust, dirt and moisture.
- Do not store the heater with chemicals or vapours, e.g. fuels, battery fluids or brake fluids.
- Dirt, water or chemicals must not get into the heater through the openings, see above.
- The electrical contacts must be protected from mechanical damage.
- Always store the heater in the original or similar packaging in a closed room.

**Transporting the heater:**

The heater can be transported in any position in suitable packaging.

**Removing the delivery packaging:**

- ▶ Grasp the heater suitably at the heat exchanger (aluminium and steel parts) and remove it.
- ▶ The type label and the surface of the heater should be protected from damage by placing suitable material under them (e.g. cardboard).

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Germany

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Doncaster Carr
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