

Workshop Manual

Thermo Top Pro 120 | 150

Water Heater



English

Contents

1	About this document	3
1.1	Purpose of the document	3
1.2	Using this document	3
1.3	Use of symbols and highlighting	3
2	C. L.L.	~
2	Satety	3
2.1	General safety information	3
2.2	Qualification of personel	4
2.3	Working on the heater	4
2.4	Working on the vehicle	4
2.5	Heater test run	4
2.6	Checks	4
3	Information regarding the heater	5
3.1	Basis	5
3.2	Special variants (Rail, CPoff, Chiller, ADR)	5
		~
4	Description of the components	6
4.1	Overview of the subassemblies	6
4.2	Burner head	8
4.3	Compustion air fan	8
4.4		8
4.5	Fuel pump with solenoid valve	9
4.6	Nozzle block preheater	9
4.7	Ignition spark generator with ignition electrodes	9
4.8	Fuel nozzle and battle plate	9
4.9	Control unit	10
4.1	0 Flame monitor	10
4.1	1 Pressure equalization element	10
4.1	2 Heat exchanger	10
4.1	3 Combustion tube	10
4.1	4 Coolant temperature sensors	11
4.1	5 Exhaust gas temperature sensor	11
4.1	6 Coolant pump	11
4.1	7 Coolant	12
4.1	8 Fuel filter	12
5	Functional description 1	3
5.1	Introduction	13
5.2	Control elements	13
5.3	Switch the heater on and off	13
5.4	Using the heater in hazardous material vehicles (ADR)	
	· · · · · · · · · · · · · · · · · · ·	13
5.5	Functional sequence	14
5.6	Fault switch-off	15
6	Malfunctions and troubleshooting 1	5
6.1	Basics	15
6.2	Fault list on the control element	15
6.3	Cause of malfunctions in the heater and systems	16
6.4	Instructions for cancelling the fault lock-out	16
6.5	Heater unlocking instructions	17
6.6	Overview of faults and fault codes	17

7 6	unction chocks	24
/ Г		
7.1	Basics	24
7.2	Check and set CO_2 in exhaust gas	24
7.3	Checking exhaust gas temperature sensor	25
7.4	Checking control unit	25
7.5	Check combustion tube	25
7.6	Check the blower fan wheel	26
7.7	Checking baffle plate	26
7.8	Checking drive motor	26
7.9	Fuel pump and check solenoid valve	26
7.10	Checking heater cartridge	27
7.11	Check coolant pump	28
7.12	Checking coolant temperature sensors	28
7.13	Checking ignition electrode	

8 Repairing and replacing components

		29
8.1	Required tools	29
8.2	Installation notes	29
8.3	Disconnecting control unit connections	30
8.4	Disconnect burner head	30
8.5	Install burner head	30
8.6	Removing control unit	30
8.7	Electrical wiring in the burner head	31
8.8	Removing baffle plate	31
8.9	Removing ignition electrodes	32
8.10	Removing fuel nozzle	32
8.11	Removing ignition spark generator	33
8.12	Removing fuel pump	33
8.13	Installing fuel pump	33
8.14	Removing nozzle block preheater	34
8.15	Removing blower fan wheel	34
8.16	Removing drive motor	35
8.17	Remove heat exchanger	35
8.18	Remove combustion tube	35
8.19	Remove coolant temperature sensors	36
8.20	Install coolant temperature sensors	36
8.21	Removing exhaust gas temperature sensor	36
8.22	Installing exhaust gas temperature sensor	37
9 Pa	ackaging / storage / shipping	37
9.1	General information	
9.2	Ideal position	
9.3	Storage and transportation	38
10 EI	ectrical incorporation	38
10.1	Information on the electrical connection	38
10.2	The heater in hazardous material vehicles (ADR)	38
10.3	Legend and remarks regarding wiring diagrams	38
10.4	Cable colours / cable cross-sections	39
10.5	Connector and pins	39
10.6	Wiring diagrams	40
11 Te	echnical data	48

12 List of abbreviations 48

1 About this document

1.1 Purpose of the document

This workshop manual is designed to assist trained personnel with maintenance of the Thermo Top Pro 120 | 150.

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

1.2 Using this document

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

1.3 Use of symbols and highlighting

DANGER

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

WARNING

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

CAUTION

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

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

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

- $\checkmark\,$ Requirements for the following necessary action
- Necessary action

2 Safety

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

2.1 General safety information

Danger of poisoning and suffocation

Do not operate the heater in closed rooms that do not have an exhaust extraction unit.

Do not switch on or operate the heater.



Danger of scalding from leaking hot coolant

Scalding on opening the coolant circuit. The vehicle coolant circuit is pressurised.

Allow the engine to cool before working on the vehicle coolant system.

DANGER

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

CAUTION

Overheating possible

A battery disconnector (emergency off switch) may only be actuated in the event of danger since the heater will be switched off without after-running period.

CAUTION

Overheating

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

Take care when bleeding the coolant system.

Always bleed:

- Before first commissioning the heater
- After replacing the coolant

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

Incorrect handling

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

2.2 Qualification of personel

The personnel must have the following qualifications:

- Successful completion of Webasto training
- Corresponding qualification for working on technical systems
- Read and observe installation, operating and important safety instructions

2.3 Working on the heater

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

Always carry out a visual inspection before starting repair work:

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

- Collect the coolant running out of the system in a suitable container.

- Block or disconnect coolant hoses.
- Dispose of coolants in an environmentally friendly way.

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

Once the heater and all coolant-carrying components have been installed, fill the entire coolant system according to the vehicle manufacturer's specifications.

Bleed the system according to the vehicle manufacturer's specifications and check for leaks with the default system pressure of the vehicle.

NOTE

Replace component:

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

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

2.4 Working on the vehicle

The heater temperature must not exceed 120 C when switched off. See Technical data.

2.5 Heater test run

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

2.6 Checks

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

- 1. Read out the fault code memory.
- 2. Clean heater exterior (make sure no water gets in).

- 3. Check the electrical connections for contact corrosion and firm seating.
- 4. Check exhaust gas and combustion air line for damage and ensure that they are clear.
- 5. Check the fuel line and filters for leaks.
- 6. Check the coolant circuit and coolant pump.
- 7. Check hoses for cracks.
- 8. If fitted and necessary, change the fuel filter.
- 9. Commission the heater.

Information regarding the 3 heater

3.1 **Basis**

The Thermo Top Pro 120 | 150 heaters consist essentially of the following main components:

- Burner head (with fan, fuel pump, control unit)
- Combustion chamber
- Heat exchanger

A coolant pump (type U4850) is installed in the vehicle near the heater and guarantees the required heat transport via the coolant circuit.



Fig. 1 Overview of heater and connections

А	Spray guard (optional)	J	Exhaust gas outlet
В	Burner head	K	Original vehicle coolant hose (inlet)
С	Electrical Connections	L	Fuel line
D	Coolant outlet of heater	Μ	Fuel hose clamp
E	Coolant temperature sensors with cover	Ν	Fuel connector
F	Heat exchanger	0	Seal
G	Coolant inlet of heater	Ρ	Screw for fuel connector
Η	Coolant hose (inlet)	Q	Dummy connector for coolant pump (for CPoff variant)
I	Exhaust gas temperature sensor		

NOTE æ

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

3.2 Special variants (Rail, CPoff, Chiller, ADR)

3.2.1 Thermo Top Pro 150 Rail

This is a heater model for installation and operation in rail vehicles. The essential functions correspond to the standard version of the heater.

Thermo Top Pro 120 | 150 CPoff 3.2.2

In the case of the "CPoff" variant, controlling and monitoring the coolant pump is **deactivated** by the heater. Corresponding implementation of a coolant pump must be ensured in the vehicle by the customer. For information regarding pump selection and design, see chapter 4.16, "Coolant pump" on page 11. Connection X1 on the control unit, which is provided for the coolant pump, does not have a function in this variant and must be closed in this variant with a dummy connector for sealing purposes (see Fig. 1, position Q).

WARNING

Use of an unsuitable pump or malfunction thereof may result in the heater being damaged. Compared to the basic variant, there is **no** monitoring of the pump as well as a control unit via the heater is not possible in heating mode. This must be ensured by the customer as part of the vehicle application.

The additional functions correspond to the standard version of the heater.

3.2.3 Thermo Top Pro 120 Chiller

This variant is based on the previous "CPoff" and has the same requirements for use of the coolant pump. However, operation is only permitted in the "Motor on" configuration. As a result, the permissible coolant temperature is limited to 65 °C. The heater must be connected according to the chiller-specific wiring diagram (see Fig. 56).

3.2.4 Thermo Top Pro 120 | 150 ADR

In this case it is the standard version of the heater with ADRspecific provision in the application. Special requirements for installing and operating the heater in accordance with the specifications of the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR), can be found in the general installation and operating instructions. Regarding ADR, see also: https://www.unece.org/trans/danger/ publi/adr/adr_e.html

4 Description of the components

4.1 **Overview of the subassemblies**



Fig. 2 Exploded view

The following legend extends over this and the next page.

А	Ignition spark generator	S	Coolant temperature sensors
В	Screw for ignition spark generator M5x14 PH2 (on fuel pump) (2 +/- 0.2 Nm)	Т	Cover for sensors
С	Ignition electrodes	U	Collar screw on cover for sensors M4 T20 (2 +/- 0.2 Nm)
D	Cylinder bolt for ignition electrodes M4x12 SW3 (on ignition spark generator) (3 +/- 0.3 Nm)	V	Exhaust gas temperature sensor
E	Burner head	W	Spring clip
F	Screw for drive motor M3x10 T10 (on burner head) (2 +/- 0.2 Nm)	Х	Screw for spring clip M4x5.5 T20 (2 +/- 0.2 Nm)

G	O-ring fuel pump (small)	Y	Burner
Н	Fuel pump with solenoid valve	Z	Seal
I	Screw for fuel pump M5x45 T25 (on burner head) (3.5 +/- 0.35 Nm)	AA	Nut M8 SW13 (burner head on heat exchanger) (19 +/- 2 Nm)
J	Fuel nozzle SW16 (20 +/- 2 Nm)	AB	Cable tie for electrical cables (nozzle block preheater and ignition spark generator)
К	Baffle plate	AC	Clip for electrical cables (on burner head)
L	Clip for nozzle block preheater	AD	Screw for fan cover 40x14 T20 (3 +/- 0.3 Nm)
М	Screen (fuel pump)	AE	Combustion air spray guard (optional)
N	O-ring fuel pump (large)	AF	Fan cover
0	Heater cartridge, nozzle block preheater	AG	Circlip for blower fan wheel DIN471 6x0.7 (on drive motor axle)
Р	Control unit (P1 pressure equalisation element, P2 optical sensor)	AH	Blower fan wheel
Q	Screw for control unit 4x14 T20 (on burner head) (3+/- 0.3 Nm)	AI	Drive motor
R	Heat exchanger	AJ	Axle connection

4.2 Burner head

Fig. 3 Burner head

A Burner head B Control unit



Fig. 4 Burner head details

A	Fan with cover	D	Housing
B	Drive motor Axle connection	E	Fuel pump with solenoid valve, ig- nition spark generator, ignition electrodes, nozzle with pre-heat- ing and baffle plate.

The burner head can be removed for repair and maintenance purposes.

4.3 Combustion air fan



Fig. 5 Combustion air fan

A	Spray guard (optional)	С	Fan wheel
В	Fan cover		

The fan wheel delivers the air required for combustion in the combustion tube via the combustion air inlet. The air is sucked in through the air intake opening in the fan cover.

Optionally, a spray guard or a combustion air intake line approved by Webasto can be attached to the fan cover.

4.4 Drive motor



The drive motor drives the fan wheel and the fuel pump using a axle connection (shaft coupling).

4.5 Fuel pump with solenoid valve



Fig. 7 Fuel pump with solenoid valve

_			
		D	
В	Fuel nozzle		Axle connection to the drive motor
A	Solenoid valve	С	Fuel pump

The fuel for combustion is supplied by the fuel pump. The fuel pump is driven by the drive motor using an axle connection to the drive motor (shaft coupling).

The fuel pressure is increased to approx. 11 bar in the fuel pump. The solenoid valve integrated into the fuel pump opens or closes the fuel supply to the fuel nozzle as a function of the heating mode.

4.6 Nozzle block preheater



Fig. 8 Nozzle block preheater

А	Fuel nozzle	D	Heater cartridge
В	Nozzle block	E	Fuel pump
С	Fastening clamp		

The nozzle block preheater consists of a heater cartridge (130 W) and is part of the standard equipment of the heater.

At low temperatures (factory setting: T < 5 °C, depending on the application of the heater), the heater cartridge warms the nozzle block and the fuel nozzle. This ensures an optimised atomisation of the fuel.

The heater cartridge is activated automatically by the control unit.

4.7 Ignition spark generator with ignition electrodes



Fig. 9 Ignition spark generator

A Ignition electrodes B Ignition spark generator

The high voltage for igniting the air-fuel mixture is generated in the ignition spark generator. Ignition occurs by a high-voltage spark crossing between the two ignition electrodes.

4.8 Fuel nozzle and baffle plate



Fig. 10 Fuel nozzle and baffle plate

A	Baffle plate	С	Fuel nozzle
В	Ignition electrodes		

The baffle plate guarantees the correct air distribution for the combustion process.

The baffle plate is permeable to flame light and makes visual flame monitoring possible with the control unit.

4.9 Control unit

The control unit must not be disassembled.



Fig. 11 Inside and outside of control unit

A	Pressure equalization ele- ment	F	Drive motor
В	Flame monitor	G	Control element(s), vehicle connection
С	Ignition spark generator	Н	Temperature sensors
D	Nozzle block preheater	I	Heater power supply
Е	Fuel pump	J	Connecting coolant pump

The control unit controls the functional sequence and monitors the heating mode. Sensors for continuously determining the temperature and pressure are integrated into the control unit.

4.10 Flame monitor

An optical flame monitor in the control unit detects the flame formation.

4.11 Pressure equalization element

A pressure equalisation element prevents the humidity from penetrating the inside of the control unit and establishes an equalisation of pressure with the surrounding area (altitude compensation).

4.12 Heat exchanger



Fig. 12 Heat exchanger

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

Components associated with the heat exchanger include:

- Seal
- Coolant temperature sensors with cover
- Exhaust gas temperature sensor

4.13 Combustion tube



Fig. 13 Burner

The air-fuel mixture is burned in the combustion tube. The generated hot flue gases heat the coolant flowing through the heat exchanger.

4.14 Coolant temperature sensors



Fig.	14	Coolant	temperature	sensors

A	Overheat sensor	С	Cover for sensors
В	Coolant temperature sensor		

The sensor values are used for the coolant temperature control and for protecting the heater against overheating.

The sensors are connected to the control unit by the cabling.

4.15 Exhaust gas temperature sensor



Fig. 15 Exhaust gas temperature sensor attachment and connector

A	Exhaust gas temperature sensor	В	Exhaust gas temperature
	connector		sensor

A sensor is installed on the exhaust gas stub of the heater to monitor the temperature in the exhaust gas. The sensor is connected to the control unit by the cabling.

4.16 Coolant pump

The standard variant of the Thermo Top Pro 120 | 150 are operated with the coolant pump U4850. The coolant pump is switched on by the heater control unit.

If using a CPoff heater variant (see chapter 3.2.2, "Thermo Top Pro 120 | 150 CPoff" on page 5), which can also be recognised via the "CP OFF" label, then a coolant pump is controlled externally. Exact specifications to this effect can be found at the end of this chapter in the section "Use of an external coolant pump".



Fig. 16 Coolant pump U4850

A	Coolant pump U4850	С	Coolant inlet
В	Coolant outlet		

The use of the U4850 coolant pump in military vehicles or military applications is prohibited.

The heater must be operated with a coolant pump. Pumps that have been dropped must not be re-used. Dropping may lead to external impact points and internal damage.

Possible cracks in the plastic part of the pump may lead to a leakage in the pump compartment or the surrounding area. This may result in operational failures of the pump due to the ingress of coolant into the electronic area.

Characteristics of the coolant pump U4850

Reactivation of the coolant pump motor:

The coolant pump motor can be reactivated from the dry-running protection or sleep mode. This is done by isolating the power supply for > for 2 min. After restoring the power supply, the coolant pump motor starts in soft-start again.

Start-up

The coolant pump motor starts up within 2 seconds.

• Protection against blocking, running dry and overload A continuous check of the coolant pump for blocking, running dry and overload is carried out during the start and regular operation.

If such an error case is detected, the coolant pump sends a corresponding diagnostic signal to the heater control unit and automatically deactivates itself temporarily. The coolant pump attempts to start again.

After 20 unsuccessful start attempts, the coolant pump switches itself off. To carry out a renewed start attempt, the coolant pump must be turned off and switched back on again.

The coolant pump motor is not damaged by hydraulic overpressure of the coolant pump provided that the following limits are observed:

- Max. overflow forwards: 2400 l/h
- Max. overflow backwards: 500 l/h

Overvoltage protection

In the event of overvoltage, the coolant pump automatically shuts down at a voltage supply above 36 V (24 V) and 16 V (12 V). If the voltage drops to 35 V or 15 V, the pump automatically switches itself on again.

If overvoltage is diagnosed, the coolant pump sends a corresponding diagnostic signal to the heater control unit.

• Undervoltage protection

BIn the event of undervoltage, the coolant pump automatically shuts down at below 13.5 V (24 V) and 8 V (12 V) power supply. If the voltage rises to 14.5 V or 9 V, the pump automatically switches itself on again. If undervoltage is diagnosed, the coolant pump sends a

corresponding diagnostic signal to the heater control unit.Reverse-polarity protection

The coolant pump motor is not equipped with internal reverse-polarity protection.

• Electrical protection

The fuse for the coolant pump must never be pulled out during operation

The fuse for the coolant pump must never be replaced when switched on.

• Transport and storage

The pumps should only be transported and stored in the appropriate transport packaging. Unsorted transport (e.g. bulk product) is not permitted.

- The coolant pump shuts off for:
- Overvoltage
- Undervoltage
- An internal fault
- Dropping below the minimum speed
- Permissible operating temperature exceeded

Use of an external coolant pump

The externally controlled coolant pump in the CPoff variant must ensure that the coolant is delivered in the coolant circuit of the heater or vehicle. It must satisfy the following technical features:

	Thermo Top Pro 120	Thermo Top Pro 150		
Nominal volume flow [l/h] (against 0.56 bar)	1500			
Minimal volume flow [l\h] (if lower than this then there is a risk of overheating. Heater may be damaged)	1100	1400		
After-running period	Min. 60 s			
Connection piece diameter / Reduction of cross-section	System diameter TTP120 150 = 20 mm. Reduction of cross-sections should be avoided.			

The coolant pump must be in operation during the entire heating mode and during the after-running period.

4.17 Coolant

Follow the instructions of the vehicle manufacturer when checking the coolant level. You will find further information in the installation instructions and at the vehicle manufacturer.

Coolant Mix ratio e.g. Glysantin®/water.

Permissible water/glycol (monoethylene glycol) mixes:				
Glycol [%] Water [%]				
Minimum	33	40		
Maximum	60	67		

4.18 Fuel filter



Fig. 17 Fuel filter

ithout heating C Electrical connection
ith heating Bleed screw
ith heating Bleed screw

The externally located fuel filter is used for separating sediment from the fuel and therefore prevents blocking of the fuel nozzle. Filter heating is available as an option. It is recommended or necessary to install filter heating under certain use and operating conditions. See installation instructions.

The filter heating cut-in point is approx. -5 °C and the cut-out point is approx. +5 °C.

5 Functional description

5.1 Introduction

The Thermo Top Pro 120 | 150 is a water heater with coolant temperature control, monitored by its integrated control unit. To regulate the coolant temperature, the heater works in cycle operation.

The necessary, continuous coolant flow is provided by a coolant pump.

After the heater is activated, heating mode and the residual heat utilisation/control pause are controlled automatically depending on the switching thresholds.

Standard temperature range (standard values)	Temperature °C
Motor OFF	65 – 80
Motor ON	50 – 65
Residual heat utilisation, motor OFF	55 – 65

The switching thresholds are dependent on the heater variant and the type of heating mode.

To produce heat, the fuel is sprayed under pressure through a fuel nozzle, mixed with combustion air and burned.

The volume of combustion air is provided by the fan.

The fuel is supplied by a fuel pump with pressure limiting valve. The fuel pump is driven directly by the speed-controlled drive motor and also has a temperature controlled nozzle block preheater for improving fuel atomisation at low temperatures.

The fuel system is opened and closed by a solenoid valve at the fuel pump.

The air-fuel mixture is ignited by a high voltage spark in the combustion chamber.

Flame monitoring is done with a flame monitor (optical sensor) in the control unit.

The coolant temperature and the exhaust gas temperature are monitored by the sensor system in order to protect the heater from overheating.

The correct volume of combustion air for combustion is maintained by the speed control of the drive motor. The speed control automatically compensates for the air pressure influence (altitude compensation) on combustion.

The speed is calibrated for correct combustion in the Device production department at Webasto. In case of service, calibration can be done in the workshop during CO_2 adjustment when carrying out the Webasto-Thermo test diagnosis (WTT diagnosis see chapter 7.2, "Check and set CO_2 in exhaust gas" on page 24).

If combustion does not take place, see chapter 6, "Malfunctions and troubleshooting" on page 15.

The operating state is displayed by the control panel or an indicator lamp (LED).

5.2 Control elements

The Thermo Top Pro 120 | 150 heater can be controlled with various control units such as a rocker switch, SmartControl/ Multi Control and ThermoCall TC4. A combination of control elements is also possible in certain cases.

Observe the operating instructions for the control element.

5.3 Switch the heater on and off

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



Overheating possible

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

i See the operating and installation instructions for the control element.

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

Always switch off the heater via the control element

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

5.4 Using the heater in hazardous material vehicles (ADR)

It is not possible to set a preselection time in hazardous material vehicles (ADR). The SmartControl (if present) shows how much heater operation time is left (remaining operation time).

An ADR after-running period is applied in the following cases:

- the generator signal (D+, light machine) is discontinued.

- the pumping device (auxiliary drive) belonging to the vehicle is put into operation.

After the end of the ADR after-running period, the heater is in ADR locking mode.

Release ADR lock:

- Put the pumping device belonging to the vehicle out of operation.
- Restart the heater by switching it off and on again using the control element.

5.5 Functional sequence



Fig. 18 Functional sequence

1	Switch on/ component test	A	Operating indicator
2	Supply	В	Coolant pump
3	External light request 1	С	Fan
4	Pre-ignition/flame ignition	D	Ignition spark generator
5	Flame stabilisation	E	Fuel cut-off valve
6	Control mode	F	Flame indicator
7	After-running period		
8	Control pause	*	ADR heaters < 40 s
9	Switching off		

5.6 Fault switch-off

If the heater detects a malfunction, the indicator lamp flashes. The malfunction must be located and rectified. To assist with troubleshooting, see chapter 6, "Malfunctions and troubleshooting" on page 15.

6 Malfunctions and troubleshooting

6.1 Basics

Troubleshooting is generally restricted to locating faulty heater components.

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

- Corroded connector
- Loose plug connector
- Crimping defect at connector
- Completeness of the connector
- Corroded cables and fuses
- Corroded battery terminals
- Impermissibly high ambient temperature

Carry out a function check in the vehicle after rectifying each fault.

6.1.1 Diagnostics with Webasto Thermo Test



Fig. 19 Diagnostics with WTT

A WTT USB interface B Diagnostic adapter

i Connect and use the Webasto Thermo Test (WTT) USB interface, diagnostic adapter and adapter cable as described in the Operating Instructions.

The heater is diagnosable and can be tested with the WTT diagnostic adapter and the WTT diagnostic software installed on a PC/laptop when installed.

- 1. The diagnostic adapter is connected to the diagnostic connector provided in the heater wiring harness (see chapter 10.6, "Wiring diagrams " on page 40).
- 2. The diagnostic adapter is connected to the WTT USB interface.
- 3. The WTT USB interface is connected to the PC/laptop (at least, USB 2.0 port).
- 4. Then, the WTT diagnostic software is started and the connection is established to the heater.

i For more information about the WTT and adapters, see https://dealers.webasto.com.

When the control element is connected via W-bus, disconnect the connector and connect the adapter plug. After the diagnostics, reconnect the control element.

6.1.2 Fault lock-out and heater lock-out

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

Procedure for analogue signals

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

If the **fault lock-out** is active, the heater can be restarted using the control element after rectifying the fault. See chapter 6.4, "Instructions for cancelling the fault lock-out" on page 16.

If the **heater lock-out** is active, switching on the heater again does not restart it. See chapter 6.5, "Heater unlocking instructions" on page 17.

Procedure for digital signals (with WTT)

Select in Webasto Thermo Test PC Diagnostics: Diagnostics => Device Selection => W-bus. Before removing the heater or add-on parts, always print out the logs with the following data:

- Operating and fault data.
- Extended fault conditions.

(select in Webasto Thermo Test PC Diagnostics: Logs.)

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

6.2 Fault list on the control element

The fault codes of the heater are explained in chapter 6.6, "Overview of faults and fault codes" on page 17.

6.2.1 Switch (On/Off)

On control elements without a display (analogue), the fault code is indicated in the form of a flash pulse.

Error code output:

After **5** fast flash pulses, the fault code is output by a sequence of long flash pulses. The long flash pulses must be counted. This number (fault code) provides information for the workshop about the type of heater malfunction.

6.2.2 MultiControl / SmartControl / UniControl

Malfunctions are shown with fault codes in the display.

Error code output:

The fault code is indicated by a combination of digits and letters (e.g. 'H02' or 'F05').

NOTE

Other fault codes (e.g. TXX) do not stem from the heater and describe control element, system, or communication faults.

6.3 Cause of malfunctions in the heater and systems

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

- Overvoltage / Undervoltage
- Malfunctions of components, e.g. due to short-circuit or break
- The overheating of heater
- Impermissible exhaust temperature
- unsuccessful starts,
- flame failure.

6.4 Instructions for cancelling the fault lock-out

6.4.1 Analogue cancelling the fault lock-out



6.4.2 Digital cancelling the fault lock-out (with WTT)



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

6.5 Heater unlocking instructions

The heater can be unlocked with or without Webasto Thermo Test PC diagnostics.

6.5.1 Analogue heater unlocking

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

The fault must be rectified.

To do so, follow these steps:

- Switching on the heater (via control element).
- Remove fuse for at least 2 s within 2 s after switching on (e.g. F3 on-board power supply of the vehicle).
- ▶ Reinsert the fuse.
- Switching off the heater (via control element).

6.5.2 Heater unlocking, digital (with WTT)

See chapter 6.4.2, "Digital cancelling the fault lock-out (with WTT)" on page 16.

6.6 Overview of faults and fault codes

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

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

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

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

NOTE

Hexadecimal fault codes

The letter "H" is shown on the control element <u>before</u> the code, and in the WTT Diagnostics, the "h" is shown <u>at the end</u> of the code. This means that, for example, "H01" is equivalent to "01h".

The heater can lock if several faults are registered. To unlock the heater, see chapter chapter 6.5, "Heater unlocking instructions" on page 17.

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

Replace component:

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

6.6.1 Troubleshooting with error code output

*: Indicator lamp of control element flashing: count the number of long flash pulses after 5 short flash pulses						
Analogue fault code	Fault code (hexa- decimal)	Fault message / Symptom	Possible causes	Recommended action in workshop		
F00 or	H01 H07	No component fault	Fuses	1. Check fuses: F1, F2 and F3		
0*	H13 H16 H18		Electrical wiring	2. Check battery connections: At connector X2: - at pin 2 / + at pin 1 (heater voltage)		
	H20 H26 H81 H91 H92 H2C H3F HA0			 3. Check control element and test connector contacts: W-bus connection: contacts X4, pin 2 Analogue connection: connector X4: + at pin 1 / + at pin 7 (if present) 		
	HA6 HAC HAD HAE		Electrical wiring vehicle blower	4. Check wiring of vehicle fan for damage, break and short-circuit, see wiring diagram		
			Heater lock-out	5. Delete heater lock-out (Rectify cause)		
			ADR function (if in- stalled)	6. Check auxiliary drive input: S5, Y2, see wiring diagram with ADR		
				7. Check Dynamo Plus input: X4, pin 3 and pin 4		
			Battery disconnector (BTS) (if available)	8. Check connections BTS , replace BTS if necessary. See wiring diagram with BTS		
			Control unit defective	9. Replace control unit		
F01 or 1*	H02 H82 H83	2 No start 2 3	Fuel supply	 Check fuel supply (tank empty, fuel lines clogged) Check fuel filter Check tank extracting device and fuel line for leaks Bleed fuel system 		
			Burner head	 5. Check ignition electrode distance 6. Clean baffle plate, replace if necessary 7. Replace fuel nozzle 8. Fuel pump, check solenoid valve 9. Check fuel pump, replace if necessary 		
F02 or 2*	H03	H03	D3 Flame failure	Fuel supply	 Check fuel supply (tank empty, fuel lines clogged, fuel line only partially filled) Check fuel filter Check tank extracting device and fuel line for leaks Bleed fuel system 	
			Flame monitor	5. Flame monitor		
			Burner head	 6. Clean baffle plate, replace if necessary 7. Replace fuel nozzle 8. Fuel pump, check solenoid valve 		
F03 or 3*	H04 H84	Overvoltage or undervoltage	Power supply	 Check battery Check charging voltage Check electrical connections 		
F04	H05	Flame was detected	Fuel pump solenoid	1. Visual check burner head, clean if necessary		
or 4*	H85	prior to combustion	valve defect	2. Check solenoid valve		
F05 or	H1A H9A	Flame monitor	Flame monitor defect	Replace control unit		

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*: Indicator lamp of control element flashing: count the number of long flash pulses after 5 short flash pulses.						
Analogue fault code	Fault code (hexa- decimal)	Fault message / Symptom	Possible causes	Recommended action in workshop		
5*						
F06 or	H14 H93	Short circuit of coolant temperature	Coolant temperature sensors wiring defective	1. Check wiring for damage and short-circuit		
6*	H94	sensors	Coolant temperature sensors	2. Carry out function check of coolant temperature sensors, replace if necessary		
F07 or	H08 H88	Fuel pump solenoid valve short-circuit in	Fuel pump solenoid valve defect	1. Check wiring and connector for damage, break and short-circuit		
7*		electrical circuit		2. Check solenoid valve, replace fuel pump if neces- sary		
F08	H09	Fan drive motor	Fan lock-up protection	1. Rectify cause of block and sluggishness		
or 8*	H15 H89	short-circuit or break		2. Check wiring and connector for damage, break and short-circuit		
	H95			3. Check operation of drive motor, replace if neces- sary		
F09 or	H19 H99	Ignition spark circuit is defective	Ignition spark generator	1. Check wiring and connector for damage, break and short-circuit		
9*	H2E			2. Check ignition spark generator, replace if neces- sary		
F10	H06	Heater overheats	Coolant temperature	1. Check wiring for damage, break and short-circuit		
or 10*			sensors defective	2. Measure resistance of coolant temperature sensors, replace coolant temperature sensors if necessary		
			Coolant system	3. Check coolant level, bleed coolant circuit		
				4. Carry out function check of coolant pump, re- place if necessary		
				5. Check wiring and connector for damage, break and short-circuit		
F11	HOB	Coolant pump short-	Coolant system	1. Check coolant level		
or 11*	HC0 HC1	circuit or break		2. Check coolant flow		
	HC2			3. Bleed coolant pump. Rectify possible cause		
	HC3 HC4			4. Check anti-freeze in the coolant, change coolant if necessary		
			Coolant pump defective	5. Check wiring for damage, break and short-circuit		
				 Carry out function check of the coolant pump, replace if necessary 		
F14 or	H1B HAB	Coolant temperature sensors breaks or	Wiring defective	1. Check coolant temperature sensor wiring and connector for damage		
14^		snort-circuits	Coolant temperature sensors defective	2. Check coolant temperature sensors		
F16 or	H4F H5B	IF Exhaust gas temper- IB ature too high	Exhaust gas temperat- ure sensor defective	1. Check wiring and connector of exhaust gas tem- perature sensor for damage, replace if necessary		
16*				2. Measure resistance of exhaust gas temperature sensor, replacing if necessary		
			Heater fouled	3. Visual inspection with cleaning of inner surface of heat exchanger, replace if necessary		
			Ambient temperature of heater too high	4. Allow the heater to cool down, check temperat- ure and ventilation of installation space (see installa- tion instructions)		
			Control unit defective	5. Replace control unit		
F17 or 17*	H4D H31	Exhaust gas temper- ature sensor	Wiring defective	1. Check wiring and connector for damage, break and short-circuit		

*: Indicator count the nu	*: Indicator lamp of control element flashing: count the number of long flash pulses after 5 short flash pulses.					
Analogue fault code	Fault code (hexa- decimal)	Fault message / Symptom	Possible causes	Recommended action in workshop		
			Exhaust gas temperat- ure sensor defective	2. Check exhaust gas temperature sensor, replace if necessary		
			Heater fouled	3. Visual inspection with cleaning of inner surface of heat exchanger and combustion tube, replace if necessary		
F20 or	H25 HA5	No fuel preheating	Heater cartridge wiring defective	1. Check wiring and connector for damage, break and short-circuit		
20*			Heater cartridge defect- ive	2. Check operation of heater cartridge, replace if necessary		

* The number of long pulses corresponds to the number of the fault code.

6.6.2 Troubleshooting without error code output

NOTE

We generally recommend the following procedure:

- Check fuses
- Check operating voltage
- Check for damage and ensure passages are clear:
 - combustion air intake
 - exhaust pipe
 - --- fuel line
- Also check condition of filter.

Symptom	Possible cause	Possible troubleshooting	Comments / Service	
Heater does not respond, no component running. Indicator lamp not flashing .	Operating voltage	 Fuse blown Rectify cause, change fuse Unlock heater 	The indicator lamp is provided by the heater (see wiring dia- gram). Check / replace control	
		3. Supply voltage to heater con- nector	element.	
		Measure voltage		
	Indicator lamp (control ele- ment, Quick Heating button)	 Control element fuse blown Rectify cause, change fuse Supply voltage on control element (switch with function display) Measure voltage at pin 		
		 3. Continuity at control element (switch with function display) Check pin to ground 		
		 4. Control element indicator lamp defective Replace control element if necessary 		

Symptom	Possible cause	Possible troubleshooting	Comments / Service
Heater will not start, coolant pump briefly starts up then switches immediately to after- running period, or the heater switches off. The indicator lamp flashes . (error code output, see chapter 6, "Malfunctions and troubleshooting" on page 15	Component fault	See chapter 6.2, "Fault list on the control element" on page 15	
Heater will not start or coolant pump and drive motor may briefly start up, the heater switches off.	Low voltage cutoff: Brief drop or interruption in power supply	 Check fuses Rectify cause, change fuse Supply voltage to heater connector Measure voltage Battery defective Check battery Electrical wiring break Check electrical wiring 	Voltage drop (Example of cause: by start pulse of a starter: The maximum current load leads to the drop of the power supply and loss of the processor circuit functionalities (under- voltage can not be detected, the heater reinitialises itself and starts again).
Excessive smoke from heater during start-up phase	Remaining fuel in combustion tube and in heat exchanger (un- combusted fuel in previous heating mode)	Operate heater, the smoke reduces as the burning dur- ation increases (self-clean- ing)	 The heater can be extremely overfilled with fuel due to commissioning or improper use of fuel priming and must self-clean first. In the previous heating mode, fuel still has been supplied, after the flame was already out (e.g. the solenoid valve does not close or closes with a delay). Excessive smoke during after-running period after switched off (T >10 s). Possibly also fault code for flame abort after combustion mode (F04 or H05) in fault memory.
Excessive smoke from heater during start-up phase. Unstable combustion can be heard	Fuel supply malfunction	 Tank empty or leaking Refill tank, replace if necessary Fuel lines blocked or leaking Unblock fuel lines, replace if necessary Fuel filter clogged Replace fuel filter Tank extracting device or fuel lines leaking Check tank extracting device and fuel lines for leaks. Air in fuel system Bleed fuel system 	 Leaks lead to air in the fuel system Vacuum and high fuel temperatures lead to outgassing of the fuel in the supply pipe. Several symptoms can occur at the same time. Low pressure in the fuel line >0.4 bar fuel.
Excessive smoke from heater during start-up phase and dur- ing stationary operation. Un- stable combustion can be heard Heater starts again	Fuel supply malfunction	 Tank empty or leaking Refill tank, replace if necessary Fuel lines blocked or leaking Unblock fuel lines, replace if necessary Fuel filter clogged Replace fuel filter 	 Leaks lead to air in the fuel system. Vacuum and high fuel temperatures lead to outgassing of the fuel in the supply pipe Several symptoms can occur at the same time.

6 | Malfunctions and troubleshooting

Symptom	Possible cause	Possible troubleshooting	Comments / Service
		 4. Tank extracting device or fuel lines leaking Check tank extracting device and fuel lines for leaks. 5. Air in fuel system Bleed fuel system 	
	Combustion air line blocked	 Unblock combustion air in- let and combustion air line, replace if necessary 	
	Exhaust pipe blocked	 Check exhaust line for for- eign objects and clean if ne- cessary Replace exhaust pipe if ne- cessary 	
	Fuel processing: nozzle clogged, baffle plate defective	 Replace baffle plate Replace fuel nozzle 	 Fuel processing (spray pattern) by deposits in or on the nozzle not OK. Fuel nozzle must be replaced. Cleaning is not recommended
	Combustion tube damaged	Visual inspection of com- bustion tube, clean or re- place if necessary	 Combustion tube components cracked Welded seam cracked Burner components deformed Combustion tube head tilted Combustion tube to heat exchanger leaking
	Heat exchanger damaged	 Visual inspection of heat ex- changer, clean or replace if necessary 	Soot or coke deposits disturb combustion. Mainly result of other causes (e.g. fuel nozzle or combustion tube defective)
	Fuel pump disrupted	Check fuel pump, replace if necessary	 Fuel pump not OK. Fuel pump leaks, draws air or looses pressure.
Excessive smoke from heater during after-running period (after switched off, T >10 s)	Fuel pump solenoid valve	Check fuel pump, replace if necessary	 Solenoid valve does not close, closes with a delay or closes only partly due to fouling or defect. If as a result smoke is observed also being given off during the start-up phase. Another consequential fault would be flame after combustion mode (F04 or H05). It can give off smoke for up to 25 s and the fault flame after combustion mode is not triggered.
 Heater goes out prematurely Coolant does not heat up Heater switches on and off in cycle operation constantly 	Coolant circuit	 Check connections in coolant circuit for leaks and kinks Bleed coolant circuit Check coolant flow 	In principle, an error message is stored if combustion is stopped. Component faults, such as drive motor, fuel pump, solenoid valve, etc. are dis- played).

Symptom	Possible cause	Possible troubleshooting	Comments / Service
	Fuel supply disrupted	 Check fuel supply (tank empty, lines clogged, fuel line only partially filled) Check fuel filter Check tank extracting device and fuel line for leaks Bleed fuel system 	
 Coolant heats up Vehicle interior remains cold 	Vehicle fan does not actuate	 Check fuse Check the relay for vehicle blower Check coolant temperature (switches On at approx. 30 °C) Check switch signal at the relay, ground and voltage (audible, see wiring dia- gram) Measure coolant temperat- ure signal line (green/white, gr/ws), pin on relay 	 If the coolant gets warm but the vehicle interior re- mains cold, heat removal out of the coolant circuit is disturbed. The switch signal of the vehicle fan is not OK. Vehicle fan not OK. Vehicle fan not activated, vehicle heat control flap position for warming the vehicle interior not OK
Smell of exhaust in vehicle in- terior	Exhaust system	 Check exhaust pipes (not clogged, rectify leaks) Check if exhaust pipe has been incorrectly installed (see installation instructions) 	

7 Function checks

7.1 Basics

Continue to follow the warnings and information provided in the operating- and Installation instructions.

7.1.1 Required test and measuring equipment

• Digital multimeter:

for measuring electrical resistance [ohms], electrical continuity 0.1 ohms test current < 5 mA

- Suitable voltage source
- Charged vehicle battery
- PC / Laptop
- Diagnostic adapter including Webasto Thermo Test software for displaying the fault code memory, operating data, control unit information. See chapter 6.1.1, "Diagnostics with Webasto Thermo Test" on page 15.
- Pressure measuring device with fuel nozzle adapter
 CO₂ measuring device:
- Minimum specifications of CO₂-measuring device:

	Resolution	Precision	Division
CO	10 ppm	±5%	0-2000 ppm
CO ₂	0.1%	±5%	0-16%

Technical data refer to an ambient temperature of 20 °C, an air pressure of 1013 hPa.

7.1.2 Function check in the vehicle

The heater switches first on the vehicle fan when the coolant reaches a temperature of 30 $^{\circ}$ C.

Check the following points:

1. Vehicle settings

- Set the fan and temperature such that maximum heat is provided in the vehicle (fan speed high, temperature maximum, flap position).
- Check the coolant circuit and bleed it in accordance with the vehicle manufacturer's regulations
- Test and bleed fuel system.

2. Heater settings

- Switch on the heater at the control element.
- Check heating action. Run the heater in combustion mode. Check heating effect on the outflow nozzles of the vehicle blower.
- Check the heater for leaks between the burner head and the heat exchanger (visual inspection of the rough quantity of the leak).
- Switch off the heater again at the control element.

7.2 Check and set CO₂ in exhaust gas

After repairing the heater it will be necessary to check the CO_2 setting.

It is recommended to check or reset the CO₂ content after replacing the burner unit, the fan or the control unit.

 CO_2 data: see chapter 11, "Technical data" on page 48.

It is permitted to change the factory-set level of combustion air by amending the CO_2 setting using the Webasto Thermo Test PC Diagnostics.

7.2.1 Check CO₂ in exhaust gas

The heater should be in combustion mode to test the fuel values.

Maximum heat dissipation must be ensured so that the coolant temperature remains as low as possible and several minutes in combustion mode (approx. 5-10 minutes) are possible for the test.

Procedure:

1. Switch on the heater

2. Read CO_2 value after >5 minutes in combustion mode Check the following values (see instructions to that effect at chapter 11, "Technical data" on page 48):

 CO_2 in exhaust gas, CO and soot number as per Bacharach

7.2.2 Set CO₂ in exhaust gas

level must increase

The heater features automatic altitude compensation.

Increase the speed of drive motor \Rightarrow measured CO₂ level must drop Decrease the speed of drive motor \Rightarrow measured CO₂

The CO_2 setting can only be carried out with Webasto Thermo Test (WTT).

- 1. Connect the WTT (see chapter 6.1.1, "Diagnostics with Webasto Thermo Test" on page 15).
- 2. Select the CO_2 setting. The heater starts automatically. The heater is operated in CO_2 setting mode, which is exclusively used for the CO_2 setting.
- 3. Correction of the CO₂ setting is recommended in increments of 100 rev/min.
- 4. Position the CO₂ measuring device in the exhaust system branch of the heater according to the manufacturer's specifications. For measurement values, see CO₂ data in Chapter 11.

Enabling the setting function accepts the CO_2 value.

7.3 Checking exhaust gas temperature sensor

When testing with a digital multimeter, the exhaust gas temperature sensor should show the following values: Resistance at 20 °C: 2130 - 2230 ohms.

Connectors and con- tacts OK? yes	no	Replace com- ponent.		
Cables damaged or ceramic element broken?	yes	Replace	component.	
Resistance measure- ment with digital mul- timeter, is resistance outside the 2130-2230 Ohm range?	yes	Replace (component.	
Component is OK.				
Contraction of the second seco				

Check the exhaust gas temperature cable for signs of mechanical damage from the outside.

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

7.4 Checking control unit



- The control unit has an optical sensor (flame monitor).
 Clean the sensor before installing the control unit, if necessary.
- Replace the whole control if it is defective.

7.5 Check combustion tube





7.6 Check the blower fan wheel

Electrical wiring must not lie against the blower fan wheel.

7.7 Checking baffle plate



7.8 Checking drive motor



7.9 Fuel pump and check solenoid valve



В

A Pin 1

The pump pressure is non-adjustable ex-factory. Adjusting the pump pressure is not permitted.

Pin 2

The fuel pump and the fuel lines must be replaced after 5 years.

7.9.1 Connect to Webasto Thermo Test PC Diagnostics

Test the fuel pump for abnormalities and activate the fuel supply.



А	USB interface 1	В	Diagnostic adapter 2

Testing with Webasto Thermo Test Diagnostics:

- 1. Connect WTT
- 2. Start WTT
- 3. Start burner motor component test
- 4. Set speed of 5550 rpm

5. Heater evaluation:

- Fan is running
- Audible start-up noises (The fan starts up until the set speed is reached.)
- No disturbing scraping noises must be audible, e.g., squeaking.

Fuel is sucked in, the supply pipe and the return line are OK.

7.9.2 Check fuel pump for leaks



DANGER Risk of injury:

Connector X3 must be disengaged, see chapter 10.5.2, "Overview of plug assignments at control unit" on page 40

Follow these steps:

- 1. The burner head is disconnected from the heat exchanger. See chapter 8.4, "Disconnect burner head" on page 30.
- 2. Connector **X2** and **X4** must be connected.
- 3. Testing the fuel pump with Webasto Thermo Test Diagnostics:
 - Disconnect connector X3 from the control unit
 - Connect WTT
 - Start WTT
 - Start component test for burner motor speed
 - Input set speed of 5550 rpm for 5 min.

4. Evaluation:

- Fan is running
- Audible start-up noises (The fan starts up until the set speed is reached.)
- No disturbing scraping noises must be audible, e.g., squeaking.
- Monitor the fuel pump during operation (5 min).
- No fuel may escape at the pump.

7.9.3 Check solenoid valve on fuel pump

DANGER

Risk of injury:

Connector X3 must be disengaged, see chapter 10.5.2, "Overview of plug assignments at control unit" on page 40.

Follow these steps:

- 1. The burner head is disconnected from the heat exchanger. See chapter 8.4, "Disconnect burner head" on page 30.
- 2. Connector **X2** and **X4** must be connected.
- 3. Testing the fuel pump with Webasto Thermo Test Diagnostics:
 - Disconnect connector X3 from the control unit
 - Connect WTT
 - Start WTT
 - Start component test for fuel cut-off valve of fuel pump
 - Activate / deactivate solenoid valve

4. Evaluation:

- Audible opening sound of the solenoid valve
- If faulty, the fuel pump should be replaced
- 5. Connect solenoid valve contacts on the connector X8 Pin 1 and 2. See chapter 11, "Technical data" on page 48.

Checking the cold resistance at 20°C:	
12 V valve	$R = 20.8 \ \Omega \pm 5\%$
24 V valve	$R = 61.0 \ \Omega \pm 5\%$
Checking the opening voltage:	
12 V valve	opens at 7 - 10 Volt
24 V valve	opens at 10 - 15 Volt
Checking the power consumption at 20°C:	
12 V valve	10 Watt
24 V valve	10 Watt

7.9.4 Check pressure on fuel pump

Follow these steps:

- 1. Burner head removed
- 2. Removing fuel nozzle
- 3. Install pressure measuring device (screw into the area of the fuel nozzle)
- 4. Connect WTT
- 5. Start WTT
- 6. Start fuel priming with WTT service.
- 7. The solenoid valve opens in this function automatically.

Alternative:

- 8. Start component test for burner motor speed. **Speed target**:
 - Thermo Top Pro 120: 5400 rpm
 - Thermo Top Pro 150: 5550 rpm
- 9. The solenoid valve must be opened manually by applying the supply voltage to the fuel pump connector.
- 10. Read the pressure on the measurement device.

Fuel pressure at 20°C	Value
Thermo Top Pro 120 (bar):	10.5 +/- 0.2
Thermo Top Pro 150 (bar):	12.0 +/- 0.2

7.10 Checking heater cartridge



DANGER

• Heater cartridge becomes hot Do not touch the heater cartridge.

Testing the heater cartridge when installed and using WTT Diagnostics

Follow these steps:

- 1. Connect Webasto Thermo Test (WTT).
- 2. Start WTT.
- 3. Start component test for nozzle block preheater.

Testing the heater cartridge when removed



A Pin 1 В Pin 2

Follow these steps:

- Connect supply voltage (12 V or 24 V) to PIN1 and PIN2 of 1. connector.
- Measure current 2.

Evaluation: 3.

10.8A	+/- 10 %	12 V
5.4A	+/- 10 %	24 V

7.11 **Check coolant pump**



7.12 **Checking coolant temperature** sensors

7.12.1 Testing the coolant temperature sensors via WTT Diagnostics



Fig. 23 Coolant temperature sensors testing via WTT

А	WTT USB interface	В	Diagnostic adapter		
Follow these steps:					

- 1. Connect WTT
- 2. Start WTT

- 3 Evaluation:
 - The temperature values displayed in the WTT must be plausible.

Testing resistance of coolant temperature 7.12.2 sensors via WTT

Test of coolant temperature sensors when installed on the heater by testing the electrical resistance. See chapter 10.6, "Wiring diagrams " on page 40.

Evaluation:

- Coolant temperature sensor contacts on connector X3 pin 1 and 2
- Overheating sensor contacts on connector X3 pin 5 and 6
- Checking the cold resistance at 20°C: R = 3.266 3.479ohms

Checking ignition electrode 7.13

Testing the ignition electrode via WTT 7.13.1 **Diagnostics**

Follow these steps:

- Connect WTT 1.
- 2. Start WTT
- 3. Activate component test for ignition spark generator (maximum duration of 10 s, process can be repeated).

7.13.2 Testing ignition electrode when removed



Potentially hazardous high voltage

This operating mode is not intended for the ignition spark generator and safety precautions must be taken to rule out a danger for the worker in the workshop.



Fig. 24 Checking ignition electrode when removed Follow these steps:

1. Removing ignition spark generator. See chapter 8.11, "Removing ignition spark generator" on page 33.

Evaluation:

- 2. After all safety precautions have been made:
 - Briefly connect the resistor and voltage as shown above. Maximum duration of 10 seconds.
 - Visual check of the flashover between the electrode tips.

7.13.3 Checking the ignition electrode distance



Fig. 25 Ignition electrode distance **Visual inspection**

The electrodes are not:

- Bent
- Dirty

Follow these steps:

If the electrodes are dirty:

- 1. Rectify cause.
- 2. Remove spark corrosion from electrode tips with sandpaper.
- 7.13.4 Check the distance between ignition electrode and fuel nozzle tip



Fig. 26 Distance between ignition electrode and fuel nozzle tip Follow these steps:

- 1. When installed on the open heater, burner head removed
- 2. Visual check for bending, dirt on the electrodes

8 Repairing and replacing components

8.1 Required tools

Phillips head screwdriver (PH2)

- Ring spanners SW13
- Ring spanners SW16
- Torque wrench SW16
- Circlip pliers
- Flat-blade screwdriver
- Socket spanners for screws with hex socket (SW3)
- Torx screwdriver T10
- Torx screwdriver T20
- Torx screwdriver T25

8.2 Installation notes

Installation is in the reverse order to removal as described. Specific installation instructions are provided.

8.3 Disconnecting control unit connections



Fig. 27 Detaching the control unit connector

Unlatch all connectors from the control unit and disconnect as shown above.

Unclip the yellow clip in the connector:

While the yellow clip is carefully pressed down with the flat-blade screwdriver, remove the connectors.

8.4 Disconnect burner head





- Fig. 29 Install burner head, check position of combustion tube.
- When attaching the burner head to the heat exchanger, combustion tube must not be damaged.

Check the position of combustion tube.

8.6 Removing control unit



Fig. 28 Disconnect burner head

А	Nut	С	Connectors
В	Burner head		

Follow these steps:

- 1. Remove 3x nuts M8 SW13 (A).
- 2. Disconnect the fuel line if necessary.
- 3. Remove burner head (B).



Fig. 30 Remove screws of control unit housing T20, do not remove T10.

- ▶ Remove screws with a Torx screwdriver T20.
- Do not remove screws of control unit housing T10.
 Warranty claims on the control unit are voided if the screws have been removed.



Fig. 31 Removing control unit

А	Control unit	С	Connectors	
В	Bolt T20			
			·	

Follow these steps:

- 1. Pull connector (C) out of control unit (A).
- 2. Remove screws of control unit (B) 4x14 T20 (4x).
- 3. Turn control unit toward front.
- 4. Pull connector at back out of control unit.
- 5. Remove control unit.

8.7 Electrical wiring in the burner head

Electrical wiring must not lie against the blower fan wheel.



Fig. 32 Electrical wiring

There must be no electrical wiring in the specified area (X).

After every removal of electrical wiring:

Carefully fit clip and cable tie, see the figures below.



Fig. 33 Position of clip for electrical cables on housing



Fig. 34 *Position of cable tie (on electrical wiring for ignition spark generator and nozzle block preheater)*

8.8 Removing baffle plate



Carefully remove baffle plate over the collar. During removal, **do not bend ignition electrodes**.

Follow these steps:

- 1. Carefully pull baffle plate forward by approx. 5 mm.
- 2. Carefully pull baffle plate diagonally.
- 3. Remove the baffle plate completely.

8.9 Removing ignition electrodes

Do not bend or damage ignition electrodes. Position and press on the ignition electrodes correctly when fitting them.



Fig. 36 Remove ignition electrodes

A	Ignition spark gener- ator	С	Cylinder screw hex socket (SW3) M4
В	Ignition electrodes		

Follow these steps:

- 1. Remove baffle plate, see chapter 8.8, "Removing baffle plate" on page 31.
- 2. Unscrew cylinder screw (C) using hex socket (SW3) M4x12.
- 3. Carefully pull ignition electrodes (B) out of the ignition spark generator (A).

8.10 Removing fuel nozzle



Fig. 37 Removing fuel nozzle Follow these steps:

- 1. Remove ignition electrodes, see chapter 8.9, "Removing ignition electrodes" on page 32.
- 2. Carefully unscrew fuel nozzle (SW16).



Please note:

When replacing the nozzle, not using the prescribed torque (20 Nm) may lead to a leak between the nozzle and the nozzle block. This can also result in problems such as leaking fuel, smoky combustion, and not achieving the stated emission values.

8.11 Removing ignition spark generator

Do not bend or damage ignition electrodes.



Fig. 38 Remove ignition spark generator (C) with ignition electrodes.

A	Clip	С	Ignition spark generator
В	Screws		

Follow these steps:

- 1. Remove control unit. See chapter 8.6, "Removing control unit" on page 30.
- 2. Remove clip (A) (electrical wiring).
- 3. Remove cable tie (electrical wiring).
- 4. Removing baffle plate. See chapter 8.8, "Removing baffle plate" on page 31.
- 5. Remove the 2 screws (B) of ignition spark generator (C) with screwdriver (PH2).
- 6. Remove ignition spark generator (with ignition electrodes, if necessary).

8.12 Removing fuel pump

Pay attention to the axle connection (to drive motor). The axle connection may fall out of the drive motor.



A Fuel pump B Screws

Follow these steps:

- 1. Remove control unit. See chapter 8.6, "Removing control unit" on page 30.
- Remove ignition spark generator with ignition electrodes. See chapter 8.11, "Removing ignition spark generator" on page 33.
- 3. Remove 3x screws (B) M5x45, T25 (fuel pump on housing).
- 4. Removing fuel pump (A).

8.13 Installing fuel pump

When installing the fuel pump, replace the old seals (A and C) and the screen (B).



Fig. 40 Installing fuel pump

А	Seal	С	Seal
В	Screen		

Removing nozzle block preheater 8.14



Fig. 41 Fuel pump with nozzle block preheater



Fig. 42 Removing clip and heater cartridge

A	Fuel pump	С	Clip
В	Heater cartridge		
Follo	w these steps:		

- Remove control unit. See chapter 8.6, "Removing control 1. unit" on page 30.
- Remove ignition spark generator with ignition electrodes. 2. See chapter 8.11, "Removing ignition spark generator" on page 33.
- Unclip clip (C). 3.
- Pull heater cartridge (B) downwards out of fuel pump. 4.

Removing blower fan wheel 8.15



Fig. 43 Overview

A	Screws	С	Blower fan wheel
В	Cover for combustion air fan	D	Circlip



Fig. 44 Circlip Follow these steps:

- Remove 3x screws (A) Torx 40x14 T20. 1.
- 2. Remove cover for combustion air fan (B).
- Remove circlip (D) DIN471 6x0.7 from drive motor axle. See 3. Note. Use suitable circlip pliers.
- 4. Remove blower fan wheel.
- 5. Pull out blower fan wheel.



Do not reuse the circlip.

8.16 Removing drive motor

If the drive motor has to be removed, the ignition spark generator and the ignition electrodes can remain installed.



Fig. 45 Removing drive motor

А	Drive motor	С	Screws
В	Axle connection		

Follow these steps:

- 1. Remove control unit. See chapter 8.6, "Removing control unit" on page 30.
- 2. Remove fuel pump, see chapter 8.12, "Removing fuel pump" on page 33.
- 3. Remove 4x screws (C), M3x10 T10.
- 4. Remove drive motor (A).
- 5. Remove axle connection (B).

8.17 Remove heat exchanger

DANGER

Danger of burns

After briefly operating the heater, the heat exchanger may be hot. Allow the components to cool down if necessary.

- Collect the coolant running out of the system in a suitable container.

- Block or disconnect coolant hoses.
- Dispose of coolants in an environmentally friendly way.



Fig. 46 Heat exchanger with burner and sensors Follow these steps:

- 1. Remove burner head, see chapter 8.4, "Disconnect burner head" on page 30.
- 2. Remove screws that are fastening the heater (see also installation instructions).
- 3. Remove heat exchanger.

8.18 Remove combustion tube

Follow these steps:

- 1. Remove burner head, see chapter 8.4, "Disconnect burner head" on page 30.
- 2. Remove heat exchanger if necessary.



Fig. 47 Remove combustion tube

А	Combustion tube	C	Heat exchanger
В	Seal		

3. Remove combustion tube (A) from the heat exchanger (C).

Damaged seals must be replaced.

Ensure that the seal does not slip.

Seals must be replaced every time it is dismantled.

8.19 Remove coolant temperature sensors

Never remove the temperature sensors for testing, just for replacement.

Do not reinstall the removed sensors.



Fig. 48 Temperature sensors with sensor cover and screws

А	Collar screws	D	Exhaust gas sensor
В	Cover for sensors	E	Connector (control unit)
С	Temperature sensors		

Follow these steps:

- 1. Pull connector (E) out of control unit.
- 2. Disconnect connector for exhaust gas sensor (D).
- 3. Remove 2x collar screws for sensor cover (A) M4 T20.
- 4. Remove cover for sensors (B).
- 5. Pull temperature sensors (C) out of the heat exchanger.

8.20 Install coolant temperature sensors

The seals of the sensors must be wetted with suitable lubricant before being inserted into the heat exchanger. Note cable routing and position of sensors. The cover protects the sensors

8.21 Removing exhaust gas temperature sensor

Never remove the sensors for testing, just for replacement.



A	Exhaust gas sensor	С	Exhaust gas temperature sensor
В	Spring clip	D	Screw for spring clip

Follow these steps:

- 1. Disconnect exhaust gas sensor connector (A).
- 2. Remove 1x screw for spring clip (D) M4 T20.
- 3. Carefully remove spring clip (C).
- 4. Carefully pull out exhaust gas temperature sensor (C).

8.22 Installing exhaust gas temperature sensor

Take particular care when handling the exhaust gas temperature sensor (as it is a sensitive electronic/ ceramic component).

Avoid pulling the cable of the exhaust gas temperature sensor at the sensor head (during installation and in operation).

Prevent damage due to shock load.

The exhaust gas temperature cable must not be sharply kinked. The Teflon insulation must not be damaged.

The exhaust gas temperature cable must not rest against the heater.

Route the cable between exhaust gas temperature sensor and spring clip without tension.



Fig. 50 Installing exhaust gas temperature sensor Follow these steps:

- 1. Install exhaust gas temperature sensor.
- 2. Position spring clip of exhaust gas temperature sensor. See Fig. 49.

9 Packaging / storage / shipping

9.1 General information

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

The temperatures during transportation and storage must not drop below or exceed the ambient temperatures defined in the technical data. See chapter 11, "Technical data" on page 48.

9.2 Ideal position



Fig. 51 Ideal position of Thermo Top Pro 120 / 150 heater for storage and transport

9.3 Storage and transportation

Sending in the complete heater

- The heater must be completely drained of fuel.
- For packaging and shipping
 - Make sure that the remaining fuel or coolant cannot leak out.
 - Seal the coolant connection pieces and the fuel connection with dummy plugs.

Storage

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

Packaging

• Always store heaters in the original or similar packaging in a closed room.

Transport

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

After removing the delivery packaging

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

10 Electrical incorporation

10.1 Information on the electrical connection

- If the signal is not applied to terminal D+ on the control unit (connector X4, pin 3), the temperatures under "Engine OFF" are used as control thresholds.
- If the signal is applied to terminal D+, the control thresholds change to the temperatures under "Engine ON".

10.2 The heater in hazardous material vehicles (ADR)

The ADR function is typically parameterised according to the specific application. In case of queries, contact a Webasto service workshop.

If the heater is parameterised for automatic ADR recognition and the ADR switch-off is set to the 'high' level, please note:

- In order to activate the ADR functions, an earth contact must be present at the control unit input X4 pin 4 via Y2 or H5 (see wiring diagram) when the heater is switched on.
- After connecting the positive potential to the control unit input X4, pin 4 (for "Auxiliary drive on) or after the signal at terminal D+ on control unit input X4, pin 3 stops (if the engine is switched off), there is a brief run-on for 40 seconds. The control unit is then in "ADR lock" mode.

10.3 Legend and remarks regarding wiring diagrams

- 10.3.1 Legend
- No. Remarks

A1 Heater components A2 Control unit ThermoCall TC4 Entry or Advanced. Optional. A4 A5 W-bus temperature sensor, optional, for TC4 Advanced only B3 Thermostat for internal fuel preheating B4 Room temperature sensor Operating indicator ΒA CAF Fan motor СР Coolant pump CTS Coolant sensor ETS Exhaust gas temperature sensor F1 Fuse 20 A, blade fuse DIN 72581-3 F2 Fuse 1 A, blade fuse DIN 72581-3 F3 Fuse 20 A, blade fuse DIN 72581-3 F4 Fuse 1A F5 Fuse 1A FH Fuel preheating FV Fuel valve FZG Vehicle blower H1 Symbol on display LED (green, blue, white, red) indicator lamp, ready indic-H2 ator, ON indicator, fault list H5 Light bulb or LED lamp, ON indicator, pumping device (max. 500 mA) ThermoCall TC4 LED green (in item S9) ON indicator, in-H8 dicator lamp ISG Ignition spark generator K5 Vehicle fan control, relay with free-wheeling diode or IPCU OTS Temperature sensor SmartControl / MultiControl or (UniControl with adapter Ρ cable), Optional. UniControl P1 S12 Button, External Quick Heating button (optional) S2 Switch for residual heat utilisation S4 On/Off switch (min. 500 mA) Switch for auxiliary drive / pumping device S5 S6 Switch (1 or 2-pin) disconnector S7 Battery disconnector, electronically controlled disconnector (max. 500 mA) S9 ThermoCall TC4 button V1 Diode, min. 500 mA (not included in wiring harness) V2 Diode, min. 500 mA (not included in wiring harness) V4 Diode, for analogue ThermoCall TC4 connection to other control units V5 Diode, for On/Off S4 switch connection to other control units V6 Diode, for analogue SmartControl/MultiControl connection to other control units X1 6-pin plug connection. Item CP to item A2 2-pin plug connection. Vehicle-specific wiring harness Х2 X3 8-pin plug connection. Item sensors to item A2

Electrical incorporation | 10

No.	Remarks					
10.3.	2 Comments					
Y2	Solenoid valve / pump, auxiliary drive / pumping device					
X31	10-pin plug connection. To Item P1					
X29	4-pin plug connection -					
X28	4-pin plug connection -					
X27	4-pin plug connection. To Item P					
X26	4-pin plug connection. To Item P					
X22	6-pin plug connection. Telestart connection (optional, see Telestart documentation)					
X21	4-pin plug connection. To Item S4					
X20	To item S4 or analogue SmartControl / MultiControl connection or analogue ThermoCall (do not connect for W-bus connection)					
X19	HE plug connection FAKRA (for TC4 Advanced only)					
X17	12-pin plug connection. To item A4 (see ThermoCall documentation)					
X16	4-pin plug connection. To item A5 (optional)					
X15	4-pin plug connection. W-bus temperature sensor con- nection					
X12	4-pin plug connection W-bus, connection SmartCon- trol / MultiControl, UniControl, ThermoCall or diagnosis					
X10	W-bus connection control element / diagnosis (do not connect for analogue connection)					
Х9	4-pin plug connection. To item P or S4 or to A4 or to P or to S4					
X8	2-pin plug connection. Item FV to item A2					
X7	2-pin plug connection. Item FH to item A2					
X6	3-pin plug connection. Item CAF to item A2					
X5	3-pin plug connection. Item ISG to item A2					
X4	12-pin plug connection. Vehicle-specific wiring harness					

	inclinating in the second se
1	D+ signal (vehicle motor ON/OFF) for determining the control temperature
3	Fuse for vehicle blower (fuse present in vehicle)
4	Switch for vehicle blower
6	Wiring harness
10	SmartControl/MultiControl connection, Telestart (12 V only), ThermoCall or diagnostics via W-bus
11	SmartControl / MultiControl connection or switch (ana- logue)
17	Positive from terminal 15/75 to connection 10: Continu- ous heating mode is possible in connection with quick heating function provided the ignition is switched on.
18	Connection to terminal 30: Continuous heating mode is possible with ignition switched off.

10.4 Cable colours / cable cross-sections

Line length	< 7.5 m	7.5 – 15 m
Cable cross-sections (Wiring diagram based on < 7.5 m)	0.5 mm²	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

Line length			< 7.5 m		7.5 – 15 m	
			4.0 mm²		6.0 mm ²	
Cable co	lours					
bl	blue	or		orar	nge	
br	brown	rt		red		
ge	yellow	SW	,	blac	k	
gn	green	vi		viole	et	
gr	grey	WS	i	whi	te	

10.5 Connector and pins

10.5.1 Overview of pin assignment on the connectors

4		X1: Coolant pump connection				
1-	1	Earth-				
3	2	PWM control input				
6 ~ %	3	Plus+				
	6	-	-			
		X2: Heate	r power sup	ply		
	1	Battery +				
	2	Battery -				
5		X3: Connection for temperature sensors and exhaust gas sensor				
4	1 + 2	Coolant sensor				
8	3 + 4	Exhaust ga	s temperatur	e ser	nsor	
	5 + 6	Overheat s	ensor			
		X4: Control element(s), vehicle con- nection				
6	1	Input, switch-on signal (ON/OFF)				
	2	W-bus				
12	3	Terminal D	+			
	4	Auxiliary drive				
	5	Output, vel	hicle fan rela	у		
	6	Output, battery disconnector afterrunning signal				
	7	Operating indicator/error code output				
8		Use of residual heat input (on/off)				
9 CAN Low (diagnosis)						
	10	CAN High (diagnosis)				
	11	CAN Shield (diagnosis)				
	12	External ac	tivation of co	olan	it pumps	
1		X10	1		X20	
4	1	W-bus	4 8 8	1	Status (LED)	
	2	Not used	2	2	Switch input	
	3	Battery +		3	Battery +	
	4	Battery -		4	Battery -	

10.5.2 Overview of plug assignments at control unit



Fig. 52 Plug assignments at control unit: exterior (left): X1 - X1, interior (right): X5 - X8

10.6 Wiring diagrams

Please read the following pages.



10.6.1 Heater



Fig. 53 Wiring diagram for heater Thermo Top Pro 120 | Thermo Top Pro 150

10.6.2 W-bus



Fig. 54 Wiring diagram for power supply, fan control and control element(s) connection via W-bus (Cable cross-sections suitable for cable lengths <7.5 m)

10.6.3 Analogue



Fig. 55 Wiring diagram for power supply, fan control and control element(s) connection via analogue (optional) (Cable cross-sections suitable for cable lengths <7.5 m)





Fig. 56 Wiring diagram for Chiller version (cable cross-sections suitable for cable lengths <7.5 m)

10.6.5 W-bus with ADR inclusion



Fig. 57 Wiring diagram for power supply, fan control and control element(s) connection via ADR W-bus (Cable cross-sections suitable for cable lengths <7.5 m)





Fig. 58 Wiring diagram for power supply, fan control and control element(s) connection via ADR analogue (Cable cross-sections suitable for cable lengths <7.5 m)



10.6.7 UniControl with battery disconnector (BTS)

Fig. 59 Wiring diagram for power supply, fan control and control element(s) connection via UniControl with battery disconnector (BTS) (cable cross-sections suitable for cable lengths <7.5 m)

11 Technical data

Technical data (except for limit values where stated) refers to an ambient temperature of 20 °C, a rated voltage of 12V or 24V, air pressure of 1013 hPa, a relative humidity of 50% and a normal tolerance of \pm 10% provided no limit values are stated. Geodetic height is 0 m above sea level and the stated nominal value are determined for diesel in line with DIN EN 590. See: https://webstore.ansi.org/standards/din/dinen5902017.

i You will find further information in the operating and sinstallation instructions for the heater.

Heater TTP (Thermo Top Pro)	TTP 120 Diesel		TTP 150 Diesel		
	12 V	24 V	12 V	24 V	
Type approval: Heating	E1 R122 0481	2 00	E1 R12 0480	2 00	
Type approval: EMC	E1 R10 7735	05	E1 R10 05 7735		
Design	Water h	neater (a	tomisin	g burner)	
Fuel	Diesel : DIN EN HVO : D	DIN EN 16709 IN EN 1	590, B2 5940	20/B30	
Heater output (kW)	12		15		
Fuel consumption [kg/h]	1.37		1.45		
Rated voltage [V]	12	24	12	24	
Operating voltage range [V]	10.5 - 15.5	20.0 - 31.0	10.5 - 15.5	20.0 - 31.0	
Rated power consumption over control range [W]	80		100		
Permissible ambient temper- ature (operation) [°C]	–40 to -	+80			
Permissible ambient temper- ature (storage) [°C]	-40 to +120				
Permissible working pressure [bar]	< 2.5				
Automatic altitude compensa- tion / max. permissible oper- ating altitude (m)	3,500				
Capacity of the heat ex- changer [l]	1.2				
Minimum volume flow for heater [l/h] (with water/glycol mix ratio of 50% / 50%)	960		1200		
Minimum fill volume of the coolant circuit [l]	10				
Check CO ₂ in exhaust gas [vol.%]	9.0 – 1′	1.0			
Set CO ₂ in exhaust gas [vol.%]	9.7 (± 0.2) 10.0 (± 0.2)				
CO in exhaust gas [ppm]	< 1000				
Soot number (Bacharach method)	< 4				
Heater length [mm]	470				
Heater width [mm]	200				
Heater height [mm]	200				
Heater weight, empty [kg]	11				

Heater TTP (Thermo Top Pro)	TTP 120 Diesel		TTP 150 Diesel		
	12 V	24 V	12 V	24 V	
Heater weight, with coolant [kg]	12.2				
IP class Heater	IP 5KX,	IP X4K			
IP class, control unit (installed)	IP 6KX,	IP X6K,	IP X9K		

Coolant pump	U4850		
	12 V	24 V	
Volume flow [l/h] (against 0.56 bar)	1500		
Rated voltage [V]	12	24	
Operating voltage range [V]	ge [V] 8 16 16 32		
Rated power consumption [W]	70		
Length [mm]	118		
Diameter Ø [mm] 80			
Weight [kg]	0.7		

12 List of abbreviations

Abbrevi- ation	Meaning
ADR	European Agreement concerning the International Carriage of Dangerous Goods by Road. (Accord européen relatif au transport international des marchandises Dangereuses par Route.)
HVO	Hydrotreated Vegetable Oil (bio-diesel)
IP	Ingress Protection
PPM	Parts per million (millionth)
TTP	Thermo Top Pro
WTT	Webasto Thermo Test (PC diagnosis)

Webasto Thermo & Comfort SE Postfach 1410 82199 Gilching Germany

Company address: Friedrichshafener Str. 9 82205 Gilching Germany UK only

Webasto Thermo & Comfort UK Ltd Webasto House White Rose Way Doncaster Carr South Yorkshire DN4 5JH United Kingdom