

Coolant Heater

Thermo Top Evo

Service 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.



WARNING: Cancer and Reproductive Harm
www.P65Warnings.ca.gov

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1 Introduction

1.1 Contents and purpose

This workshop manual serves to support instructed personnel, which repairs the Thermo Top Evo water heaters.

1.2 Meaning of signal words

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

WARNING

This heading is used to highlight operating instructions or procedures which, if not or not correctly followed, may result in personal injury or fatal accidents.

IMPORTANT

This heading is used to highlight operating instructions or procedures which, if not or not correctly followed, may result in damage to the equipment or its components.

NOTE

This heading is used to direct your attention to a special feature deemed essential to highlight.

1.3 Additional documentation to be used

Information of the general installation and operating instructions is not contained in this workshop manual. If repairs are necessary, these documents must also be used.

1.4 Safety precautions and regulations

In principle, the general accident prevention regulations and current works safety instructions are applicable.

"General safety precautions" which go beyond the scope of these regulations are listed in the following.

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 Statutory regulations governing installation

Type approvals according to ECE-R 10 (EMC) and ECE-R 122 (Heater) exist for the Thermo Top Evo heater.

For the installation, primarily the regulations of the directive ECE-R 122 and the regulations contained in the installation instructions must be observed.

NOTE

The regulations of these guidelines are binding in the scope of the EU Directive 70/156/EEC and/or EC/2007/46 (for new vehicle models from 29/04/2009) and should also be observed in countries in which there are no special regulations!

The Thermo Top Evo water heater was designed for use in commercial vehicles.

The applicable regulations must be taken into account when installing in special vehicles. Other uses are possible in consultation with Webasto.

1.4.2 General safety precautions

The repair and commissioning of the unit may only be carried out by professionals trained by Webasto. The repair and installation of the unit may only be carried out in accordance with the workshop manual and the installation instructions.

The year of initial start-up must be permanently marked on the type label by removing the inapplicable years.

The heaters are approved for heating the motor vehicle engine and the vehicle cab, however not for heating the hazardous-material cargo area.

The heater may only be installed in motor vehicles or in independent heating systems with a minimum coolant quantity of 1 gallon (4 liters).

The heater may not be installed in the cab or the passenger compartment of vehicles.

When checking the coolant level, the procedure described by the vehicle manufacturer must be followed.

WARNING

The heater **must not be operated**:

- In filling stations and tank farms.
- At locations at which highly flammable gases or dust can form, and at locations at which highly flammable liquids or solid materials are stored (e.g. near fuel, coal and wood dust, grain warehouses, dry grass and leaves, cardboard, paper, etc.)
- In enclosed rooms (e.g. garages), not even via the timer.
- Without at least 20 % brand name anti-freeze in the water of the heating circuit.
- outside the operating temperature range of -40 °F (-40 °C) to +176 °F (+80 °C). Otherwise, the electronics may suffer permanent damage.

There is a danger of burns, as the heater and the attached parts may be extremely hot.

The heater:

- may only be operated with the fuel specified on the type label and at the nominal voltage specified on the type label.
- must be shut down by immediately switching off the heater and removing the fuse in case of heavy smoke, unusual combustion noises or fuel odors. The heater must not be restarted until the unit has been checked exclusively by professionals duly trained by Webasto.
- must be switched off during work in the engine compartment and may not be cleaned with high-pressure cleaning units or compressed air.
- Must be put into operation at least once a month for 20 minutes with the engine cold.
- should be checked by a professional every 2 years, at the commencement of the heating period.

Liability:

- Non-compliance with the installation/operating 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 invalidation of the type approval for the heater and therefore of its homologation/ECE type license.

Be sure to read the operating instructions of the heater before commissioning.

1.5 Spare parts

The ID numbers of available spare parts can be found in the Webasto spare parts catalogue or online at <http://techwebasto.com>.

2 General description

Parking heating mode

The water heater is used in conjunction with the original vehicle heating system in the parking heating mode for

- Cab pre-heating
- Engine pre-heating
- Pre-heating of other equipment (e.g. units).

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

Auxiliary heating mode

The water heater operates during engine operation and is used to thermally support the cooling system. The water heater is integrated in the cooling system, the fuel system and the electrical system of the vehicle.

When the engine is shut off, the water heater is not automatically switched off.

NOTE

This workshop manual describes the retrofit variant of the heater. For heaters installed directly at the vehicle manufacturer's plant, other control units with other connectors, software or application parts may be used which are not described in this manual. Information is only available for these heaters via the documentation of the vehicle manufacturer.

The heater regulates its operation according to the coolant temperature.

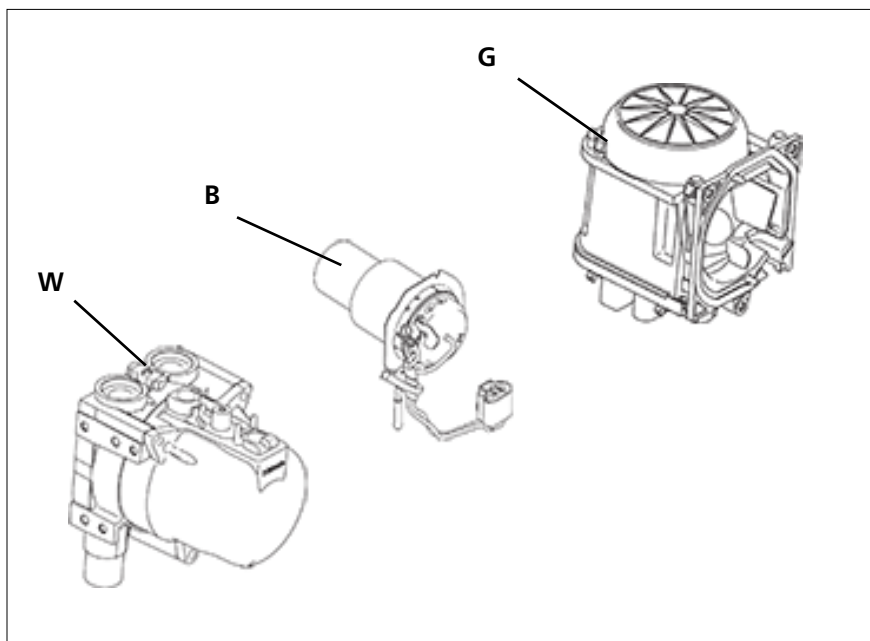
Depending on the deviation of the current coolant temperature from the set-point temperature at the coolant temperature sensor, the burner output is controlled within a range of 2.5 to 5 kW.

The Thermo Top Evo heater consists of the combustion-air fan unit (G) with the control unit, the heat exchanger (W) and the burner unit (B).

The following components are arranged in the heater for control and monitoring:

- Control unit
- Exhaust temperature sensor
- Coolant temperature sensor
- Overheating sensor

The fuel supply is provided from an external source via a metering pump, which is connected to the fuel system of the vehicle.



- B = Burner unit assembly
G = Combustion-air fan unit assembly
W = Heat exchanger assembly

Fig. 201 Thermo Top Evo

2.1 Combustion-air fan unit with control unit

The combustion-air fan unit contains:

- the heater type label
- the connection piece for the combustion air pipe
- the control unit with the plug-in contacts
- the fan motor and the impeller

The combustion-air fan unit supplies the air required for the combustion process from the combustion air inlet to the combustion chamber.

NOTE

It is not permissible to dismantle the combustion-air fan unit.

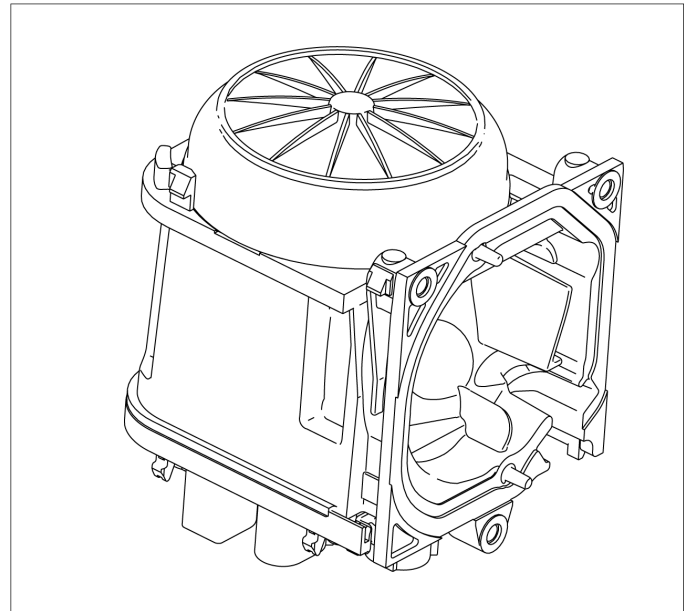
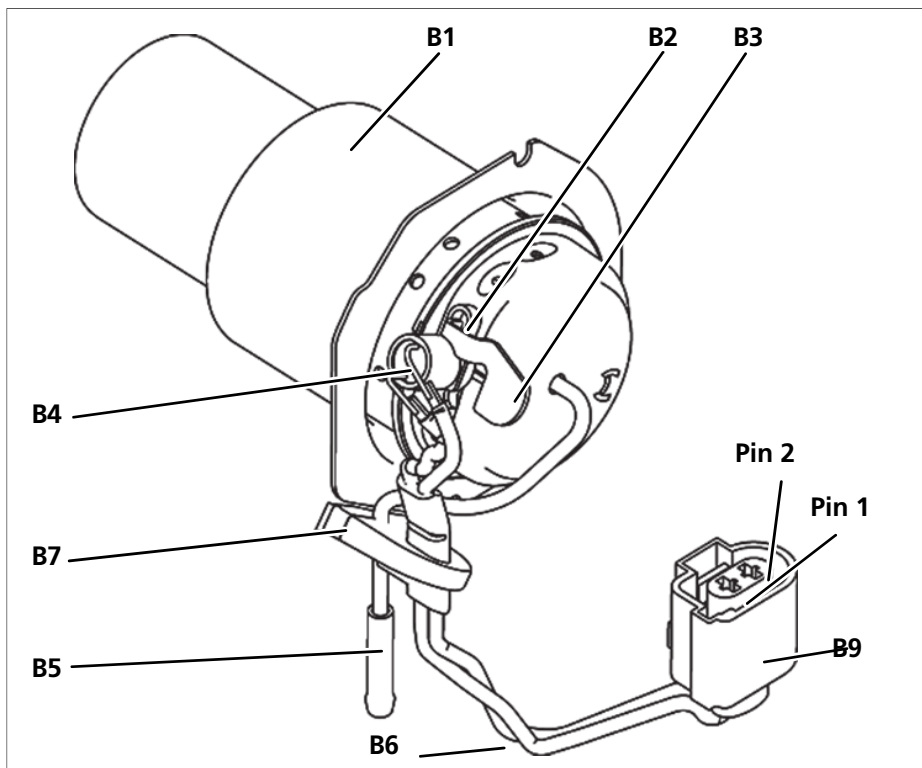


Fig. 202 Combustion-air fan unit

2.2 Burner unit

The fuel/air mixture is processed, and the actual combustion takes place in the burner unit. The fuel flows via the fuel pipe to the evaporator, where it is distributed and is evaporated.

using the glow plug. The air required for combustion is provided by the combustion-air fan unit and flows into the combustion chamber via holes in the burner.



- B1 = Combustion pipe with evaporator mount and evaporator
- B2 = Retaining spring for glow plug
- B3 = Cooling flag for glow plug
- B4 = Glow plug
- B5 = Fuel pipe
- B6 = Glow plug cable
- B7 = Grommet
- B9 = Glow plug connector

Fig. 203 Burner unit

2.2.1 Glow plug

The glow plug (B4) is connected to the control unit via an electrical line with a connector (B9). The glow plug is fastened to the evaporator mount with a retaining spring (B2). A cooling flag (B3) 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 with the glow plug when the heater is started.

2.3 Heat exchanger

The heat generated in the heat exchanger by combustion is transferred to the coolant circuit.

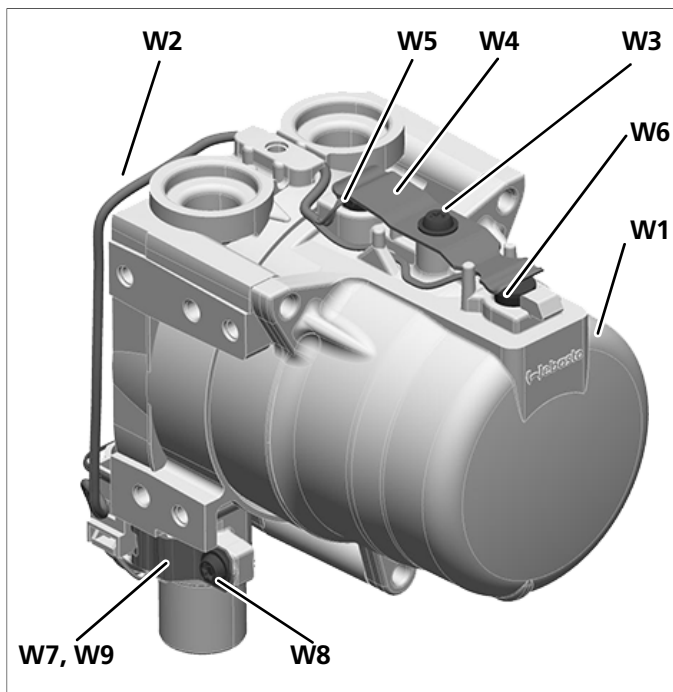


Fig. 204 Heat exchanger

- W1 = Heat exchanger
- W2 = Cable of temperature sensors
- W3 = Self-tapping screw, 40x10
- W4 = Retaining spring for sensors
- W5 = Temperature sensor
- W6 = Overheating sensor
- W7 = Exhaust temperature sensor, covered by retaining spring - diesel heaters only (W9)
- W8 = Self-tapping screw, 40x10
- W9 = Retaining spring

2.3.1 Temperature sensor and overheating sensor

The temperature sensor detects the coolant temperature in the heat exchanger of the heater as electrical resistance. This signal is fed to the control unit, where it is processed. The temperature sensor (W5) and the overheating sensor (W6) form a unit together with the cable and the connector.

The overheating sensor protects the heater against impermissibly high operating temperatures. This sensor triggers the safety switch-off of the heater at a temperature higher than $257 \pm 14 \text{ }^{\circ}\text{F}$ ($125 \pm 8 \text{ }^{\circ}\text{C}$).

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 have a linear behaviour. A sudden increase in the resistance occurs at approx. $257 \text{ }^{\circ}\text{F}$ ($125 \text{ }^{\circ}\text{C}$).

2.3.2 Exhaust temperature sensor

The exhaust temperature sensor (W7) is only found in diesel-fired Thermo Top Evo models. It is used to detect the flame and impermissible exhaust temperatures.

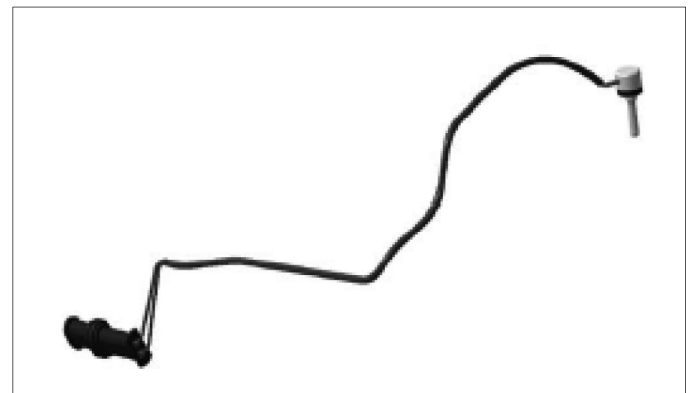


Fig. 205 Exhaust temperature sensor (diesel only)

2.4 Circulation pump

The U4847 circulation pump ensures a feed rate of the coolant in the vehicle heater and heater circuit. The pump is switched on with the control unit and runs during the entire operation of the heater. The circulation pump is a centrifugal pump with a brushless EC motor.

The circulation pump is equipped with a 2-pin connector socket which is connected to the control unit by means of a separate wiring harness.

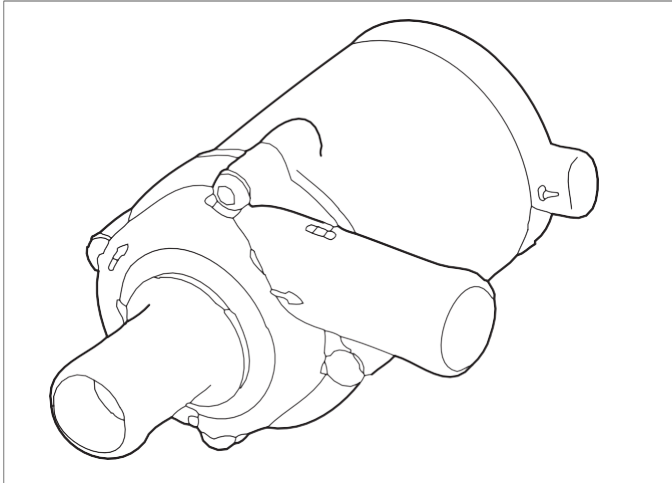


Fig. 206 Example of U4847 Econ 24 V circulation pump

NOTE

Only the U4847 circulation pump may be connected to the Thermo Top Evo heater.

2.5 Metering pump

The fuel metering pump is a combined pumping, metering and shut-off system. This reciprocating piston pump supplies the fuel from the vehicle fuel tank to the fuel connection piece of the heater via fuel lines. Installation is usually carried out near the fuel tank. The metering pump is not equipped with a pulsation damper. The metering pump is connected to the heater with the heater wiring harness.

IMPORTANT

Only the model DP42 fuel metering pump may be used for the Thermo Top Evo heater. Observe the model designation on the component for this purpose. When replacing the metering pump, the CO₂ settings must be checked. see Section 8.3.

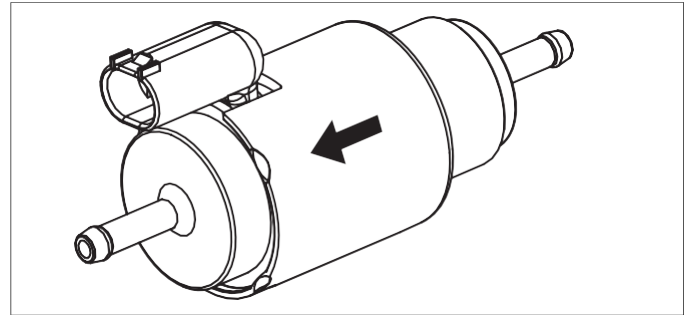


Fig. 207 DP42 metering pump

2.6 Heater controls

The heater can be operated in two ways:

- Webasto BUS (W bus)
- Analog

Examples of analog control:

- Switch with operating indicator
- Standard timer

NOTE

Additional information on the respective heater control is contained in the specific installation and operating instructions.

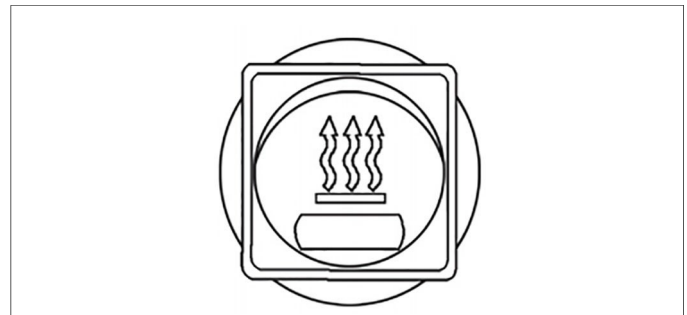


Fig. 208 Switch with operating indicator

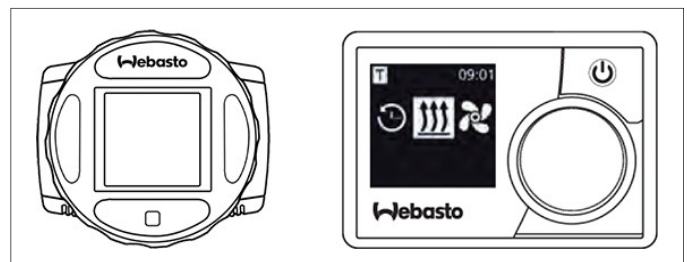


Fig. 209 Digital timers - SmarTemp (left) MultiControl (right)

3 Description of Operation

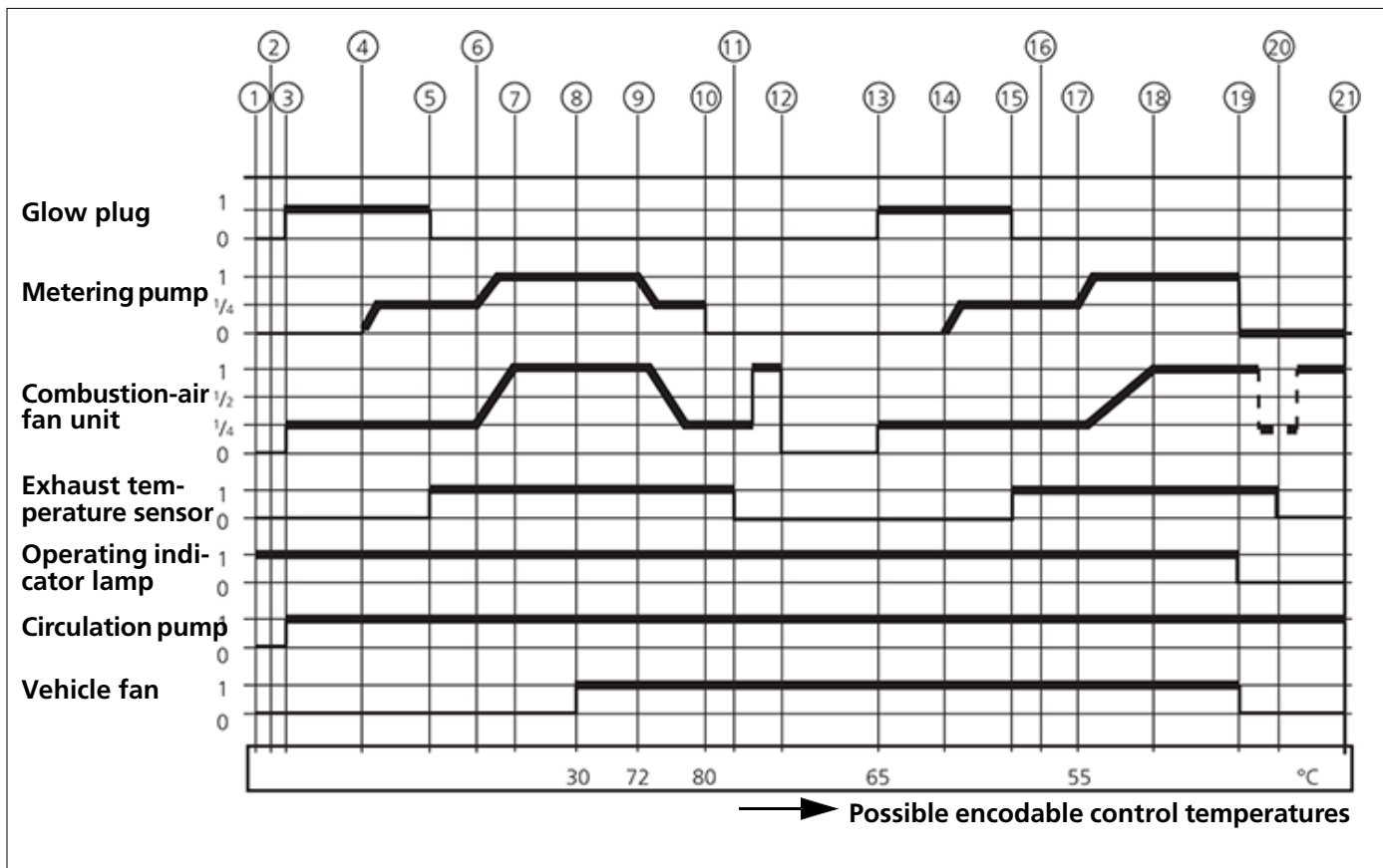


Fig. 301 Operating sequence Thermo Top Evo

- | | |
|-------------------------------------|--------------------------------------|
| 1) Switching on | 12) Run-on ended |
| 2) Component check | 13) Preheating 15 to 20 sec. |
| 3) Preheating 40 s. | 14) Metering pump/partial load (1/4) |
| 4) Metering pump/partial load (1/4) | 15) "Flame ON" detection |
| 5) "Flame ON" detection | 16) Stabilization time |
| 6) Stabilisation time | 17) Coolant temperature dropped |
| 7) Full load | 18) Full load |
| 8) Vehicle fan "On" | 19) Switching off (run-on) |
| 9) Control range | 20) "Flame OFF" detection |
| 10) Control break | 21) Run-on ended |
| 11) "Flame OFF" detection | |

3.1 Switch on

The heater is switched on depending on the equipment variant with various heater controls (see Section 2.6).

3.2 Starting and control mode

After combustion begins (start), controlled heating automatically begins.

At a higher coolant temperature, the heating capacity is modulated between 2.5 kW and 5 kW. The objective is to achieve and maintain the control temperature.

The original vehicle heater fan does not switch until the coolant is sufficiently heated (approx. 86 °F - 30 °C)

If the coolant temperature increases above the set-point value of the control temperature, the heater switches into "OFF state ready". The circulation pump, the original vehicle heater fan and the operation indicator continue to operate during the "OFF state ready".

The heater starts again automatically after the coolant has cooled to the pre-encoded restart temperature.

3.3 Switch off

When the heater is switched off, the operation indicator on the heater control goes out. Combustion is ended and the run-on (also called cool-down) begins. However, the circulation pump, the glow plug and the combustion-air fan unit continue to run during the run-on time to cool the heater. It is permissible to switch on the heater again during the run-on. However, restarting does not take place until after the run-on is complete.

IMPORTANT

A maximum run-on of 175 sec is activated when the heater is switched off.

The heater supply voltage must be ensured for this time.

4 Technical data

4.1 Technical Data Thermo Top Evo

Except where limit values are specified, the technical data below refers to the usual heater tolerances of $\pm 10\%$ at an ambient temperature of 69 °F (20 °C) and at the rated voltage.

Heater	Thermo Top Evo
ECE approval symbol	E1 122R -00 0334 (Heater) E1 10R -03 6271 (EMC)
Model	Water heater with evaporator-type burner
Heat flow (control range)	2.5 to 5 kW
Fuel	Diesel Bio-Diesel up to 30%
Fuel consumption $\pm 10\%$ (control range)	0.8 to 0.13 gal/h (0.31 to 0.49 l/h)
Rated voltage	12 V
Operating voltage range	9.6 to 15 V
Nominal power consumption without circulation pump, without vehicle fan $\pm 10\%$ (control range)	12 to 21 W
Perm. ambient temp.: Heater: - Operation - Storage Metering pump:- Operation - Storage	-40 to 176° F (-40 to +80 °C) -40 to 248° F (-40 to +120 °C) -40 °F to 86 °F (-40 to +30 °C) -40 °F to 194 °F (-40 to +90 °C)
Perm. operating pressure (heat medium)	36.25 PSI (2.5 bar)
Minimum quantity of coolant circuit	1.06 gal (4 l)
Minimum flow rate for the heater	66 gal/h (250 l/h)
Coolant	At least 20% mix of a brand-name antifreeze
CO ₂ in exhaust gas (perm. function range)	8 to 12 vol. %
Dimensions of heater (Tolerance ± 3 mm)	L = Length: 8.6" (218 mm) B = Width: 3.6" (91 mm) H = Height: 5.8" (147 mm)
Weight	4.8lb. (2.2 kg)

4.2 Circulation Pump

Circulation Pump	4847
Volume flow with counter-pressure > 14 kPa	Approx. 119 g/h - 450 l/h
Rated Voltage	12v
Operating Voltage Range	10.5 to 17v
Rated Power Consumption	18W
Dimensions, Circulation Pump	Max. length: 4.3in (109mm) Diameter: 1.9 in (48.5mm)
Weight	Approx. 0.7 lb (0.3 kg)

5 Faults, Troubleshooting

General

This section describes troubleshooting on the Thermo Top Evo heater.

NOTE: Before using Webasto Thermo Test software, the SmarTemp 3.0 must be disconnected.

IMPORTANT

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. The functional relationships are described in Section 2 and 3.

IMPORTANT

Error detection is generally limited to the localization of the defective components. The following fault causes are not taken into account and should always be checked, or a fault should be excluded for the following reasons:

- **Corrosion on connector**
- **Loose contact on connector**
- **Crimping error on connector**
- **Completeness of connector**
- **Corrosion on lines and fuses**
- **Corrosion on battery terminals**
- **Impermissible high ambient temperature**

Each time an error is eliminated, a functional check must be carried out in the vehicle; switch the heater off and on again beforehand.

NOTE: The following conditions can cause excessive carbon build-up over time. Be aware of and avoid these situations while installing Webasto heaters.

Under-voltage – refer to the specifications chart for the voltage range for each specific heater model.

Low current as measured at the heater – low current causes the combustion air fan to spin slower than necessary, causing a rich-running condition. Refer to the specifications chart for the voltage range for each specific heater model.

Under-sized wire – if the wiring harness power and ground wires are extended, calculations must be made to ensure the wire size is sufficient for the amperage draw.

Fuel system – poor quality fuel and/or air pockets in the fuel line can contribute to carbon build-up. Refer to the fuel system section of the installation manual for more information.

Combustion air system – a restriction in the combustion air tube can cause a rich-running condition. Refer to the combustion air section of the installation manual for more information.

Exhaust system – a restriction in the exhaust tube can cause a rich-running condition. Refer to the exhaust system section of the installation manual for more information.

Incorrect power disconnect device – a circuit breaker or isolation switch can interrupt the heater cool-down cycle, causing carbon build-up or damage to the heater. Refer to the wiring section of the installation or service manual for information.

Poor electrical connections – improper connections can cause various problems with the operation of the heater.

Procedure in case of errors or faults and lock-out

IMPORTANT

Always determine the error cause for the lock-out first, then eliminate the lock-out. If errors occur in the heater, they will be detected by the control unit as a fault. Depending on the type and weighting of the fault, a fault run-on can be initiated. When a fault run-on is initiated, the heater remains in **fault lock-out**. In addition, an error code is output after a fault is detected during the fault switch-off. This is carried out by the operation indicator or by the switch with an operating indicator. The error code is used by the workshop or the authorised Webasto dealer for troubleshooting.

Fault Causes

A fault occurs when one or more error have occurred. Possible errors are, e.g.

- Overvoltage/undervoltage
- Malfunctions of all components, e.g., due to a short circuit or open circuit
- Overheating of the heater
- Impermissible exhaust temperature
- False starts
- Flame failures

Elimination of fault lock-outs

- 1 Switch on heater
- 2 Within 10 seconds disconnect power from the heater (unplug the wiring harness, disconnect the battery, remove the fuse(s).
- 3 Wait 10 seconds.
- 4 Switch the heater OFF.
- 5 Reconnect power.
- 6 Switch the heater ON.
- 7 Rectify the cause of the fault.

Permanent lockout (H87) rest procedure using Multi-control

1. Turn the heater OFF by the controller or switch
2. Remove the 20A fuse
3. Wait 30 seconds
4. Reinstall the 20A fuse
5. Wait 30 seconds
6. Turn the heater ON using the controller/switch, then remove the 20A fuse within 10 seconds
7. Wait 30 seconds then reinstall the 20A fuse
8. Wait 30 seconds
9. Turn the heater on and remedy the cause of the fault

The lockout can also be released using the PC Diagnosis.

Certain faults will accumulate in the ECU memory. If the number of faults has exceeded a predetermined limit, the heater changes over to the heater lock-out. The maximum number of errors in the error memory or the error memory limit is defined by Webasto.

Cancel heater lock-out

The heater lock-out can be cancelled

- with the Webasto Thermo Test PC Diagnostics (WTT)
- or by following the procedure on the previous page

5.1 Troubleshooting without error code output

Possible faults

The overview only shows some of the possible faults. The Webasto Service Hotline must be contacted in individual cases.

IMPORTANT

The error points specified from Tables Fig. 501 and Fig. 502 DO NOT match the error code numbers for error code output!

Heater Mode	Fault Description	Possible error point (see Table Fig. 502)
Start	Heater does not react, no component starts up, no display by operation indicator	6, 8
	Heater smokes in start-up phase	1, 2, 4, 9, 11, 14, 15
Combustion operation	Heater runs through start, however switches off prematurely	1, 3, 4, 5, 7, 9, 10, 11, 14, 15
	Heater has rough combustion	1, 4, 9, 11, 14
	Heater smokes in heating phase	1, 4, 9, 11, 14, 15, 16
	Heater runs, vehicle interior cold	10, 12
Run-on	Heater smokes in run-on phase	14
Other	Fuel odor	1, 4, 9, 14
	Exhaust odor in vehicle interior	11
	Coolant loss	5, 10
	Heater lock-out	13

Fig. 501 Overview of possible errors

Functional test of heater and its components

Error point	Component	Recommended workshop action	Parameter
1	DP42 metering pump	Check continuity from connector X11 (brown wire) to earth. Check continuity from connector X1 , Pin 5 to connector X11 (blue wire)	
		Measure coil resistance of DP42 metering pump, also see Section 8.5	5.20 ohms $\pm 5\%$ at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$), test current: $< 1\text{ mA}$
		Measure fuel feed rate (use Webasto Thermo Test PC Diagnostics for controlling the metering pump), also see Section 8.5	Diesel feed rate at metering pump frequency of 7 Hz and feed time of 60 s: 12.0 to 14.6 ml
		Check connection of fuel line on all connection pieces in accordance with general installation instructions	
2	Glow plug	Measure glow plug resistance on glow plug connector X5 (green wire), also see Section 9.3.1	Cold resistance at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$): $0.780 \pm 0.110\text{ ohms}$
3	Sensors	Check the cold resistance of the coolant temperature sensor W5 on the connector X3 (Pin 2 and 4), also see Section 9.7	Cold resistance at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$): 2,296 to 5,047 ohms, Test current: $< 1\text{ mA}$
		Check the cold resistance of the overheating sensor W6 on the connector X3 (Pin 1 and 3), also see Section 9.7	Cold resistance at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$): 30 to 250 ohms, Test current: $< 1\text{ mA}$
		Check the cold resistance of the exhaust temperature sensor W7 on the connector X6 (Pin 1 and 2), also see Section 9.8	Cold resistance at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$): 2,050 to 2,220 ohms, Test current: $< 1\text{ mA}$
4	Combustion-air fan unit	Using component test, check the function of combustion-air fan unit with Webasto Thermo Test PC Diagnostics. No rubbing noises should be heard. Check CO ₂ settings in accordance with Section 8.3	- Specify a set-point speed of 6,000 rpm - Listen for rubbing and friction noises. In addition, start-up must be audible up to the specified speed. - No "Combustion air fan blocking guard" fault message may occur.

Fig. 502 Overview of functional test of heater and its components

Error point	Component	Recommended workshop action	Parameter
5	U4847 circulation pump	Check wiring	
		Conduct component test to check function of circulation pump with Webasto Thermo Test PC Diagnostics	Touch pump with hand; pump functions if slight vibration or running can be felt
		Measure resistance on circulation pump connector X4 , also see Section 8.4.	Resistance at $72 \pm 8^{\circ}\text{F}$ ($22 \pm 5^{\circ}\text{C}$): 20 ± 1 kohms
		Check pump for leaks	
		Check self-venting installation position, also see Section 8.4 for general installation instructions	
6	Power supply	Without Webasto Thermo Test PC Diagnostics Measure power supply on heater connector X2 , Pin 1. Also see Fig 701, 702, and 703.	Check fuse F2 Check power supply
		With Webasto Thermo Test PC Diagnostics Measure operating voltage from Webasto Thermo Test PC Diagnostics	
7	Undervoltage detection	With Webasto Thermo Test PC Diagnostics Measure operating voltage from Webasto Thermo Test PC Diagnostics	– The voltage may not drop below 9.8 V for more than 20 consecutive seconds – Check fuse F2
		Without Webasto Thermo Test PC Diagnostics Measure power supply on heater connector X2 , Pin 1. Also see Fig. 701, 702, and 703.	
8	Operation indicator (standard timer or switch with operating indicator)	When the immediate heat button/switch with an operating indicator is operated, the light in the display/on the operating indicator is activated	Operation indicator of standard timer: – Measure power supply on connector X9, Pin 11 – Check continuity on connector X9, Pin 12 to ground – Check fuse F2
			Operation indicator of switch with operating indicator – Measure power supply on switch with operating indicator S4, Pin A – Check continuity on switch with operating indicator S4, Pin F to ground – Check fuse F2

Fig. 502 Overview of functional test of heater and its components

Error point	Component	Recommended workshop action	Parameter
9	Fuel connection	Observe fuel fill level and fuel removal from tank	
		Check integration in vehicle fuel system	
		Check fuel lines for leaks, kinking and clogging, especially in the area of the intake-side line connectors	
		Disconnect the fuel line from the heater, hold the hose in a catch container and operate the metering pump with the Webasto Thermo Test PC Diagnostics for 60 s at 7 Hz. When doing so, watch whether the fuel is pumped bubble-free	
		If fuel sprays out of the line when the line is separated from the heater, the fuel pipe of the burner unit is probably clogged. If this is the case, the burner unit must be replaced.	
10	Coolant circuit	Check the integration in the vehicle coolant circuit in accordance with the general installation instructions	IMPORTANT Observe the direction of flow of the coolant circuit. Check the connection of the coolant hoses to the water connection piece according to the marking (arrow markings) on the heater. Check components for leaks.
		Eliminate kinks and rubbing spots	
		Check whether coolant circuit is correctly bled	
		Check for leaks on heater, water connection piece, sensors, circulation pump and hoses and eliminate	
		Check circulation in coolant circuit	
11	Exhaust system and air intake system	Check whether intake pipe and exhaust pipe are routed in accordance with general installation instructions	
		Check whether sufficient distance is present to passenger compartment fresh-air intake of vehicle	No exhaust gas may be sucked in through the combustion air pipe
		Check to make sure lines are not clogged	
		Eliminate existing leaks on intake pipe and exhaust pipe (no CO ₂ in intake air)	
		The exhaust pipe outlet may not be routed under the intake pipe inlet	
12	Vehicle fan	Check fuse F1	
		Observe coolant temperature (K5 switches at approx. 77 °F - 25 °C)	
		Check switching signal on the relay K5 , ground on Pin 85 and positive on Pin 86 (audible, also see wiring diagram in general installation instructions)	
		Check coolant temperature signal wire (green/white, gn/wh), Pin 86 on K5	

Fig. 502 Overview of functional test of heater and its components

Error point	Component	Recommended workshop action	Parameter
13	Control unit/ heater locked	Determine cause of lock-out condition, then eliminate lock-out. A distinction is made between 2 types of lock-out: – Fault lock-out Unlocking by pressing ON/OFF switch – Heater lock-out Unlock: 1 Switch on heater 2 Within 10 seconds disconnect power from the heater (unplug the wiring harness, disconnect the battery, remove the fuse(s). 3 Wait 10 seconds. 4 Switch the heater OFF. 5 Reconnect power. 6 Switch the heater ON. 7 Rectify the cause of the fault.	
14	Burner unit	Dismantling and visual inspection	
15	Sooting: Exhaust gas temperature has increased to maximum permissible value	Dismantling and visual inspection of burner unit, exhaust temperature sensor, combustion pipe and heat exchanger, see Section 9.8	Clean or completely replace depending on condition
16	Optional room thermostat	Room thermostat B4 does not switch	Clean or replace components
		Check connection	

Fig. 502 Overview of functional test of heater and its components

5.2 Troubleshooting with error code output

Equipment with switch with an operating indicator

The type of fault is displayed with a flashing code via the operating indicator lamp during the heater run-on time for operation with a switch with an operating indicator. After five short signals, the long flashing pulses must be counted.

The number of long flashing pulses matches the error code number in the table below.

Example:

.....- - - - -- - - = F 03

Equipment with standard timer

If the system is fitted with a standard timer, the fault is indicated on the timer's display after an error has occurred.

Error code number/ Number of flashing pulses	Fault message	Possible causes	Recommended workshop action
F 00	Heater lock-out or control unit defect, fuse defective, wiring defective, go to specialised workshop	Fuses	Check fuses F1, F2 and F3
		Electrical wiring	Check battery connections: + on Pin 1, – on Pin 2 (connector X2) and + on Pin 3 (connector X1 , switch-on signal) (Diesel, N.A. Version)
		Heater lock-out	Delete heater lock-out
		Control unit defect	Replace combustion-air fan unit with control unit
F 01	No start (after 2 starting attempts)	Fuel system	Check fuel level
			Check fuel filter
			Check fuel standpipe and fuel line for leaks
			Bleed fuel system
		Combustion air/exhaust pipe	Check combustion air/exhaust pipe for foreign bodies and clean if necessary
F 02	Flame abort	Burner unit	Clean burner unit and replace if necessary
		Fuel system	Check fuel level
			Check fuel filter
			Check fuel standpipe and fuel line for leaks
			Bleed fuel system
F 03	Undervoltage or overvoltage	Power supply	Check battery
			Check electrical connections
		Exhaust temperature sensor defective	Functional check of exhaust temperature sensor; replace exhaust temperature sensor if necessary
F 04	Flame was detected prior to combustion	Not available	Not available
		Not available	Not available
F 05	Coolant temperature sensor defective	Wiring	Check wiring for damage, open circuit and short circuit
		Coolant temperature sensor defective	Check resistance of coolant temperature sensor; replace if necessary
F 06	Metering pump defective	Wiring	Check wiring for damage, open circuit and short circuit
		Metering pump defective	Functional check of metering pump; replace metering pump if necessary

Fig. 503 Error code output by standard timer/switch with operating indicator

Error code number/ Number of flashing pulses	Fault message	Possible causes	Recommended workshop action
F 08	Combustion-air fan unit defective	Wiring	Check wiring for damage, open circuit and short circuit
		Combustion-air fan unit blocking guard	Functional check of combustion-air fan unit; replace combustion-air fan unit if necessary
		Combustion-air fan unit defective	Replace combustion-air fan unit
F 09	Glow plug defective	Wiring	Check wiring for damage, open circuit and short circuit
		Glow plug defective	Functional check of glow plug with Webasto Thermo Test PC Diagnostics; replace glow plug if necessary
F 10	Overheating	Heater overheated	Check coolant level, bleed coolant circuit. NOTE "Metering pump defective" subsequent fault can occur in conjunction with overheating! Check circulation pump for operation
		Coolant temperature sensor defective	Check wiring for damage, open circuit and short circuit
			Functional check of coolant temperature sensor; replace if necessary
		Overheating sensor defective	Check wiring for damage, open circuit and short circuit
			Functional check of overheating sensor; replace if necessary
F 11	Circulation pump defective	Wiring	Check wiring for damage, open circuit and short circuit
		Circulation pump defective	Replace circulation pump
F 12	Battery main switch defective	Wiring	Check wiring for damage, open circuit and short circuit
		Battery main switch defective	Functional check of battery cut-off switch; replace if necessary
F 13	Operation of vehicle fan defective	Wiring	Check wiring for damage, open circuit and short circuit
		Vehicle fan relay defective	Functional check of battery fan relay; replace vehicle fan relay if necessary
F 14	Overheating sensor defective	Wiring	Check wiring for damage, open circuit and short circuit
		Overheating sensor defective	Check resistance of overheating sensor; replace if necessary
F 15	Pre-heating/ignition circuit defective	Wiring	Check wiring for damage, open circuit and short circuit
		Glow plug defective	Functional check of glow plug with Webasto Thermo Test PC Diagnostics; replace glow plug if necessary
F 16	Exhaust gas temperature too high	Wiring	Check wiring for damage, open circuit and short circuit
		Exhaust temperature sensor defective	Resistance measurement of exhaust temperature sensor; replace exhaust temperature sensor if necessary
		Heater sooted	Visual inspection of the intake and exhaust-gas tract (exclusion of plugging and partial plugging), clean burner unit and heat exchanger; replace components if necessary
F 17	Exhaust temperature sensor defective	Wiring	Check wiring for damage, open circuit and short circuit
		Exhaust temperature sensor defective	Resistance measurement of exhaust temperature sensor; replace exhaust temperature sensor if necessary

Fig. 503 Error code output by standard timer/switch with operating indicator

NOTE

The Webasto Thermo Test PC Diagnostics provides additional information on the errors named above (measured values, point in time of occurrence, etc.).

5.5 Component fault entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
00	-	No error	No error	No activity required
01	1	Defective control unit	Defective control unit, off-line programming is not performed or water temperature sensor defective	Delete fault, carry out fault release/heater lock-out on heater (see Section 5.1.1), restart heater
08	8	Metering pump short circuit	Metering pump has short circuit to ground	Conduct electrical test of fuel system (see Section 5.7, Fig. 504, Point 5)
0B	11	Circulation pump short circuit	The connected line of the water pump has a short circuit to earth or the motor is over-loaded	Conduct electrical test of coolant system (see Section 5.7, Fig. 504, Point 9)
10	16	Coolant changeover valve short circuit	The coolant changeover valve has a short circuit to earth	Conduct electrical test of coolant change over valve (see Section 5.7, Fig. 504, Point 16)
13	19	Vehicle fan power circuit short circuit	The vehicle fan power circuit has a short circuit to earth	Conduct troubleshooting in area of vehicle fan (see Section 5.7, Fig. 504, Point 13)
15	21	Combustion air fan blocked	Combustion air fan is blocked	1 Conduct troubleshooting in combustion air fan (see Section 5.7, Fig. 504, Point 8) 2 Conduct troubleshooting in intake air system (foreign body) (see Section 5.7, Fig. 504, Point 12)
19	25	Glow/ignition element power circuit short circuit	Glow plug / electronic ignition unit has short circuit to ground	Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
1B	27	Overheat sensor short circuit	The connected line of the element has a short circuit to earth	Conduct electrical test of temperature sensors (see Section 5.7, Fig. 504, Point 7)
2D	45	The combustion-air fan power circuit is defective	Fan motor speed is below value to be expected	Delete fault, carry out fault release/heater lock-out on heater (see Section 5.1.1), restart heater
2E	46	The glow/ignition-element power circuit is defective	Glow plug resistance is outside the value range	In case of multiple occurrences(> 3): 1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
3A	58	W-bus/LIN-bus short circuit to earth	No additional information available	Troubleshooting in area of W bus communication (see Section 5.7, Fig. 504, Point 2 and 3)
3C	60	Internal control unit fault60	No additional information available	Delete fault, carry out fault release/heater lockout on heater (see Section 5.1.1), restart heater
3D	61	Internal control unit error61	No additional information available	Delete fault, carry out fault release/heater lockout on heater (see Section 5.1.1), restart heater
3E	62	Internal control unit error62	No additional information available	Delete fault, carry out fault release/heater lockout on heater (see Section 5.1.1), restart heater
3F	63	Wrong version dataset loaded	No additional information available	Delete fault, carry out fault release/heater lockout on heater (see Section 5.1.1), restart heater
40	64	Glow plug / electronic ignition unit - glow filament interruption	One of the heating circuits of the glow plug/electronic ignition unit is open	– Check glow plug (see Section 9.3.2) – Replace control unit (combustion air fan unit) or heater
81	129	EOL checksum error	Checksum of EOL dataset is wrong	Delete fault, carry out fault release/heater lockout on heater (see Section 5.1.1), restart heater
88	136	Metering pump interruption	Metering pump interrupted or short circuit to supply voltage +Ub	Conduct electrical test of fuel system (see Section 5.7, Fig. 504, Point 5)
89	137	Combustion air fan interruption	Combustion air fan interrupted or short circuit to supply voltage +Ub	Troubleshooting in combustion air fan (see Section 5.7, Fig. 504, Point 8)
8B	139	Circulation pump interruption	Circulation pump interrupted or short circuit to supply voltage +Ub	Conduct electrical test of coolant system (see Section 5.7, Fig. 504, Point 9)
90	144	Coolant changeover valve open circuit	The coolant changeover valve power circuit is open\or has a short circuit to +Ub	Conduct electrical test of coolant changeover valve (see Section 5.7, Fig. 504, Point 16)
94	148	Temperature sensor interruption	Temperature sensor interrupted or short circuit to supply voltage +Ub	Conduct electrical test of temperature sensors (see Section 5.7, Fig.504, Point 7)
99	153	Glow plug / electronic ignition unit interruption	Glow plug / electronic ignition unit interrupted or short circuit to supply voltage +Ub	Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
AB	171	Overheat sensor interruption	Overheat sensor interrupted or short circuit to supply voltage +Ub	Conduct electrical test of temperature sensors (see Section 5.7, Fig.504, Point 7)

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
00		No error	No error	No activity required
02	2	No start	After startup has been repeated, combustion still fails to occur	1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) 4) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
04	4	Supply voltage too high	Supply voltage was too long above maximum threshold value	Conduct check of vehicle electrical system supply voltage (also see Section 5.7, Fig. 504, Point 1)
05	5	Flame was detected prior to combustion	Flame detector signals flame before combustion operation	1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 5) 3) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
06	6	Heating unit overheated	Overheat protection was released	1) Check vehicle coolant circuit (see Section 5.7, Fig. 504, Point 11) 2) Check circulation pump (see Section 5.7, Fig. 504, Point 9) 3) Conduct electrical test of temperature sensors (see Section 5.7, Fig. 504, Point 7) 4) Check heater for visible damage and leaks, then check coolant circuit for leaks. Then put heater into operation again.

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
11	17	ECU wrong coded	Incorrect parameter block	This fault can only occur on vehicles with CAN bus or Lin bus connection to heater: 1) Compare heater type label with vehicle fuel type Proceed according to vehicle manufacturer's specifications
12	18	W bus communication failure	Bus fault, protocol error	Operation continues unchanged if this fault occurs. In case of frequent occurrence (> 10) and faults in heater operation: 1 Troubleshooting in area of W bus communication/Telestart receiver (see Section 5.7, Fig. 504, Point 2, and 3) 2) Replace control unit (combustion-air fan unit) or heater
2F	47	Flame abort	The flame has extinguished during operation. Another starting attempt will be carried out.	In case of frequent occurrence (> 10): 1) Troubleshooting in air intake or in exhaust system(see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
37	55	Coolant temperature during initial start-up too high	No additional information available	This fault can only occur during initial startup of the heater (at vehicle manufacturer's plant): 1) Allow coolant system to cool down - attempt initial start-up again Conduct electrical test of temperature sensors (see Section 5.7, Fig. 504, Point 7)

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double click in WTT*	Recommended workshop action
38	56	Initial starting attempt failed	No additional information available	In case of frequent occurrence (> 10): 1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
39	57	Initial starting attempt failed – not restarting	No additional information available	In case of frequent occurrence (> 3): 1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
3F	63	Wrong version dataset loaded	No additional information available	Delete fault, carry out fault release/ heater lock-out on heater (see Section 5.1.1), restart heater
4C	76	Overvoltage component protection	Switching off at extremely high overvoltage for component protection	Conduct check of vehicle electrical-system supply voltage (also see Section 5.7, Fig. 504, Point 1)

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
4E	78	Customer specific fault 3	No additional information available	In case of frequent occurrence (> 3): 1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
81	129	EOL checksum error	Checksum of EOL dataset is wrong	Delete fault, carry out fault release/heater lock-out on heater (see Section 5.1.1), restart heater
82	130	No start during test run	No start during test run	This fault can only occur during initial startup of the heater (at vehicle manufacturer's plant): 1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
83	131	Flame failure	Flame interruption during combustion operation, more than FAZ (EEPROM) times	In case of frequent occurrence (> 3): 1) Troubleshooting in air intake or in exhaust system (see Section 5.7, Fig. 504, Point 12) 2) Conduct troubleshooting in fuel system (see Section 5.7, Fig. 504, Point 10) 3) Conduct check of metering pump (see Section 5.7, Fig. 504, Point 5) Conduct electrical test of glow plug (see Section 5.7, Fig. 504, Point 6)
84	132	Operating voltage too low	Supply voltage was too long below maximum threshold value	1) Check approximate formula: Does the customer heat longer than his/her driving time? 2) Conduct check of vehicle electrical-system supply voltage (also see Section 5.7, Fig. 504, Point 1)
86	134	Excessive water temperature without combustion process	Fault will be set if water temperature has exceeded 145 °C in control break	In case of multiple occurrences (> 3): 1) Troubleshooting in coolant system (see Section 5.1) and bleed system 2) Conduct check of temperature sensors (see Section 5.7, Fig. 504, Point 7) Replace heater
87	135	Heater lock-out permanent	Permanent heater lock-out has been activated	1) Delete heater lock-out attempt restart Read out additional fault messages and work through their recommendation for action
92	146	Command refresh failure	Command refresh failure. In case of this fault no operation	Troubleshooting in area of Wbus communication (see Section 5.7, Fig. 504, Point 2, 3 and 4)

Fig. 504 Overview of component faults entered in the fault memory

Fault code (HEX)	Fault code (DEZ)	WTT* fault message	Fault details with double-click in WTT*	Recommended workshop action
9C	156	Heating time exceeded	Calculated heating time from intelligent under voltage detection exceeded	1) Check approximate formula: Does the customer heat longer than his/her driving time? Check vehicle electrical-system supply voltage
A9	169	Insufficient coolant flow	The fault occurs if the coolant temperature exceeds the switching threshold for burning out during the phases Start/GPR (glow plug ramp)/FMM (flame monitor measuring phase) during the control break	1) Check vehicle coolant circuit (see Section 5.7, Fig. 504, Point 11) 2) Check circulation pump (see Section 5.7, Fig. 504, Point 9) 3) Conduct electrical test of temperature sensors (see Section 5.7, Fig. 504, Point 7) 4) Check heater for visible damage and leaks, then check coolant circuit for leaks. Then put heater into operation again.
AA	170	S on W-Bus not succeed	S on W-Bus not succeed (nor or faulty response, even after repeating telegram four times)	1) Check vehicle coolant circuit (see Section 5.7, Fig. 504, Point 11) 2) Check circulation pump (see Section 5.7, Fig. 504, Point 9) 3) Conduct electrical test of temperature sensors (see Section 5.7, Fig. 504, Point 7) 4) Check heater for visible damage and leaks, then check coolant circuit for leaks. Then put heater into operation again.
AB	171	Overheat sensor interruption	Overheat sensor interrupted or short circuit to supply voltage +Ub	Conduct electrical test of temperature sensors (see Section 5.7, Fig. 504, Point 7)

Fig. 504 Overview of component faults entered in the fault memory

6 Operating tests

6.1 General

This section describes the tests of the heater and its components in the installed and the removed state.

The coolant temperature as detected by the heater might be considerably different due to the different locations in the coolant system. The heater will regulate the coolant temperature based on the temperature sensor internal to the heater.

WARNING

The heater may not be operated in closed rooms, such as garages or workshops, without exhaust extraction, this includes timer events.

6.2 Operating checks in vehicle

1. Switch on vehicle fan and set temperature control to "hot".
2. Make sure that the coolant circuit and the fuel system are carefully tied-in in accordance with the vehicle manufacturer's specifications.
3. Switch on the heater with the heater control.
When the heater is switched on, the circulation pump and the combustion-air fan unit run. This is audible. The vehicle fan is switched on by the heater when the coolant temperature has reached approx. 86 °F - 30 °C (diesel).
4. Allow the heater to run in the combustion mode. Check the heating effect at the outlet nozzles of the vehicle fan.
5. Switch off the heater with the heater control after the functional check.

A maximum run-on of 175 sec is activated when the heater is switched off. Acoustically perceptible due to a reduction in the burner noise, continued running of the combustion-air fan unit with an increase in the speed after approx. 60 sec., for active cooling of the heater and operation of the circulation pump.
Then the entire system is switched off.

NOTE

The effectiveness of the heater is dependent on several factors:

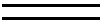
- outside temperature
- vehicle model
- engine temperature
- how the heater is integrated in the vehicle's coolant system
- quantity of coolant in the system
- duration the heater run-time

7 Circuit diagrams

Fig. 701, Fig. 702, and Fig. 704 show the possible circuits of the Thermo Top Evo heater.

Legend for wiring diagram.

Table 1 Cable cross-sections

	Length < 7.5 m	Length 7.5 - 15 m
	0.75 mm ²	1.0 mm ²
	1.0 mm ²	1.5 mm ²
	1.5 mm ²	2.5 mm ²
	2.5 mm ²	4.0 mm ²
	4.0 mm ²	6.0 mm ²

The information for the line lengths and cross sections only apply to cables which comply with the standard DIN EN 13602.

Table 3 Legend for wiring diagrams

Item	Description	Comment
2	Timer	– with positive on timer connection 10: Continuous operation with immediate heating – Timer connection 10 open: Heating duration is programmable (10 to 120 min.), basic setting 120 min.
A1	Heater	Thermo Top Evo
A2	Control module	Thermo Top Evo
B1	Exhaust Temperature Sensor	PT2000
B2	Coolant Temperature Sensor	Temperature sensor for coolant circuit
B3	Overheat Sensor	Sensor on heat exchanger
DP	Fuel Metering Pump	Fuel pump for heater
F1	Fuse (20A)	Mini fuse
F2	Fuse (20A)	Mini fuse
F3	Fuse (2A)	Mini fuse
F4	Fuse (2A)	Mini fuse
GS	Glow Plug	
H1	Operation Indicator Light	On switch or timer
M1	Combustion Air Fan	
M2	Circulation Pump	
S1	Toggle switch	ON/OFF operation
X1	Plug connector, 10 pin	Vehicle plug on item A2
X2	Plug connector, 2 pin	Power supply on item A2
X3	Plug connector, 4 pin	Overheat sensor and coolant temperature sensor on item A2
X4	Plug connector, 2 pin	Circulation pump to control module
X5	Plug connector, 2 pin	Glow plug to control module
X6	Plug connector, 2 pin	Exhaust temperature sensor to control module
X10	Plug connector, 4 pin	W-bus PC diagnostics
X11	Plug connector, 2 pin	to fuel metering pump
X20	Plug connector, 3 pin	control module engine contact

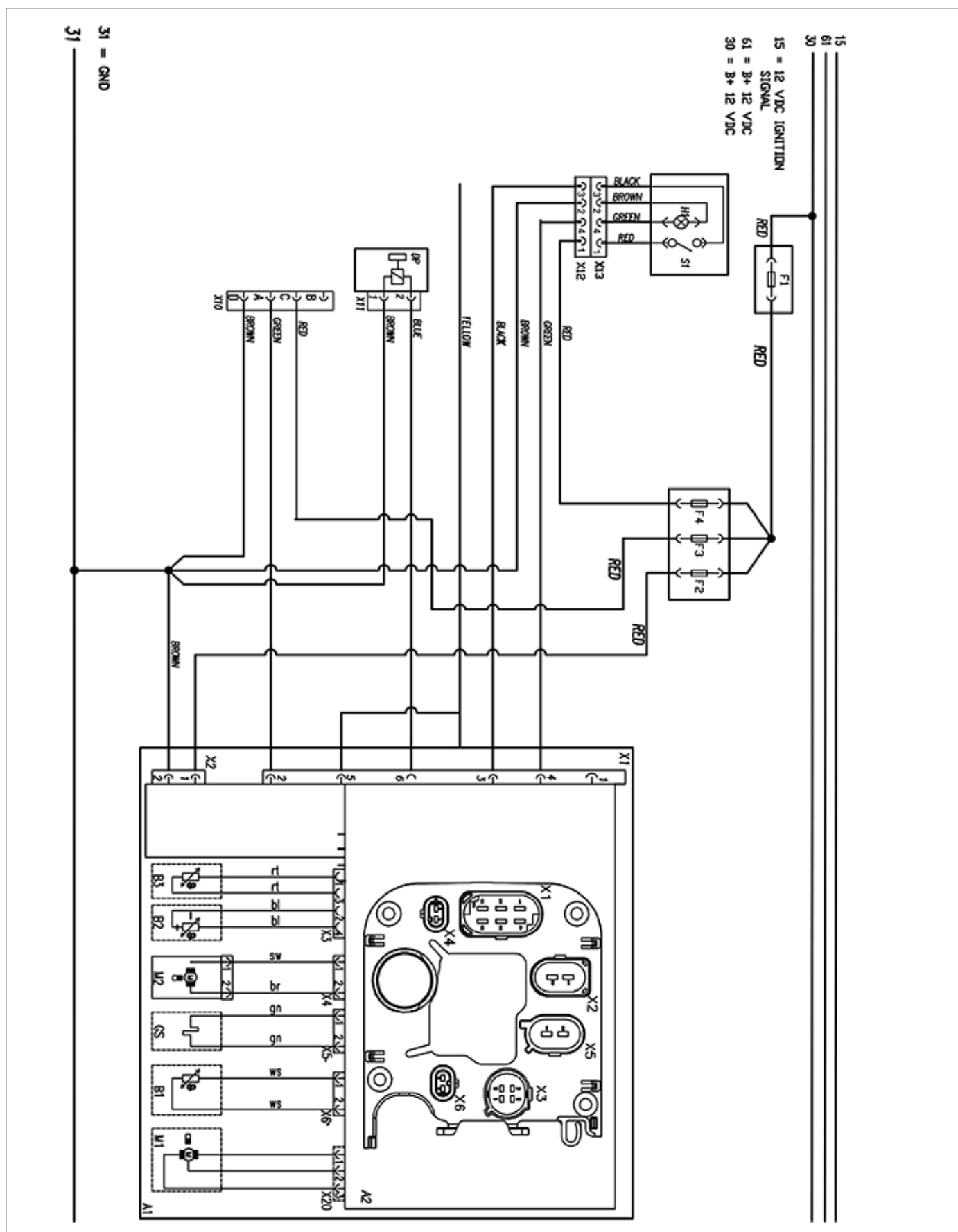


Fig. 701 Thermo Top Evo with On/Off switch - wiring diagram

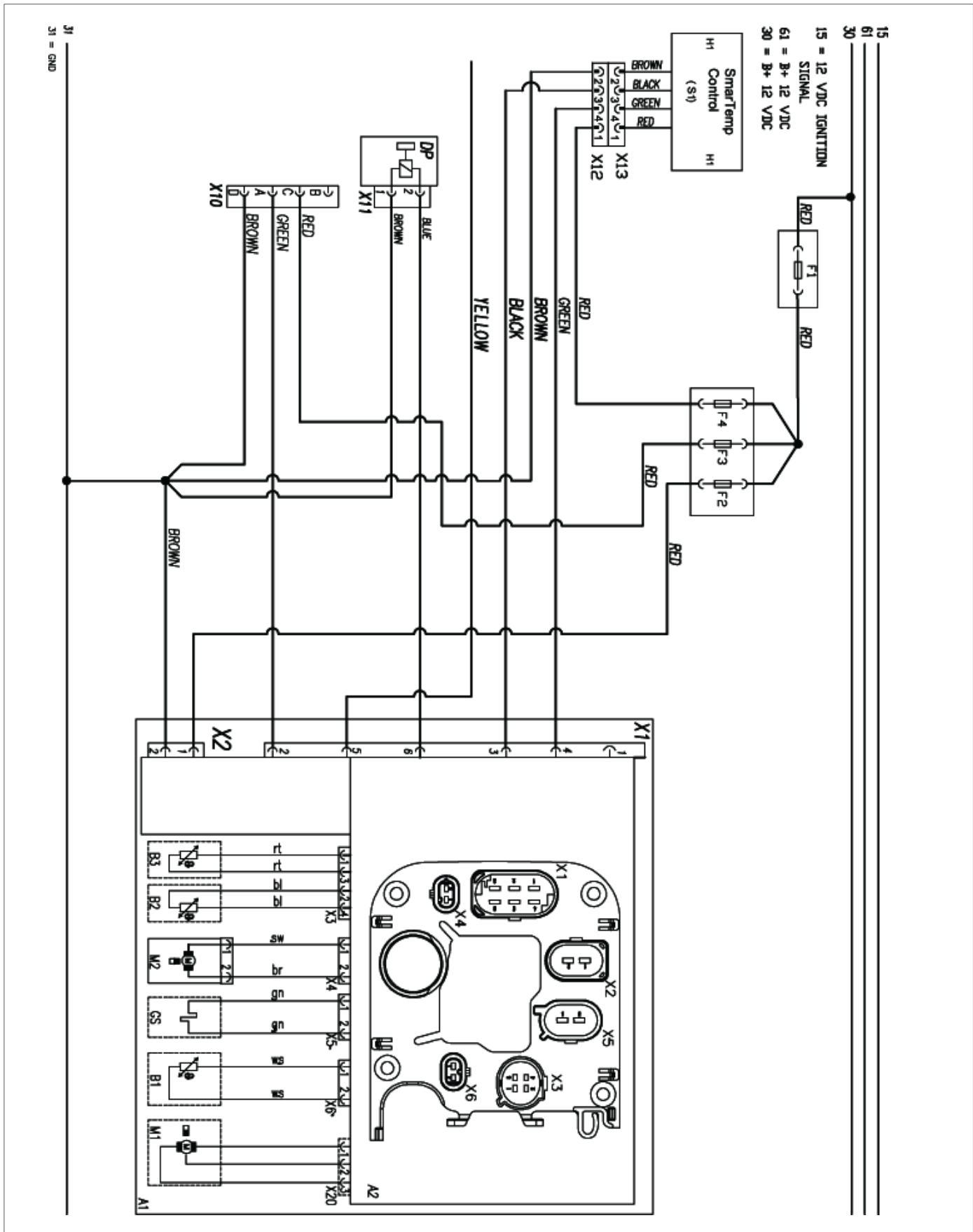


Fig. 702 Thermo Top Evo with 7-Day, 4 Program SmarTemp Control fx 2.0

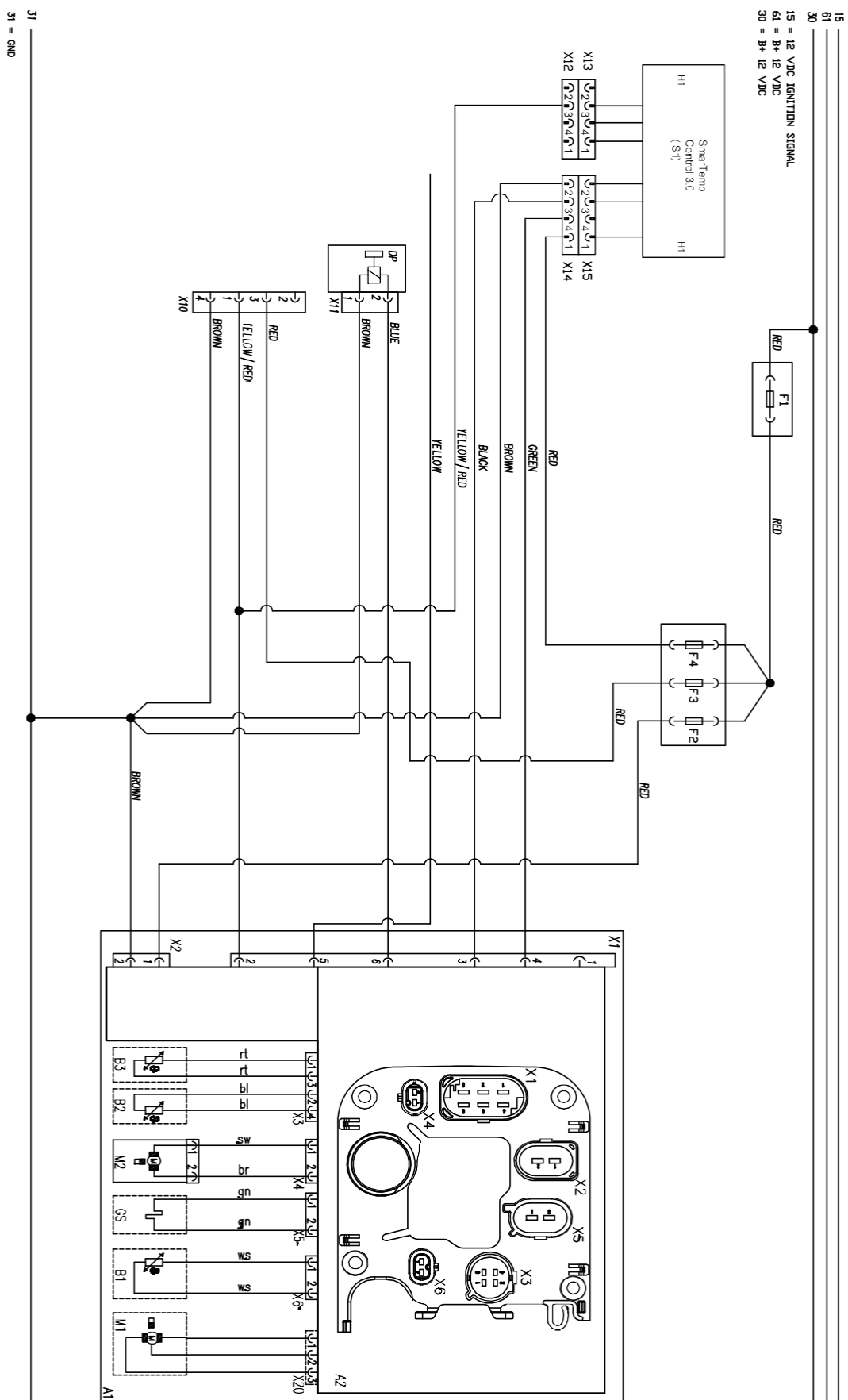


Fig. 703 Thermo Top Evo with 7-Day, 4 Program SmarTemp Control 3.0 / 3.0 Bluetooth

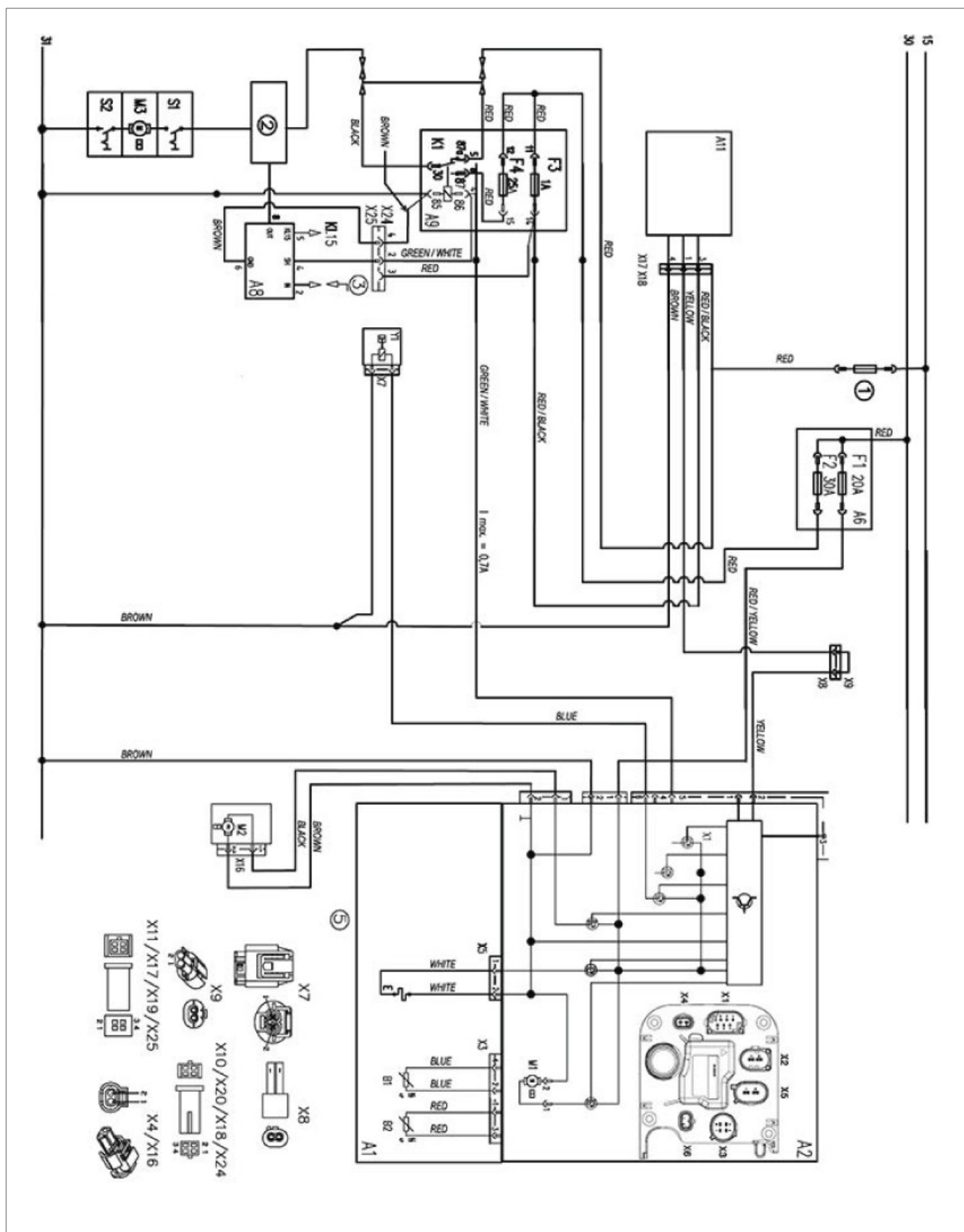


Fig. 704 System wiring diagram for Thermo Top Evo with MultiControl

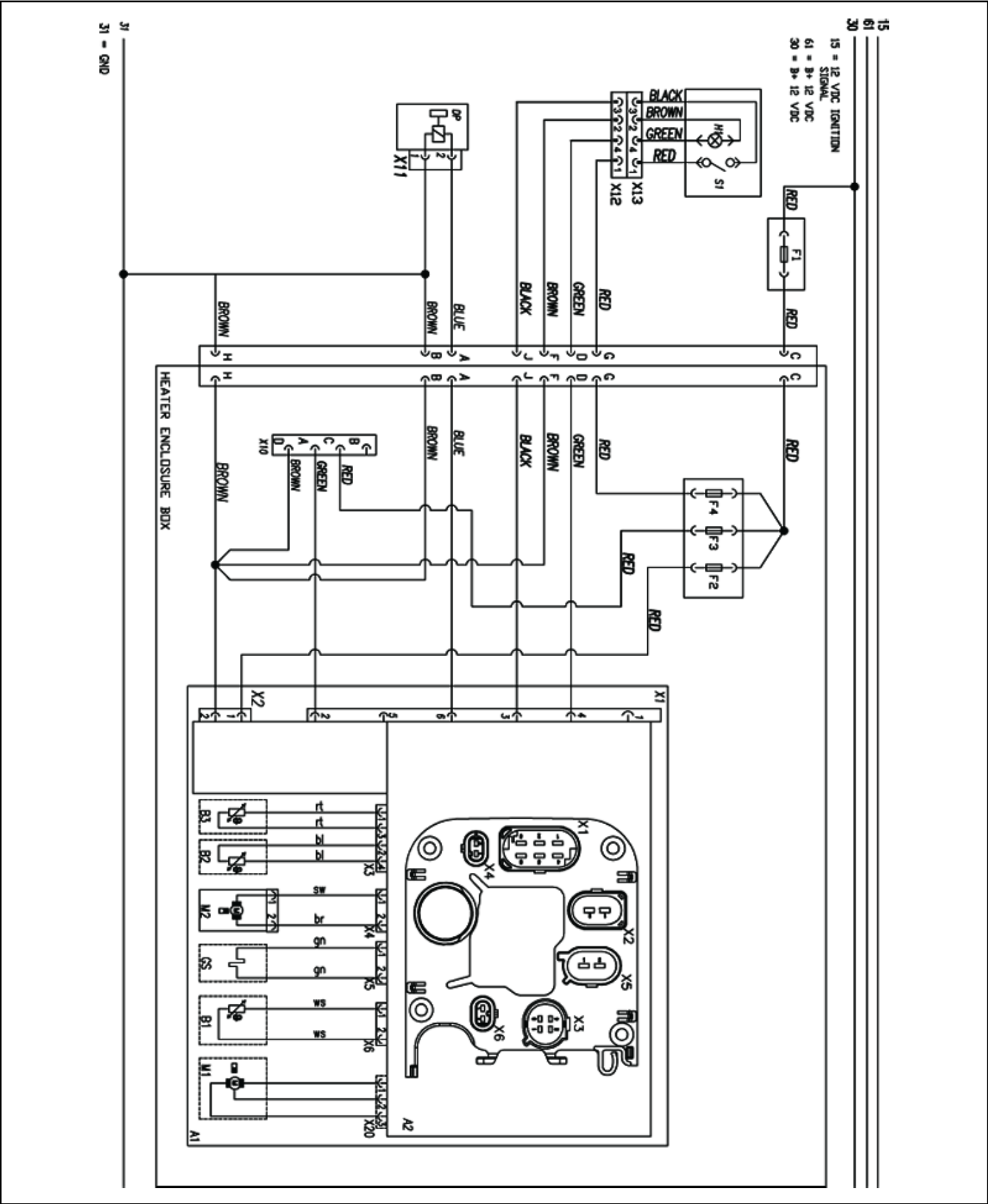


Fig. 705 System wiring diagram for Thermo Top Evo with enclosure box

8 Servicing work

This section describes the servicing work that can be carried out on the heater and its components while installed.

8.1 Work on heater

The power supply must always be disconnected before all work on the heater (pull fuses F1, F2 and F3, see wiring diagrams in Chapter 7).

To prevent component damage, the heater power supply must not be interrupted during operation or run-on.

When conducting repair work on the heater, it must be completely removed.

After the heater and all coolant-carrying components have been installed, the entire coolant system must be filled, bled and checked for leaks with the specified system pressure in accordance with the vehicle manufacturer's instructions.

The general installation instructions and the vehicle-specific installation instructions for the heater must be observed when carrying out repairs which make it necessary to change the installation location.

8.2 Work on vehicle

IMPORTANT

The heater must not be subjected to temperatures above 248 °F (120°C) at any time. Failure to heed this advice may result in damage to the heater.

8.3 CO₂ setting

NOTE

After repairing the heater and/or replacing the metering pump, the adjustment of the CO₂ value should be checked.

IMPORTANT

After replacing the combustion-air fan unit with the control unit, the CO₂ value must be checked and reset if necessary.

The CO₂ setting is carried out with Webasto Thermo Test PC Diagnostics.

The heater is set at the factory to for optimum performance at altitudes up to approximately 3,200 ft (1000 m) above sea level. Continuous operation above that altitude may lead to a high level of CO₂, causing excessive smoke and soot.

NOTE

The CO₂ value is corrected with the Webasto Thermo Test PC Diagnostics. The CO₂ measurement and setting must be carried out at the maximum heating capacity. The measurement of the CO₂ content is carried out approx. 0.75 in (20 mm) in front of the end of the exhaust outlet inside the exhaust pipe with a CO₂ tester.

The following table shows the nominal CO₂ setting value in full-load combustion operation in dependence on the geodetic altitude at which the setting is made.

Table 4 CO₂ adjustment values

Altitude above seal level ft (m)	Nominal CO ₂ setting value at 68 °F (20 °C) ambient temperature [% by vol.]
	5 kW
0	9.4
1,640 (500)	10.2
3,300 (1000)	10.7
5,000 (1500)	11.5

8.4 Circulation pump

The power consumption is approx. 18 W with a nominal volume flow rate with counter-pressure > 140 mbar of 450 l/h.

Electrical checking of circulation pump

Internal resistance of the circulation pump: 20 ± 1 kohms

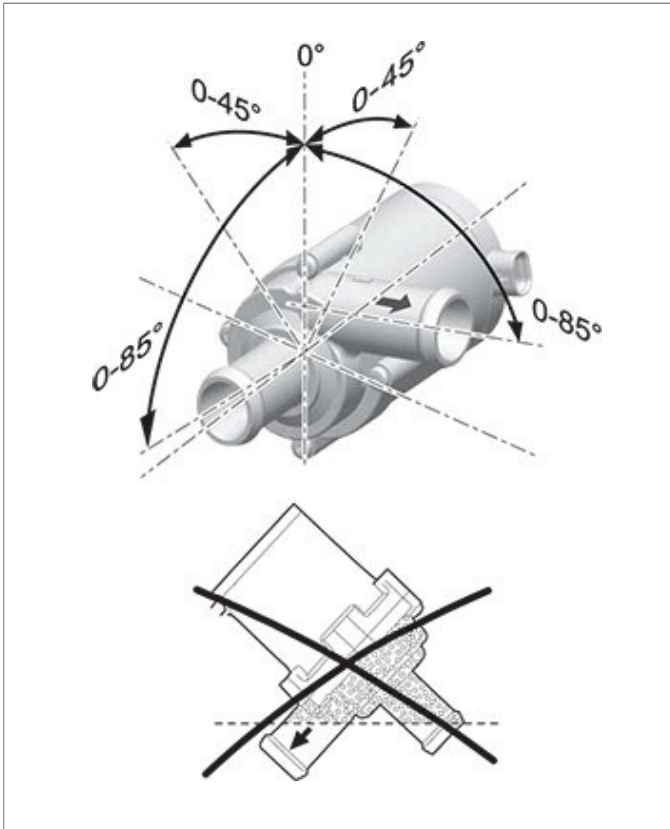


Fig. 801 Installation positions of U4847 circulation pump

NOTE

Ensure the correct direction of flow of the circulation pump (arrow marking) to the vehicle coolant circuit. The installation position of the circulation pump must be chosen so that the circulation pump is self-bleeding. It must be possible for the air volume trapped in the circulation pump to escape upward by itself via the connection piece. Improper installation can result in faults in the circulation pump operation.

NOTE

Dropped pumps must not be used further. Dropping the pump can result in external impact points and internal damage. External damage can result in leaks in the hose connection pieces. In extreme cases, possible cracks in the plastic part can result in a leak between the pump interior or the surrounding area and the electronics area. As a consequence, pump malfunctions can occur due to the penetration of cooling liquid into the electronics area.

8.5 DP42 metering pump

Check the installation positions and installation conditions of the metering pump in accordance with the general installation instructions for the Thermo Top Evo. The Thermo Top Evo heater may only be operated with the DP42 metering pump.

Electrical checking of metering pump

Coil resistance of the DP42 metering pump:

5.20 ohms $\pm 5\%$ at $72 \pm 5^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$), test current: < 1 mA

Carry out the function **component test of metering pump** with Webasto Thermo Test PC-Diagnostic software.

Setting	7 Hz / 60 sec	7 Hz / 240 sec
Diesel	13.4 ml	53.6 ml

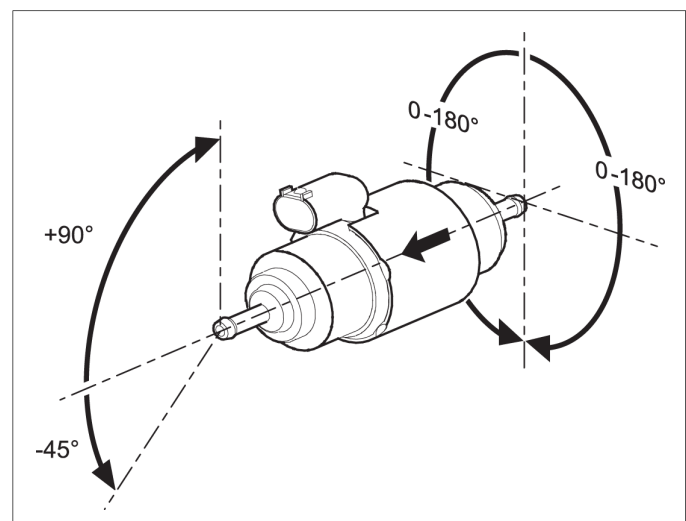


Fig. 802 Installation position of DP42 metering pump

8.6 Checking work

The following servicing work is to be carried out at least every two years to maintain the functional reliability of the heater:

- Read out fault memory.
- Check electrical connections for contact corrosion and firm seating.
- Check exhaust and combustion air lines for damage and to ensure that they are clear.
- Check fuel line for leaks.
- Check coolant circuit and circulation pump for leaks.
- Check hoses for cracks.
- Replace fuel filter if installed.
- Conduct operating test of heater as described in Chapter 6.

8.7 Heater, removal and installation

WARNING

The heater may not be operated in closed rooms, such as garages or workshops, without exhaust extraction, not even with a timed event.

8.7.1 Removal

- 1 Interrupt the heater power supply by removing the fuses F1, F2, F3, and F4.
- 2 Disconnect electrical connectors from heater.

NOTE

All open plugs and connectors must be protected against moisture and soiling.

- 3 Relieve the coolant system pressure.
- 4 Remove the coolant hoses from the heater. It is advisable to use hose-crimping pliers to reduce coolant loss.
- 5 Remove the combustion air tube.
- 6 Remove the fuel hose. Use a plug in the rubber coupler to reduce fuel loss.
- 7 Remove the heater from the mounting bracket. Removing the bracket from the vehicle might be necessary.

8.7.2 Installation

- 1 Move heater into specified installation position and tighten heater screws to 70 in-lb (8 Nm).

NOTE

The screw must be carefully inserted in the existing threads and screwed in by hand.

- 2 Mount fuel line and secure with hose clamp. It is critical that the hose clamp be tightened to the point that the two tabs on the clamp contact each other.
- 3 Mount coolant hoses and secure with clamps.

IMPORTANT

Observe the direction of flow of the coolant circuit. Mount the coolant hoses on the heater on the water connection pieces according to the marking (arrow markings).

- 4 Restore all electrical connections.
- 5 Connect combustion air pipe and exhaust pipe.
- 6 Remount fuses F1, F2, F3, and F4.
- 7 Bleed coolant circuit.
- 8 Bleed vehicle fuel system if necessary.

8.8 Restarting

After the heater has been installed, the coolant circuit and the fuel supply system must be carefully bled. The specifications of the vehicle manufacturer must be observed when doing so. All coolant and fuel connections must be checked for leaks and secure attachment during the test run. Should a fault occur in the heater during operation, then troubleshooting must be carried out (see Chapter 5).

NOTE

To support bleeding of the coolant circuit, the circulation pump can be put into operation via the Component test function of the Webasto Thermo Test PC Diagnostics.

NOTE

The heater can be put into operation with the Webasto Thermo Test Diagnostics. With the fuel line completely drained, the line must be filled with the Webasto Thermo Test PC Diagnostics.

9 Repair

NOTE

The seals must always be replaced before assembling the heater.

9.1 Dismantling and assembling heater

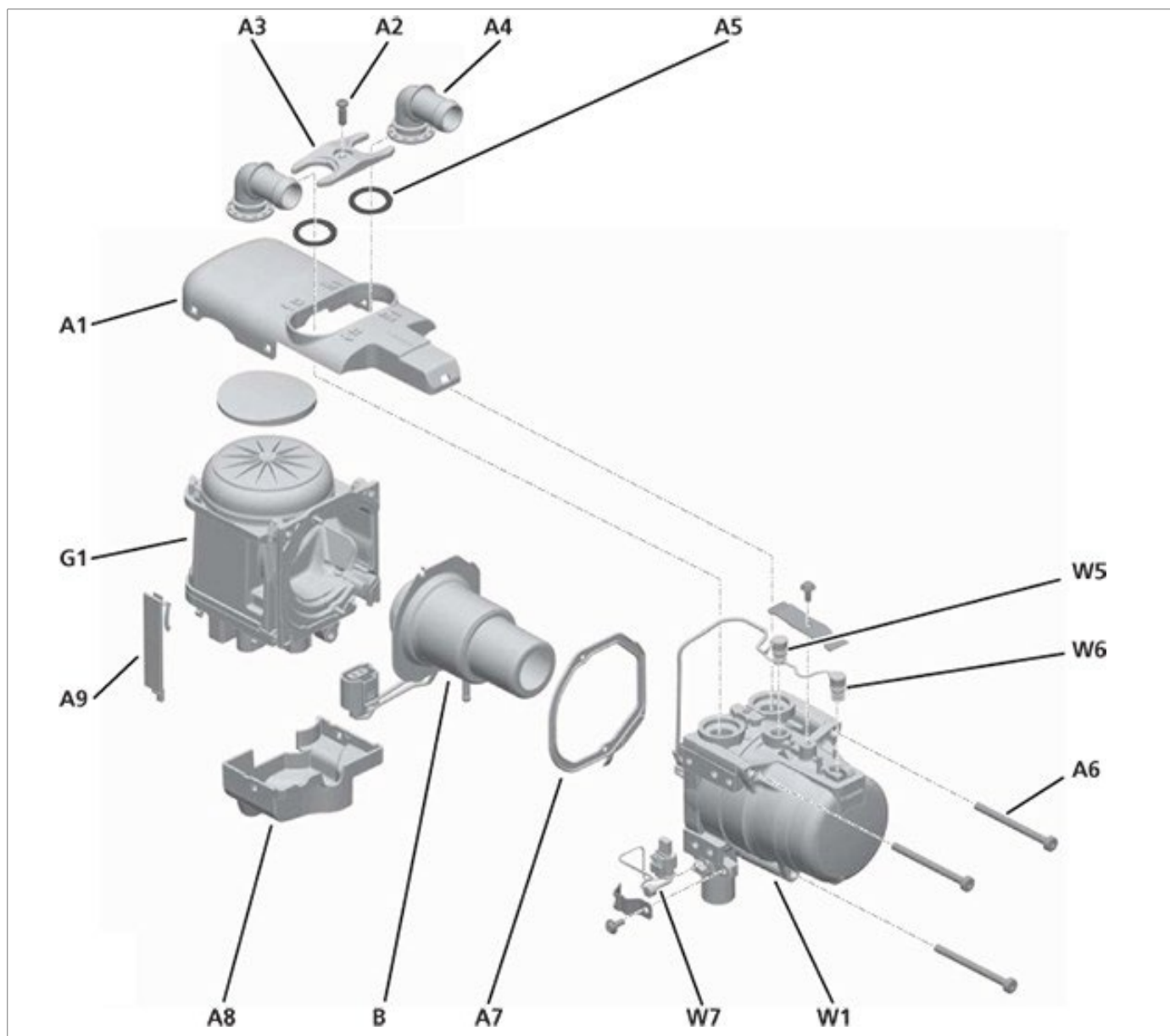


Fig. 901 Component description for Thermo Top Evo heater

A1	= Heater cover	A7	= Gasket	W1	= Heat exchanger
A2	= Screw	A8	= Connector cover	W5/W6	= Sensors
A3	= Retaining plate	A9	= Cable cover	W7	= Exhaust temperature sensor
A4	= Water connection piece	B	= Burner unit		
A5	= O-ring	G1	= Combustion-air fan unit with control unit		
A6	= Screw				

9.1.1 Dismantling heater

1. Loosen screw (A2, Fig. 901) and remove water connection piece (A4) with retaining plate (A3) and O-rings (A5).
2. Loosen heater cover (A1) at side detents on combustion-air fan unit (G1) with a screwdriver. Then remove heater cover (A1) from heater toward front.
3. Remove cable cover (A9) from combustion-air fan unit (G1).
4. Release connector cover (A8) on side facing away from fuel connection piece at side detents with a screwdriver and take off heater.
5. Release latch of connector and pull connector off control unit.
6. For information on replacing defective temperature sensors (W5 and W6): see Section 9.6.
7. Replacement of defective exhaust temperature sensor (W7), see Section 9.7.
8. Loosen screws (A6) and pull heat exchanger (W1) of combustion-air fan housing (G1) in axial direction of screw fitting.
9. For information on removing the burner unit (B), see Section 9.2.1.
7. Hook heater cover (A1) on heat exchanger (W1) into heater and engage in locking lugs of combustion-air fan unit (G1).
8. Moisten new O-rings (A5) and lay in heat exchanger (W1), then fasten water connection piece (A4) and retaining plate (A3) with screw (A2).
66 in-lb $\pm$ 10% (7.5 Nm $\pm$ 10%).

NOTE

The sensors can be damaged during removal. Once removed, sensors may not be reinstalled. Only new sensors may be used.

9.1.2 Assembling heater

1. Installation of temperature sensors (W5/W6): see Section 9.6.3.
2. Installation of exhaust temperature sensor (W7), see Section 9.7.2.
3. For information on installing burner unit (B) see Section 9.2.2.
4. Clean heat exchanger (W1) inside and outside and place on fan. Tighten 3 screws (A6) to 62 in-lb $\pm$ 10% (7 Nm $\pm$ 10%).
5. Lay cable in cable duct, see Fig. 919.
6. Place cable cover (A9) on combustion-air fan unit (G1).

9.2 Burner unit

9.2.1 Removing burner unit

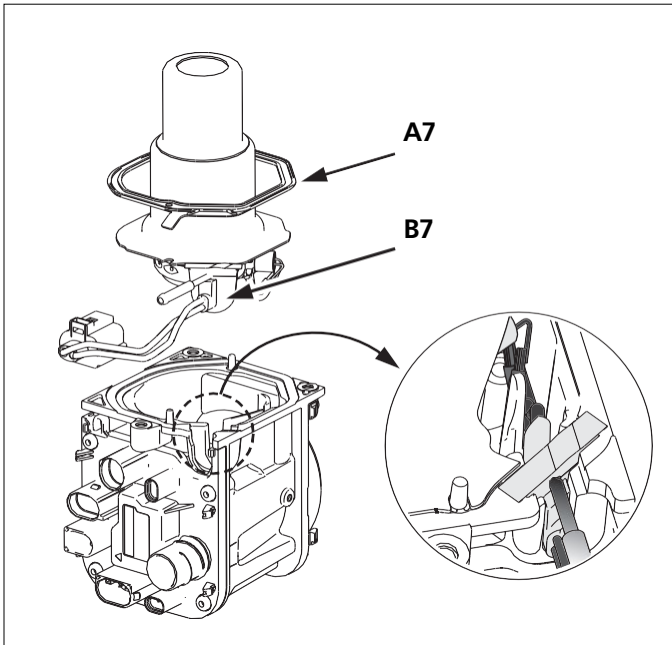


Fig. 902 Burner unit and combustion-air fan unit

Dismantle the heater as described in Section 9.1.1 up to Point 8. The connectors are disconnected. Set down the fan with the burner unit vertically.

1. Remove gasket (A7).
2. Slide grommet (B7) with slight pressure onto fuel pipe (B5) out of combustion-air fan unit (G1) while lifting off burner unit (B) vertically upward.

9.2.2 Installing burner unit

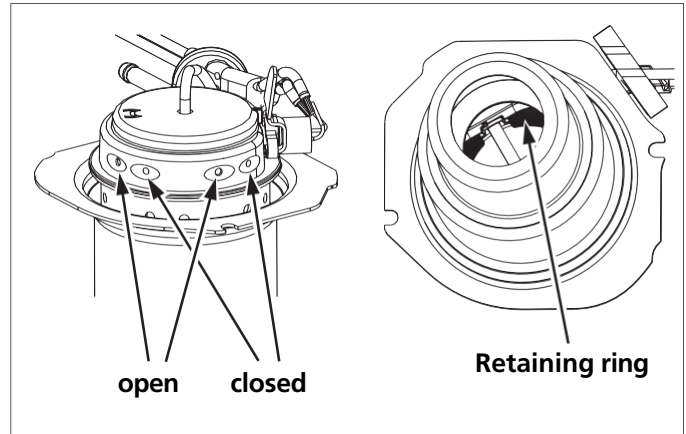


Fig. 903 Burner unit

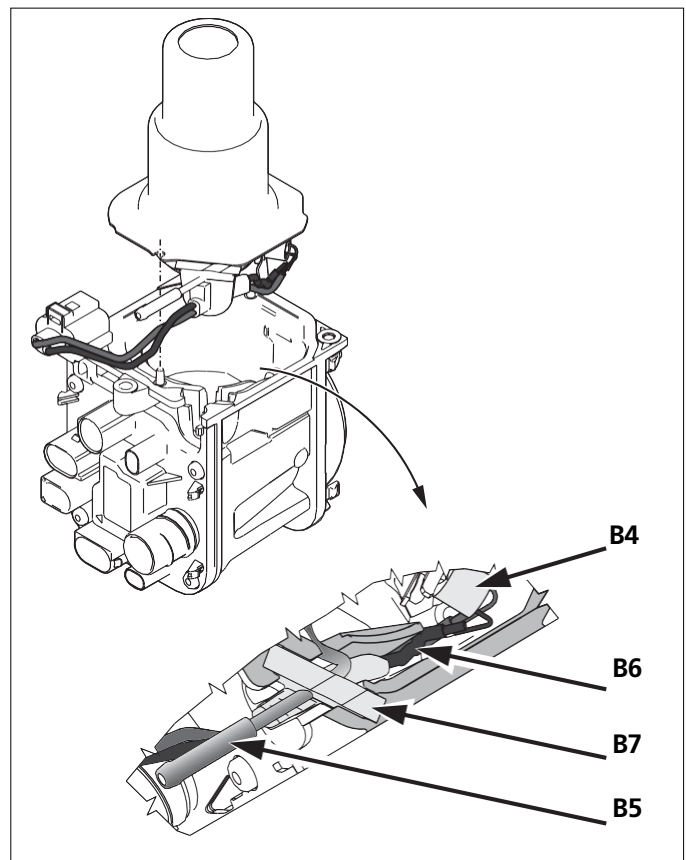


Fig. 904 Detailed illustration of cable routing for glow plug

1. Pre-position burner unit with grommet (B7) in combustion-air fan unit (G1). During installation, make sure that the glow plug cable (B6) and grommet (B7) are mounted in the guide and groove provided on the combustion-air fan unit (G1) (see Fig. 904). Press grommet (B7) into groove provided until it completely fill out the installation space.
2. Mount gasket (A7) on positioning pins of combustion-air fan unit (G1) with flat side facing combustion-air fan unit (G1).
3. Then proceed with the installation of the heat exchanger (W1) as described in Section 9.1.2.

9.3 Glow plug

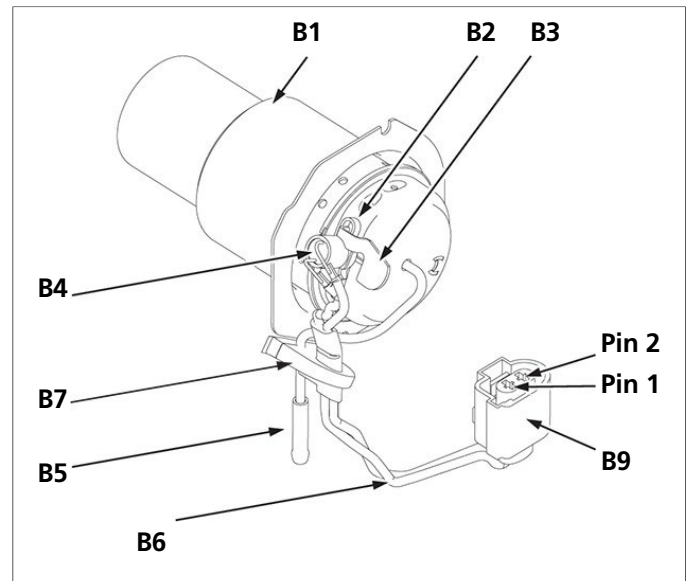


Fig. 905 Burner unit with glow plug

9.3.1 Electrical test of glow plug

The cold resistance must be tested by connecting contacts 1 and 2 of the connector from the glow plug to a multimeter.

Cold resistance at $77 \pm 9 \text{ }^{\circ}\text{F}$ ($25 \pm 5 \text{ }^{\circ}\text{C}$): 0.235 to 0.355 ohms

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

Short-circuit resistance: < 0.500 ohms.

NOTE

The measurement must be carried out with a multimeter according to the four-conductor measuring principle. To measure the cold resistance, the glow plug must be adjusted to room temperature.

9.3.2 Removing glow plug

NOTE

The removal of the glow plug may entail an increased application of force, therefore destroying the glow plug.

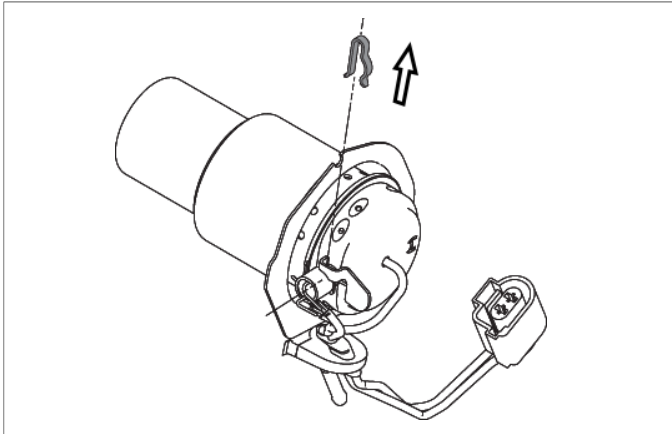


Fig. 906 Remove retaining spring

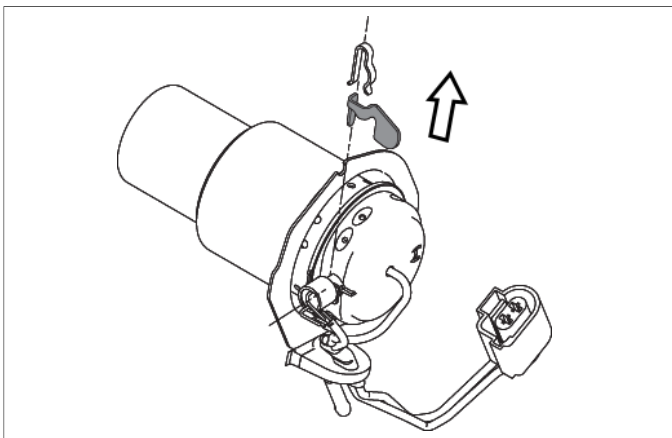


Fig. 907 Remove cooling flag

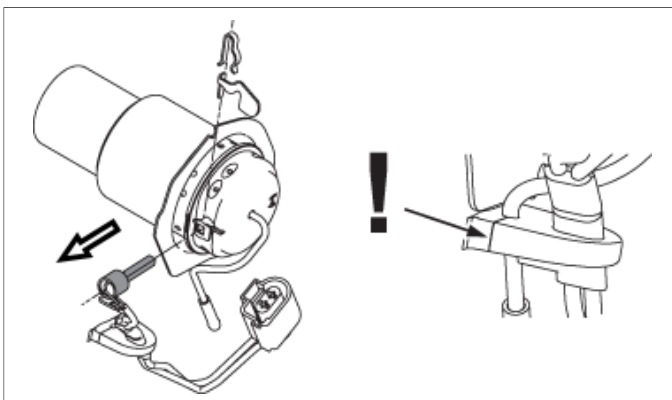


Fig. 908 Remove glow plug

9.3.3 Installing glow plug

IMPORTANT

Only use a new glow plug during installation. Uninsulated areas of the glow plug cable must not touch and must not come into contact with metal parts of the burner unit or the combustion air housing (danger of short circuits). The glow plug must not be twisted or jammed and must be seated in the guide as far as possible during installation (danger of breakage). When installing the burner unit, the cable must be routed so that it lies in the groove provided. Also see Section 9.2.2 and Fig. 904.

1. Position combustion pipe with evaporator mount horizontally toward rear (see Fig. 909).
2. Slide glow plug (B4) with unbent cable (B6) as far as possible into mounting hole of glow plug dome (B8).

IMPORTANT

Install glow plug (B4) with groove (B11, below ceramic) toward combustion pipe (see detail Fig. 913).

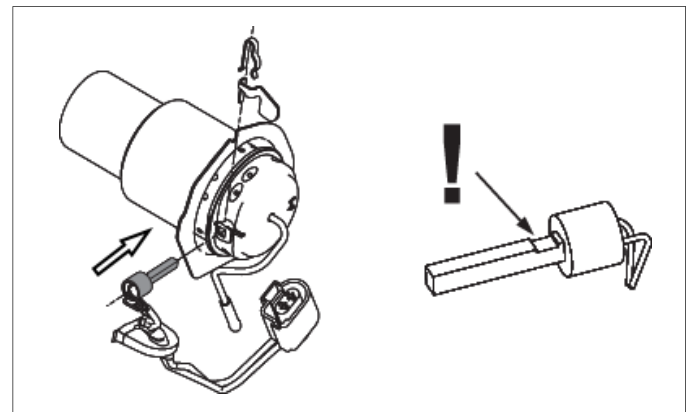


Fig. 909 Installing glow plug

3. Hold cooling flag (B3) in groove (B11) with hand on glow plug dome (B8) (see Fig. 910 and Fig. 913).

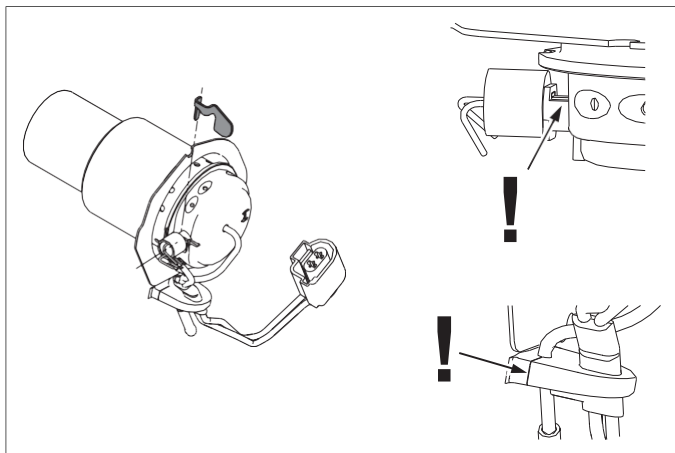


Fig. 910 Installing cooling flag

IMPORTANT

The glow plug (B4) must be installed in the glow plug dome as far as possible.

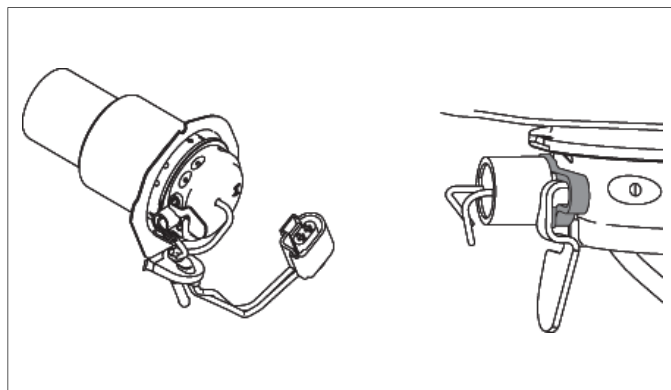


Fig. 912 Installing glow plug properly

4. Slide retaining spring of glow plug (B2) over cooling flag (B3) and glow plug dome (B8) (for orientation of retaining spring B2, see Fig. 913).

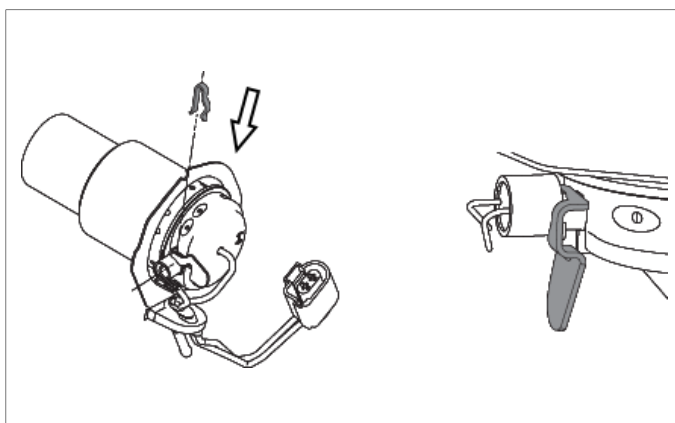


Fig. 911 Installing retaining spring

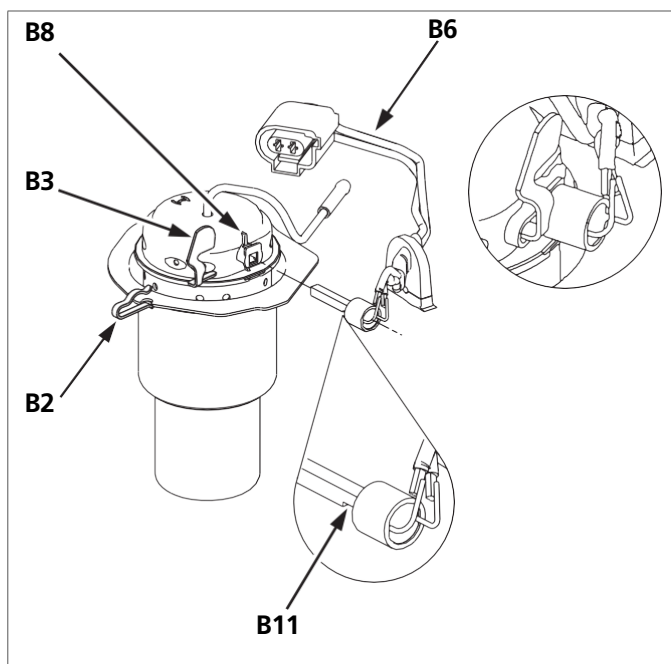


Fig. 913 Installing glow plug

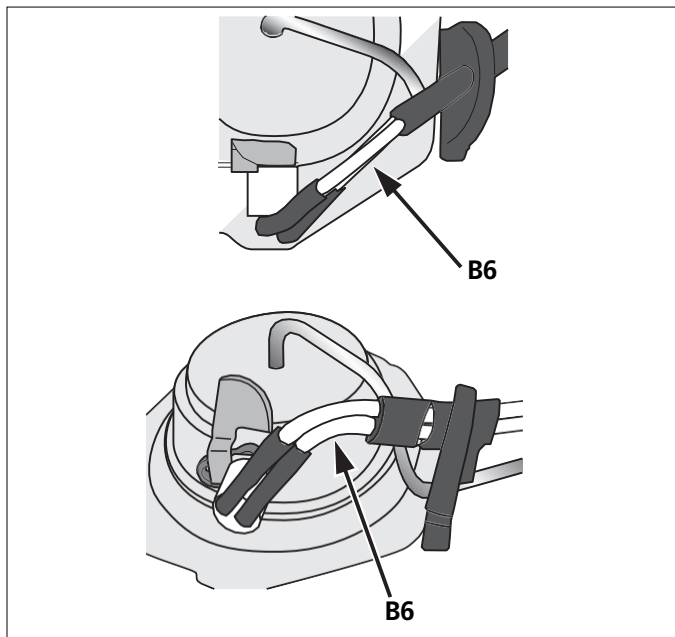


Fig. 914 Routing glow plug cable with slight bend

5. Route glow plug cable (B6) as shown in Fig. 915 with a slight bend and slide grommet (B7) onto fuel pipe (B5).

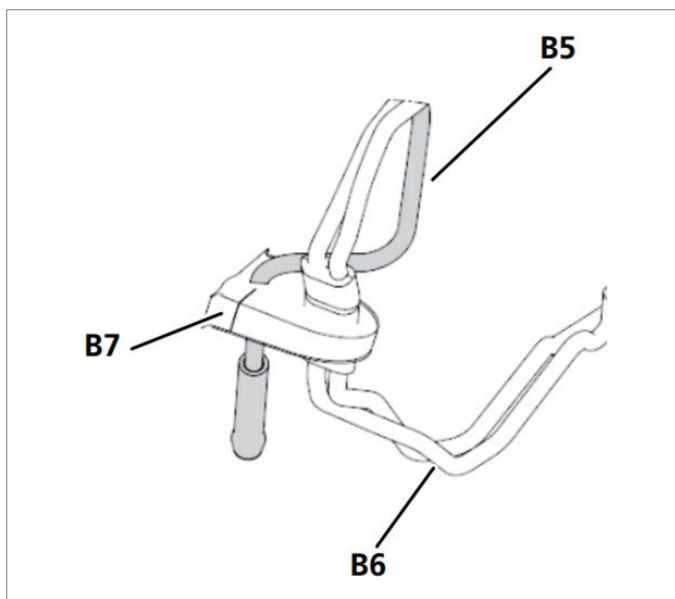


Fig. 915 Glow plug cable, grommet, and fuel pipe

9.4 Combustion-air fan unit and control unit

The combustion-air fan unit and the control unit may not be disassembled further.

Combustion-air fan unit assembly spare part.

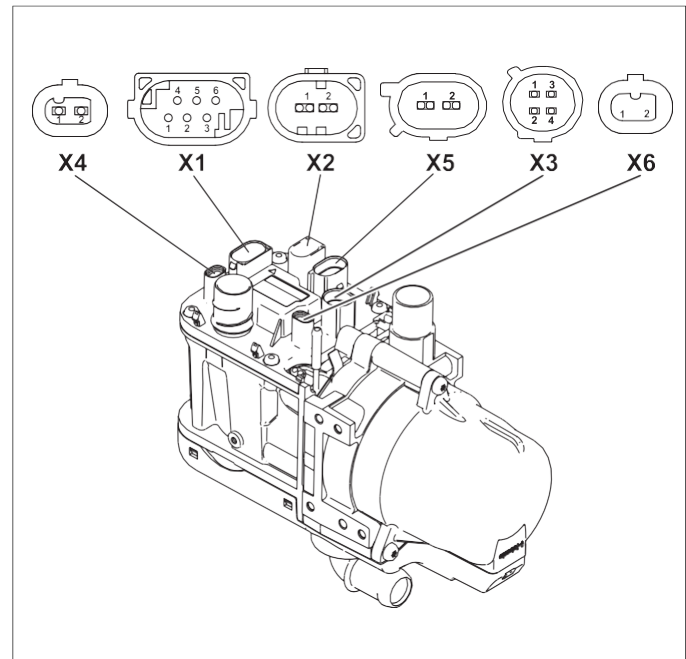


Fig. 916 Combustion-air fan unit with illustration of connectors
(variant shown is equipped with the maximum connector assignment)

- X1 = Heater controller connector (6-pin)
- X2 = Power supply connector to vehicle (2-pin)
Contact 1: Battery positive
Contact 2: Battery ground
- X3 = Temperature sensor connector (4-pin)
- X4 = Connector for 2x circulation pump (2-pin)
- X5 = Glow plug connector (2-pin)
- X6 = Exhaust temperature sensor connector

NOTE

When replacing the combustion-air fan unit, the CO₂ setting must be checked in accordance with Section 8.3.

IMPORTANT

Any blind connectors present must be remounted on the new control unit.

9.5 Heat exchanger

The heat exchanger must be replaced as a complete assembly.

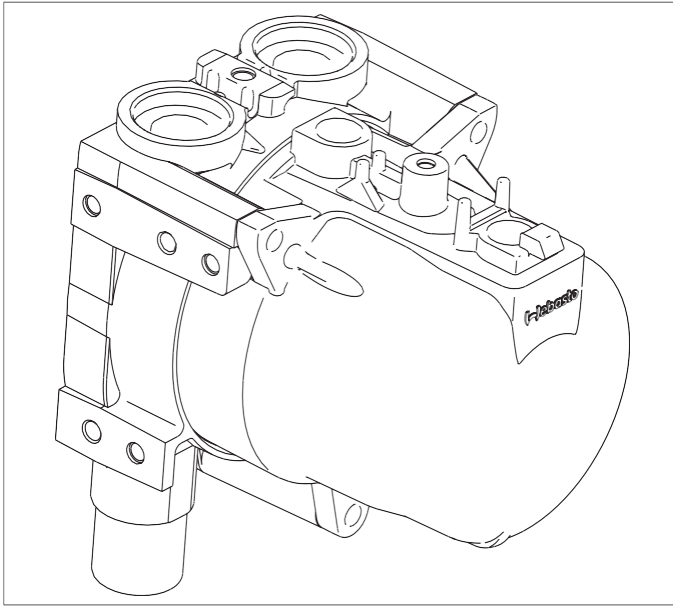


Fig. 917 Heat exchanger

IMPORTANT

The heat exchanger may not be dismantled into its individual parts.

NOTE

Water connection pieces with retaining plate must be checked for damage and replaced if necessary.

The unit's temperature sensors, exhaust temperature sensor, gaskets and screws for water connection pieces and temperature sensors must be replaced in accordance with Section 9.6.3, 9.7.2 and 9.8.1.

IMPORTANT

Observe the direction of flow of the coolant circuit.

Mount the connection of the coolant hoses to the water connection piece according to the marking (arrow markings) on the heater.

9.6 Temperature sensor/Overheating sensor

9.6.1 Checking sensors

NOTE

The sensors must not be removed for checking. Removing the temperature sensors will not cause coolant loss.

When checking the cold resistance, a distinction must be made between the variants of the sensors W5 and W6 (see Fig. 919). To do this, the contacts of connector X3 of the sensors are connected to a multimeter and the resistance is measured (test current: < 1 mA).

Table 5 Sensor resistance values

Sensors	Contacts on connector X3	Cold resistance at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$) [ohms]	
		min.	max.
W5	2 and 4	2.296	5.047
W6	1 and 3	30	250

In addition, the short-circuit to earth to the metal housing, wire crimpings and deformations of the plastic cap of the sensors must also be checked.

9.6.2 Removing temperature sensor/overheating sensor

For information on removing heater cover, see Section 9.1.1. Pull connector X3 of sensors out of control unit. When doing so, make sure connector lock is released. Loosen screw (W3, see Fig. 204), remove retaining spring (W4) and pull sensors (W5 and W6) out of heat exchanger (W1).

NOTE

The sealing O-ring of the sensor can stick to the housing after some operating time, preventing its removal. Once sensors have been removed, they cannot be reused, but instead must be replaced with new ones.

9.6.3 Installing temperature sensor/overheating sensor

NOTE

The gaskets of the sensors must be moistened with a suitable lubricant prior to installation in the heat exchanger.

1.

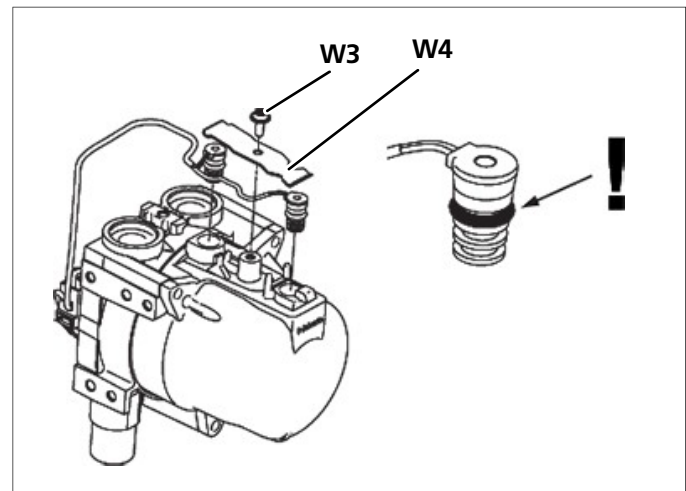


Fig. 918 Moistening gaskets

2.

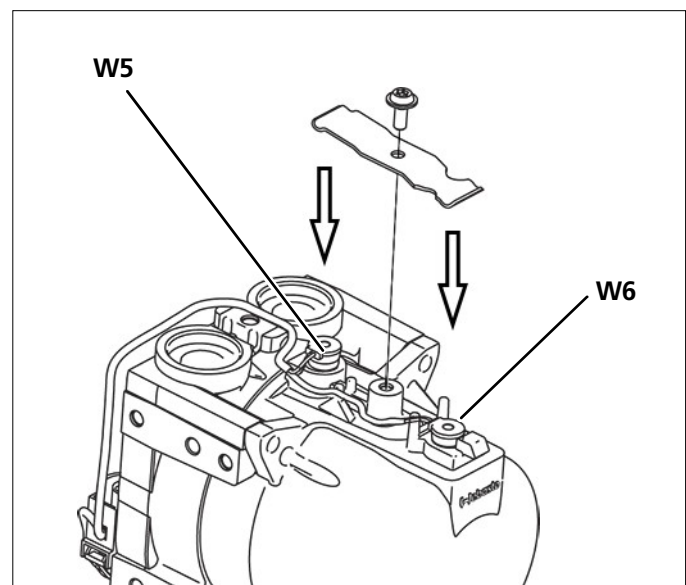


Fig. 919 Position retaining spring while watching cable routing and position of sensors W5 and W6

IMPORTANT

When screwing on the sensors, do not re-cut the thread several times. The screw must be carefully inserted in the existing threads and screwed in by hand.

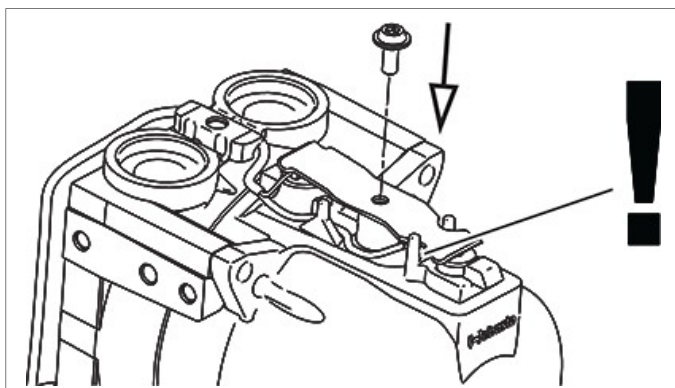


Fig. 920 Mounting screw

4.

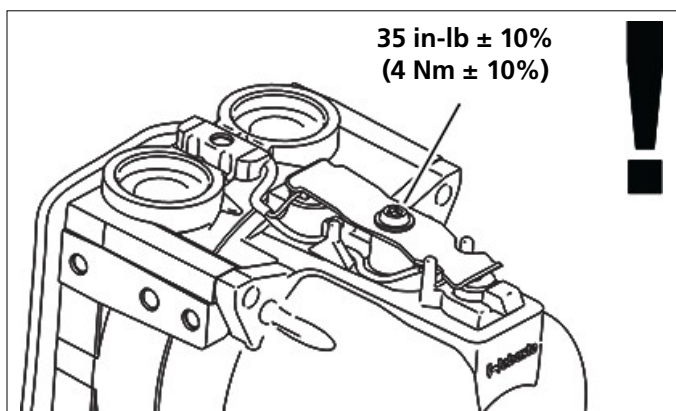


Fig. 921 Tightening screw

9.7 Exhaust temperature sensor (diesel only)

9.7.1 Checking exhaust temperature sensor

NOTE

The exhaust temperature sensor may not be removed for checking.

Touch the contacts of the X6 connector of the exhaust temperature sensor with a multimeter and measure the resistance.

Table 6 Resistance value of exhaust temperature sensor

Sensor	Contacts on connector X6	Cold resistance at $72 \pm 8^\circ\text{F}$ ($22 \pm 5^\circ\text{C}$) [ohms]	
		min.	max.
W7	1 and 2	2.050	2.220

In addition, the short-circuit to earth to the metal housing, wire crimpings and deformations of the plastic cap of the exhaust temperature sensor must also be checked.

9.7.2 Removing exhaust temperature sensor

For information on removing the connector cover, see Section 9.1.1. Pull connector X6 out of the control unit. When doing so, make sure connector lock is released.

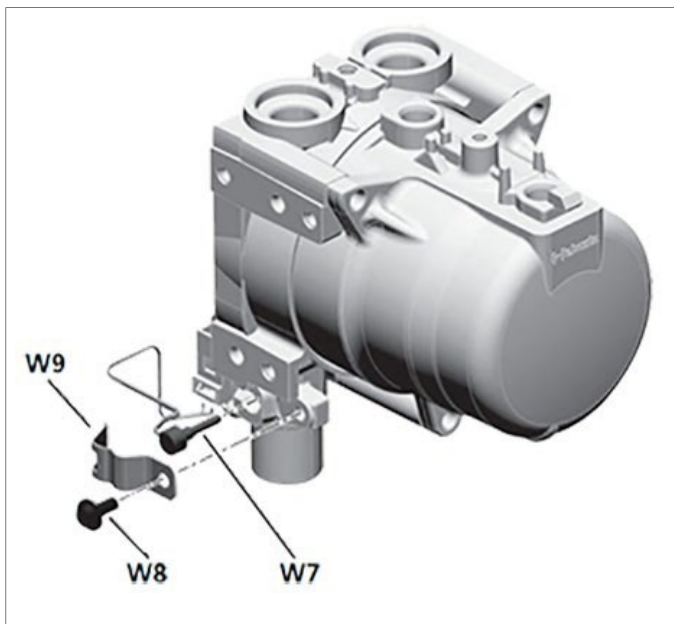


Fig. 922 Removing exhaust temperature sensor

1. Loosen screw (W8).
2. Remove retaining spring (W9) and pull exhaust temperature sensor (W7) out of exhaust pipe on heat exchanger.

9.7.3 Installing exhaust temperature sensor

NOTE

Once sensors have been removed, they cannot be reused, but instead must be replaced with new ones.

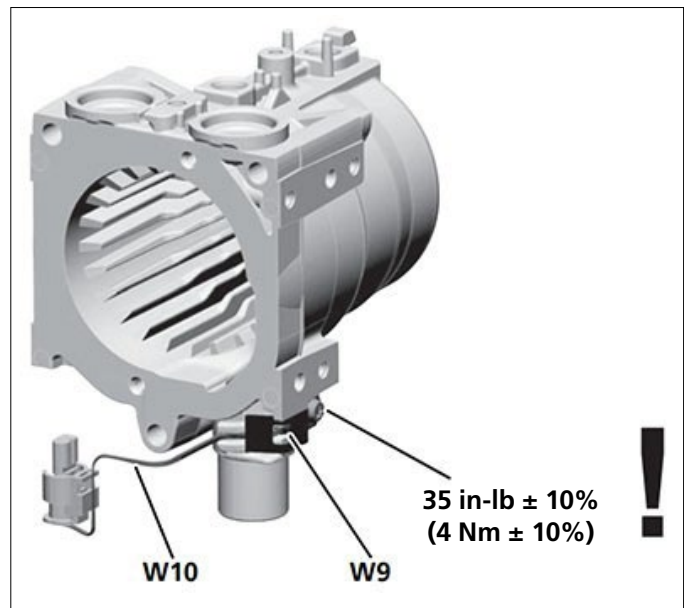


Fig. 923 Installing exhaust temperature sensor

1. Mount exhaust temperature sensor (W7, Fig. 922) in hole on exhaust pipe of heat exchanger.

IMPORTANT

- Do not kink cable (W10) on exhaust temperature sensor.
 - When screwing on, do not re-cut the thread several times. The screw must be carefully inserted in the existing threads and screwed in by hand.
2. Lay cable (W10) in groove on exhaust pipe and fasten retaining spring (W9) with screw (W8, Fig. 922). Tightening torque 35 in-lb $\pm$ 10% (4 Nm $\pm$ 10%).
 3. Insert connector X6 on connector place on control unit.

IMPORTANT

When mounting the connector cover, make sure that the cable of the exhaust temperature sensor is not crushed.

9.8 Water connection piece



Fig. 924 Retaining plate

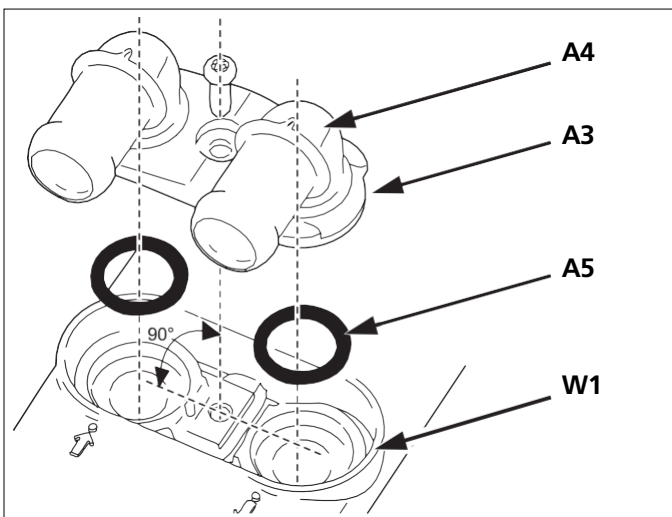


Fig. 925 Retaining plate for installing water connection piece

9.8.1 Installing water connection piece

1. The contact surfaces of the O-rings in the heat exchanger must be clean and must not have any damage.
2. Moisten new O-rings (A5) and lay in heat exchanger openings.
3. Fix water connection piece (A4) in place in retaining plate (A3) and position as assembled unit in heat exchanger (W1). Align water connection piece for installation case.

IMPORTANT

When screwing on the retaining plate with the water connection piece, do not re-cut the thread several times. The screw must be carefully inserted in the existing threads and screwed in by hand.

4. Guide screw into hole and tighten to 66 in-lbs (7.5 Nm).

10 Packing, Storage and Shipping

10.1 General

If the heater or its components are sent to Webasto for testing or repair, it must be cleaned and packed in such a way that it is protected against mechanical damage, soiling and environmental influences during handling, transport and storage.

The temperatures during transport and storage may not drop below -40 °F (-40 °C) and may not exceed 140 °F (60 °C).

10.2 Storage

Position of heater:

The heater can be stored in any position. There are no restrictions here.

Heaters must always be stored in the delivery packaging or in similarly suitable packaging in closed rooms!

After being removed from the delivery packaging, the heaters should only rest on the aluminium parts. The type label and the surface of the heater must be protected against damage with a suitable surface (e.g. cardboard).

During storage the heater should be covered, it must be protected from dust, dirt and moisture.

The heater may not come into contact with chemicals or their vapours, e.g. fuel, battery fluids or brake fluids.

No dirt, water or chemicals may enter into the openings of the heater during storage.

The heater must be protected from impact loads and penetration of foreign bodies.

10.3 Transport

The heater can be transported in any position and must always be packed in suitable packing.

The heater must be protected against mechanical damage.

NOTE

If an entire heater is returned, then it must be completely drained of operating fluids. It must be ensured that no fuel or coolant residues can escape during packing and/or shipping. The coolant connection piece and the fuel connection must be sealed off with blind plugs.

Shipping address

The address of the responsible Webasto service-center can be found on www.techwebasto.com.

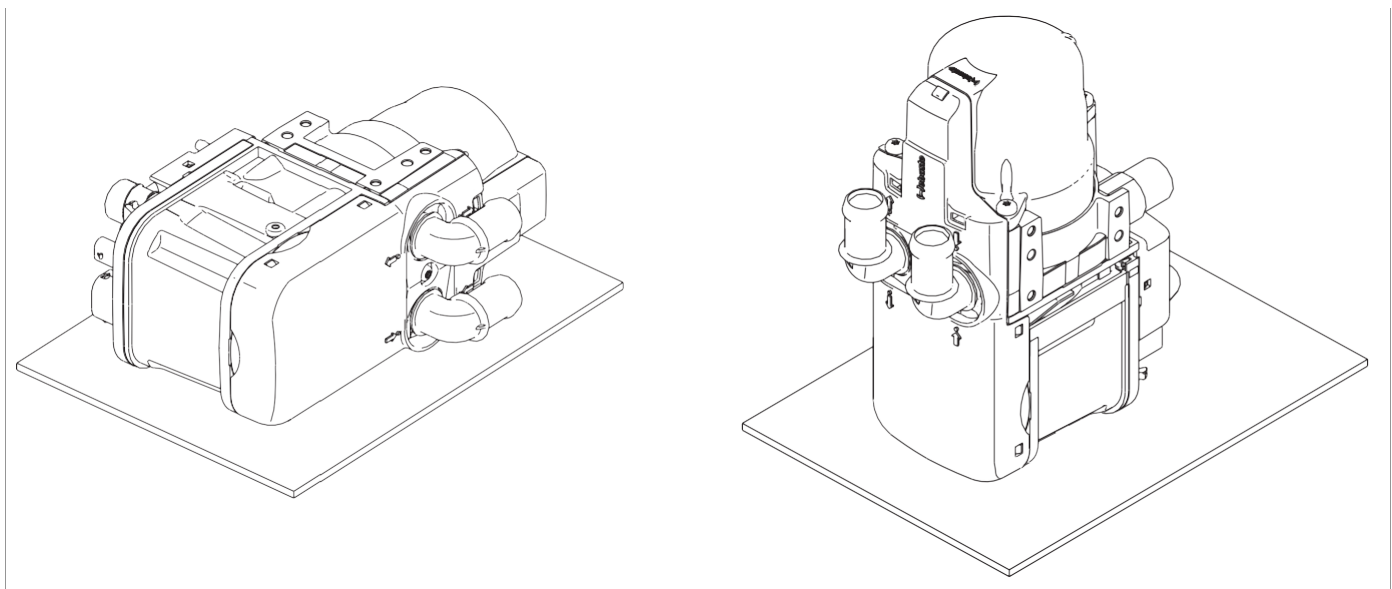


Fig. 1001 Preferred position of Thermo Top Evo heater for storage and transport



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