

Coolant Heater

Thermo 90 ST D (Diesel) **Thermo 90 ST B (Gasoline)**

Service and Repair Manual



- While a Webasto heater is in use, the product surface, connected hoses, ducting and air outlet(s) may become hot to the touch. Contact with skin may cause burns.
- Improper installation or repair of Webasto heating systems can cause fire or the leakage of deadly carbon monoxide leading to serious injury or death.
- NEVER attempt to install or repair a Webasto heating system unless you have successfully completed Webasto factory training and have the technical skills, technical information, tools and equipment required to properly complete the necessary procedures. Only genuine Webasto parts may be used.
- Webasto rejects any liability for problems and damage caused by the system being installed by untrained personnel.
- Webasto products produce temperatures high enough to ignite surrounding combustible materials such as inflammable liquids, gases, vapor, and other combustible matter. The heater must be switched off when loading or unloading inflammable materials to prevent the risk of explosion.
- ALWAYS and carefully follow Webasto installation and repair instructions and heed all WARNINGS.

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1. INTRODUCTION

1.1 CONTENTS AND PURPOSE

This repair shop manual is intended to assist trained personnel with repairing both the gasoline and the diesel versions of the Thermo 90 ST water heaters.

1.2 MEANING OF SIGNAL WORDS

Throughout this manual, the signal words DANGER, WARNING, CAUTION, and NOTE have the following meanings:



DANGER: This heading and text style is used to highlight that non-compliance with instructions or procedures will cause injuries or lethal accidents to personnel.



WARNING: This heading and text style is used to highlight that non-compliance with instructions or procedures may cause injuries or lethal accidents to personnel.



CAUTION: This heading and text style is used to highlight that non-compliance with instructions or procedures may cause damage to equipment.



NOTE: This heading and text style is used to highlight and draw attention to information we feel you would like to have. It could have to do with procedures and tips that will help you work more efficiently.

1.3 ADDITIONAL DOCUMENTATION

This workshop manual contains all the information and instructions required for repairing Thermo 90 ST water heaters. Normally, there is no need to use additional documentation. If required, the installation instructions, the vehicle-specific installation instructions and the operating instructions can be used as well.

1.4 SAFETY INFORMATION AND REGULATIONS

In principle, the general accident prevention regulations and current works safety instructions are applicable. The "General safety regulations" that go beyond the scope of the above regulations are stated below.

Any special safety regulations relevant to this instruction manual will be highlighted in the relevant sections or text passages of the procedures.

1.4.1 GENERAL SAFETY REGULATIONS

The year of first start-up must be indelibly identified on the rating plate by removing the corresponding year number.

The heaters are only licensed for heating the motor vehicle engine and vehicle cabin, not however for heating hazardous material transport space.

The heater is only allowed to be installed in motor vehicles or in independent heating systems with a minimum coolant volume of 6 liters (6.34 quarts).

The heater is not allowed to be installed in the driver's cab or passenger compartment of vehicles. If the heater is nevertheless installed in such a place, the installation box must be tightly sealed against the vehicle interior. The installation box must have sufficient external ventilation to ensure that a maximum temperature of 40 °C (104 °F) is not exceeded in the box. Malfunctions may occur if the temperature exceeds this level.



WARNING: The heater must not be operated in enclosed areas, such as garages or workshops without an exhaust emissions extraction system, not even using the timer or Telestart, because of the risk of asphyxiation and poisoning.



WARNING: Webasto heaters must be switched "off" when re-fueling at filling stations and/or while loading or unloading flammable materials for transport, to prevent the risk of explosion. Please review owner's manual for safety and use instructions.



CAUTION: Wherever inflammable vapors or dust may form (for example near fuel, coal, wood dust or cereal stores or the like), the heater must be switched off because of the risk of explosion.

A temperature of 85 °C (185 °F) (storage temperature) must not be exceeded in the vicinity of the control unit (for example when completing painting work on the vehicle).

If this temperature is exceeded, the electronic systems may suffer permanent damage.

Follow the instructions supplied by the vehicle manufacturer to check the cooling water level. The water in the heating circuit of the heater must contain at least 10% branded anti-freeze.

Non-compliance with the installation instructions and the warnings contained therein will lead to the exclusion of all liability by Webasto. The same applies if repairs are

carried out incorrectly or with the use of parts other than genuine spare parts. This will result in the revocation of the type license for the heater and therefore the general operating license for the vehicle.

1.5 SUGGESTIONS FOR IMPROVEMENTS AND CHANGES

Complaints, improvement suggestions or corrections relating to this workshop manual should be addressed to:

Webasto Thermo & Comfort N.A., Inc.

Technical Documentation Group

15083 North Road

Fenton MI 48430

Phone: 810.593.6000 PC-Fax: 810.593.6135

2. GENERAL DESCRIPTION

Thermo 90 ST water heaters operate in conjunction with the vehicle's own heating system and serve

- to heat the cab,
- to defrost the vehicle windows and
- to preheat water-cooled engines.

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

The concept of the heater is based on the evaporator principle. It is controlled by the temperature sensor and operates intermittently.

Depending on the deviation between the current coolant temperature and the nominal value measured at the temperature sensor, the burner power is regulated between the limits of 1.8 to 7.6 kW in diesel heaters and 2.0 to 7.6 kW in gasoline heaters. When the heating requirement is particularly high (preheating), diesel heaters provide a maximum power of 9.1 kW for up to 2 hours after the heater is switched on.

Thermo 90 ST heater is principally composed of

- the combustion air fan
- the heat exchanger
- the burner insert with combustion pipe
- the circulating pump

To control and monitor it, the heater has

- a control unit (external)
- a flame monitor
- a glow pin
- a temperature sensor
- a temperature limiter

inside it.

The Thermo 90 ST heater is delivered with the control unit already flange-mounted on the combustion air fan.

The fuel supply is provided from an external source using a metering pump.

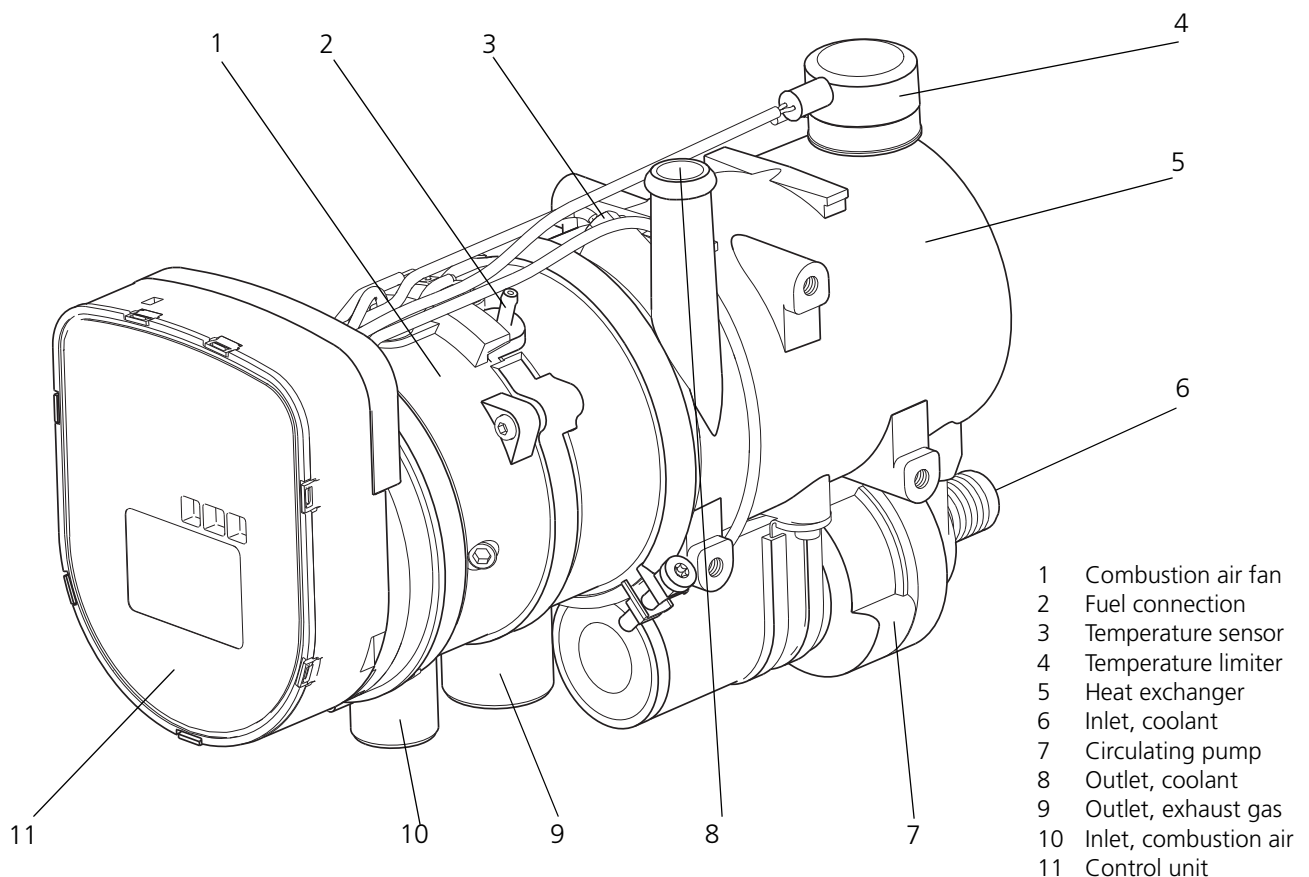


Figure 1: Thermo 90 ST heater

2.1 COMBUSTION AIR FAN

The combustion air fan supplies the air required for the combustion process from the combustion air inlet to the burner insert.

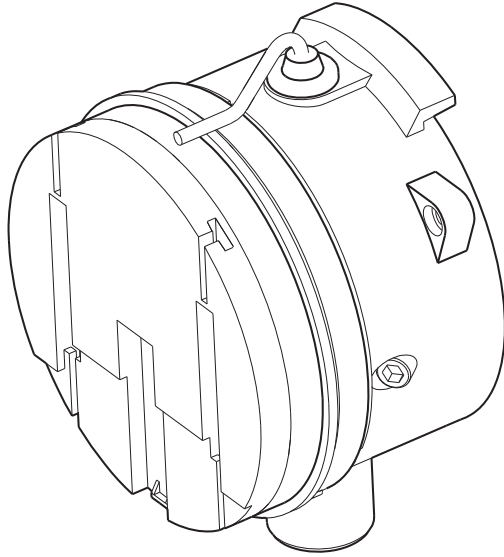


Figure 2: Combustion air fan

2.2 HEAT EXCHANGER

In the heat exchanger, the heat generated by combustion is transferred to the coolant circuit.

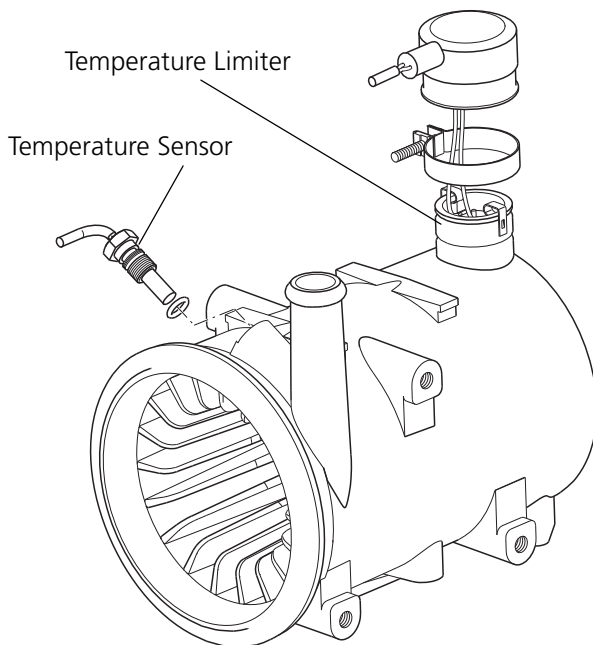


Figure 3: Heat exchanger

2.3 TEMPERATURE SENSOR

The temperature sensor records the coolant temperature at the coolant outlet of the heater as an electrical resistance. This signal is fed to the control unit where it is processed.

2.4 TEMPERATURE LIMITER

The overheat guard circuit (bimetallic) protects the heater against impermissibly high operating temperatures. The overheat guard circuit trips if the heat exchanger temperature exceeds $127 \pm 7^\circ\text{C}$ ($260.6 \pm 10^\circ\text{F}$) and switches off the heater. This is a self resetting switch.

2.5 BURNER INSERT

The fuel is distributed over the burner cross-section in the combustion pipe in the burner insert.

2.6 GLOW PIN

The mixture of fuel and air is ignited by the glow pin when the heater is started. The glow pin takes the form of an electrical resistor and is positioned in the burner insert on the side away from the flame.

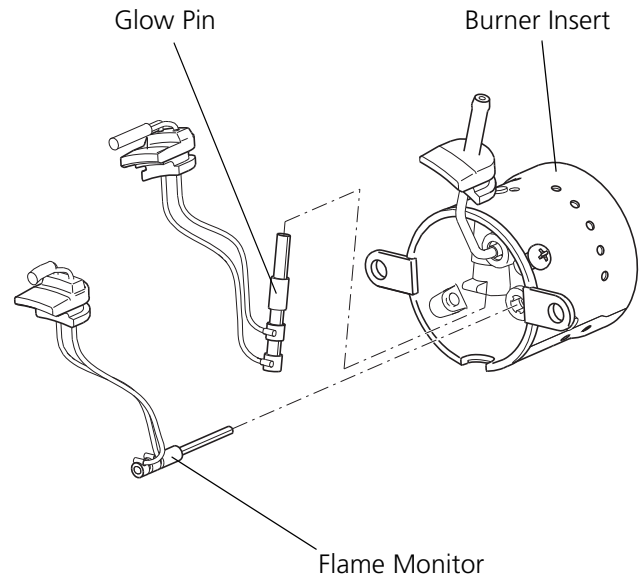


Figure 4: Burner Assembly

2.7 FLAME MONITOR

The flame monitor is a low-ohm PTC resistor, which changes its resistance depending on the heat emitted by the flame. The signals are fed to the control unit where they are processed. The flame status is monitored by the flame monitor whenever the heater is operating.

2.8 COMBUSTION PIPE

The mixture of fuel and air burns in the combustion pipe, thus causing the heat exchanger to become hot.

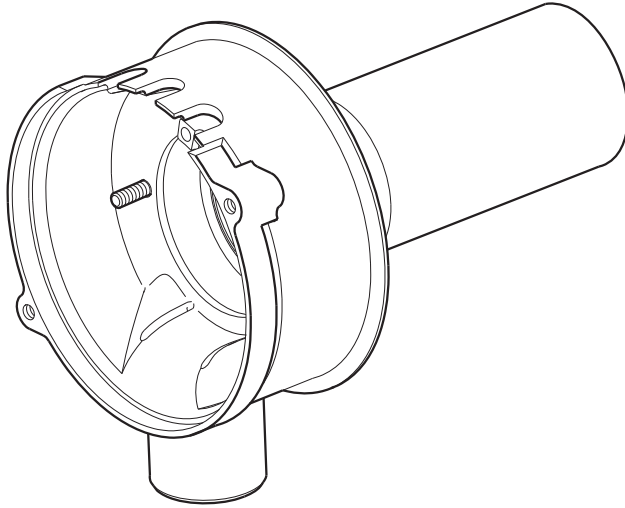


Figure 5: Combustion pipe

2.9 CIRCULATING PUMP

The circulating pump ensures that coolant is pumped through the vehicle and heater circuits. The pump is switched on by the control unit and it runs throughout operation of the heater (including in the control pause).

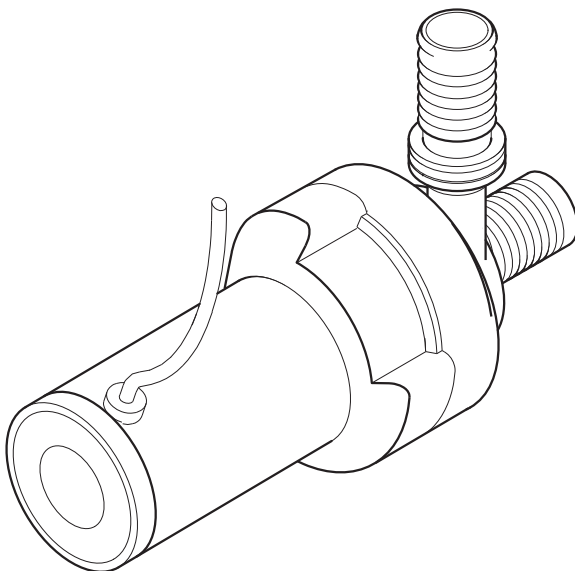


Figure 6: Circulating pump

2.10 CONTROL UNIT

The control unit is the central component. It guarantees the sequence of functions and monitoring of combustion mode. It is flange-mounted on the combustion air fan.

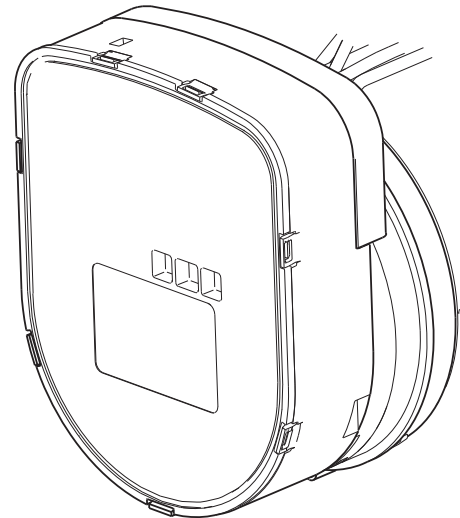


Figure 7: Control unit - flange mounted

2.11 METERING PUMP

The fuel supply and metering for the heater is assured by an external metering pump. In addition, it serves as a shut-off element when the heater is switched off.

The solenoid coil of the metering pump receives its pulses from the microprocessor in the control unit.

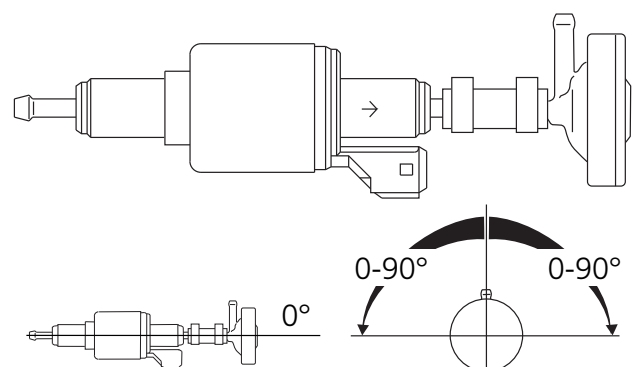


Figure 8: Fuel metering pump

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3. FUNCTIONAL DESCRIPTION

3.1 SWITCHING ON

The “operating indicator” on the digital timer lights up when the “immediate heating” button is pressed.

or

When switching on with the switch, the operating indicator in the switch lights up.

The circulating pump, glow pin and combustion air fan start operating.

3.2 HEATING MODE

Combustion starts after approx. 60 to 140 seconds. Automatically controlled heating operation runs at full load for a maximum of 2 hours.

The vehicle’s own heater fan does not switch on until the heat carrier (coolant) has heated up sufficiently. Once the preset nominal temperature has been reached (see table of regulating temperatures) the heating power is reduced to the lowest part load in small individual steps.

3.3 CONTROL MODE

The heater switches to the control pause if the temperature of the coolant continues to rise to the threshold of the control pause. The circulating pump, the vehicle’s own heater fan and the operating indicator continue to operate during the control pause.

The heater restarts when the coolant cools to the preset temperature for switching back on.

Diesel Heaters

If the water temperature in the heater is higher than the nominal temperature but has not yet reached the threshold for the control pause and if the temperature then falls back to the nominal temperature within 10 minutes (after reaching this temperature for the first time), the heater switches back to the 9.0 kW heating stage.

When the nominal temperature is reached, the heater is only switched back on again up to the 7.6 kW heating stage.

Gasoline Heaters

The maximum heating power in gasoline heaters is always 7.6 kW.

3.4 SWITCHING OFF

The operating indicator on the digital timer/switch goes out when the heater is switched off. The combustion process will be ended and the run-on phase will start.

The circulating pump and the combustion air fan continue to run, however, in order to cool down the heater (run-on) and are switched off automatically after approx. 105 seconds. The heater may be switched on again during the run-on time.

The temperature in the cabin can also be controlled using the vehicle’s own heater fan with a cabin thermostat.

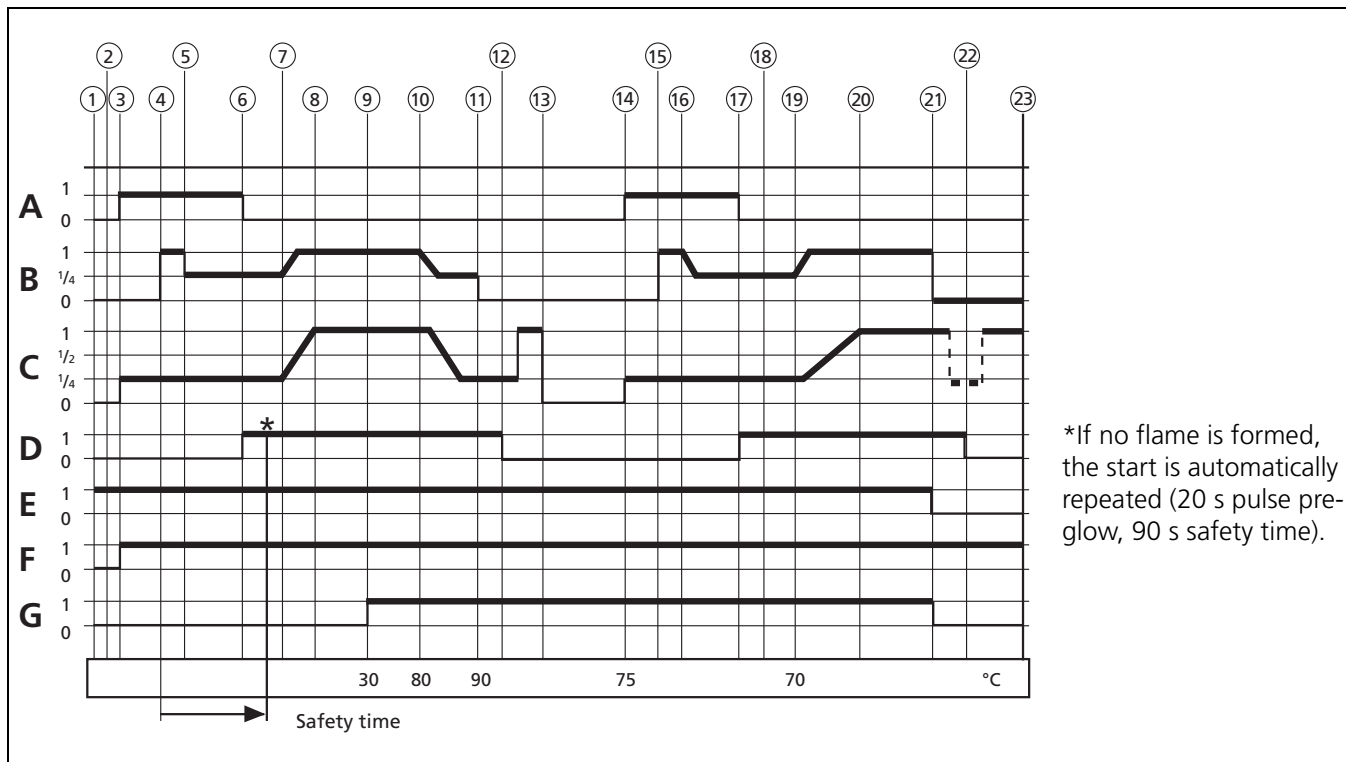


Figure 9: Sequence of functions

Sequence of functions for Thermo 90 ST

- A.** Glow pin
- B.** Metering pump
- C.** Combustion air fan
- D.** Flame monitor
- E.** Operation indicator light
- F.** Circulating pump
- G.** Vehicle fan

- | | |
|------------------------------------|------------------------------------|
| ① Switch on | ⑬ Run-on ended (cool-down) |
| ② Component interrogation | ⑭ Pre-glow 15 – 20 s (pulsed) |
| ③ Pre-glow 40 s (pulsed) | ⑮ Metering pump supply 5 – 7 s (1) |
| ④ Metering pump supply 5 – 7 s (1) | ⑯ Metering pump / part load (1/4) |
| ⑤ Metering pump / part load (1/4) | ⑰ Flame monitor take-over |
| ⑥ Flame monitor take-over | ⑱ Stabilization time |
| ⑦ Stabilization time | ⑲ Coolant temperature reduced |
| ⑧ Full load | ⑳ Full load |
| ⑨ Vehicle fan "On" | ㉑ Switch off (run-on) |
| ⑩ Control range | ㉒ Flame monitor "Cold" (0) |
| ⑪ Control pause | ㉓ Run-on ended (cool-down) |
| ⑫ Flame monitor "Cold" (0) | |

3.5 MALFUNCTIONS

3.5.1 FAULT LOCK-OUT

Fuel is supplied for max. 240 seconds if the flame does not start to burn.

Fuel is supplied for max. 240 seconds if the flame goes out during operation.

The fuel supply is shut off if the system overheats (temperature limiter is tripped). If the system overheats the temperature limiter will reset itself after cool down period.

Once the cause of the fault has been eliminated, the fault lock-out is canceled by following the heater lockout procedure steps below:

1. Using switch or standard timer control, turn heater on
2. Remove the main power connection to heater from battery or pull fuse for a minimum of 20 seconds.
3. Using switch or standard timer control, turn the heater off.
4. Reinstall main heater power connection where previously disconnected.

Rectify the cause of the fault.

IMPORTANT: Heater fault codes can be read using PC Diagnostics, however, the heater lockout reset must be manually performed using the procedure stated above.

If the under voltage protection switches off the system for longer than 20 seconds, the fuel supply is interrupted and the heater is shut off. (see table below).

	Thermo 90 ST
12 volts	10.5 V - 0.5 V
24 volts	21 V -1 V



CAUTION: A forced reset of the return spring when hot can result in damage to the component.

3.5.2 DIAGNOSIS AFTER FAULT LOCK-OUT

Check the fuses and plug connectors.

3.5.2.1 VERSION WITH DIGITAL TIMER

If the system is equipped with a standard timer, a fault message appears on the display of the digital timer after a fault occurs:

F 01	No start (after 2 attempts to start)
F 02	Flame failure
F 03	Under voltage or over voltage
F 04	Premature flame recognition
F 05	Flame monitor interrupt or flame monitor short circuit
F 06	Temperature sensor interrupt or temperature sensor short circuit
F 07	Metering pump interrupt or metering pump short circuit
F 08	Fan motor interrupt or fan motor short circuit or fan motor incorrect speed
F 09	Glow pin interrupt or glow pin short circuit
F 10	Overheating
F 11	Circulating pump interrupt or circulating pump short circuit

3.5.2.2 VERSION WITH SWITCH

If the system is operated with a switch, the nature of the fault is indicated by a flashing code on an operating indicator light during the run-on time of the heater.

After five short signals, count the long flashes:

1x	No start (after 2 attempts to start)
2x	Flame failure
3x	Under voltage or over voltage
4x	Premature flame recognition
5x	Flame monitor interrupt or flame monitor short circuit
6x	Temperature sensor interrupt or temperature sensor short circuit
7x	Metering pump interrupt or metering pump short circuit
8x	Fan motor interrupt or fan motor short circuit or fan motor incorrect speed
9x	Glow pin interrupt or glow pin short circuit
10x	Overheating
11x	Circulating pump interrupt or circulating pump short circuit

This page for your notes.

4. TECHNICAL DATA

Except where limit values are specified, the technical data listed in the table refer to the usual heater tolerances of $\pm 10\%$ at an ambient temperature of $+20\text{ }^{\circ}\text{C}$ ($+68\text{ }^{\circ}\text{F}$) and at the rated voltage and in rated conditions.

Electrical components:

The control unit, motors for combustion air fan and circulating pump, ceramic glow pin, metering pump, timer, and switch are designed for 12 V or 24 V.

The temperature limiter, temperature sensor and flame monitor are identical on 12 V and 24 V heaters.

Fuel for Thermo 90 ST B (gasoline):

The fuel specified by the manufacturer must be used.

Fuel for Thermo 90 ST D (diesel/PME):

The diesel fuel specified by the vehicle manufacturer must be used.

We know of no negative influences due to additives.

If fuel is extracted from the vehicle's tank, follow the additive instructions issued by the vehicle manufacturer.

If you change to low-temperature fuel, the heater must be operated for approx. 15 minutes so that the fuel system is filled with the new fuel.

The Thermo 90 ST D heater is also licensed for use with PME (bio-diesel), which complies with ASTM D6751 and DIN EN 14214.

HEATER	Operation	THERMO 90 ST B	THERMO 90 ST D	
EC licensing symbol		~S299	~S298	
Model		Water heater with Ferro-Tec Burner		
Heat Output	Boost max. Regulating range	N/A 2.0 kW – 7.6 kW (6830 – 25955 BTU/h)	9.1 kW (31078 BTU/h) 1.8 kW – 7.6 kW (6147 – 25955 BTU/h)	
Fuel		Gasoline	Diesel #1, #2, Arctic, PME and Kerosene	
Fuel Consumption	Boost max. Regulating range	N/A 0.25 l/h – 1.0 l/h (0.066 g/h – 0.264 g/h)	1.1 l/h (0.29 g/h) 0.19 l/h – 0.9 l/h (0.05 g/h – 0.24 g/h)	
Rated Voltage		12 V	12 V	24 V
Operating Voltage Range	V	10 – 15 V	10 – 15 V	20 – 30 V
Nominal power consumption with circulating pump	Boost max. Regulating range	N/A 37 W – 83 W	90 W 37 W – 83 W	
Max. ambient temperature: Heater: - Operation - Storage Control unit: - Operation - Storage Metering pump: - Operation - Storage		-40... +110 °C (90 °C with control unit installed on heater) -40... +230 °F (194 °F with control unit installed on heater) -40... +110 °C (90 °C with control unit installed on heater) -40... +230 °F (194 °F with control unit installed on heater) -40... +85 °C (-40... +185 °F) -40... +85 °C (-40... +185 °F) -40... +20 °C (-40... +68 °F) -40... +40 °C (-40... +104 °F) -40... +85 °C (-40... +185 °F)		
Permitted operating pressure (heat carrier)	Maximum	2.0 bar (29 PSI)		
Capacity of the heat exchanger		0.15 liters (0.16 quarts)		
Max. Combustion Air Inlet Temperature		+40 °C (104 °F)		
Minimum capacity of the circuit		6.0 liters (6.34 quarts)		
Delivery rate of the circulating pump against 0.15 bar		1650 l/h (435.8 g/h)		

HEATER	Operation	THERMO 90 ST B	THERMO 90 ST D
CO ₂ In Exhaust Gas (permitted function range)	Maximum	10... 12.0% by volume	
CO ₂ adjustment values at approx. +20 °C and geographic altitude above sea level	Maximum	0 m (0 ft) 500 m (1640 ft) 1000 m (3280 ft) 10% 10.6% 11.3%	
Heater dimensions (* Control unit installed on the heater)	tolerance ± 3 mm (± 0.12 in)	L 307 mm (352* mm) [12.08 in (13.85 in*)] W 131 mm (5.15 in) H 232 mm (9.13 in)	
Weight Of Heater		4.8 kg (10.6 lb)	

Table 1. Technical data (page 2 of 2)

5. TROUBLESHOOTING

5.1 GENERAL

This section describes how to identify and remedy faults on the Thermo 90 ST air heater.

If a fault occurs, an error code will be output in the display of the timer. If the heater has a switch, the ON control light will flash. In addition, the heater can be checked using a personal computer (see PC heater diagnostic operating manual).



CAUTION: *Troubleshooting work demands precise knowledge of the structure and theory of operation of the various components and must be carried out by trained personnel only.*

If in doubt, refer to sections 2 and 3 for a description of how the functions interact.



CAUTION: *As a rule, fault detection is restricted to the localization of defective components. The following potential sources of malfunctions are not taken into account and should always be checked so that they can then be excluded as the cause of the particular fault:*

- Corroded plugs
- Loose plug contacts
- Poor crimp contacts on plugs
- Corroded cables and fuses
- Corroded battery terminals
- Impermissibly high ambient temperature

Conduct a function test in the vehicle after rectifying each fault; switch the heater off and back on again first.

5.2 GENERAL FAULT INDICATIONS

The following table lists the possible general fault indications.

Fault Indication	Possible Cause	Remedy
Heater switches off automatically	No combustion after start and restart	Control unit enters fault lock-out status. Switch heater off and then on again.
	Flame extinguishes during operation	Contact a Webasto service facility if heater operation does not start again.
	Heater overheats due to lack or loss of coolant	Top up coolant. After the unit has cooled down, press the button on the temperature limiter to reset it before switching on or fit a new temperature limiter.
	Voltage failure longer than 20 seconds	Check fuses, plug connectors and charge condition of battery
	Switch off by temperature limiter	After the unit has cooled down, the temperature limiter will automatically reset itself.
	No flame recognition on start	Check flame monitor and connections

Table 2. General fault indications



NOTE: *In many cases, the burner may be one possible cause. Perform a visual check in accordance with 5.4*

5.3 FAULT INDICATIONS ON FAULT LOCK-OUT



NOTE: If the system is operated with a switch, the nature of the fault is indicated by a flashing code on an indicator light during the run-down time of the heater.

After five short signals, count the long flashes.

In the Thermo 90 ST heater with a standard timer, the fault is output on the timer display (see 3.5.2). The following table can be used accordingly.

Fault indication	Possible cause	Remedy
No function	Electrical cabling, fuses	Check fuses Check battery connections: + on 12 / – on 9 / + on 3, plug X8
	Control unit defective	Replace control unit
1 Flashing pulse (start did not occur)	Fuel system	Check fuel level Check fuel filter Bleed fuel system
	Combustion air/exhaust line	Check combustion air/exhaust line for foreign bodies and clean if necessary
	Burner	Clean burner and change if necessary
2 Flashing pulses (flame failure during burner operation)	Fuel supply	Check fuel level Check fuel filter Bleed fuel system
	Burner	Clean burner and change if necessary
3 Flashing pulses (under voltage)	Electrical power supply	Check battery Check electrical connections
4 Flashing pulses (flame monitor continuously hot)	Flame monitor defective	Replace flame monitor
5 Flashing pulses (flame monitor defective)	Cabling	Check cabling for damage, discontinuity and short-circuit
	Flame monitor defective	Replace flame monitor
6 Flashing pulses (temperature sensor defective)	Cabling	Check cabling for damage, discontinuity and short-circuit
	Temperature sensor defective	Replace temperature sensor

Fault indication	Possible cause	Remedy
7 Flashing pulses (metering pump defective/ (overheating guard circuit defective)	Coolant circuit Cabling Metering pump defective	Check coolant level Bleed coolant circuit Check cabling for damage, discontinuity and short-circuit Replace metering pump
8 Flashing pulses (combustion air fan defective)	Cabling Combustion air fan defective	Check cabling for damage, discontinuity and short-circuit Replace combustion air fan
9 Flashing pulses (glow pin defective)	Cabling Ceramic glow pin defective	Check cabling for damage, discontinuity and short-circuit Replace glow pin
10 Flashing pulses (overheating)	Heater overheats	Check coolant and top up if necessary. After the unit has cooled down, the temperature limiter will automatically reset itself.
11 Flashing pulses (circulating pump defective)	Cabling Circulating pump defective	Check cabling for damage, discontinuity and short-circuit Replace circulating pump

Table 3. Fault indications on fault lock-out
(Page 2 of 2)

5.3.1 PERMANENT HEATER FAULT LOCK-OUT

A permanent fault lock-out is indicated by five short flash pulses with no long flash pulses following.



NOTE: The permanent fault lock-out serves as a safety feature for the customer.

Failure	Consecutive number of failed start attempts	Remedy
F 01 No start / no flame formation F 03 Under voltage or over voltage F 04 Premature flame detection F 05 Flame monitor F 06 Temperature sensor F 07 Fuel pump F 08 Fan motor F 09 Ceramic glow pin F 10 Overheat condition F 11 Coolant circulating pump	After <u>3</u> consecutive attempts, of any one of the listed fault indicators, the heater and control unit are locked out with no further start attempts possible.	See appropriate fault indication in Table 3. After eliminating the cause of a heater fault lock-out: 1. Using switch or standard timer, turn heater on. 2. Remove the main power connection to heater from battery or pull fuse for a minimum of 20 seconds. 3. Using switch or standard timer control, turn heater off.
F 02 Flame failure	After <u>6</u> consecutive attempts, heater and control unit are locked out.	4. Reinstall main power connection where previously disconnected. Contact a Webasto service facility if heater operation cannot be restored.

Table 4. Permanent heater fault lock-out

5.4 VISUAL CHECK FOR ASSESSING THE BURNER

The burner and the evaporator in the heater display specific characteristics when they must be replaced or do not have any fault source.

The criteria of a correct check are listed below.

5.4.1 BURNER HOUSING

- The start air hole (item 9, Fig. 10) must be clear otherwise no start will occur.

Remedy

Carefully remove impurities from the start air hole (e.g. using a 1.5 mm or 1/16 in. diameter wire). Remove the glow pin first.

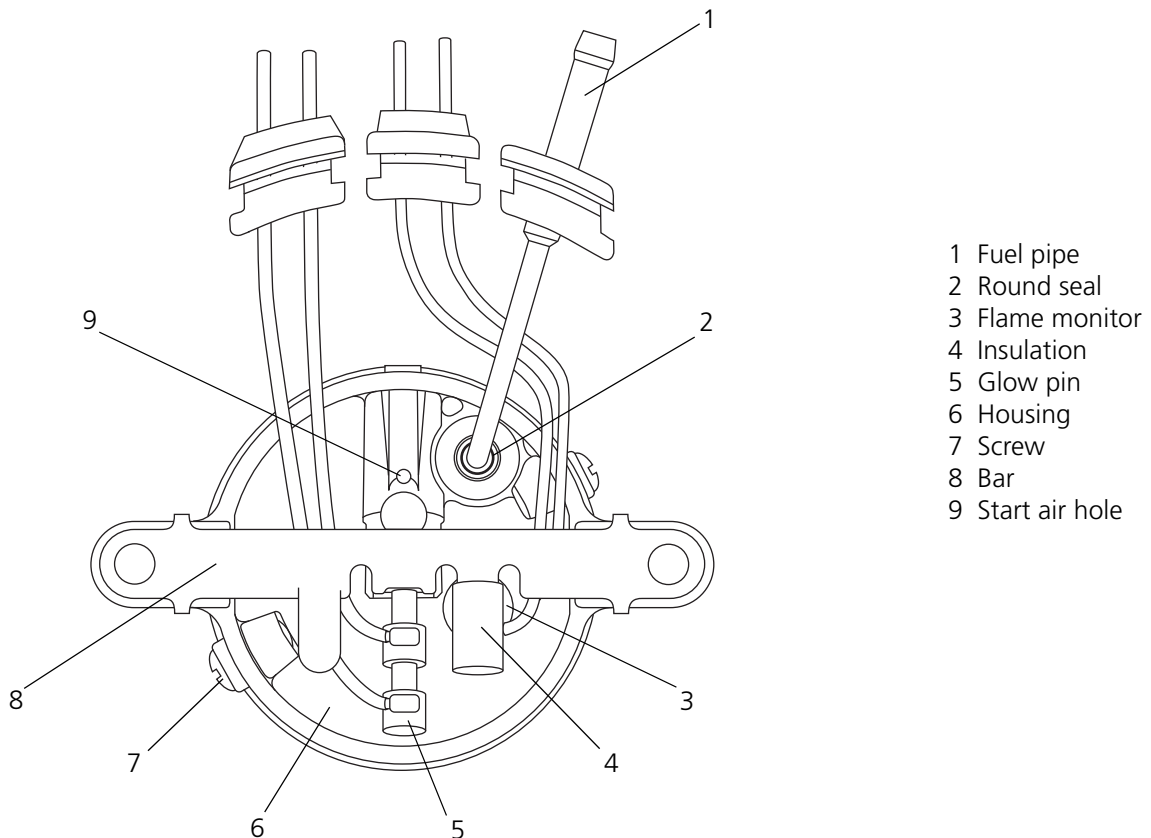


Figure 10: Visual check, burner back wall

5.4.2 BACK WALL WITH METAL EVAPORATOR

The pilot flame outlet opening (Fig. 11) must be clear otherwise no start will occur.

Remedy

Replace burner

- Cracks, flaking as well as black or other discoloration of the evaporator do not lead to burner failure and are not significant.
- Coke deposits on the evaporator surface (except for the pilot flame outlet opening) are normal; as a rule, the burner cleans itself due to the load changes from full load to part load and part load to full load.

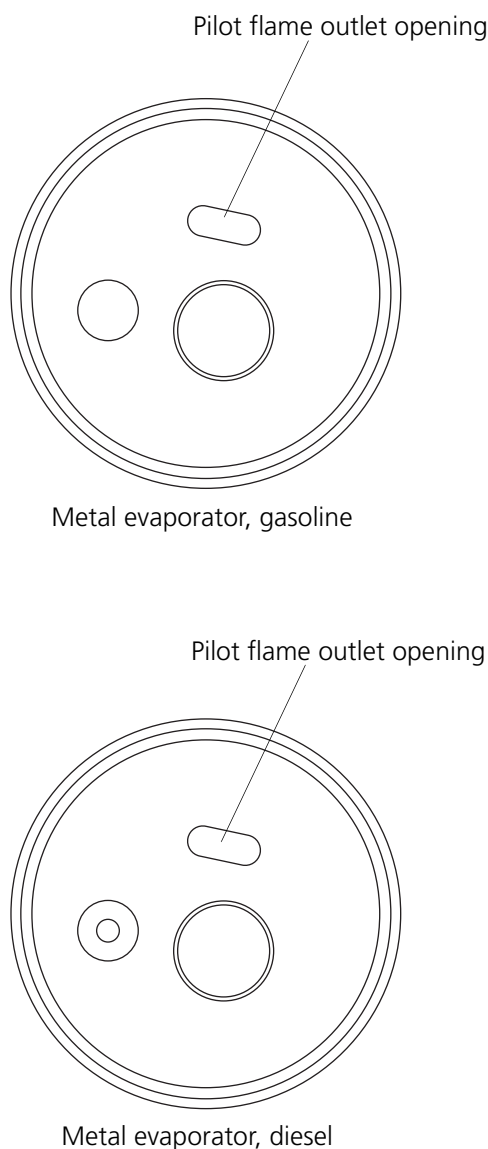


Figure 11: Visual check, pilot flame outlet opening

5.4.3 COMBUSTION CHAMBER

- The combustion chamber (Fig. 12) should not be damaged (e.g. dented). A dented combustion chamber can lead to poor combustion or carbon build-up in the heater.

Remedy

Replace burner

- The air holes (Fig. 12) in the combustion chamber must not be blocked up by carbon deposits. If the air holes are blocked up by carbon deposits, this may result in failure of combustion to start or to run effectively.

Remedy

Carefully scratch clear the air holes

5.4.4 COMPLETE BURNER

- The cables of the glow pin and flame monitor must be routed as shown in Fig. 10.
- The screw connection of the housing and combustion chamber (Fig. 12) must be tight.
- The housing and the combustion chamber (Fig. 12) must be firmly connected together and there must not be any play (check by moving the fuel pipe slightly).
- The round sealing ring (item 2, Fig. 10) must evenly surround the fuel pipe and must not leak.
- The distance (gap) between the edge of the housing and the top edge of the combustion chamber (Fig. 12) does not have to be even all the way around.
- The insulation (item 4, Fig. 10) must not be missing.

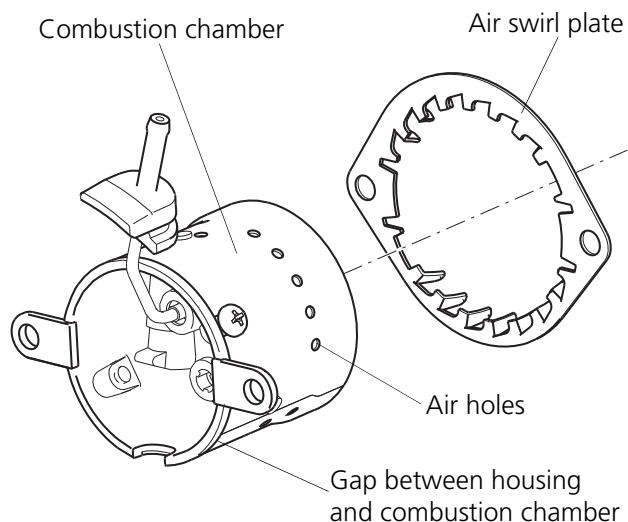


Figure 12: Visual check, complete burner

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6. FUNCTIONAL TESTS

6.1 GENERAL

This section describes the tests conducted on the heater when it is installed and not installed to verify that it is in working order.



WARNING: *The heater must not be operated in enclosed areas such as garages and workshops without an emissions extraction system.*

6.2 SETTINGS

6.2.1 SETTING THE CO₂ CONTENT

It is permitted for the factory-set combustion air quantity to be modified. This is achieved by turning the air regulating screw.

Setting procedure

Turning clockwise: CO₂ value is reduced (let the heater run for about 5 minutes before measuring).

Rough setting: Screw the adjusting screw fully in clockwise and then one turn back



CAUTION: *The CO₂ measuring instruments must be calibrated.*

6.3 TESTING INDIVIDUAL COMPONENTS

6.3.1 RESISTANCE TEST OF THE TEMPERATURE SENSOR

If you conduct this electrical test with a digital multimeter, the temperature sensor should have the following values at room temperature:

Resistance at 25 °C: 990 ... 1010 Ω

Test current: < 1 mA

6.3.2 RESISTANCE TEST OF THE CERAMIC GLOW PIN

If you conduct this electrical test with a digital multimeter, the glow pin should have the following values:

Glow pin:	12 V (red)	24 V (green)
Resistance at 25 °C :	0.3 ... 0.6 Ω	1.3 ... 1.44 Ω
Resistance at 77 °F :	0.3 ... 0.6 Ω	1.3 ... 1.44 Ω
Test current:	< 5 mA	< 5 mA

6.3.3 RESISTANCE TEST ON THE FLAME MONITOR

If you conduct this test with a digital multimeter, the flame monitor must have the following values:

Cold Testing:

Resistance at 25 °C (77 °F): 3.0 ± 0.4 Ω

Test current: < 5mA

Hot Testing:

Resistance at 800 ± 20 °C: 8 ± 1.0 Ω

Resistance at 1472 ± 36 °F: 8 ± 1.0 Ω

(ceramic rod at red heat over length of approx. 20 mm)

Test current: < 5 mA

6.3.4 TESTING THE COMBUSTION AIR FAN

The motor speed test must be performed with the heater assembled and in the operating voltage range. Listen out for grinding noises.



NOTE: *The cover must be removed from the fan in order to check the motor speed. Install a new seal before re-installing.*



CAUTION: *Make sure the detent lugs do not break off. Fit a new cover and a new seal if the detent lugs have broken off.*

Speed in control range min. 1800 rpm (±9%)

Speed in control range max. 5600 rpm (±9%)

Install a new combustion air fan if the speeds are outside tolerance (see 9.2.4).

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7. CIRCUIT DIAGRAMS

7.1 GENERAL

The circuit diagrams (Figs. 13 and 14) show the possible circuits for the Thermo 90 ST heater with

- Standard switch
- Standard timer

7.2 THERMO 90 ST CIRCUIT DIAGRAM LEGEND

① Digital timer P2:

Connection X14 to Red jumper of switch harness results in continuous operation with immediate heating (recommended for trucks requiring sleeper heating)

Connection X14 to vehicle ignition connection results in variable heating duration that can be programmed (10 min. to 120 min.); default setting 120 min. when ignition key is switched off. (Recommended for School bus, Coach and Transit vehicles.)

② Optional connection to vehicle instrumentation panel lighting circuit.

The following Table applies to Figures 13 and 14.

Item	Designation	Comment
A1	Heater	
A2	Control module	
B1	Flame sensor	
B2	Temperature sensor	
B3	Temperature limiter/ Overheating guard	
B4	Room thermostat	
BT	Battery	Vehicle battery
DS	Illuminated toggle	Operating indicator (in item S1)
E	Glow plug	
F1	Fuse 10 A	ATM mini flat fuse
F2	Fuse 5 A	ATM mini flat fuse
F3	Fuse 20 A	ATM mini flat fuse
H1	“Heating” symbol in the display	Operating indicator (in item P2)

Item	Designation	Comment
H3	Symbol light	Light (in item P2)
H6	Red LED	Immediate heat button light, ready indicator, switch-on control (in item P2)
K1	Relay	Vehicle fan interface harness option
M1	Motor	Combustion air fan
M2	Motor	Circulating pump
P2	Digital timer 1531	For programmed operation
S1	Toggle switch	ON/OFF
X1	Plug connector, 4-pin	To item A2
X2	Plug connector, 2-pin	To item A2
X3	Plug connector, 2-pin	To item A2
X4	Plug connector, 2-pin	To item A2
X5	Plug connector, 2-pin	To item A2
X6	Plug connector, 2-pin	To item A2
X7	Plug connector, 2-pin	To item A2
X8	12-pin plug connection	To item A2
X9	12-pin plug connection	To item P2
X10	Plug connector, 2-pin	W-Bus Diagnostics
X11	Plug connector, 2-pin	To Y1
X12	9-pin plug connection	Power/Control Harness
X13	Plug connector, 8-pin	To X9 of item P2
X14	Plug connector, 1-pin	To pin-10 of item X9 (see ①)
X15	Plug connector, 3-pin	To optional blower interface systems (Sleeper Pak™)
X16	5-pin relay socket	Vehicle fan interface harness option
Y1	Metering pump	Fuel pump for heater

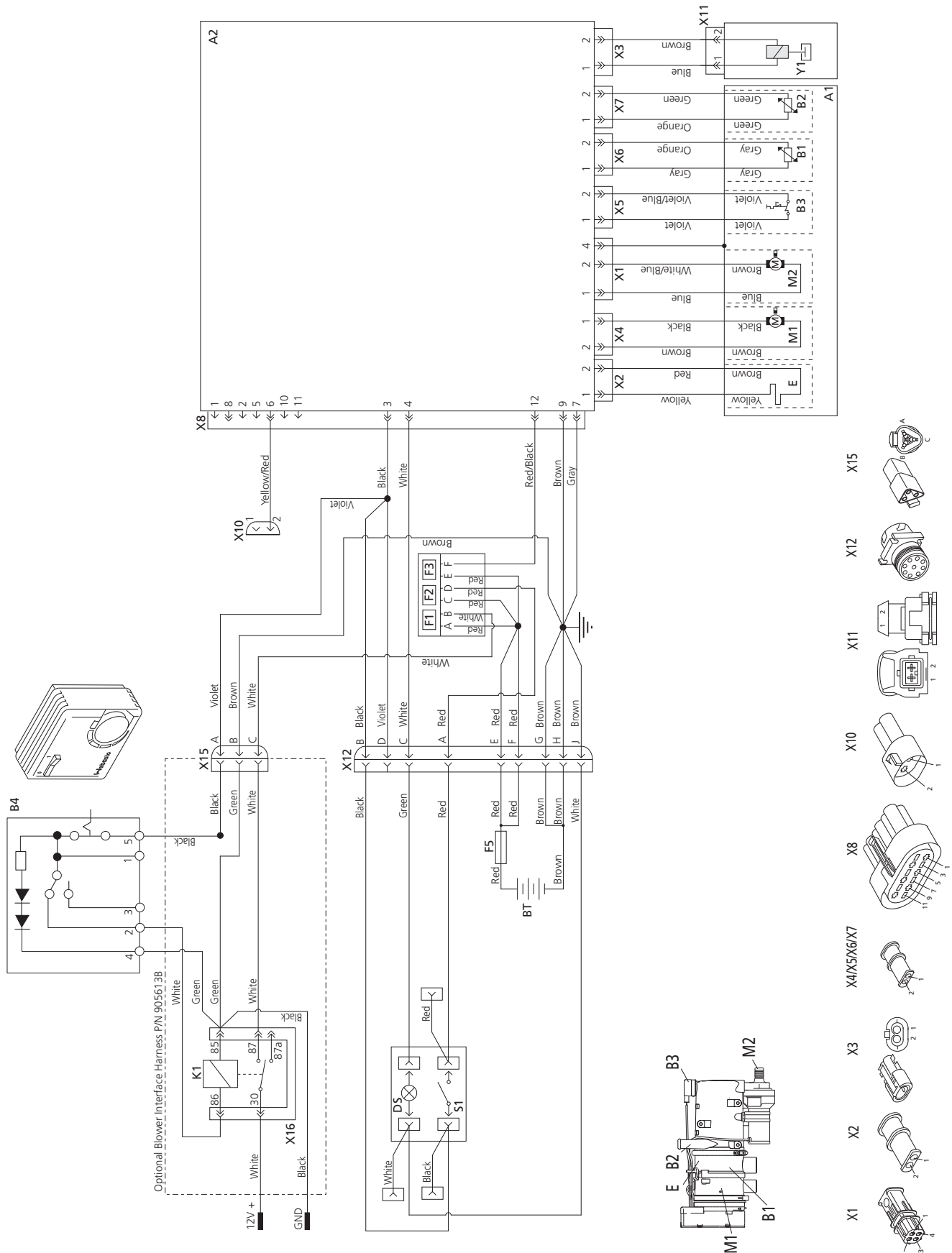


Figure 13: Thermo 90 ST with On/Off switch - connection diagram (Includes optional blower interface harness)

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8. SERVICING WORK

8.1 GENERAL

This section describes the servicing work that can be carried out on the heater when it is installed.

8.2 WORK ON THE HEATER

Disconnect the main power cable from the vehicle's battery before carrying out any work on the heater. The main battery power must not be disconnected whilst the heater is operating or slowing down as a result of the risk of the heater overheating and the overheating guard thus being tripped.

If you wish to carry out extensive repair work on the heater, it may be a good idea to remove it completely. After working on the heating circuit, top up with a coolant mixture of water and antifreeze according to the manufacturer's instructions and carefully bleed the heating circuit.

Refer to the relevant installation instructions and the installation proposal for the heater for the specific vehicle for repairs that necessitate the installation position being changed.

8.3 WORK ON THE VEHICLE



CAUTION: A temperature of 90 °C (194 °F) must not be exceeded in the vicinity of the heater in any circumstances (for example when completing painting work on the vehicle). See Section 4.

8.4 HEATER TRIAL



WARNING: The heater must not be operated in enclosed areas such as garages and workshops without an emissions extraction system, even if the heater is equipped with a timer.

8.5 SERVICE WORK



NOTE: The heater should be operated for approximately 20 minutes every 4 weeks to prevent mechanical parts seizing.

The following service work is to be carried out after or before each heating period to maintain the functional reliability of the heater:

- Clean the exterior of the heater (avoid the ingress of water).
- Check the electrical connections for contact corrosion and to ensure that they are secure.
- Check the exhaust and combustion air lines for signs of damage and to ensure that they are clear.
- Check the fuel line and filter for leaks.
- Check the coolant circuit and circulating pump for leaks.
- Inspect hoses for cracks.
- Replace the fuel filter if there is one.

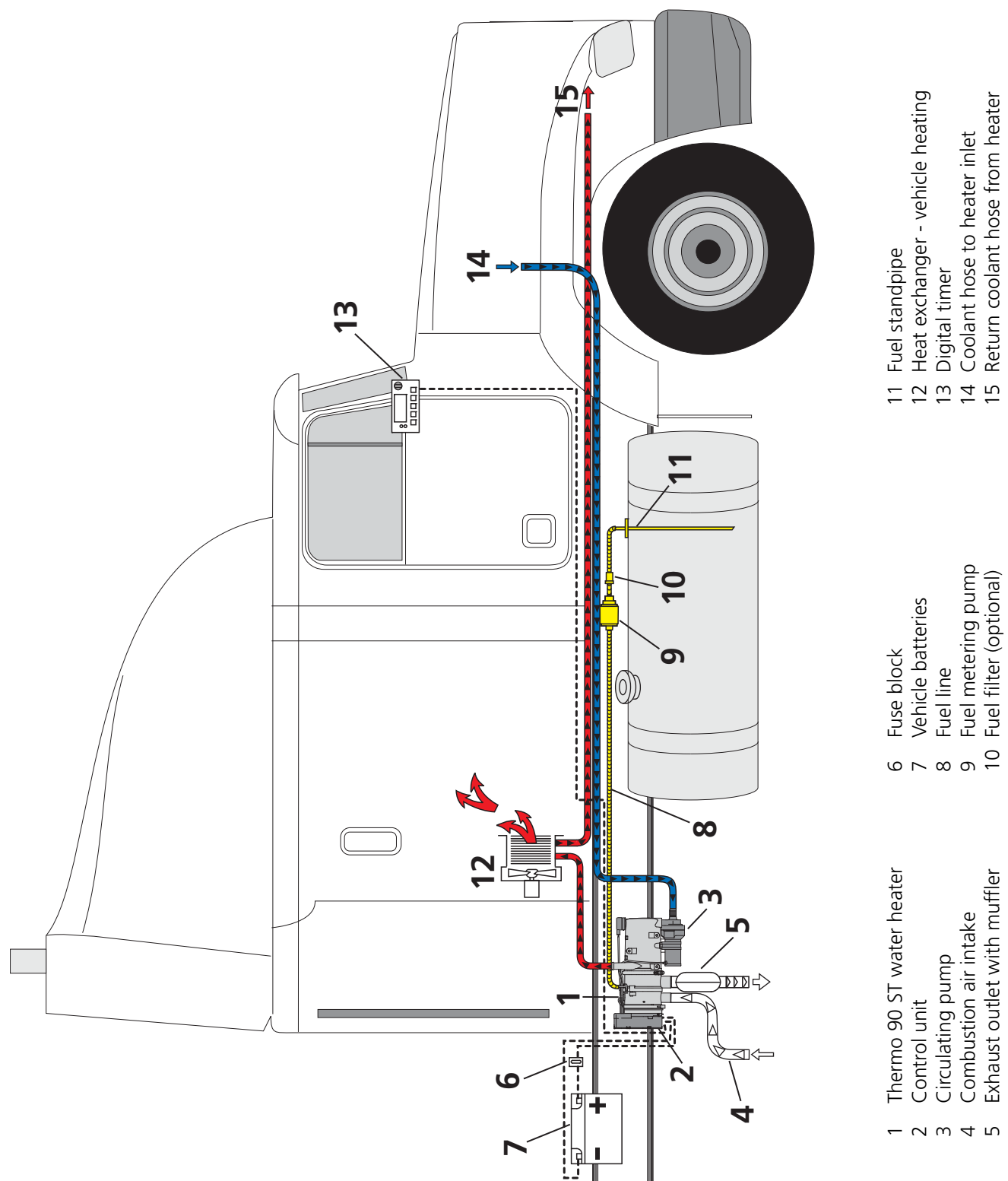


Figure 15: Installation example of a heater in a truck

8.6 VISUAL INSPECTIONS AND INSTALLATION INSTRUCTIONS

8.6.1 CONNECTION TO THE VEHICLE COOLING SYSTEM

In thermostat circuits, only use thermostats which start to open at < 65 °C (< 149 °F).

The heater should be installed in as low a position as possible to allow the heater and circulating pump to be bled automatically.

This is particularly important as the circulating pump is not self-priming.

The heater is connected to the vehicle cooling system as shown in Fig. 15. The system must contain at least 6 liters (6.34 quarts) of coolant.

The coolant hoses supplied by Webasto must always be used. If you do not use these hoses, the hoses that you do use must comply with DIN 73411. The hoses must be installed without kinks and (to ensure proper bleeding) rising if possible.

Hose connections must be supported by hose clips to prevent them slipping.



NOTE: The hose clips must be tightened with a torque of 4 Nm.

The cooling system must be bled carefully before using the heater for the first time or after replacing the coolant. The heater and lines should be installed in such a way as to ensure static bleeding.

Proper bleeding can be identified by the circulating pump operating almost silently. Poor bleeding may cause the resetting temperature limiter to trip while the heater is in operation.

8.6.2 CONNECTION TO THE VEHICLE FUEL SYSTEM

The fuel is taken from the vehicle fuel tank or from a separate fuel tank.

The values for the maximum pressure at the fuel extraction point are shown in the table below.

Permissible fuel inflow height H (m)	At max. pressure (bar) in fuel line
0.00 m (0.00 in.)	0.20 bar (2.9 PSI)
1.00 m (39.4 in.)	0.11 bar (1.6 PSI)
2.00 m (78.7 in.)	0.03 bar (0.44 PSI)
Maximum fuel intake height S (m)	At max. negative pressure (bar) in fuel tank
0.00 m (0.00 in.)	-0.10 bar (-1.45 PSI)
0.50 m (19.7 in.)	-0.06 bar (-0.87 PSI)
1.00 m (39.4 in.)	-0.02 bar (-0.29 PSI)



NOTE: A sign must be affixed to the fuel filler neck warning that the heater must be switched off before refuelling.

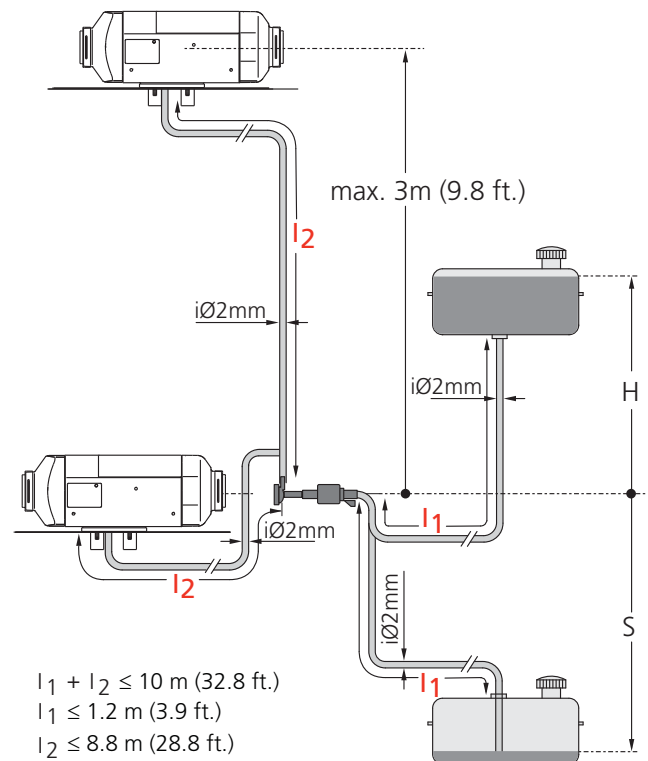


Figure 16: Fuel supply

8.6.2.1 FUEL EXTRACTION

Vehicles with Diesel Engines

The fuel must be taken from the vehicle fuel tank or from a separate tank (Figs. 17, 18 and 19).

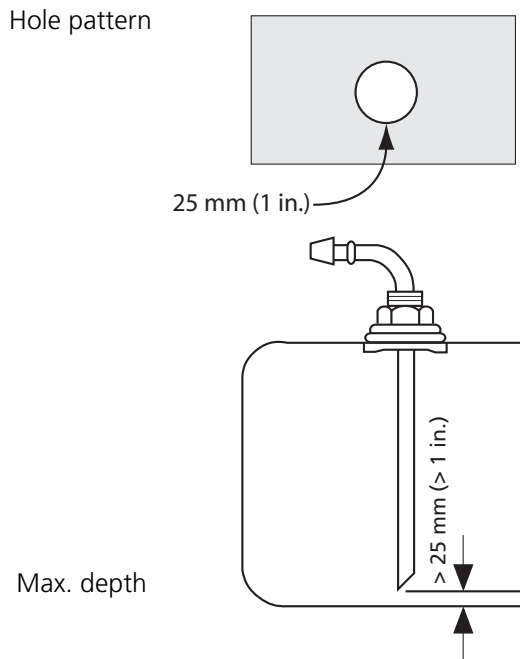


Figure 17: Webasto fuel standpipe



NOTE: Only use this style of standpipe with metal fuel tanks.

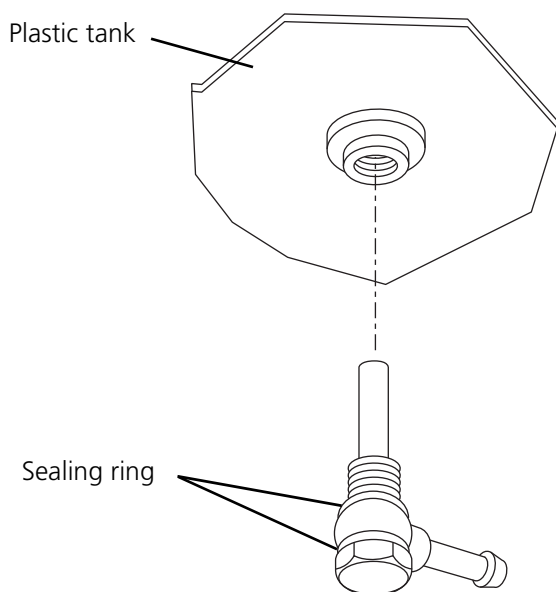


Figure 18: Fuel extractor from a plastic or metal tank (extraction through tank drain screw)

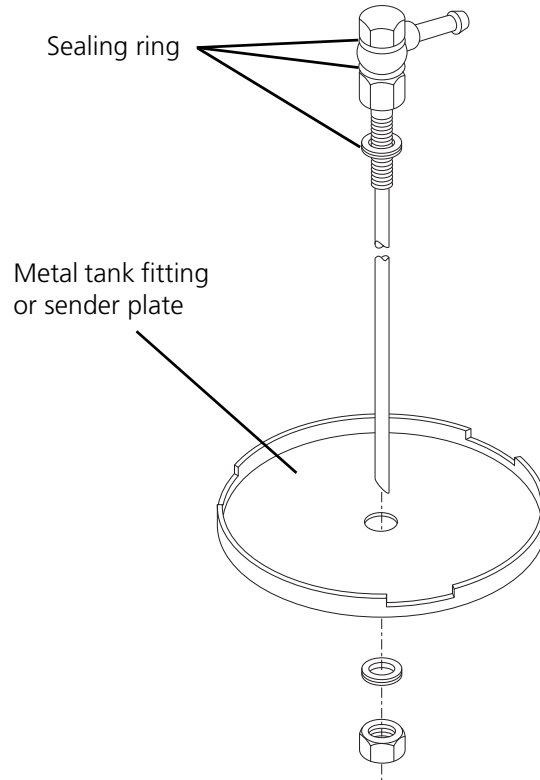


Figure 19: Fuel standpipe for a plastic or metal tank (extraction through metal tank fitting)



NOTE: Deburr the cut on the fuel extractor after sawing it off and remove any metal chips

Vehicles with Gasoline Engines

The heater must be integrated into the return line of fuel systems in carburetor and injection engines with a return line.

In carburetor engines without a return line the heater must be integrated into the fuel system in the supply line between the fuel tank and the vehicle pump.

IMPORTANT!

- A fuel feed line can normally be identified by the fact that a fuel filter is installed in it.
- If there is an evaporation tank in the vehicle's fuel system, the fuel must be extracted upstream of the evaporation tank.

Fuel may only be taken from the supply or return line using the special Webasto fuel extractor tee (Fig. 20). The fuel extractor must be fitted in such a way that any air or gas bubbles are automatically discharged towards the tank (Fig. 20). Air or gas bubbles may be produced in the vehicle's fuel line if there are leaks in the carburetor

or vehicle fuel pump or if the ambient temperature is higher than the evaporation temperature of the fuel.

The fuel extractor should not be located near the engine, as gas bubbles may form in the lines on account of heat radiated from the engine. This may cause problems during combustion.

When installing the heater in a vehicle with fuel injection system, it is important to establish whether the fuel pump is located inside or outside the tank. If the fuel pump is located inside the tank, fuel can only be extracted from the return line. In this case it must be ensured that the return line continues almost to the bottom of the tank and is not sealed by a non-return valve. If this is not the case the return line may be extended. If the fuel pump is installed outside the tank, the fuel connection may be made between the tank and the fuel pump.

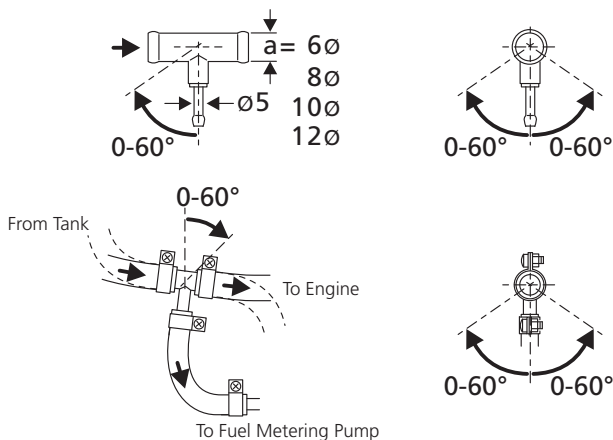


Figure 20: Webasto fuel extractor tee installation

8.6.2.2 FUEL LINES

Only steel, copper and plastic lines of plasticized, light and temperature-stabilized PA11 or PA12 (for example Mecanyl RWTL) according to DIN 73378 may be used for the fuel lines.



NOTE: Cut Mecanyl lines without burr and do not crush them. Do not cut them with side-cutting pliers.

Since the lines cannot normally be routed with a constant rising gradient, the internal diameter must not be allowed to exceed a certain size. Air or gas bubbles will accumulate in lines with an internal diameter of more than 4 mm (5/32 in) and these will cause malfunctions if the lines sag or are routed downwards. The diameters specified in Fig. 16 will ensure that bubbles do not form.

The lines should not be routed downwards from the metering pump to the heater.

Unsupported fuel lines must be secured to prevent them sagging. They must be installed in such a way that they cannot be damaged by flying road debris and high temperatures (exhaust line).

The fuel lines must be secure at the connections using hose clips to prevent their slipping.

Connecting Two Fuel Lines with a Hose

The correct procedure for connecting fuel lines with hosing is shown in Fig. 21.

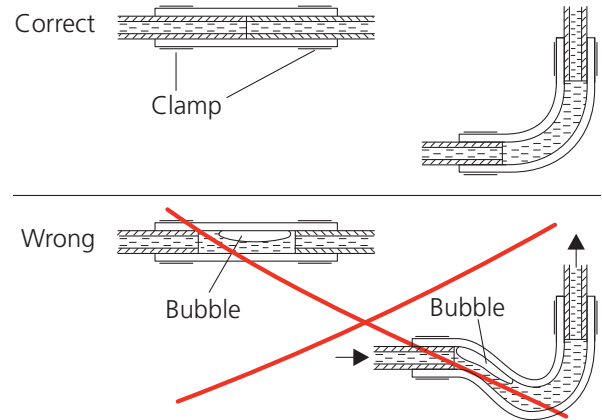


Figure 21: Fuel line connections

8.6.3 FUEL METERING PUMP

The metering pump is a combined delivery, metering and shut-off system and is subject to certain installation criteria (Fig. 16 and 22).

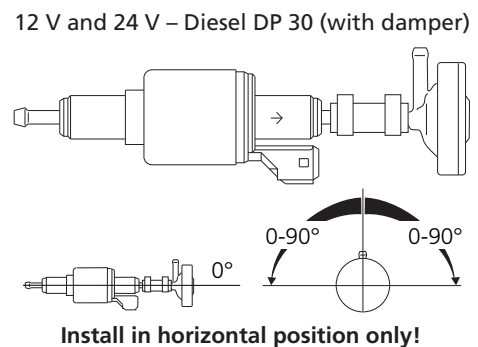


Figure 22: Metering pump, installation position and attachment

8.6.3.1 INSTALLATION POSITION

Before installing the fuel metering pump, ensure that the maximum pressure occurring at the fuel pickup point is less than 0.2 bar (2.9 PSI).

It is advisable to install the metering pump in a cool place. The maximum ambient temperature must not exceed +20 °C (+68 °F) for gasoline and +40 °C (+104 °F) for diesel at any time during operation.

The metering pump and fuel lines must not be installed within range of the radiated heat from hot vehicle parts. A heat shield must be used if necessary.

The pump should ideally be installed near the tank.

8.6.3.2 INSTALLATION AND ATTACHMENT

The metering pump must be secured with a vibration-damping mounting. Its installation position is limited as shown in Fig. 22 in order to ensure effective automatic bleeding.

As a result of the risk of corrosion, only genuine Webasto parts may be used for the plug connections between the metering pump and the metering pump wiring harness.

8.6.4 FUEL FILTER

Only a Webasto filter, P/N 50487171A, is allowed to be used if the fuel is expected to be contaminated. Install vertically if possible, however at most horizontally (check flow direction).

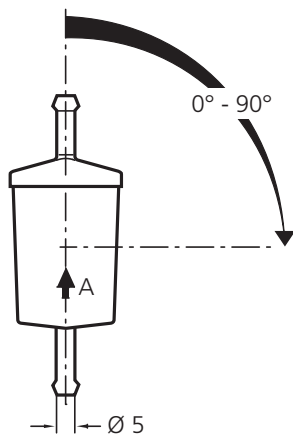


Figure 23: Fuel filter

8.6.5 COMBUSTION AIR SUPPLY

Under no circumstances may the combustion air be taken from areas occupied by people. The combustion air intake opening must not point in the direction of travel.

It must be located so that it cannot become clogged with dirt or snow and cannot suck in splashing water.

The combustion air intake line (internal diameter at least 30 mm) may be 0.5 m to 5 m long with several bends totalling 360°. Minimum bending radius is 45 mm.

The combustion air inlet must not be routed above the exhaust outlet.



NOTE: If the combustion air intake line cannot be installed so that it slopes downwards, a water drain hole with a diameter of 4 mm (5/32 in) is to be made at its lowest point.

If the heater is installed in a general installation space near the vehicle's fuel tank, the combustion air must be taken in from the outside and the exhaust fumes discharged into the atmosphere. The openings must be splash-proof.

A ventilation opening measuring at least 6 cm² (1 in²) is required if the heater is installed in an enclosed box. The size of the ventilation opening must be increased accordingly if the temperature in the box exceeds the permitted ambient temperature of the heater (see Technical data).

8.6.6 EXHAUST LINE

The exhaust line (internal diameter 38 mm) can be installed with a length of 0.5 m to 5 m and several bends (360° altogether, minimum bending radius 85 mm). The exhaust muffler is essential and must be installed near the heater.

An attachment is required no further than 150 mm (6 in) from the end of the exhaust pipe to ensure that the angle of 90° ± 10° is achieved.

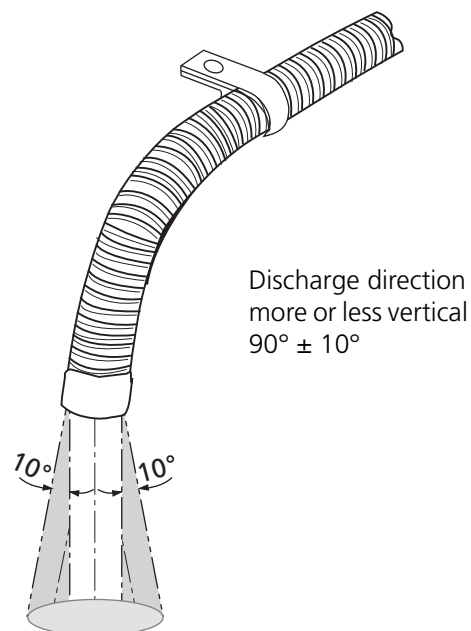


Figure 24: Exhaust pipe opening, installation position

The opening of the exhaust pipe must not point towards the front of the vehicle (see Figure 24).

The exhaust pipe opening must be located so that it cannot become clogged with snow and mud.

Rigid pipes of unalloyed or alloyed steel with a minimum wall thickness of 1.0 mm or flexible piping of alloyed steel only must be used as the exhaust line. The exhaust pipe is secured to the heater using a clamping collar, for example. See your local jurisdiction for statutory regulations for other requirements that may be in force.

8.7 REMOVAL AND INSTALLATION



CAUTION: When the heater is installed, only the following dismantling or removal procedures are permitted providing the upper cover cap is accessible and can be removed, and there is sufficient room for removal:

- Changing the circulating pump
- Changing the temperature limiter
- Changing the temperature sensor
- Changing the combustion air fan
- Changing the control unit

8.7.1 HEATER, REMOVAL AND INSTALLATION

8.7.1.1 REMOVAL

1. Disconnect the battery.
2. Remove the upper cover cap.
3. Disconnect the wiring harness plug from the heater.
4. Disconnect the connection for the combustion air inlet on the heater.
5. Unfasten the hose clips and pull the coolant hoses off the heater.
6. Disconnect the connections for the combustion air inlet and exhaust outlet on the heater.
7. Remove three screws and washers from the heater holder.
8. Remove the heater.

8.7.1.2 INSTALLATION

1. Position the heater in its installation position and screw in 3 screws with washers to attach it.
2. Connect the coolant hoses and secure with hose clips. Tighten the hose clips to 5 Nm (44 lb-in).
3. Secure the connection for the combustion air inlet on the heater.
4. Secure the connections for the combustion air inlet and exhaust outlet on the heater.
5. Connect the wiring harness plug to the heater.
6. Put on the top cover cap and lock it in place.
7. Connect the battery.
8. Bleed the fuel supply system.
9. Bleed the coolant circuit.

8.7.2 CHANGING THE CIRCULATING PUMP



NOTE: The process for changing the circulating pump is the same irrespective of whether the heater is installed or removed. Change as described in 9.2.1.

8.7.3 CHANGING THE TEMPERATURE LIMITER



NOTE: The process for changing the temperature limiter is the same irrespective of whether the heater is installed or removed. Change as described in 9.2.2.

8.7.4 CHANGING THE TEMPERATURE SENSOR



NOTE: The process for changing the temperature sensor is the same irrespective of whether the heater is installed or removed. Change as described in 9.2.3.

8.7.5 CHANGING THE COMBUSTION AIR FAN



NOTE: The process for changing the combustion air fan is the same irrespective of whether the heater is installed or removed. Change as described in 9.2.4.

8.8 START-UP

After you have installed the heater, bleed the coolant circuit and the fuel supply system carefully. Comply with the instructions given by the vehicle manufacturer when doing this. During the trial run, check all coolant and fuel connections for leaks and to ensure that they are secure. If the heater suffers a fault during operation, the fault must be located and remedied (see section 5).

Before starting the heater for the first time, complete the following checklist.

HEATER MOUNTING		Complete (Yes/No/Comments)
1	Is the heater installation safely secure / rigid? (Ensure that all bracket bolts are tight)	
2	Is there a safe clearance from heat generating Components? (I.e. exhaust, etc...)	
3	Is there sufficient clearance between heater and any vehicle moving components under all operating conditions? (steering cranked to extreme positions, torqued engine, suspension, etc...)	
4	Is the heater mounted in an acceptable position according to the limitations noted in the installation manual?	
5	Is the heater installed in a protected location from road debris and splash-water or items stored in the same area?	
6	Is there a sufficient amount clearance between the heater and the ground? (Coolant heaters only)	

COOLANT SYSTEM		Complete (Yes/No/ Comments)
1	Is there a safe clearance (min 4 in.) from heat generating components? (exhaust, etc...)	
2	Is there a safe clearance from sharp edges / objects? Ensure a heat protective has been installed (if applicable)	
3	Are there any kinks, sharp bends or the possibility for pinched hoses or harnesses, cuts and rub through?	
4	Have all the hose clamps been properly positioned and tightened?	
5	Has the coolant system been topped off and bleed per the vehicle manufacture's specifications for proper mixture and type?	
6	Has a pressure test been performed on the coolant system under all operating conditions?	
7	Have the coolant hoses been installed so that they are below the coolant filler cap?	
8	Has the coolant flow direction been verified?	

ELECTRICAL		Complete (Yes/No/Comments)
1	Has all wiring been safely secured away from moving components and / or heat sources?	
2	Check for proper power and ground connections.	
3	Has blower motor functionality been tested (if applicable)?	
4	Check for proper fuse tap connection.	
5	Verify the correct fuses are in the specified locations per the installation manual.	
6	Ensure heater and vehicle fuse boxes are closed and secure. Was the Webasto fuse block installed in a location protected from water and / or moisture?	
7	Ensure blower motor resistor (1.0?) is securely mounted and has sufficient clearance from any plastic component and battery.	
8	Ensure battery is mounted securely and connections are properly tightened.	
9	Ensure battery is at ? 12.2Vdc.	

FUEL SYSTEM		Complete (Yes/No/ Comments)
1	Is the standpipe properly mounted in the fuel tank? (sealed, structural integrity maintained).	
2	Validate the standpipe does not interfere with function of sending unit by checking fuel gauge for proper operation before completing installation of tank.	
3	Verify that all fuel lines are properly secured and are a safe distance (min. 4 in.) from exhaust systems and / or moving components.	
4	Check all fuel lines for leaks or kinks.	
5	Check fuel line clamps for proper positioning and tightness. Ensure fuel system is free of leaks.	
6	Ensure fuel pump is securely mounted in a cool location NOTE: Vehicle fuel tank area is generally a location with minimal sound transfer path to vehicle interior.	

EXHAUST SYSTEMS		Complete (Yes/No/Comments)
1	Is the muffler and clamps securely tightened?	
2	Has muffler and exhaust tube been routed a safe distance (min. 2 in.) from flammable material?	
3	Ensure drain-holes are drilled in low bend areas of exhaust tube.	
4	Ensure exhaust is venting a safe distance from any vehicle interior openings.	
5	Ensure exhaust is venting in the direction that will not cause back pressure while driving.	

COMBUSTION AIR INTAKE		Complete (Yes/No/Comments)
1	Is the combustion air intake drawing fresh air from a non-turbulent location? (i.e. not in direction of travel)	
2	Ensure air intake system is securely fastened.	

HEATER FUNCTION		Complete (Yes/No/ Comments)
1	Ensure heater starts and runs for a minimum of 20 minutes.	
2	Ensure vehicle blower turns "ON".	
3	Ensure warm air is blown out of interior vents after blower is activated.	
4	Ensure timer (control device) is functioning.	
5	Check and Modify CO2 setting as needed based on altitude (will the heater "live" or spend a lot of time above XXXXXX Feet) (See service manual for instructions to make adjustment)	

COSMETICS		Complete (Yes/No/ Comments)
1	Has the vehicle interior, engine compartment, trunk & glove compartment been inspected for cleanliness after installation.	
2	Has user manual placed in glove box?	
3	Is the vehicle clock time correct after disconnecting the battery?	

If you have any questions, contact our technical support team at (800) 860-7866 or via email at:

info-us@webasto.com.

This page for your notes.

9. REPAIR

9.1 GENERAL

This section describes the repair work that may be carried out on the Thermo 90 ST heater after it has been removed from the vehicle. Any further dismantling will invalidate the warranty. Only use the spare parts from the appropriate spare parts kits for assembling the heater.

9.1.1 WORK ON STRIPPED-DOWN COMPONENTS



CAUTION: *All sealing elements between the stripped-down components must always be discarded and replaced with new.*

9.1.1.1 CLEANING

- Clean all stripped-down components.
- Remove all seal residue on the components carefully using a suitable tool.

9.1.1.2 VISUAL INSPECTION

- Check all components for damage (cracks, deformation, wear, etc.) and fit new ones if necessary.

- Inspect the plugs and cables for corrosion, loose contacts, crimping faults, etc. and repair them if necessary.
- Check plug contacts for signs of corrosion and to ensure they are secure. Repair them if necessary.

9.2 DISMANTLING AND ASSEMBLING

9.2.1 REPLACING THE CIRCULATING PUMP

9.2.1.1 REMOVAL

1. Remove the heater (see 8.7.1.1).
2. Remove the screws (4, Fig. 25).
3. Remove the clip (3) and circulating pump (2).
4. Unplug electrical cable from control unit.
5. Complete the work on stripped-down components (see 9.1.1).

9.2.1.2 INSTALLATION

1. Apply acid-free grease (Vaseline) to the sealing ring (1, Fig. 25).
2. Place the circulating pump (2, Fig. 25) in the assembly position and attach with the clip (3) and screws (4).
3. Tighten the screws (4) to 3 Nm (26.5 lb-in) $\pm 10\%$.
4. Plug electrical cable into control unit.
5. Install the heater (see 8.7.1.2).

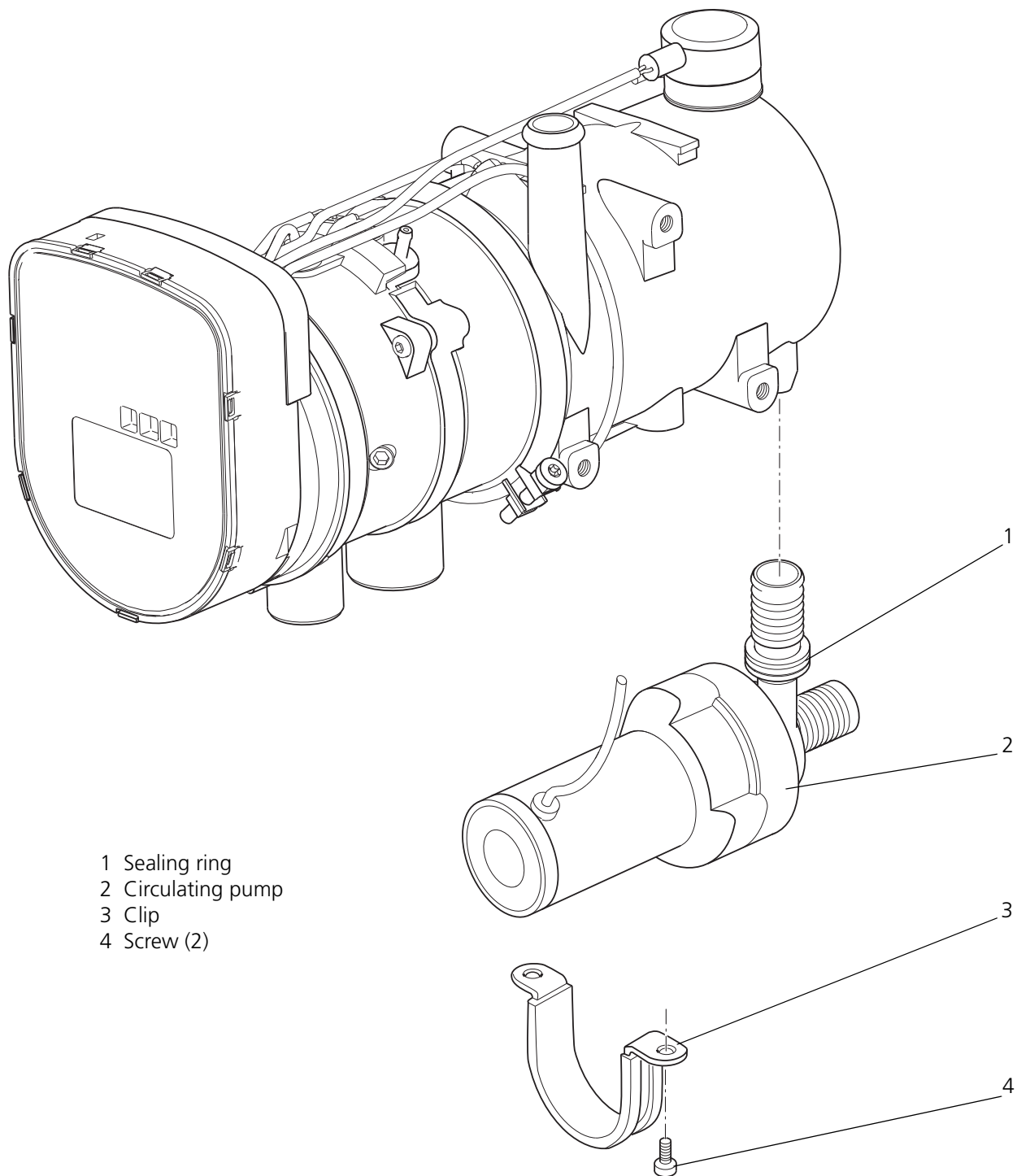


Figure 25: Replacing the circulating pump

9.2.2 REPLACING THE TEMPERATURE LIMITER

9.2.2.1 REMOVAL



NOTE: The temperature limiter only has to be removed if it is being replaced with a new one. The function must be checked in the installed condition.

1. Remove the heater (see 8.7.1.1).
2. Remove the clip (2, Fig. 26) and pull off the protective cap (1).
3. Use a screwdriver to lever off the retaining spring and remove the temperature limiter (3).
4. Unplug electrical cable from control unit.
5. Complete the work on stripped-down components (see 9.1.1).



NOTE: It is essential to fit a new temperature limiter to replace a removed one!

9.2.2.2 INSTALLATION



CAUTION: Incorrect installation will cause the heat exchanger to melt.

1. Insert the new temperature limiter (3, Fig. 26) into the heat exchanger (4) and press in the retaining spring.



NOTE: You must be able to hear and feel the spring clip into the groove. Only then is the temperature limiter in the correct installation position.

If you do not hear and feel the spring clip in:

- Clean the contact surface of the temperature limiter on the heat exchanger
 - Clean the groove in the heat exchanger
 - Ensure that the detent lugs are present on both sides of the spring. Fit a new temperature limiter if necessary.
2. Put on the protective cap (1) and secure it with the clip (2).
 3. Tighten the clip to 1 Nm (8.8 lb-in) $\pm 10\%$.
 4. Plug electrical cable into control unit.
 5. Install the heater (see 8.7.1.2).

9.2.3 REPLACING THE TEMPERATURE SENSOR

9.2.3.1 REMOVAL

1. Remove the heater (see 8.7.1.1).



WARNING: Leaking hot coolant can cause burns.

2. Unscrew and remove the temperature sensor (6, Fig. 26) and remove it together with the round sealing ring (5).
3. Unplug electrical cable from control unit.
4. Complete the work on stripped-down components (see 9.1.1).

9.2.3.2 INSTALLATION

1. Apply acid-free grease (Vaseline) to the round sealing ring (5, Fig. 26).
2. Fit the temperature sensor (6) with the round sealing ring (5) and screw it into the heat exchanger (4). Tighten to 1.5 Nm (13.3 lb-in) $\pm 10\%$.
3. Plug electrical cable into control unit.
4. Install the heater (see 8.7.1.2).

- 1 Protective cap
- 2 Clamp
- 3 Temperature limiter
- 4 Heat exchanger
- 5 Round sealing ring
- 6 Temperature sensor

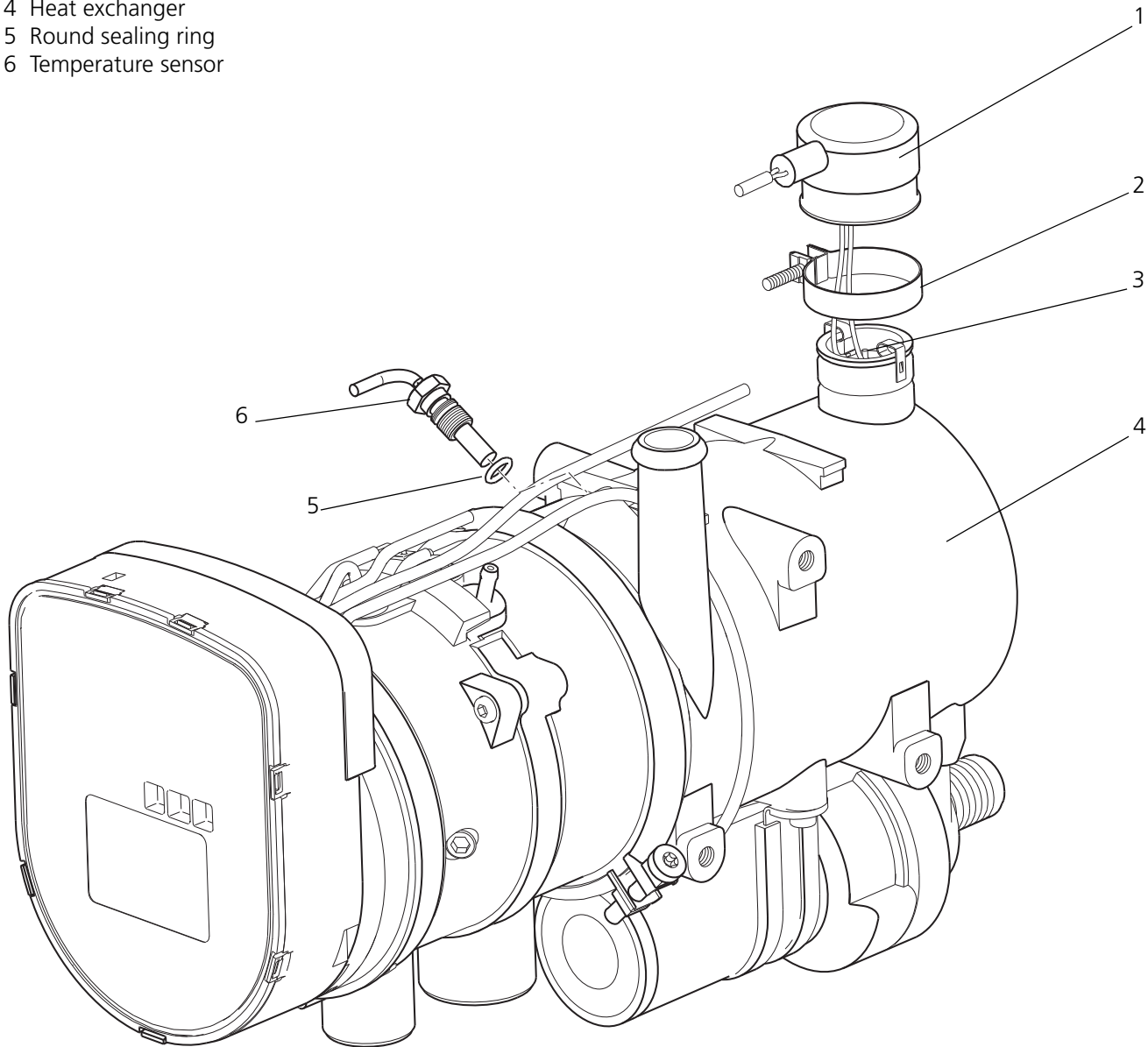


Figure 26: Replacing the temperature limiter and temperature sensor

9.2.4 REPLACING THE COMBUSTION AIR FAN

9.2.4.1 REMOVAL

1. Remove the heater (see 8.7.1.1).
2. Remove the screws (2, Fig. 27).
3. Pull the combustion air fan (1) off the burner head (4) and remove together with the shaped sealing ring (3).



NOTE: Remove the control unit if necessary from the Thermo 90 ST heater with flange-mounted control unit.

4. Unplug electrical cable from control unit.
5. Complete the work on stripped-down components (see 9.1.1).

9.2.4.2 INSTALLATION



NOTE: Insert the shaped seal (3, Fig. 27) correctly and grease it (e.g. with Vaseline). Take care not to squash it.

1. Fit the new shaped sealing ring (3) onto the combustion air fan (1). Bring the fan into the assembly position and secure it with screws (2).
2. Tighten the screws (2) to 3 Nm (26.5 lb-in) $\pm 10\%$.



NOTE: Install the control unit if necessary on the Thermo 90 ST heater with flange-mounted control unit.

3. Plug electrical cable into control unit.
4. Install the heater (see 8.7.1.2).

- 1 Combustion air fan
- 2 Screw (2)
- 3 Shaped sealing ring
- 4 Burner head
- 5 Control unit

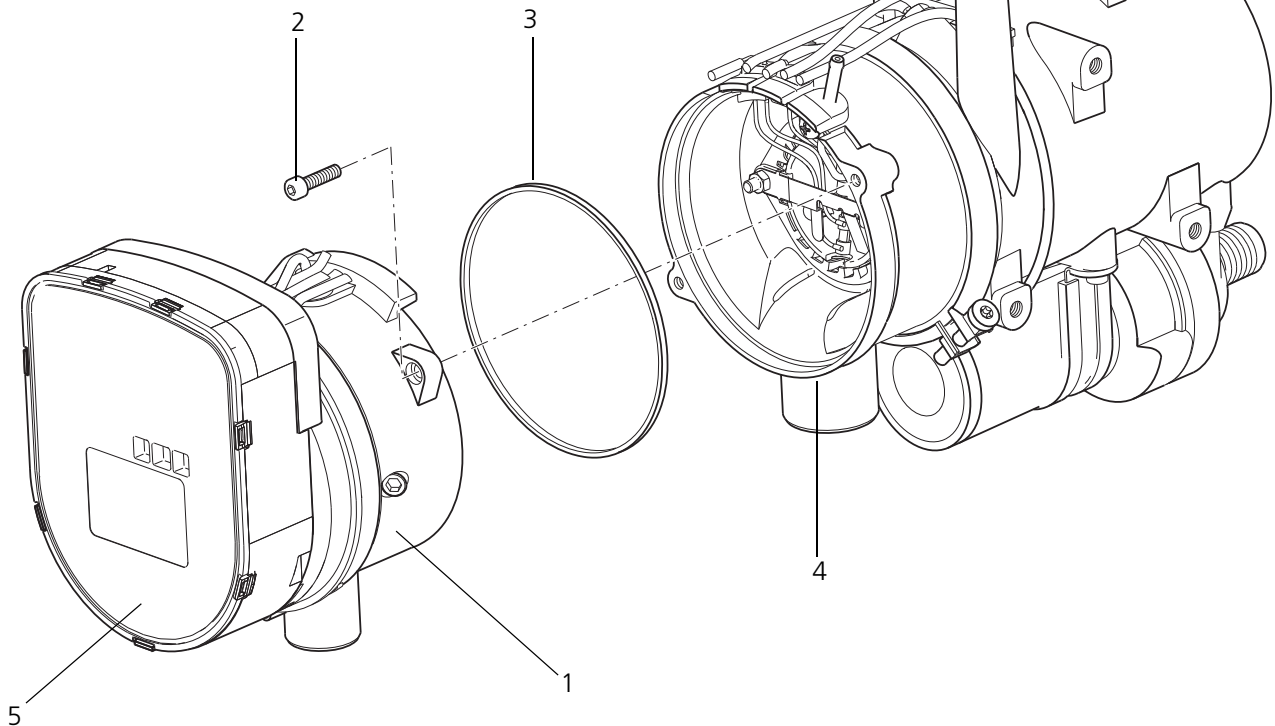


Figure 27: Replacing the combustion air fan

9.2.5 REPLACING THE BURNER, FLAME MONITOR AND GLOW PIN

9.2.5.1 REMOVAL

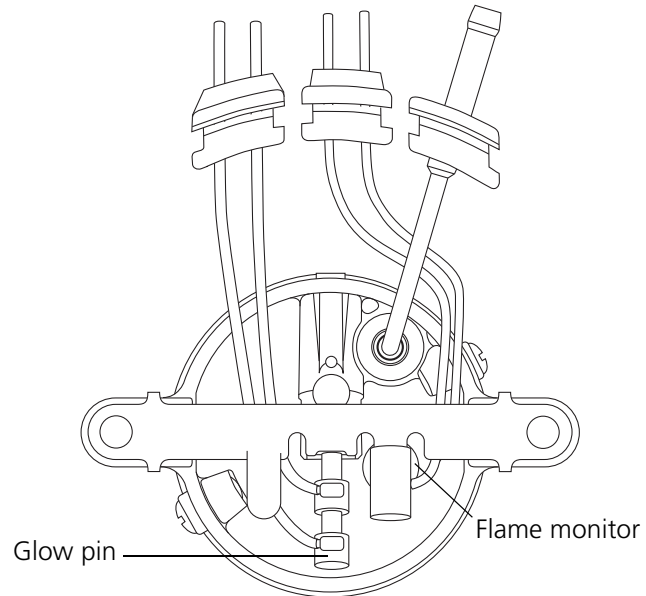
1. Remove the heater (see 8.7.1.1).
2. Remove the combustion air fan (see 9.2.4.1).
3. Remove the screw (5, Fig. 28) and washer (4).
4. Remove the nuts (10) and pull off the bar (8).
5. Pull the grommets (11 and 12) out of the slots in the housing of the combustion pipe (3).
6. Pull the grommet (13) and burner (1) out of the burner head and remove with the air swirl plate (2).
7. Pull the flame monitor (7) and glow pin (6) from the burner (1) and remove.
8. Perform a visual check for assessing the burner (see 5.4).
9. Complete the work on stripped-down components (see 9.1.1).

9.2.5.2 INSTALLATION

1. Place the air swirl plate (2, Fig. 28) onto the burner (1).
2. Carefully insert the flame monitor (7) and glow pin (6) into the burner up to the stop and push the grommets (11 and 12) into the slots in the housing of the burner pipe (3).
3. Insert the burner (1) and grommet (13) into the burner head (3).



CAUTION: During the following procedure, make sure that the cables of the flame monitor (7) and the glow pin (6) are routed as shown in the figure.



4. Push the insulation (9) onto the bar (8) and bring the bar into the assembly position.



NOTE: Route the cable of the flame monitor and the glow pin as shown in the figure!

5. Secure the bar (8) using the nuts (10). Tighten the nuts to 3 Nm (26.5 lb-in) $\pm 10\%$.
6. Secure the fuel line using the screw (5) and washer (4). Tighten the screw to 3 Nm (26.5 lb-in) $\pm 10\%$.
7. Install the combustion air fan (see 9.2.4.2).
8. Plug in any electrical cables removed from the control unit.
9. Install the heater (see 8.7.1.2).

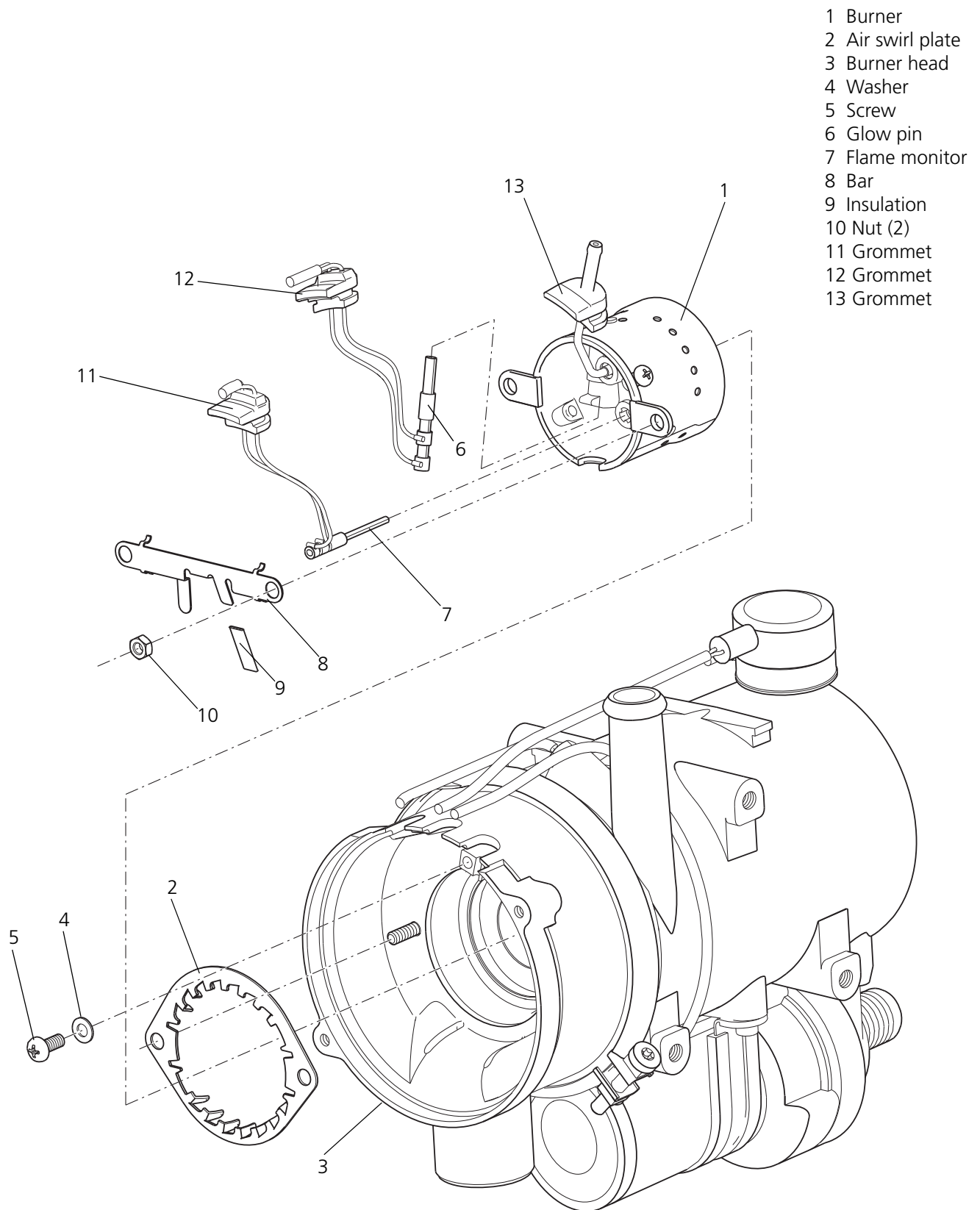


Figure 28: Replacing the burner, flame monitor and glow pin

9.2.6 REPLACING THE BURNER HEAD

9.2.6.1 REMOVAL

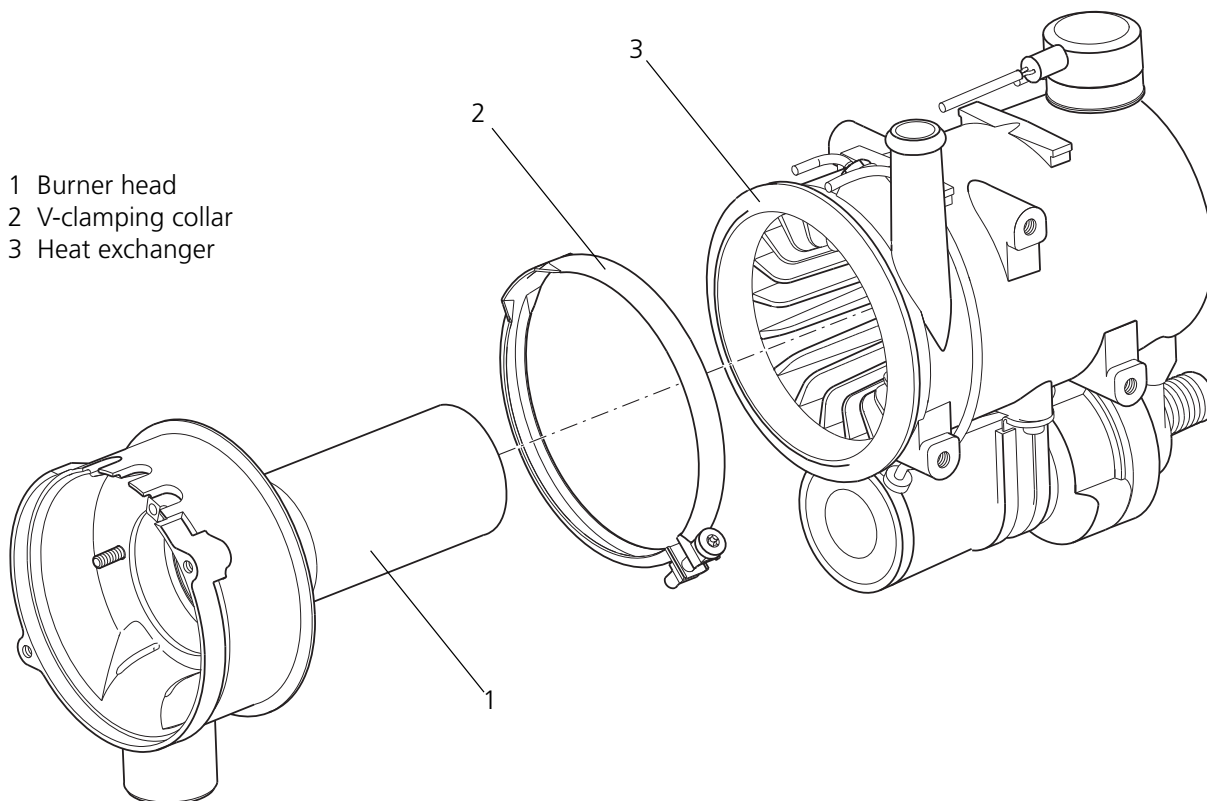
1. Remove the heater (see 8.7.1.1).
2. Remove the combustion air fan (see 9.2.4.1).
3. Remove the burner, flame monitor and glow pin (see 9.2.5.1).
4. Remove the mounting screw of the V-clamping collar (2, Fig. 29) and pull off the clamping collar.
5. Pull out and remove the burner head (1) from the heat exchanger (3).
6. Complete the work on stripped-down components (see 9.1.1).

9.2.6.2 INSTALLATION



NOTE: The burner head and exhaust outlet port can also be aligned during installation in the vehicle.

1. Guide the burner head (1, Fig. 29) into the heat exchanger (3), align it if necessary and secure with the V-clamping collar (2).
2. If necessary, tighten the mounting screw of the V-clamping collar to 3 Nm (26.5 lb-in) $\pm 10\%$.
3. Install the burner, flame monitor and glow pin (see 9.2.5.2).
4. Fit the combustion air fan (see 9.2.4.2).
5. Install the heater (see 8.7.1.2).



1 Burner head
2 V-clamping collar
3 Heat exchanger

Figure 29: Replacing the burner head

9.2.7 REPLACING THE HEAT EXCHANGER**9.2.7.1 REMOVAL**

1. Remove the heater (see 8.7.1.1).
2. Remove the circulating pump (see 9.2.1.1).
3. Remove the temperature limiter (see 9.2.2.1).
4. Remove the temperature sensor (see 9.2.3.1).
5. Remove the combustion air fan (see 9.2.4.1).
6. Remove the burner, flame monitor and glow pin (see 9.2.5.1).
7. Remove the burner head (see 9.2.6.1).
8. Complete the work on stripped-down components (see 9.1.1).

9.2.7.2 INSTALLATION

1. Install the burner head (see 9.2.6.2).
2. Install the burner, flame monitor and glow pin (see 9.2.5.2).
3. Fit the combustion air fan (see 9.2.4.2).
4. Install the temperature sensor (see 9.2.3.2).
5. Install the temperature limiter (see 9.2.2.2).
6. Install the circulating pump (see 9.2.1.2).
7. Install the heater (see 8.7.1.2).

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10. PRODUCT INFORMATION

No new or updated information available at this time.

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WEBASTO LIMITED NON-TRANSFERABLE WARRANTY

Webasto Thermo & Comfort North America, Inc. (hereinafter referred to as Webasto) warrants their heaters and heater kits against defects in material and workmanship for two (2) years effective at the time of installation or vehicle registration date for original equipment installation (OEM). This warranty period may not exceed three (3) years from the original date of sale by Webasto. This warranty period may be superseded by written contractual agreements.

All models are limited to 2,000 maximum operating hours except for DBW series.

Replacement parts are covered for six (6) months or the remainder of the original warranty period, whichever is longer. The Thermo Top C heater is the only heater considered a replacement part.

The intent of the Webasto warranty is to protect the original end-user of the heater from defects and provide free repair and replacement of defective parts in the manner provided herein. During the warranty period, the exclusive remedy will be for Webasto, at their discretion, to repair or replace those parts which are demonstrated to be defective in material or workmanship.

While warranty is provided to the "original end-user", it is to be administered and serviced through an authorized Webasto dealer in accordance with the Webasto warranty policy or contractual agreement between Webasto and a second party. To locate the nearest Webasto authorized dealer for warranty service, visit <http://www.webasto.com> or call (800) 860-7866 in USA, (800) 667-8900 in Canada.

Limitations: Webasto specifically excludes and limits warranty from the following:

- Normal wear of service parts: **(filters and fuses are not covered)**
- Removal and replacement of heater (with the exception of the Thermo Top C 12 volt heater).

Note: Thermo 50 Heaters have changed from a replacement heater to a repairable heater.

- Damage to product in transit. All claims must be filed with carrier.
- Improper installation, which is not in accordance with valid, supplied installation instructions or approved OEM applications.
- Deterioration due to normal wear, corrosion, abuse, damage, accident, improper storage or operation, lack of reasonable and necessary maintenance.
- Modification of product by alteration, use of non-genuine parts or repair by unauthorized personnel.
- Economic loss for expenses related to travel, vehicle disability, personal injury or other incidental or consequential damages arising from any breach of this expressed warranty.

Product registration:

The heater can be registered by visiting www.techwebasto.com or by completing the Warranty Registration Card if included with your product. A proof of purchase is required for all heaters that are not registered.

THIS WARRANTY IS NON-TRANSFERABLE.

IMPLIED WARRANTIES INCLUDING THAT OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY LIMITED TO THE DURATION OF THIS WARRANTY. WEBASTO DISCLAIMS ANY LIABILITY FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

SOME STATES AND CANADIAN PROVINCES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATION OR EXCLUSIONS MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY AMONG STATES AND CANADIAN PROVINCES.

WEBASTO RETAINS THE RIGHT TO MODIFY THESE WARRANTY TERMS WITHOUT NOTICE IN ORDER TO COMPLY WITH POLICY OR LAWS GOVERNING WARRANTY ISSUES IN STATES OR COUNTRIES HAVING SPECIFIC REMEDIES DIFFERING OR ADDITIONAL TO THOSE DESCRIBED WITHIN THIS DOCUMENT.



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