

**Wasserheizgeräte
Water Heaters
Appareils de chauffage**

**Einbauanweisung
Installation Instructions
Instruction de montage**

**Thermo 230
Thermo 300
Thermo 350**

Typ/Type Thermo 230/300/350

**Thermo 231
Thermo 301**

Typ/Type Thermo 231/301

**mit Steuergerät 1572D
with Control Unit 1572D
avec boîtier de commande 1572D**

01/2005



Improper installation or repair of Webasto heating and cooling systems can cause fire or the leakage of deadly carbon monoxide leading to serious injury or death.

To install and repair Webasto heating and cooling systems you need to have completed a Webasto training course and have the appropriate technical documentation, special tools and special equipment.

NEVER try to install or repair Webasto heating or cooling systems if you have not completed a Webasto training course, you do not have the necessary technical skills and you do not have the technical documentation, tools and equipment available to ensure that you can complete the installation and repair work properly.

ALWAYS carefully follow Webasto installation and repair instructions and heed all WARNINGS.

Webasto rejects any liability for problems and damage caused by the system being installed by untrained personnel.



La réparation ou l'installation impropre des systèmes de chauffage et de refroidissement Webasto peut conduire à l'incendie de l'appareil ou encore à des fuites mortelles de monoxyde de carbone pouvant entraîner de graves lésions voire même la mort.

Pour l'installation ou la réparation des systèmes de chauffage ou de refroidissement Webasto, il est nécessaire d'avoir une formation Webasto, une documentation technique, des outils spécifiques et des équipements particuliers.

N'essayez JAMAIS d'installer ou de réparer un système de chauffage ou de refroidissement Webasto si vous n'avez pas suivi avec succès la formation Webasto et obtenu ainsi les capacités techniques indispensables et si vous ne disposez pas de la documentation technique, des outils et des équipements nécessaires à une installation ou à une réparation dans les règles de l'art.

TOUJOURS suivre scrupuleusement les instructions Webasto relatives à l'installation et à la réparation des appareils et tenir compte de toutes les MISES EN GARDE.

Webasto décline toute responsabilité, en cas de problème ou de dommage causé par un système ayant été installé par du personnel non qualifié.

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1 Statutory regulations governing installation

1.1. Statutory regulations governing installation

The Thermo 230 / Thermo 231 / Thermo 300 / Thermo 301 / Thermo 350 heater has been type-tested and approved in accordance with EC Directives 72/245/EEC (EMC) and 2001/56/EC (heater) with the following EC permit numbers:

e1*72/245*95/54*1010*XX
e1*2001/56*0007*00 for Thermo 230
e1*2001/56*0008*00 for Thermo 300
e1*2001/56*0009*00 for Thermo 350
e1*2001/56*0010*00 for Thermo 231
e1*2001/56*0011*00 for Thermo 301

Installation is governed above all by the provisions in Annex VII of Directive 2001/56/EC.

NOTE:

The provisions of these Directives are binding within the territory governed by EU Directive 70/156/EEC and should similarly be observed in countries without specific regulations.

(Extract from Directive 2001/56/EC Annex VII)

1.7.1. A clearly visible indicator within the user's field of vision must show when the heater is switched on or off.

2. Regulations for installation in the vehicle

2.1. Scope

2.1.1. Subject to the provisions of paragraph 2.1.2, internal combustion heaters must be installed in accordance with the requirements contained in this Annex.

2.1.2. In the case of class O vehicles of class O (*trailers*) with heaters for liquid fuel, it is presumed that these vehicles comply with the requirements in this Annex.

2.2. Position of the heater

2.2.1. Parts of the vehicle body and other components in the immediate vicinity of the heater must be protected against excessive heat and the danger of contamination by fuel or oil.

2.2.2. The internal combustion heater must not pose a fire hazard even when overheated. This requirement is deemed to have been met if care is taken during installation to ensure an adequate distance from all parts, as well as adequate ventilation and if fire-resistant materials or heat shields are used.

2.2.3. In class M2 and M3 vehicles the heater must not be installed in the passenger cabin. A device in a sealed cover, which also meets the requirements set out in paragraph 2.2.2, may be used, however.

2.2.4. The plate mentioned in paragraph 1.4 (*model plate*) or a duplicate thereof (*duplicate model plate*) must be fitted in such a way that it is still clearly legible when the heater has been installed in the vehicle.

2.2.5. When positioning the heater, all reasonable precautions must be taken to minimise the risk of personal injury or damage to items in the vehicle.

2.3. Fuel supply

2.3.1. The fuel filler neck must not be located in the passenger compartment and must have a tightly fitting cap to prevent any fuel leaks.

2.3.2. The type of fuel and the fuel filler neck must be clearly identified on heaters for liquid fuel, for which the fuel supply is separate from the fuel supply for the vehicle.

2.3.3. A sign must be affixed to the fuel filler neck warning that the heater must be switched off before refuelling. An identical warning must also be included in the manufacturer's operating instructions.

2.4. Exhaust system

2.4.1. The exhaust outlet must be positioned in such a way that exhaust fumes cannot get into the interior of the vehicle through ventilation devices, hot-air inlets or open windows.

2.5. Combustion air inlet

2.5.1. The air for the combustion chamber of the heater must not be extracted from the passenger cabin of the vehicle.

2.5.2. The air inlet must be positioned in such a way that it cannot be obstructed by other objects.

2.6. Hot air inlet

2.6.1. The supply of heating air must consist of either fresh air or recirculated air and must be taken from a clean area which cannot be contaminated by exhaust fumes from the engine, the internal combustion heater or any other source in the vehicle.

2.6.2. The inlet line must be protected by a grating or other suitable means.

2.7. Hot air outlet

2.7.1. Hot air lines within the vehicle must be positioned or protected in such a way as to exclude all risk of injury or damage caused by direct contact.

2.7.2. The air outlet must be positioned or protected so that it cannot be obstructed by other objects.

2.8. Automatic control of the heating system

When the engine stops, the heating system must cut out automatically and the fuel supply must be stopped within 5 seconds.

The heating system may remain in operation if a manual unit has already been activated.

IMPORTANT

Failure to follow the installation instructions and the notes contained therein will lead to all liability being refused 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 / EC type licence*.

1.2. Provisions relating to the installation in rail vehicles

For heater models Thermo 230 / 300 /350 Rail designed for installation in rail vehicles, a design certification acc. to § 33 EBO (= Federal Railway Authority) has been issued with the following approval number: EBA 32AZ3/0141/04.

Particular attention must be given to incidental provision 1.6 of the design certification:

Should the manufacturer, operator or service technician gain knowledge of any accidents and damage (caused by fire, explosion, escape of Diesel fuel or heating oil EL) that may have occurred despite proper use of the heater, he is required to immediately notify the certifying body thereof.

2 Use / version

2.1. Use of the water heaters

The Webasto Thermo 230/231/300/301/350 water heaters are used in connection with the vehicle's own heating system

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

The water heaters operate independently of the engine and are connected to the cooling system, the fuel system and the electrical system of the vehicle.

The heater is approved for heating the passenger cabin or the driver's cab, but not to heat a cargo space used to transport hazardous substances.

NOTE:

The Thermo 230/300/350 heaters are only licensed for horizontal installation. The Thermo 231/301 heaters are licensed for vertical and horizontal installation.

2.2. Versions

Thermo 230

Water heater for "diesel"
with 23 kW heat current (20000 kcal/h)

Thermo 231

Water heater for "diesel"
with 23 kW heat current (20000 kcal/h)

Thermo 300

Water heater for "diesel"
with 30 kW heat current (26000 kcal/h)

Thermo 301

Water heater for "diesel"
with 30 kW heat current (26000 kcal/h)

Thermo 350

Water heater for "diesel" fuel
with 35 kW heat current (30000 kcal/h)

The water heaters are designed for 24 V.

On request, and depending on the configuration, the heater may be equipped with a nozzle holder preheating system.

3 Installation

IMPORTANT

- The statutory regulations governing installation on pages 35 and 36 must be adhered to.
- If the water heater is to be operated in a separately installed heating system, prior to installation an installation planning report must always be submitted to Webasto for approval. If this approval is not obtained, all warranty and liability claims will be void. The water heater has been designed, tested and approved for specific bus requirements.

NOTE:

Check the installation situation of the relevant vehicle type.

3.1. Installation location

The heater and circulating pump are to be integrated into the cooling system (or in a separate heating system).

The heater must be installed in as low a position as possible to allow the heater and circulating pump to be bled automatically. This is particularly important as the circulating pump is not self-priming.

If it is not possible to install the heater in the vehicle's engine bay it may be installed in a box. The installation box must have sufficient external ventilation to ensure that the maximum temperature of 85°C is not exceeded in the box.

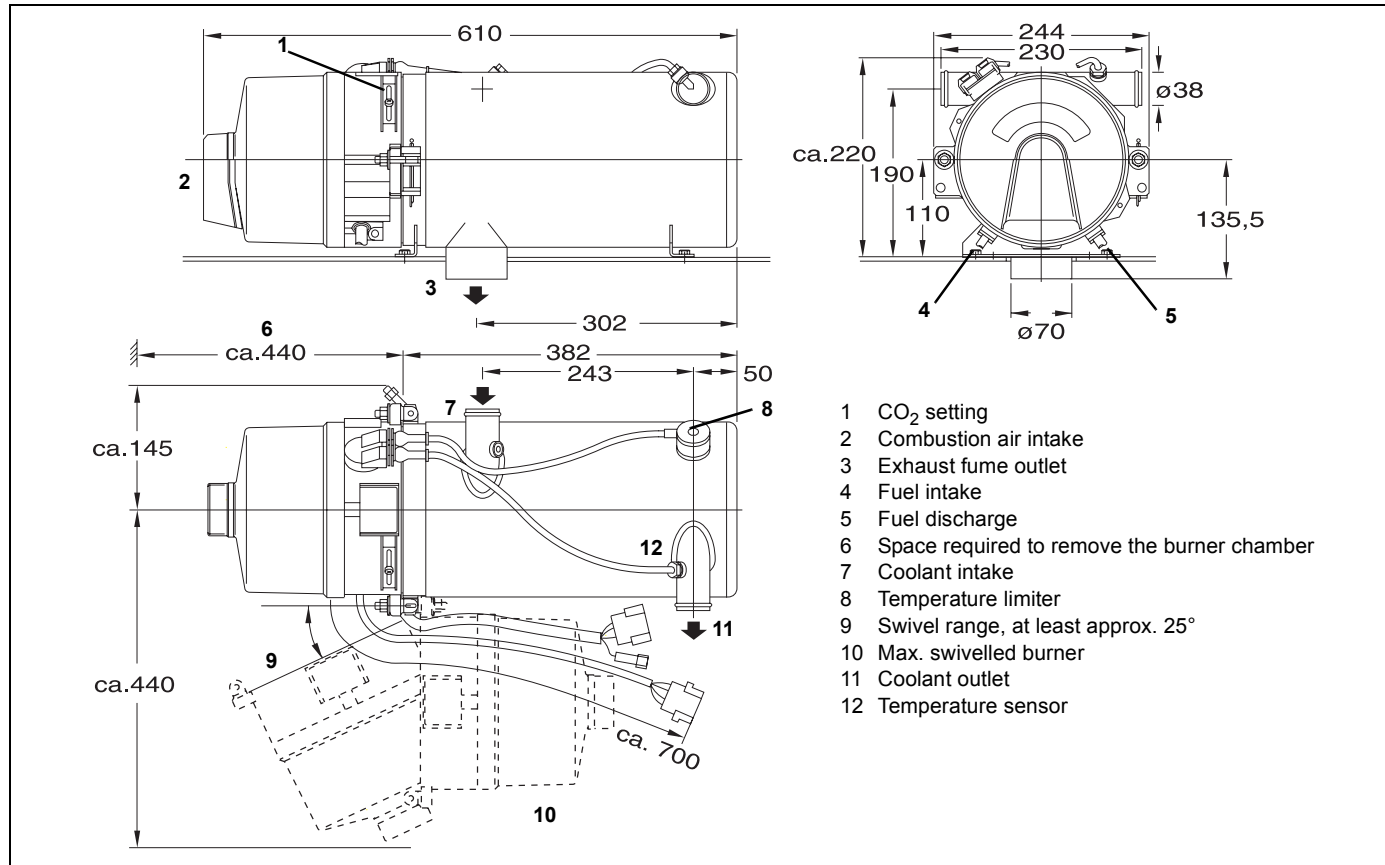
Bear in mind the space required for servicing accessibility (for example for removing the combustion chamber) (see Figures 1, 2, 5, and 10) when installing the heater.

3.1.1. Installation Location in Rail Vehicles

When the heater is to be installed in rail vehicles, it should be installed either in the engine room (e.g. locomotive) or underfloor in an installation box at the wagon body (e.g. railcar). Other installation locations require Webasto's approval in writing.

NOTE

No antivibration mounts must be used for securing the heater in rail vehicles.



- 1 CO₂ setting
- 2 Combustion air intake
- 3 Exhaust fume outlet
- 4 Fuel intake
- 5 Fuel discharge
- 6 Space required to remove the burner chamber
- 7 Coolant intake
- 8 Temperature limiter
- 9 Swivel range, at least approx. 25°
- 10 Max. swivelled burner
- 11 Coolant outlet
- 12 Temperature sensor

Fig. 1: Dimensions of the Thermo 230 / 300 / 350 heater (horizontal installation)

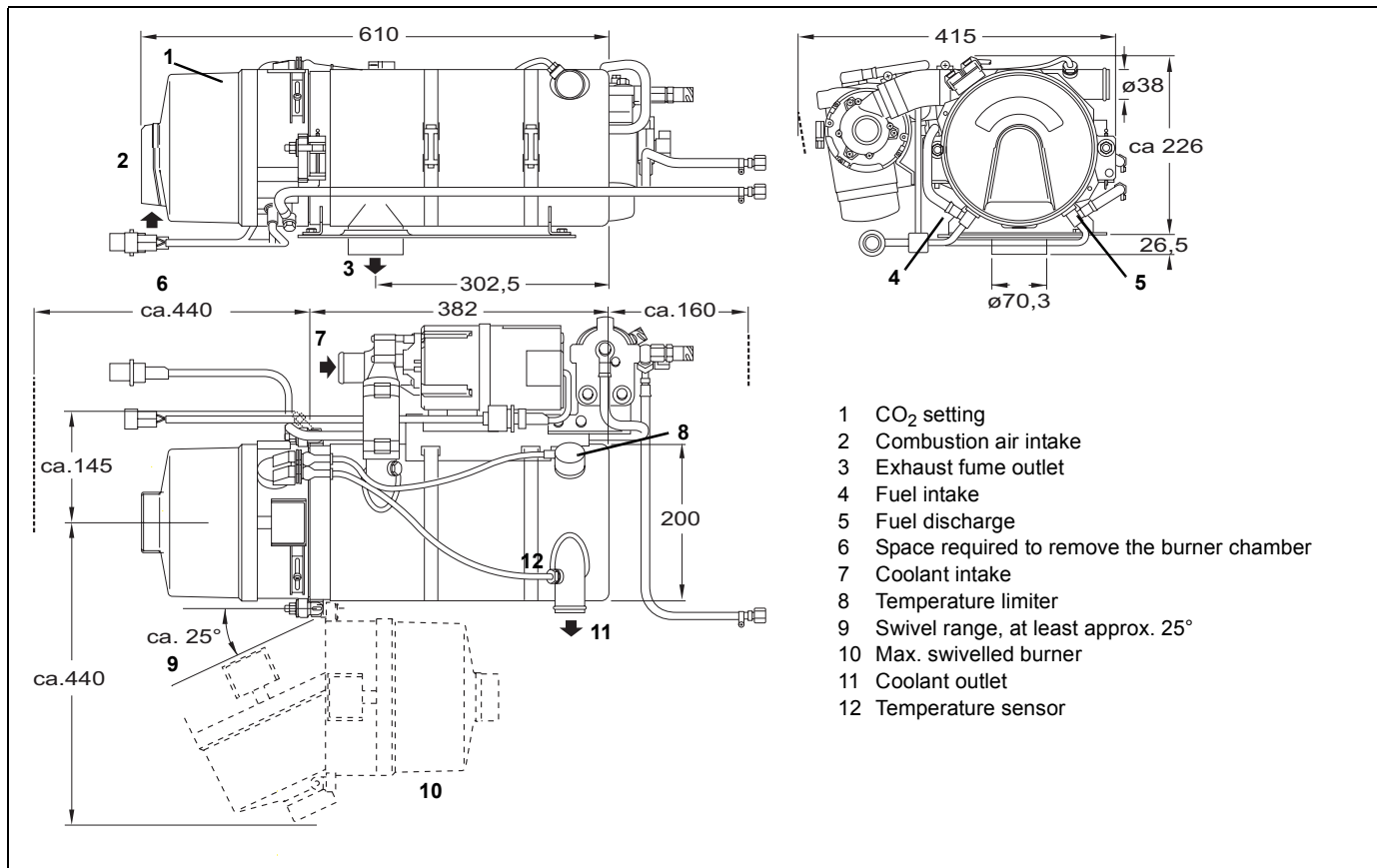


Fig. 2: Dimensions of the Thermo 230 / 300 / 350 Rail heater

3.2. To install the Thermo 230 / 300 / 350 heater

The heater may be secured either with four screws M8 (Figure 4/1) or with four screws and nuts (Figure 4/2).

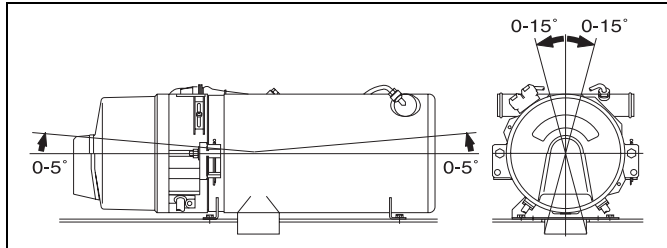


Fig. 3: Horizontal installation position

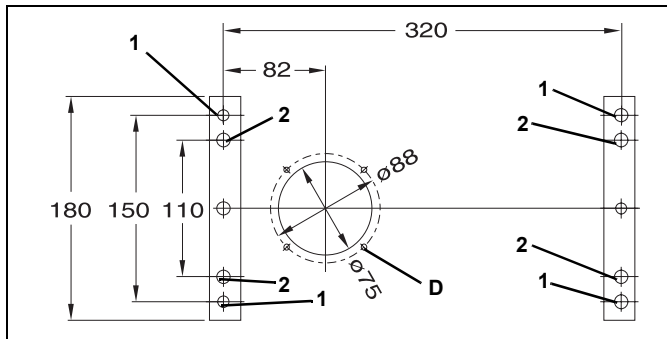


Fig. 4: Hole pattern for Thermo 230 / 300 / 350 heater

4.5 mm diameter for using M4 screws,
2.9 mm diameter for using B3.9 self-tapping screws

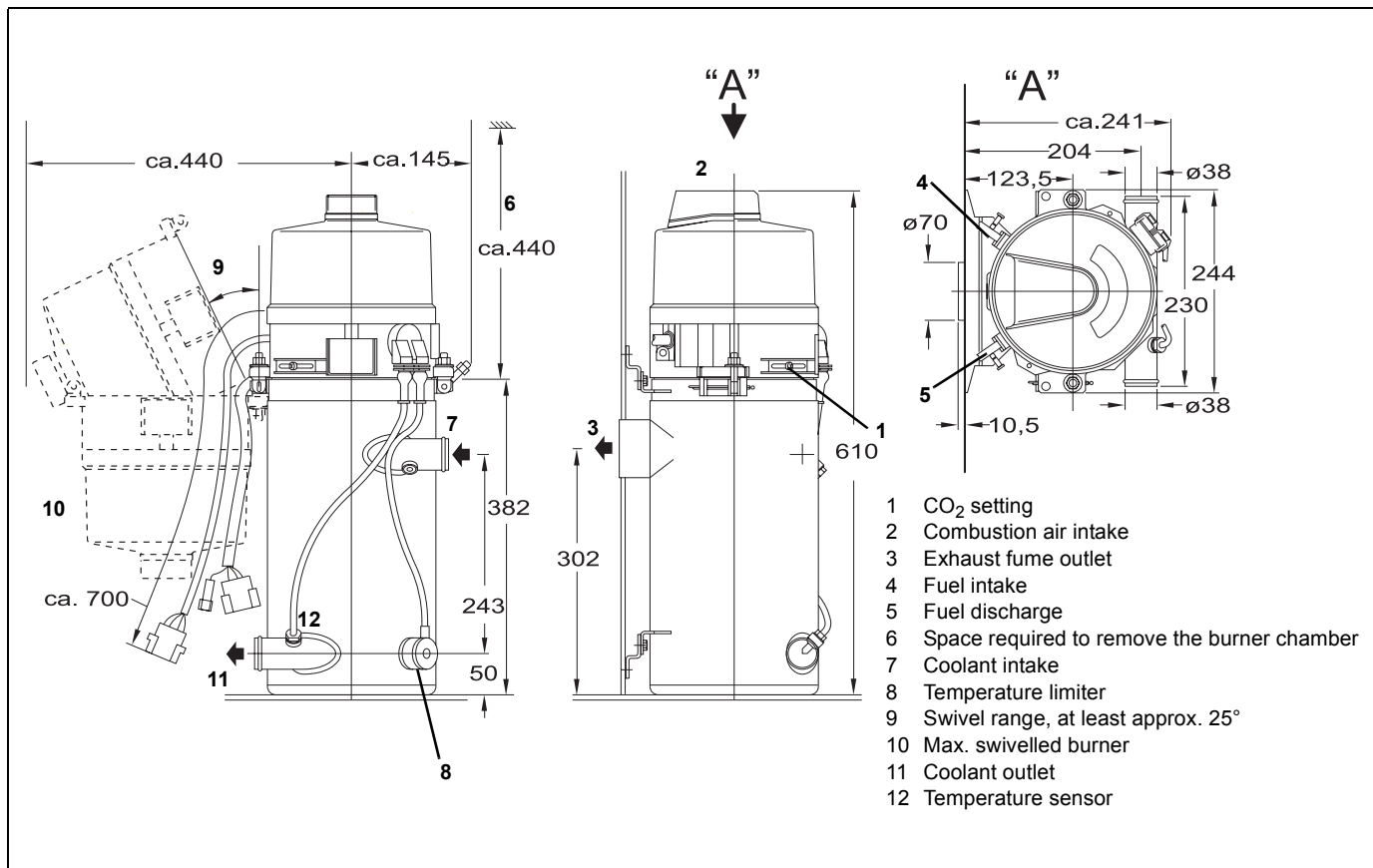


Fig. 5: Dimensions of the Thermo 231 / 301 heater (vertical installation)

3.3. To install the Thermo 231 / 301 heater

The heater is to be secured with four M8 screws (Figure 7), body washers and nuts.

IMPORTANT

The heat transfer base must be supported on a stable surface connected to the floor of the car.

The securing screws are designed to fix the heater in position, not to suspend it.

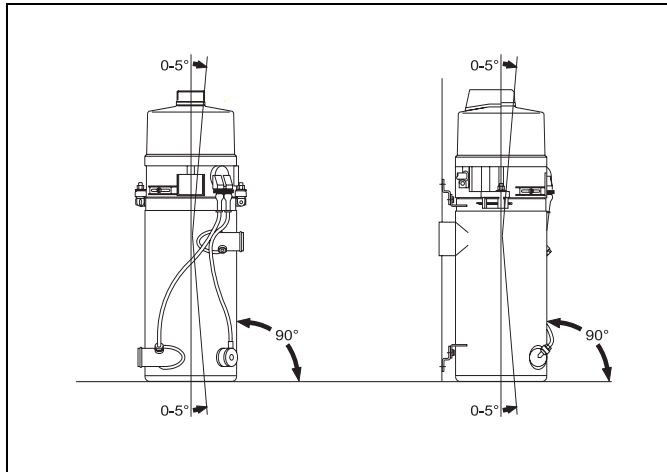


Fig. 6: Vertical installation position

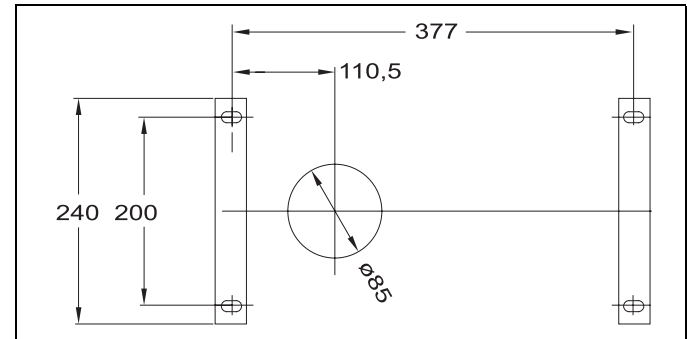


Fig. 7: Hole pattern for the Thermo 231 / 301 heater

3.4. Model plate

The model plate must be protected from damage and must be clearly legible when the heater is installed (otherwise a duplicate model plate must be used).

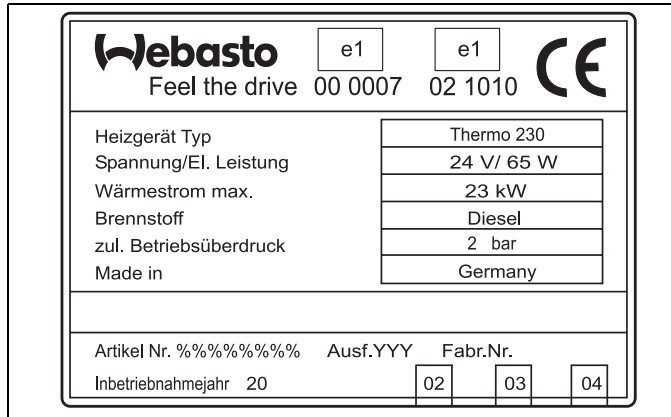


Fig. 8: Model plate for Thermo 230

3.5. Additional Type Plate

Heaters approved for use in rail vehicles are additionally identified by the type plate illustrated below:

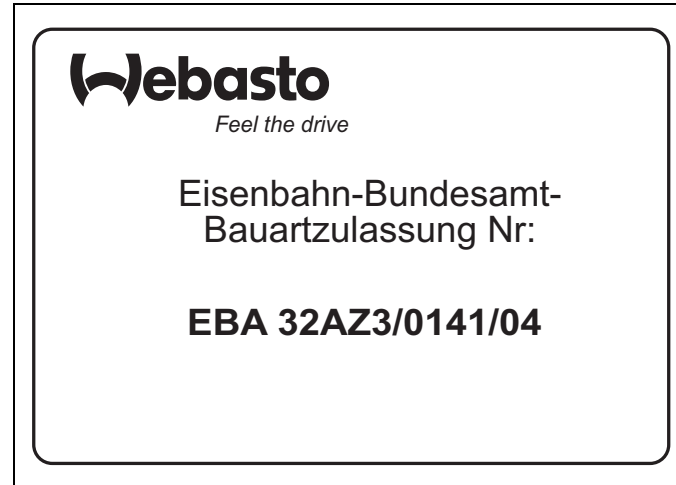


Fig. 9: Additional Type Plate

4 Installation example for the Thermo 230 / 300 / 350 heater

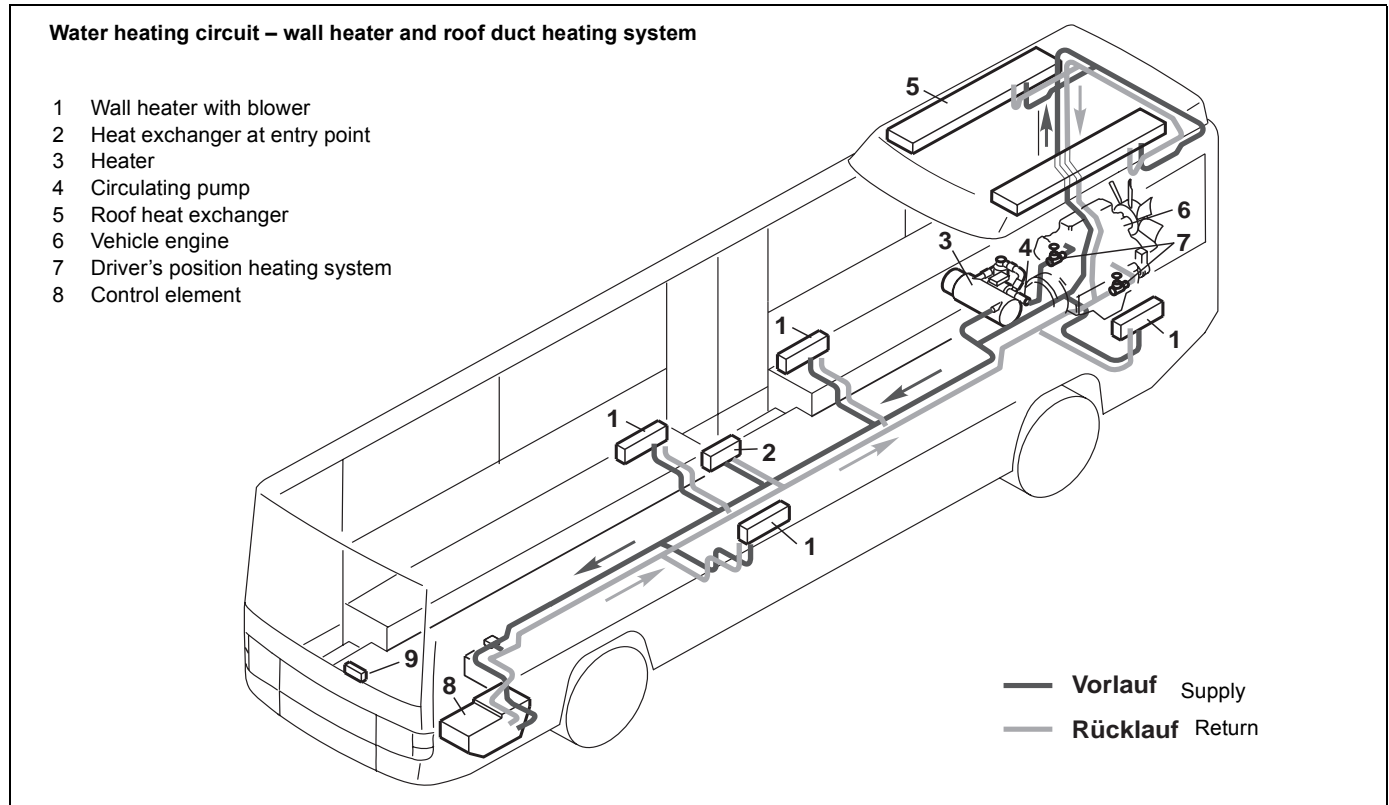


Fig. 10: Installation example for the Thermo 230 / 300 / 350 heater

5 To install the circulating pump

The circulating pump must be installed as shown in Figures 11 and 12, Figure 14 and 15, Figure 17 and 18 or Figures 20 and 21. Note the installation position.

NOTE:

The pump ports and connection lines from the water intake and water outlet must be flush (no stress).

5.1. U 4814 circulating pump

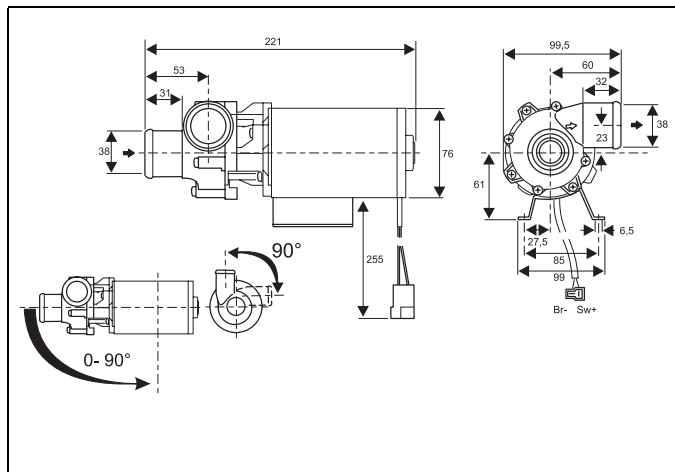


Fig. 11: U 4814 circulating pump
Installation position

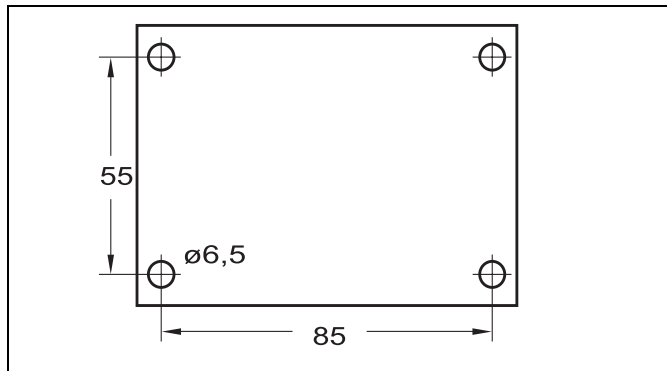


Fig. 12: Hole pattern for the stand for U 4814 circulating pump

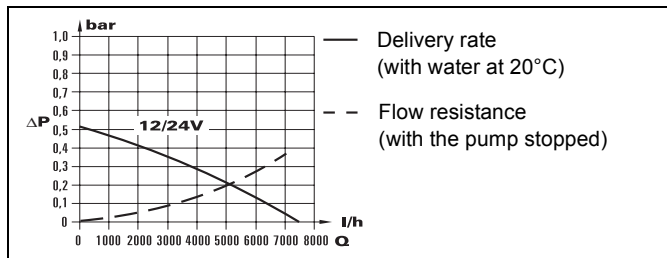


Fig. 13: Delivery rate and flow resistance
U 4814 circulating pump

5.2. Aquavent 5000 S circulating pump

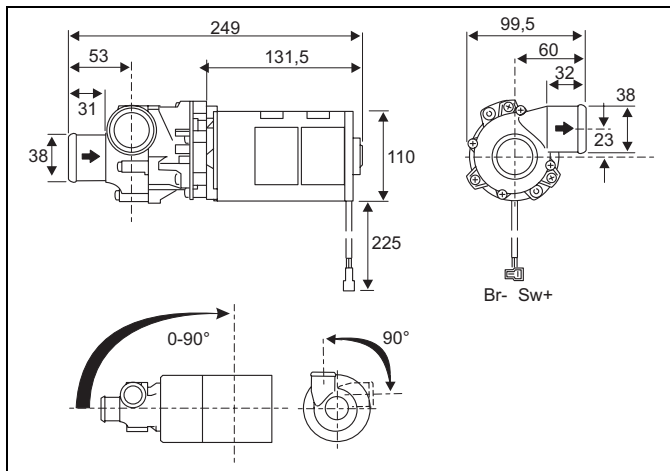


Fig. 14: Aquavent 5000 S circulating pump
Installation position

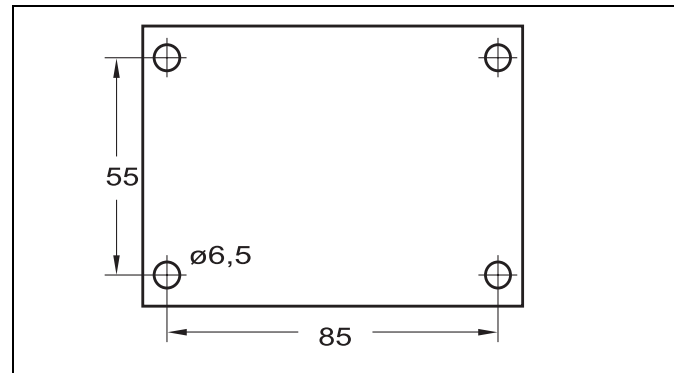


Fig. 15: Hole pattern for the stand for Aquavent 5000 S circulating pump

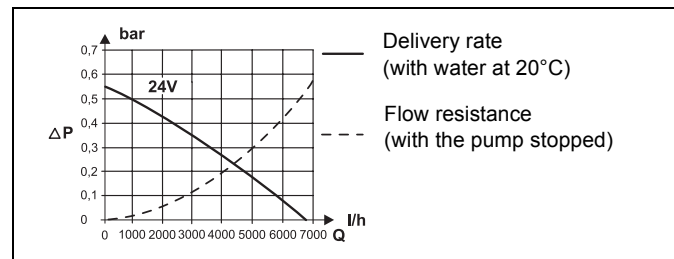
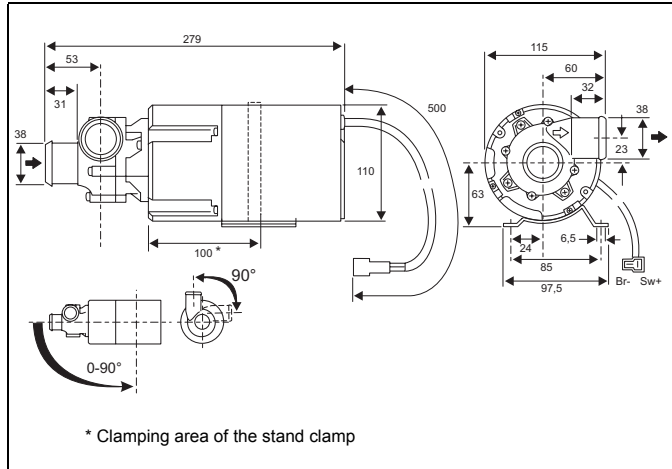


Fig. 16: Delivery rate and flow resistance
Aquavent 5000 S circulating pump

5.3. U 4851 circulating pump



**Fig. 17: U 4851 circulating pump
Installation position**

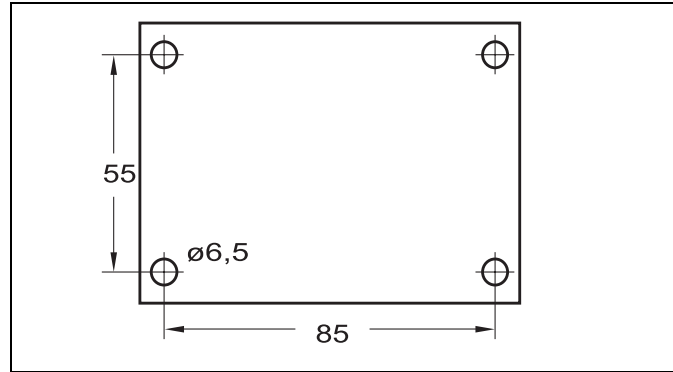
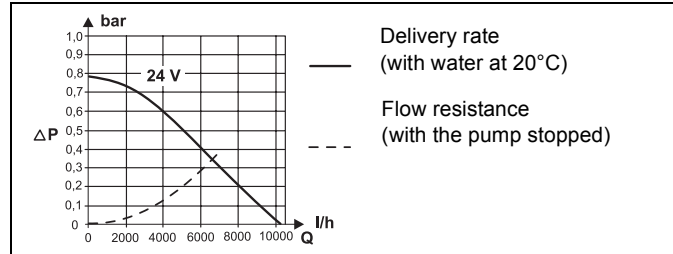


Fig. 18: Hole pattern for the stand for U 4851 circulating pump



**Fig. 19: Delivery rate and flow resistance
U 4851 circulating pump**

5.4. Aquavent 6000 S circulating pump

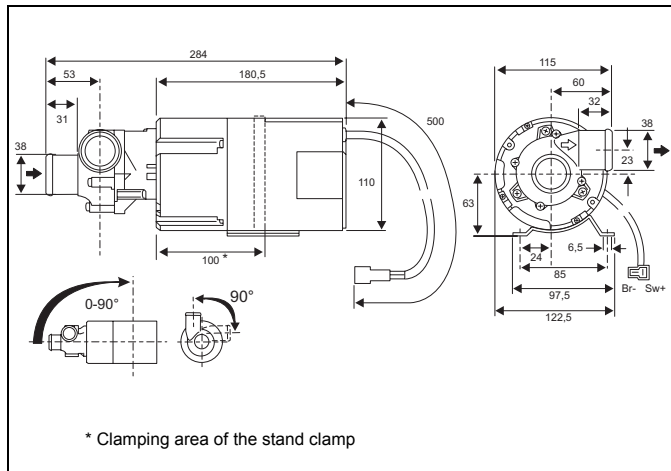


Fig. 20: Aquavent 6000 S circulating pump
Installation position

NOTE:

When connecting the circulating pump is must be ensured that the volume flow does not drop below 1800 l/h !

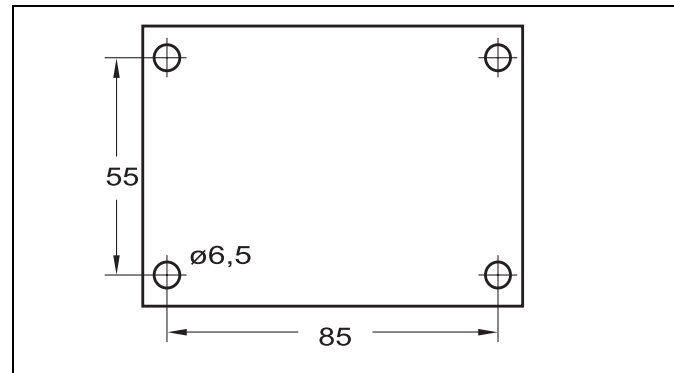


Fig. 21: Hole pattern for the stand for the Aquavent 6000 S circulating pump

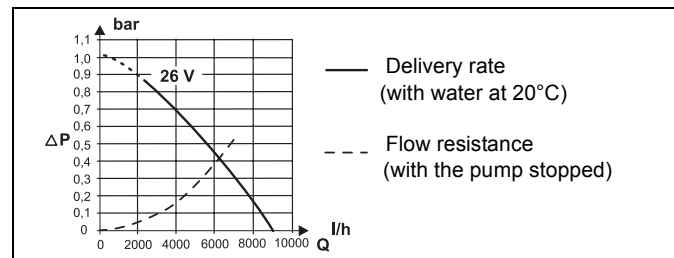


Fig. 22: Delivery rate and flow resistance
Aquavent 6000 S circulating pump

5.5. Motor for the U 4851 / Aquavent 6000 S circulating pump

The U 4851 / Aquavent 6000 S circulating motor is fitted with a brushless motor.

5.5.1. Soft start

The motor starts slowly to protect its material.

It does not reach its maximum speed for approx. 5 seconds.

5.5.2. Dry running protection (U 4851 only)

A dry running protection is integrated in the motor for speeds >3300 rpm.

If the motor consumes less than 4 A of current in a timeframe of 1018 revolutions, it assumes that it is running dry. The motor is switched off by the error motor (after approx. 10 seconds of operation or approx. 15 seconds after it was switched on).

5.5.3. Blocking protection

If the speed falls to below 57 rpm the motor is switched off after approx. 1 second by the error mode. If the motor does not complete a full revolution in 1 seconds despite the medium flow, it is also switched off by the error mode.

5.5.4. Error mode

The error mode switches off the motor in the event of faults. The motor is switched to power-saving sleep mode by the error mode after approx. 5 seconds.

5.5.5. Sleep mode

In sleep mode the internal consumers of the motor's electronics are switched off. The current consumption in this mode is then < 2 mA.

5.5.6. To reactivate the motor

The motor can be reactivated from sleep mode. This is done by disconnecting it from the power supply for approx. 2 minutes. When the voltage supply is reconnected the motor will restart in soft start mode.

5.5.7. Reverse polarity protection

The motor does **not** have polarity reversal protection. The motor is protected from polarity reversal by the wiring harness and a 25 A fuse.

6 Connection to the vehicle cooling system

The heater is connected to the vehicle cooling system as shown in Figures 1, 2, 5 and 10. The system must contain at least 10 litres of coolant. A minimum of 20% of a good quality antifreeze should be maintained in the heating circuit of the heater at all times.

The water hoses supplied by Webasto must always be used. If you do not use these hoses, the hoses that you do use must comply with DIN 73411. The hoses must be installed without kinks and (to ensure perfect bleeding of the heater) rising if possible. Hose connections must be supported by hose clips to prevent them slipping.

NOTE:

The specified tightening torques of the hose clamps used must be complied with.

Only pressure valves with an opening pressure of min. 0.4 bar and max. 2.0 bar may be used in the vehicle's cooling system or in a separate heating system.

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

Perfect ventilation can be identified by the circulating pump operating almost silently. Poor bleeding may cause the resetting temperature limiter to trip whilst the heater is operating.

When using circulating pump U 4851, approximately 15 seconds after switch-on the circulating pump is automatically switched off when there is a lack of coolant or the pump impeller is obstructed; it may be restarted after approximately 2 minutes.

When using Aquavent 6000 S circulating pump, approximately 45 seconds after switch-on the circulating pump is automatically switched

off when there is a lack of coolant or the pump impeller is obstructed; it may be restarted after approximately 2 minutes.

Also in the case of Thermo 230/231/300/301/350 heaters featuring control unit SG 1572 D in combination with a programmed check of the circulating pump, will the heater be switched off when there is a lack of coolant.

7 Fuel supply

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

7.1. Fuel lines

Fuel lines are to be installed with a gradient wherever possible to prevent air inclusions. Connections within the line are to be secured with hose clips if no mechanical screw connectors are used.

If fuel hoses are used, the hoses supplied by or available from Webasto must generally be used. If you do not use these hoses, the fuel hoses that you do use must comply with DIN 73379. Fuel hoses must not be kinked or twisted and must be secured with clips approx. every 25 cm. Materials commonly used in automobile manufacture, e.g. steel and plastic lines made of plasticized, light-resistant and temperature-stabilized PA 11 or PA 12 (e.g. Mecanyl RWTL) as per DIN 73378 may also be used for fuel lines taking into account the suitable connection system in each case.

The following must be observed for the installation of fuel lines:

- The lines must be protected from the effects of high temperatures.

IMPORTANT!

The external casing on the heater may reach the ignition temperature of diesel if it is operated without coolant.

- **The lines must be protected from stone damage.**
- **Dripping or evaporating fuel must not be allowed either to accumulate or to ignition hot parts or electrical equipment**

It is not permissible to install a shut-off device in the return line!

IMPORTANT

Operation with a closed return line will damage the fuel pump. Fuel may escape. Danger of fire!

Unsupported fuel lines must be secured to prevent them sagging.

Do not install an additional fuel pump.

See pages 35 and 36 for the statutory regulations.

7.1.1. Maximum dimensions of the fuel lines:

- Internal diameter for intake and return line: 6 mm (other diameters to order).
- Maximum line length for each intake and return line: 10 m
- Maximum intake height: 2 m (we recommend the installation of a foot valve if the max. intake height is used)
- Max. permissible suction height: 2 m
- Max. permissible pressure in flow and return lines: 0.3. bar

7.2. Fuel filter

A fuel filter supplied or approved by Webasto must be used (check the flow direction). To avoid malfunctions the filter or filter insert is to be replaced before the start of the cold weather.

8 Combustion air supply

Under no circumstances may the combustion air be taken from areas occupied by people. The combustion air intake opening must not point in the direction of travel. It must be located so that it cannot become clogged with dirt or snow and cannot suck in splashing water.

Maximum dimensions of the air intake line:

- Internal diameter: 55 mm
- Maximum line length: 5 m without the exhaust extension
- Maximum bends: 270°
- Total length of air intake line and exhaust pipe max. 5m

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

NOTE:

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

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

A ventilation opening is required if the heater is installed in an enclosed box.

Thermo 230 / Thermo 231 / Thermo 300 / Thermo 301 30 cm²

Thermo 350 35 cm²

The size of the ventilation opening must be increased subject to consultation with Webasto if the temperature in the box exceeds the permitted ambient temperature of the heater (see Technical data).

9 Exhaust pipe

The opening of the exhaust pipe must not point towards the front of the vehicle.

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

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

Maximum dimensions of the exhaust pipe:

- Internal diameter: 70 mm
- Maximum line length:
 - 5 m without the combustion air intake extension
- Total length of air intake line and exhaust pipe max. 5m
- Maximum bend: 270°

NOTE:

If the exhaust line is installed near heat-sensitive parts, it must be insulated.

10 Electrical connections

10.1. Heater connection

IMPORTANT HIGH VOLTAGE:

Danger of death. Disconnect the plug connection to the vehicle before you open the heater.

Make the electrical connections to the heater as shown in Figure 23: Automatic circuit diagram for water heaters type Thermo 230, Thermo 231, Thermo 300, Thermo 301 and Thermo 350

Any plug designs that differ from the standard versions (Figures 23 and 24) are to be requested separately from Webasto.

Use the specified cable cross-sections.

Connect the negative and positive terminals of the heater controller direct to the battery.

10.2. Connecting the controls

The heater can be switched on and off using the following Webasto controls:

- Switch, see automatic circuit diagram Figure 23
- Timer, see circuit diagram Figure 24

10.3. Control module

The control module is installed in the heater.

10.4. Economy mode

The connection of the switch for economy mode is shown in the automatic circuit diagram, Figures 23 and 24.

10.5. Water Temperature Control Thresholds::

Heater	Auxiliary heating		Parking heating		Economy setting		Comment
	0->1	1->control idle period	0->1	1->control idle period	0->1	1->control idle period	
Thermo 230.032 Thermo 300.031 Thermo 350.032	78	85	70	85	55	70	Standard data record
Thermo 230.126 Rail Thermo 300.126 Rail Thermo 350.126 Rail	70	85	45	60	5	20	Engine start-up (>+60°C) Preheat + heat preservation (>+40°C) Freeze protection (>+0°C)

10.5.1. Pin Assignment of Cable Harness for Control Thresholds, Models Thermo 230 / Thermo 300 / Thermo 350 (Standard)::

Control unit function	on/off	volts	Connector	Pin	Comment
Auxiliary heating	on	24 V	X3	5	only in conjunction with parking heater
Parking heating	on	24 V	X1	5	switch connecting wire to control unit
Economy setting	on	24 V	X3	4	only in conjunction with parking heater

NOTE:

Auxiliary heating has priority over the economy setting!

10.5.2. Pin Assignment of Cable Harness for Control Thresholds, Models Thermo 230.126 / Thermo 300.126 / Thermo 350.126 (Rail)::

Control unit function	on/off	volts	Connector	Pin	Comment
Auxiliary heating	on	24 V	X3	3	only in conjunction with parking heater
Parking heating	on	24 V	X3	5	switch connecting wire to control unit
Economy setting	on	24 V	X3	2	only in conjunction with parking heater

NOTE:

Auxiliary heating has priority over the economy setting!



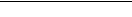


10.6. Legend for circuit diagrams

- ① Diagnostic connector
- ② Digital timer P:
with positive at connection 10= Continuous operation with immediate heating
Connection 10 open = Variable heating duration can be programmed (10 min to 120 min);
Default setting 120 min

③ Plug assignment:

Plug assignment	4-core cable	7-core cable
D1	0.75 gr	0.75 rt
D2	0.75 or	0.75 or
D3	0.75 gn	0.75 bl
D4	0.75 br	2.0 br
F1	Not occupied	2.0 sw
F2	Not occupied	2.0 rt/ws

- ④ with connection to terminal 61 heating mode
- ⑤ Option

Cable cross-sections		
	< 7.5 m	7.5 - 15 m
	0.75 mm ²	1.5 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

Cable colours	
bl	blue
br	brown
ge	yellow
gn	green
gr	grey
or	orange
rt	red
sw	black
vi	violet
ws	white

Item	Designation	Comment
A1	Heater	
A2	Control module	SG 1572 D
B1	Flame sensor	Check polarity
B2	Temperature sensor	Any polarity
B3	Temperature limiter	
B4	Thermostat	For nozzle preheating
B5	Thermostat	Alternative to B3
B6	Thermostat	For vertical installation (MV Y1)
E	Filter heater	
E1	Heating cartridge	For nozzle preheating
F1	Fuse 25 A	Blade-type fuse DIN 72581 Part 3
F2	Fuse 25 A	Blade-type fuse DIN 72581 Part 3
F3	Fuse 5 A	Blade-type fuse DIN 72581 Part 3
F4	Fuse 25 A	Blade-type fuse DIN 72581 Part 3
F5	Fuse 5 A	Blade-type fuse DIN 72581 Part 3
F6	Fuse 5 A	Blade-type fuse DIN 72581 Part 3
F7	Fuse 5 A	Blade-type fuse DIN 72581 Part 3
H1	Light	Indicator
H2	Light	Flame indicator
H4	Heating symbol on the display	Power-on indicator (in item P)
K4	Relay	
M1	Motor	Combustion air fan
M2	Motor	Circulating pump
P	Digital timer, standard (1531)	For programmed operation
S1	Switch	ON/OFF

Item	Designation	Comment
S3	Switch	External activation Circulating pump
S4	Switch	Economy mode
S5	Switch	Auxiliary heating mode
S6	Switch	Filter heater on
T	Temperature switch	Filter heater
U1	Ignition spark generator	
U2	Ignition electrodes	
W1	Wiring harness (1)	
W2	Wiring harness (2)	
W3	Wiring harness (3)	
A	Plug connector, 6-pin	
C	Plug connector, 1-pin	
D	Plug connector, 4-pin	
F	Plug connector, 2-pin	
O	Plug connector, 2-pin	
Q	Plug connector, 2-pin	
X1	Plug connector, 6-pin	
X2	Plug connector, 2-pin	
X3	Plug connector, 8-pin	
X4	Plug connector, 12-pin	
X5	Plug connector, 4-pin	
X6	Plug connector, 4-pin	
X7	Plug connector, 7-pin	
Y1	Solenoid valve	

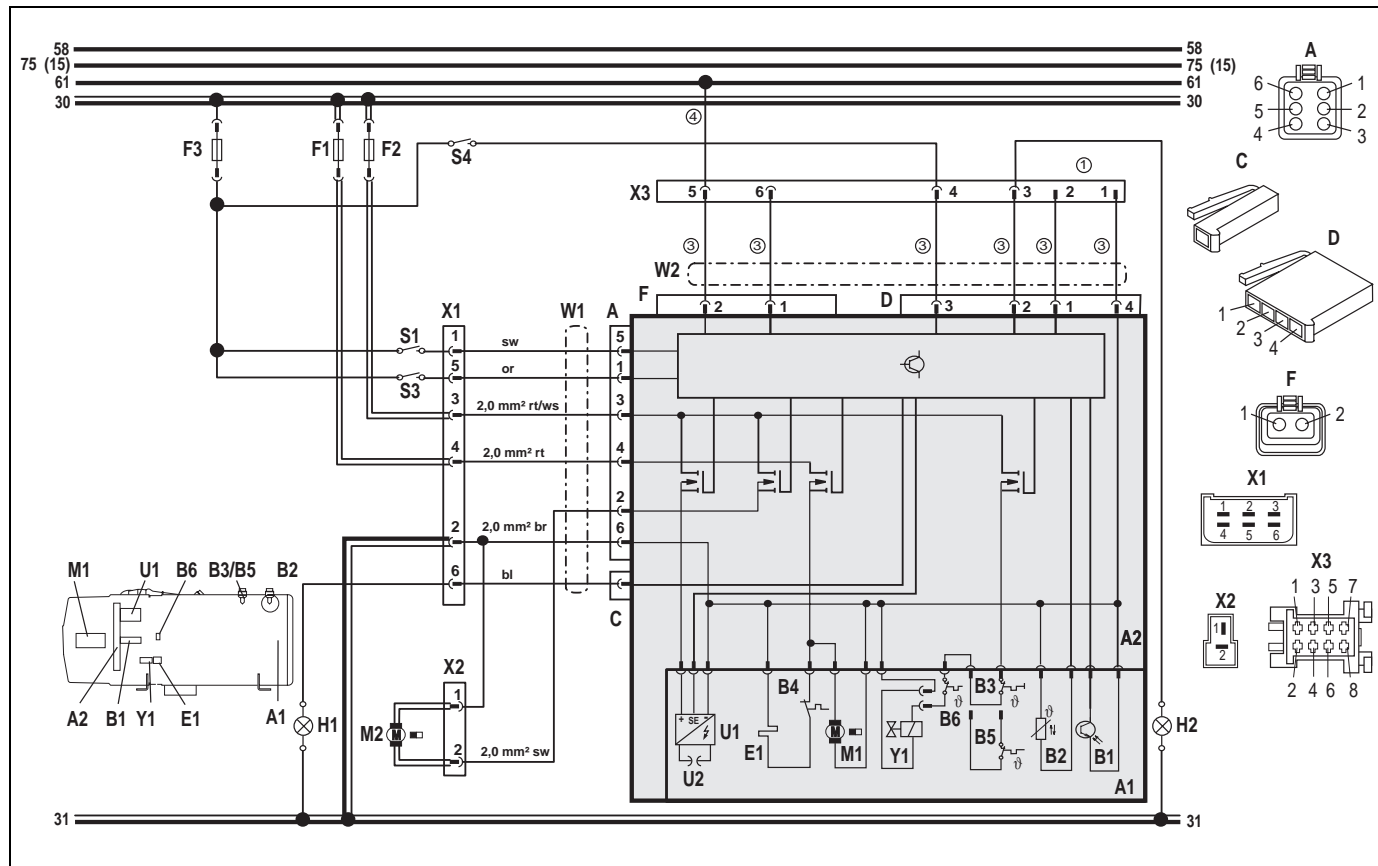


Fig. 23: System circuit for Thermo 230 / 231 / 300 / 301 / 350 24V with control module 1572 D, with switch, for legend see page 57 and 58

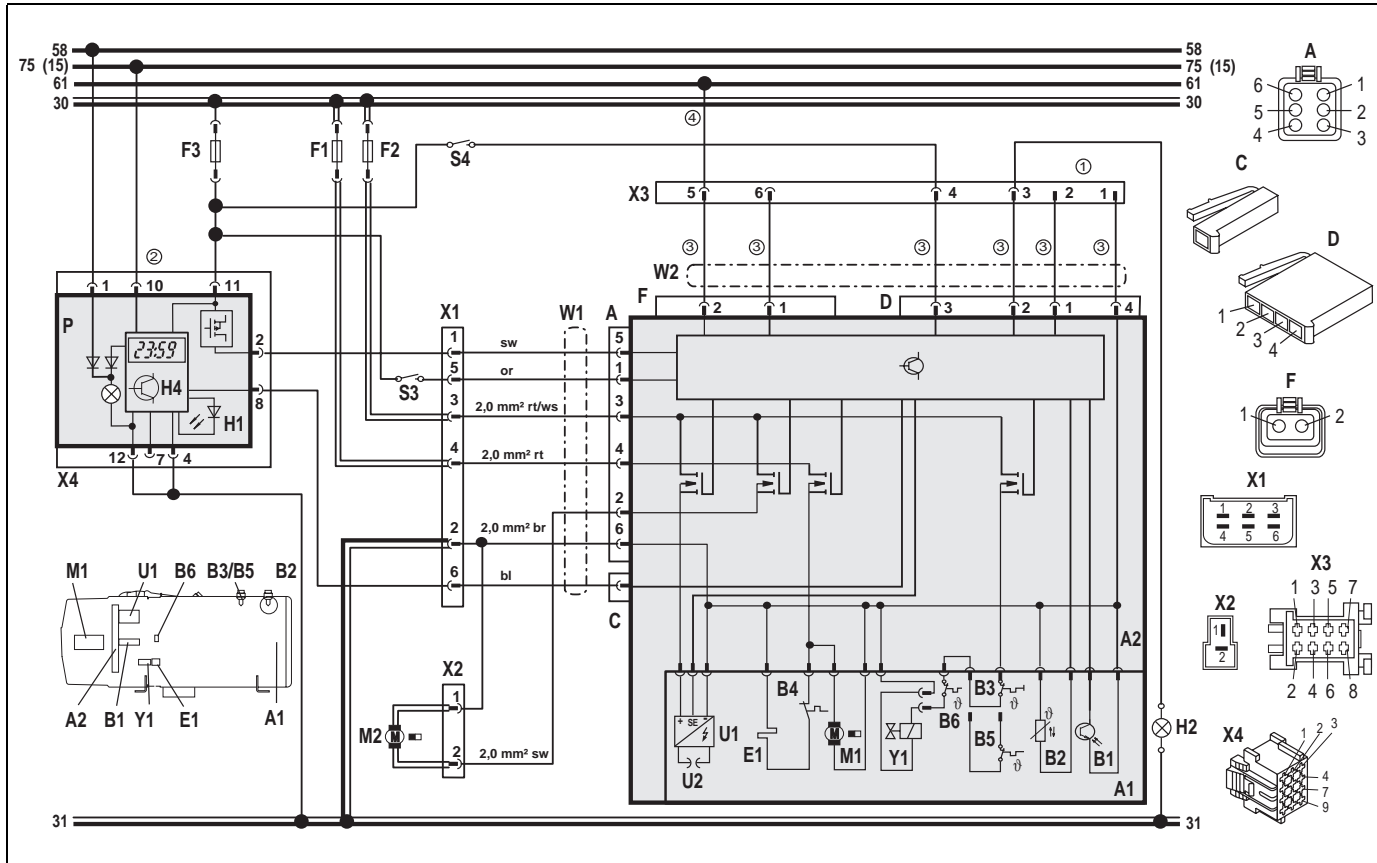


Fig. 24: System circuit for Thermo 230/231/300/301/350 24V with control module 1572 D, with standard timer, for legend see page 57 and 58

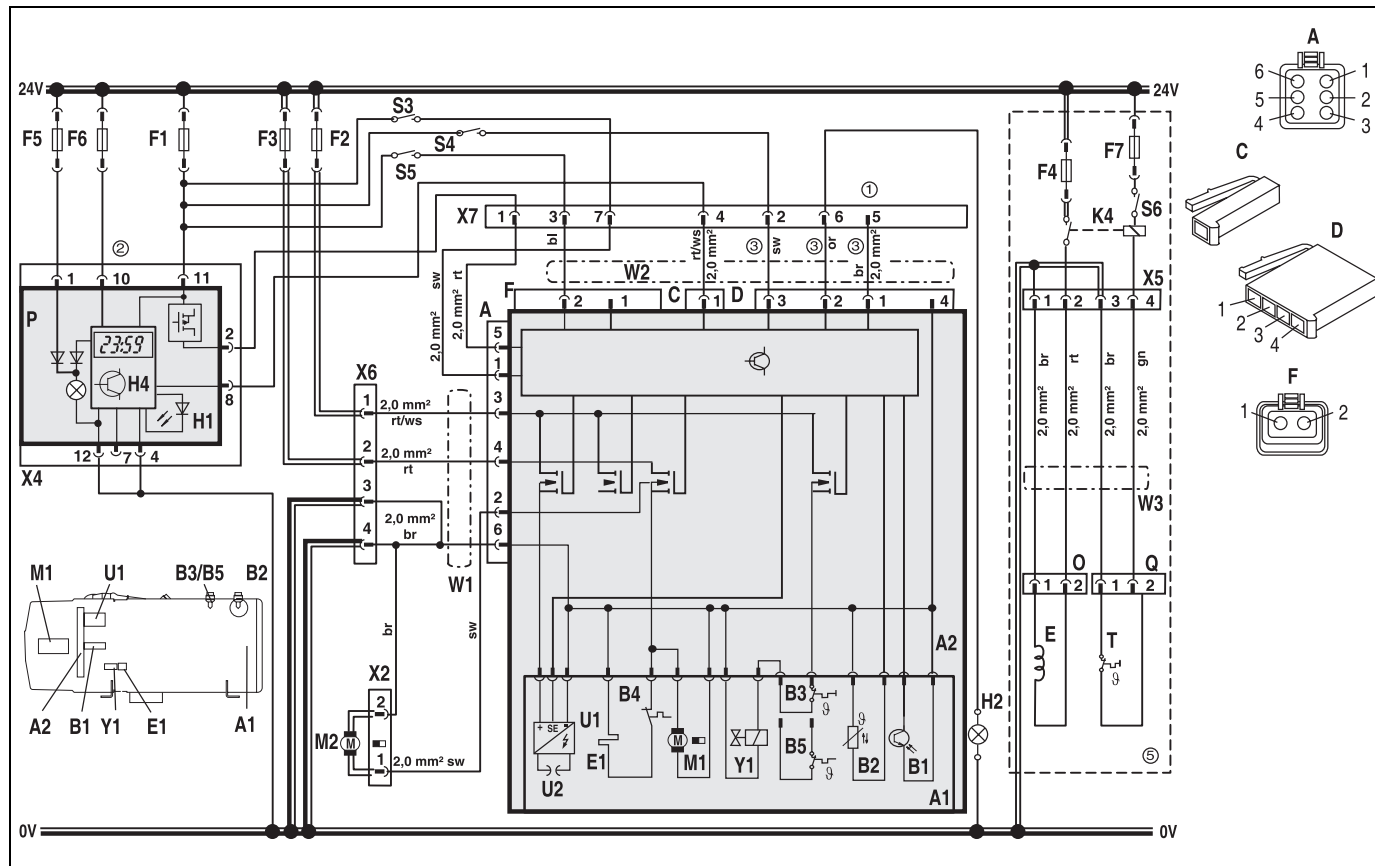


Fig. 25: System circuit for Thermo 230 / 300 / 350 Rail 24V with control module 1572 D, with standard timer, for legend see page 57 and 58

11 Starting the heater for the first time

NOTE:

Refer to the safety instructions in the operating and maintenance instructions.

The operating and maintenance instructions must be read through without fail before starting the heater.

After you have installed the heater, bleed the water system and the fuel supply system carefully. Follow the instructions supplied by the vehicle manufacturer for this purpose.

Conduct a trial of the heater to check all the water and fuel connections for leaks and to ensure that they are secure. If the heater suffers a fault during operation, the fault must be located and remedied.

12 Maintenance

Periodic service activities have to be performed in accordance with Chapter 8 and Appendix A of the Workshop Manual.

When the heater is operated in rail vehicles, maintenance chart / test certificate item no. 90 087 22 is to be used.

13 Troubleshooting

13.1. Fault lock-out

If it recognises one of the following fault features, the heater will conduct a fault lock-out.

If several fault lock-outs occur in sequence, the heater will be disabled.

Flashing pulse signals are output by the operation indicator light for heaters with control module 1572D. The combustion air blower and the circulating pump will be shut down after approx. 120 seconds.

13.1.1. Faults when the heater is switched on:

Short-circuit or break

- Water temperature sensor
- Flame sensor
- Burner motor
- Solenoid valve

13.1.2. Faults during the start procedure:

- A flame is detected by the photo-electric controller before the high tension ignition spark is triggered.
- No flame identified approx. 25 seconds after the heater is started.
- Short-circuit / Break or dry operation (if programmed) of the circulating pump.

If you use the U 4851 circulating pump, the pump will cut out automatically approx. 15 seconds after it is switched on if there is insufficient coolant or the pump impeller is blocked automatically and can be restarted after approx. 2 minutes.

13.1.3. Faults whilst the heater is operating:

- The voltage level falls below the lower threshold of approx. 21 V for a period of 20 seconds.
- Break in combustion for longer than 10 seconds.
- Short-circuit in the water temperature sensor.
- Break in the water temperature sensor.
- Short-circuit in the flame detector.
- Break in the flame detector.
- Short-circuit in the solenoid valve.

13.1.4. Faults whilst the heater is shutting down:

Detection of a flame over than 30 seconds after the start of the shut-down cycle, with only the circulating pump operating during the following 90 seconds.

13.1.5. Faults due to overheating:

If the heater overheats the temperature limiter/thermostat will complete a fault lock-out.

Depending on the heater equipment:

- The button on the temperature limiter must be reset.
- The thermostat will be reset automatically when the heater has cooled down.

The fault lock-out can be cancelled by switching the heater off and on again.

13.2. Fault code output on heaters with control module 1572D

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

NOTE

If the system is operated with a switch, the nature of the fault is indicated by a flashing code on an indicator light during the run-on time of the heater. After five short signals, count the long flashes. The flashes correspond to the number in the table below:

F 01	No start
F 02	Flame failure *
F 03	Undervoltage or overvoltage
F 04	Flame simulation identified during start-up or shut-down
F 05	Flame detector defective
F 06	Temperature sensor defective
F 07	Solenoid valve defective
F 08	Blower motor defective
F 09	unused
F 10	Temperature limiter defective / Overheating
F 11	Ignition spark generator defective
F 12	Fault lock-out due to repeated malfunction or repeated flame failure (8x no start-up or 5x flame failure)

* On the Thermo 231 and 301, if the overheating thermostat trips this is saved as a flame failure (F 02) in the control module

13.2.1. To reset the heater after a fault lock-out

To reset the heater after a fault lock-out, switch on the heater and cut the power supply to it during the starting process.

14 Technical data

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

NOTE:

The assignment of circulating pumps to heaters must be made using the water-side resistors.

14.1. Fuel

The diesel fuel specified by the manufacturer must be used. Heating oil of class EL (not heating oil class L) can also be used as long as it of standard German market quality.

We know of no negative influences due to additives.

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

If fuel is extracted from a separate fuel tank, a winter diesel or equivalent winter PME fuel must be used in temperatures below 0°C . Media to improve the flow properties of the fuel may also be used.

If you change to low-temperature fuel, the heater must be operated for approx. 15 minutes so that the fuel line, filter and fuel pump are filled with the new fuel.

Heater		Thermo 230	Thermo 231	Thermo 300	Thermo 301	Thermo 350
Type		Thermo 230	Thermo 231	Thermo 300	Thermo 301	Thermo 350
EC type approval number	e1*2001/56*	0007*--	0010*--	0008*--	0011*--	0009*--
Model		High pressure atomiser				
Heating flow	kW (kcal/h)	23 (20 000)		30 (26 000)		35 (30 000)
Fuel		Diesel / Heating oil EL				
Fuel consumption	kg/h	2,5		3,3		3,7
Rated voltage	V -	24				
Operating voltage range	V -	20...28				
Rated power consumption (without circulating pump)W		65		110		140
Max. ambient temperature during operation (Heater, control module, circulating pump)	C°	-40... + 85				
Max. storage temperature (control module)	C°	+110 max.				
Max. operating pressure	bar	0,4...2,0				
Capacity of the heat exchanger	l	1.8 l				
Minimum capacity of the system	l	10.00 l				
CO ₂ in exhaust gas at rated voltage	% v/v	10,5 ± 0,5				
Heater dimensions (Tolerance ± 3 mm)	mm	Length 610				
	mm	Width 246				
	mm	Height 220				
Weight	kg	19				

Circulating pump		U 4814	Aquavent 5000 S	U 4851	Aquavent 6000 S
Delivery rate	l/h	5200 (against 0.15 bar)	5200 (against 0.15 bar)	6000 (against 0.4 bar)	6000 (against 0.4 bar)
Rated voltage	V -	24	24	24	24
Operating voltage range	V -	20...28	20...28	18...32	18...32
Rated power consumption	W	104	104	215	215
Dimensions (Tolerance ± 3 mm)	mm	Length 228.5	Length 249	Length 279	Length 284
	mm	Width 100	Width 100	Width 115	Width 115
	mm	Height 105	Height 105	Height 110	Height 110
Weight	kg	2,1	2,2	2,7	2,95

Optional Fuel Filter Heater

Filter heater		
Rated power consumption	W	240
Rated voltage	V -	24
Switch-on point	C°	0,5 \pm 2,5
Switch-off point	C°	5,5 \pm 2,5