



HEATING SYSTEMS

THERMO E+ 120/200/320

12/24V

Installation instructions

Rev. 05/2026
Id.No. 11125702D-001

SPHEROS



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

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

NEVER try to install or repair Spheros heating or cooling systems if you have not completed a Spheros 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 Spheros installation and repair instructions and heed all **WARNINGS**.

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

Highlighted words like Warning, Caution, ATTENTION and NOTE in these installation instructions signify the following precautions:



This caption is used to indicate possible severe injuries or fatal accidents if instructions or procedures are carried out incorrectly or entirely disregarded.



This caption is used to indicate possible minor injuries if instructions or procedures are carried out incorrectly or entirely disregarded.

ATTENTION:

This caption points to actions which may cause material damage.

NOTE:

This caption is used to draw attention to an important feature.

NOTE: Subject to modification. In multilingual versions the German language is binding. The latest version of this document you will find in the download center on www.spheros.com.



Table of Contents

1	Statutory regulations governing installation	1
2	Use / version	3
3	Installation	5
4	Installation example	10
5	Installation of the circulating pump	11
6	Connection to the vehicle cooling system	12
7	Fuel supply	13
8	Combustion air supply	15
9	Exhaust pipe	16
10	Electrical connections	17
11	Initial start-up	23
12	Maintenance	24
13	Technical data	25
14	Environment	28
 Annex		
	Circulating pumps installation position /	A-1

1 Statutory regulations governing installation

1.1. Statutory regulations governing installation

For the heaters exist type approvals according to the ECE Regulations

R10 (EMC):	No. 05 8344 and
R122 (Heater)	No. 00 0539 for Thermo E+ 120
	No. 00 0540 for Thermo E+ 200
	No. 00 0541 for Thermo E+ 320

Installation is governed above all by the provisions in Annex 7 of the ECE Regulation R122.

NOTE:

The provisions of these Regulations are binding within the territory governed by ECE Regulations and should similarly be observed in countries without specific regulations.

Extract from ECE Regulation R122, Annex 7:

“...“

4 The heater must have a manufacturer's label showing the manufacturer's name, the model number and type together with its rated output in kilowatts. The fuel type must also be stated and, where relevant, the operating voltage and gas pressure.

(...)

7.1 A clearly visible tell-tale in the operator's field of view shall inform when the combustion heater is switched on or off.

...“

Extract from ECE Regulation R122, Part I:

„ ...

5.3 Vehicle Installation Requirements for Combustion Heaters

5.3.1 Scope

5.3.1.1 Subject to paragraph 5.3.1.2., combustion heaters shall be installed according to the requirements of paragraph 5.3.

5.3.1.2 Vehicles of category O having liquid fuel heaters are deemed to comply with the requirements of paragraph 5.3.

5.3.2 Positioning of combustion heater

5.3.2.1 Body sections and any other components in the vicinity of the heater must be protected from excessive heat and the possibility of fuel or oil contamination.

5.3.2.2 The combustion heater shall not constitute a risk of fire, even in the case of overheating. This requirement shall be deemed to be met if the installation ensures an adequate distance to all parts and suitable ventilation, by the use of fire resistant materials or by the use of heat shields.

5.3.2.3 In the case of M2 and M3 vehicles, the combustion heater must not be positioned in the passenger compartment. However, an installation in an effectively sealed envelope which also complies with the conditions in paragraph 5.3.2.2. may be used.

5.3.2.4 The label referred to in Annex 7, paragraph 1.4., or a duplicate, must be positioned so that it can be easily read when the heater is installed in the vehicle.

5.3.2.5 Every reasonable precaution should be taken in positioning the heater to minimize the risk of injury and damage to personal property.

5.3.3 Fuel supply

5.3.3.1 *The fuel filler must not be situated in the passenger compartment and must be provided with an effective cap to prevent fuel spillage.*

5.3.3.2 *In the case of liquid fuel heaters, where a supply separate from that of the vehicle is provided, the type of fuel and its filler point must be clearly labelled.*

5.3.3.3 *A notice, indicating that the heater must be shut down before refuelling, must be affixed to the fuelling point. In addition a suitable instruction must be included in the manufacturer's operating manual.*

5.3.4 Exhaust system

5.3.4.1 *The exhaust outlet must be located so as to prevent emissions from entering the vehicle through ventilators, heated air inlets or opening windows.*

5.3.5 Combustion air inlet

5.3.5.1 *The air for the combustion chamber of the heater must not be drawn from the passenger compartment of the vehicle.*

5.3.5.2 *The air inlet must be so positioned or guarded that blocking by rubbish or luggage is unlikely.*

(...)

5.3.8 Automatic control of the heating system

5.3.8.1 *The heating system must be switched off automatically and the supply of fuel must be stopped within five seconds when the vehicle's engine stops running. If a manual device is already activated, the heating system can stay in operation.*

...“

ATTENTION:

Failure to follow the installation instructions and the notes contained therein will lead to all liability being refused by Spheros. 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 expiry of the ECE type approval of the heater and thus the general operating permit.



Warning!

Fire and explosion hazard!

At petrol stations and other fuel filling facilities the heater must be switched off due to the explosion hazard. To advice to this requirement the self-adhesive label with the text "Switch off heater before refueling!", delivered with each heater, is to be affixed next to the filler neck.

2 Use / version

2.1. Use of the water heaters

The water heaters, hereafter referred to as heaters, are used in conjunction with the vehicle's own heating system

- to heat the passenger cabin, and
- for pre-heating.

The heater may only be installed and operated in vehicles of the class **M, N, O**.

Any use beyond is not permitted.

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

	Warning!	Danger to life and health!
---	-----------------	----------------------------

The heater is not approved for use in vehicles carrying dangerous goods according to Annex 9 of the UN/ECE Regulation R122.

	Warning!	Risk of fire, explosion, poisoning and asphyxiation!
---	-----------------	--

The heater must not be operated:

- at filling stations and other refueling points.
- if the heater or its exhaust outlet is in locations where inflammable vapors or dust may form (e.g. close to fuel, plastic, coal, wood dust or cereal storage facilities or similar).
- if the heater or its exhaust outlet is located close to inflammable materials for example dry grass and leaves, cartons, paper etc.
- in enclosed areas (e.g. garages, hall without extraction system), not even if the pre-selection timer or Tele Start is used.
- if the exhaust outlet of the heater is partial or fully obstructed (e.g. by soil or snow, as it may occur while move the vehicle backwards).

The heater must:

- be shut down and the fuse shall be removed in the event of extensive smoke development, unusual combustion noises or fuel odors. The heater must not be used again until personnel trained by Spheros have examined it.

2.2. Versions

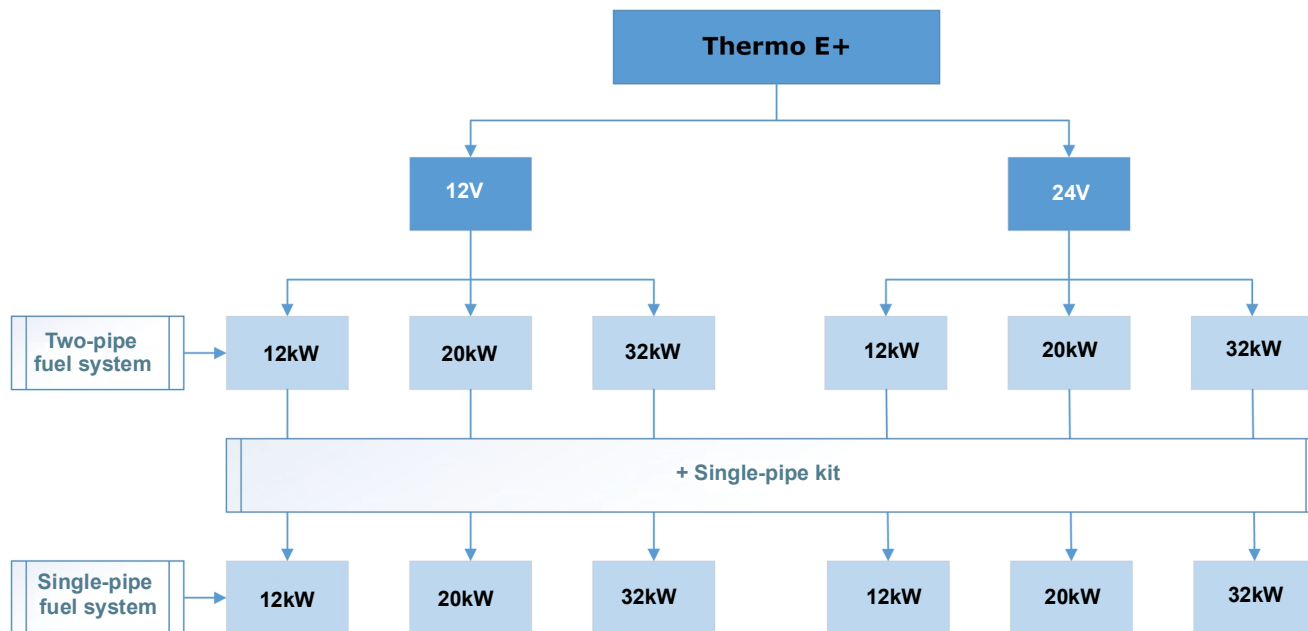


Bild 1: Thermo E+ variants - Overview

2.3. Use / Function

See Workshop Manual (Id. No. 11125705_)

ATTENTION:

It is not possible to operate the same device in different on-board voltage systems (12V or 24V)!

3 Installation

ATTENTION:

- The statutory regulations governing the installation must be adhered.
- If the water heater is to be operated in a separately installed heating system (not in the circuit of the vehicle engine), prior to installation an installation planning report must always be submitted to Spheros 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.
- To the temperature sensor cable no mechanical load must be applied (pull on the cable, carry the heater at the cable etc.).
- Heaters and components shall be always installed in such a way that negative impacts by road dirt, splashing water, exhaust gases or other harmful influences is excluded.

NOTE:

Consider the installation situation of the relevant vehicle type.

3.1. Installation location

The heater and the circulating pump are to be integrated into the cooling system (or in a separate heating system). The requirements regarding the combustion air supply (see Chapter 8) must be considered.

The heater should be installed as low 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 a box, it may also be installed in the vehicle's engine bay.

The installation box must have a sufficient external ventilation to ensure that the maximum temperature of 85°C is not exceeded in the box.

This installation space is not a stowage compartment and must be kept clear. This prohibition applies in particular for fuel canisters, oil cans, fire extinguishers, cleaning rags, paper and all easily flammable materials.

Water which has been ingressed or condensed must be able to run autonomously from the installation space.

Bear in mind the space required for servicing accessibility (for example for removing the combustion chamber) (see Figures 2 and 3) when installing the heater.

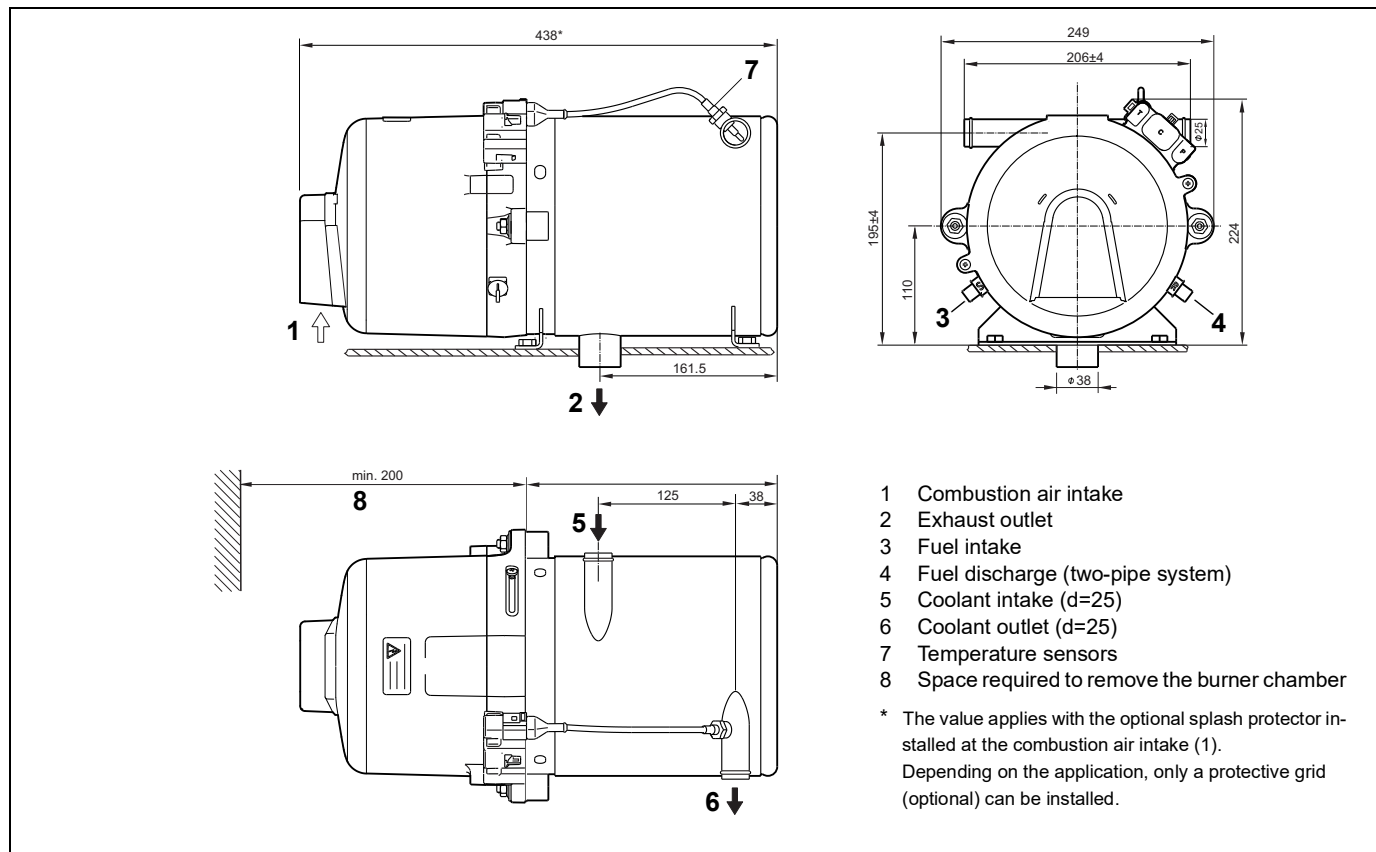


Fig. 2: Dimensions of the heater Thermo E+ 120

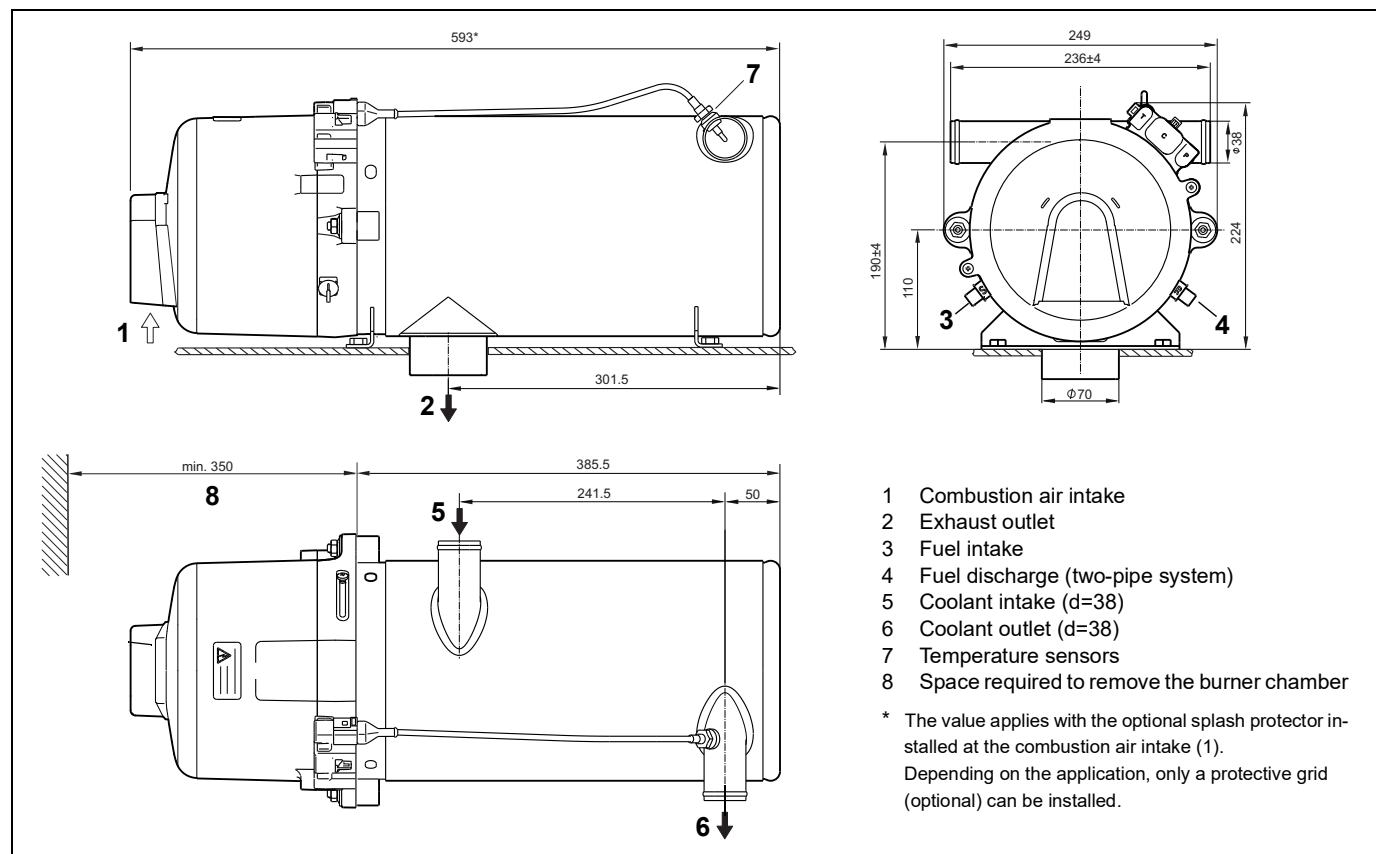


Fig. 3: Dimensions of the heater Thermo E+ 200/320

3.2. Installation of the heater

NOTE:

The heaters are only licensed for horizontal installation (see Fig. 4).

The heater may be secured either with four M8 screws or with four screws and nuts (see Figure 5 and 6).

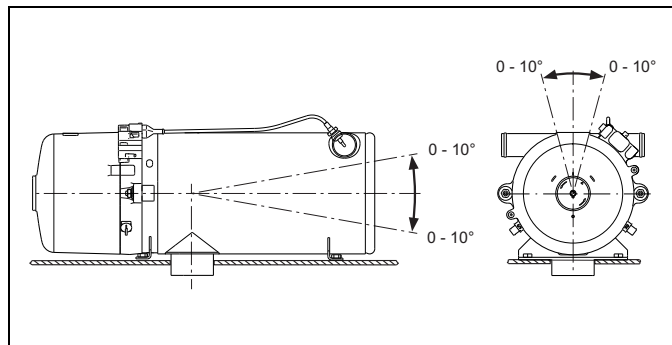


Fig. 4: Installation position Thermo E+ 200/320
(applies analogously also for Thermo E+ 120)

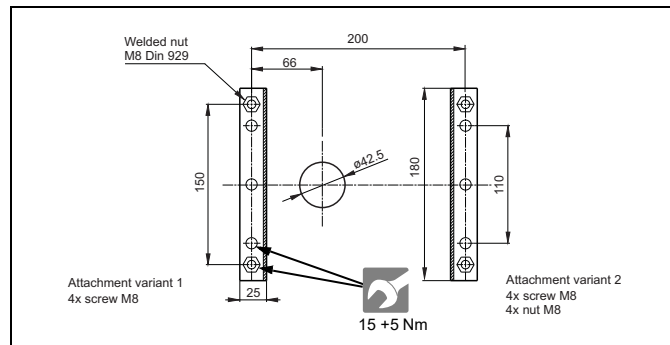


Fig. 5: Hole pattern Thermo E+ 120

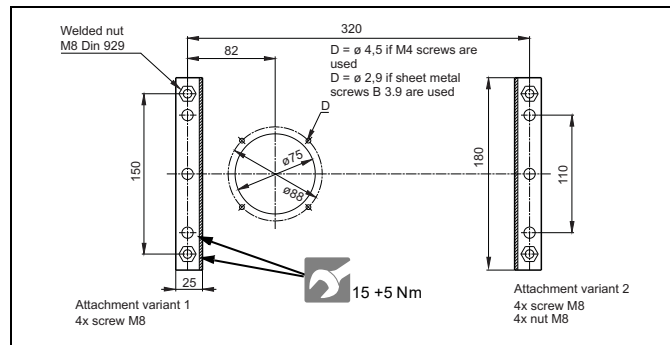


Fig. 6: Hole pattern Thermo E+ 200/320

3.3. 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).

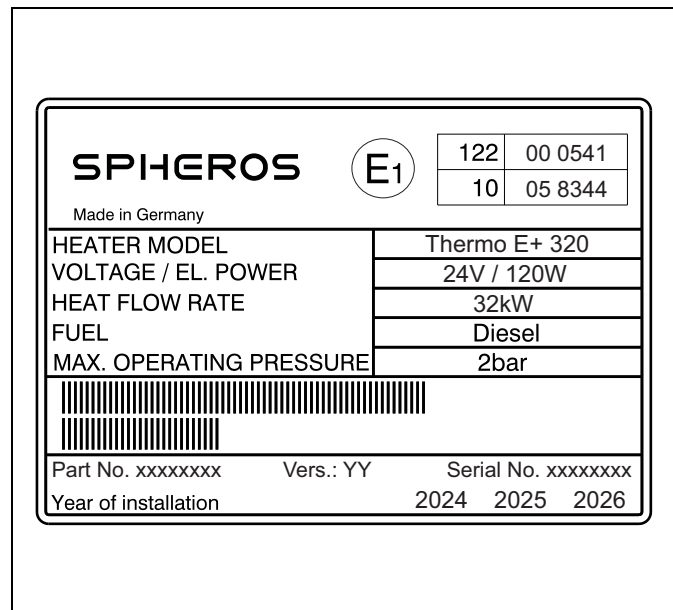


Fig. 7: Model plate (example)

NOTE:

The year of the initial operation must be durably marked on the model plate by removing the year numbers that are not applicable.

4 Installation example

Water heating circuit – wall heater and roof duct heating system

- 1 Wall heater with blower
- 2 Heat exchanger at entry point
- 3 Heater
- 4 Circulating pump
- 5 Roof heat exchanger
- 6 Vehicle engine
- 7 Driver's position heating system
- 8 Control element

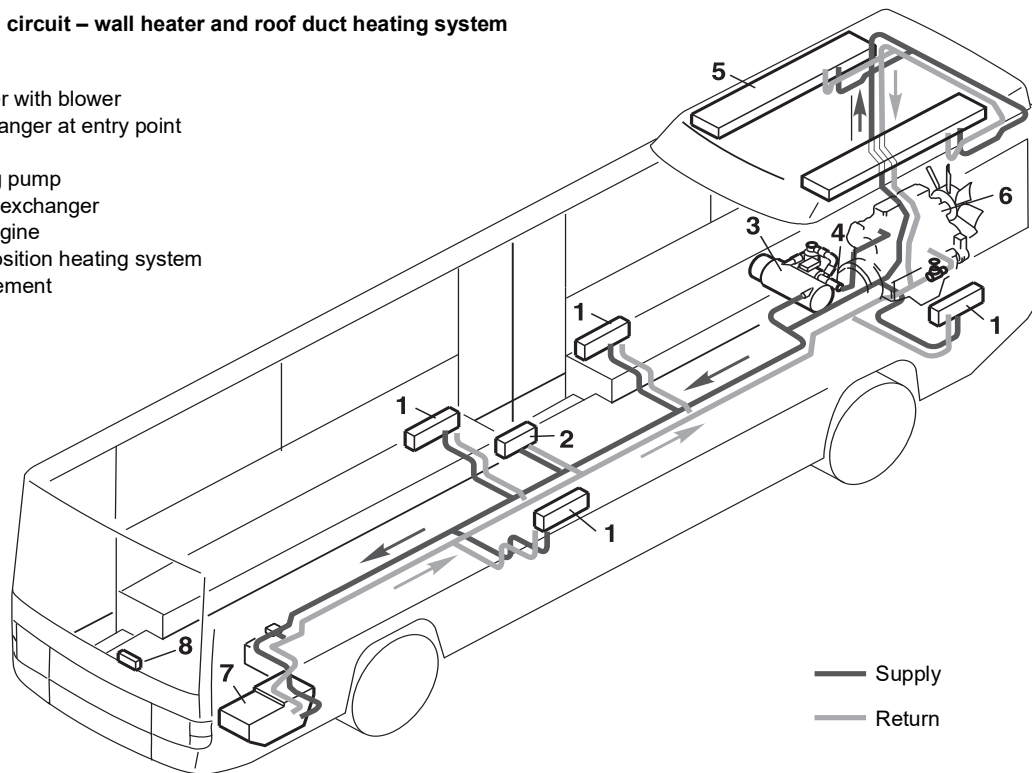


Fig. 8: Installation example for the heater

5 Installation of the circulating pump

ATTENTION:

**The heater should be equipped with a Spheros circulating pump.
Pumps of other manufacturers must be approved by Spheros.**

The following pumps are available:

- U4814 (Aquavent 5000) 12 and 24 VDC
- U4854 (Aquavent 5000S) 24 VDC
- U4855 (Aquavent 6000C) 24 VDC
- U4856 (Aquavent 6000SC) 24 VDC
- SPump 24 VDC

NOTE:

Information about these pumps and their installation you find in the download center on www.spheros.com.



NOTE:

- The annex of this Installation instructions contains the permitted installation positions of the pumps.
- The pump ports and connection lines from the water intake and water outlet must be flush (no stress).

ATTENTION:

- **Only ONE circulating pump may be connected to the heater.**
- **When connecting the circulating pump U4856 it must be ensured that the volume flow does not drop below 2500 l/h for longer than a brief period only! Continuous operation at less than 2500 l/h will result in an undue wear of the wearing disc of the impeller!**

6 Connection to the vehicle cooling system

The heater is to be connected to the vehicle cooling system in accordance with Figures 2 and 3. The system must contain at least 25 liters (Thermo E+ 200/320) respectively 10 liters (Thermo E+ 120) of coolant. The water in the heating circuit of the heater must contain at least 30% of a brand name anti-freeze.

A current list of approved by Spheros antifreeze agents can be found in the download center under www.spheros.com.

Basically the water hoses supplied by Spheros should be used. If this is not the case, the hoses must comply at least with DIN 73411 requirements. The hoses are to be routed without any kinks and - for proper venting of the heater - in an upward pitch, if possible. Hose connections must be secured against slipping off by means of hose clamps.

NOTE:

The tightening torques of the hose clamps used must be observed (see Workshop Manual Id.-No. DOK50059).

After 2 hrs. / 100 km heating operation, the hose clamps should be re-tightened.

In the vehicle cooling system, or in a separate heating circuit, only pressure control valves with an opening pressure of min. 0.4 bar and max. 2.0 bar may be used.

Before the heater is started up for the first time, or after the coolant has been replaced, it must be ensured that the cooling system is properly bled without use of the circulating pump. Heater and piping should be installed in such a way that static bleeding of the system is ensured.

Proper bleeding action can be recognised by the nearly silent operation of the circulating pump. Insufficient bleeding during heater operation can result to tripping of the temperature limiter.

If the circulating pump U 4855 / Aquavent 6000C is used it will be automatically deactivated approx. 10 seconds after its activation if coolant is lacking or a blockage of the pump impeller has occurred, and can then be restarted after approx. 2 minutes.

If the circulating pump U 4856 / Aquavent 6000SC is used, it will be automatically deactivated approx. 45 seconds after its activation if coolant is lacking or a blockage of the pump impeller has occurred, and can then be restarted after approx. 2 minutes.

ATTENTION:

Before commissioning the heating system, the heating hoses, the pump and the heater must be completely filled.

Only by Spheros approved antifreeze agents may be used.

The Thermo E + 120 is to be operated exclusively with the circulating pump U4814, connections 1 " / 25mm.

7 Fuel supply

Fuel is extracted from the vehicle's fuel tank or from a separate fuel tank. Fuel lines and filters must be completely vented without using the fuel pump of the heater before commissioning. Thereby also during vehicle operation a safe fuel supply without air bubbles must be ensured continuously.

7.1. Fuel lines

When using fuel hoses, basically the hoses supplied or offered by Spheros are to be used. If this is not the case, the fuel hoses must at least comply with the requirements of DIN 73379. Fuel hoses must not be kinked, crushed or twisted and must be secured at intervals of about 25 cm with clamps.

Materials commonly used in the construction of vehicles may be also used for fuel hoses taking into account a suitable connection system in each case. The selection should be done considering the ambient temperature range and the fuel (Bio Diesel) used.

To prevent air inclusions from forming in the fuel, the fuel lines should be routed in an upward pitch, if possible. Connections within the fuel lines must be secured by means of hose clamps unless mechanical screwed connections are used.

ATTENTION:

If the heater is operated without coolant, the outer shell of the heater may reach a temperature equalling the ignition temperature of diesel fuel!

- The lines must be protected from thrown-up gravel
- any dripping or evaporating fuel must neither collect nor be ignited by hot components or electrical equipment.

To prevent this, optionally a drip pan with defined drain holes is

to be installed in the area below the interface burner housing/fuel line connectors/heat exchanger.

NOTE:

To prevent the fuel lines from draining, the outlet of the return line in the tank should be below the fuel level.

ATTENTION:

The operation with a closed return line (two-pipe version) will cause damage to the fuel pump or to the fuel pipe, fuel can leak out - fire hazard!

Fuel lines and filters must be protected against excessive heat.

A dry-run of the fuel pump must be prevented.

Unsupported fuel lines must be secured to prevent them from sagging.

The installation of an additional fuel pump is permissible only in consultation with Spheros.

For legal provisions refer to Chapter 1.

7.1.1. Permissible dimensions of the fuel lines

- Inside diameter for suction and return lines: 6 mm (other diameters on request)
- Max. permissible length of each suction and return line: 15 m
- Max. permissible suction height: 1 m
- Max. permissible admission pressure: 0.3 bar

Deviations are to be approved by Spheros.

7.2. Fuel filter

Install the filters supplied by Spheros.

NOTE:

Use only filters approved by Spheros.

Pay attention to the flow direction when installing the filter.

ATTENTION:

With increasing operating time, the flow resistance in the fuel supply can increase due to deposits. Filters can become clogged. This can lead to malfunctions of the heater.

-> Change the filter or filter insert before each heating season.

7.3. Permissible negative pressure in the fuel system (at the heater at the fuel inlet)

To ensure the proper functioning of the heater, make sure that the negative pressure in the fuel system is not too high.

Vacuum suction line (supply)		
Max. permissible negative pressure	mbar	-350

NOTE:

Any alternative fuel-related applications must be approved by Spheros.

7.4. Single-pipe usage of the heater

The heaters can also be operated in single-pipe systems if an appropriate single-pipe kit is used. To do this, a bypass must be installed between the return port of the heater and the filter inlet with the parts included in the kit.

ATTENTION:

Particularly with single-pipe operation, prior to commissioning a careful bleeding of the fuel system is mandatory (see information material coming with the single-pipe kit).

NOTE:

Before installing the heater, turn the fan wheel at least one turn counter-clockwise by hand.

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.

Air filter systems in the combustion air intake line are not permitted.

Permissible dimensions of combustion air intake line:

		Combustion air intake line		Exhaust pipe	
	Operation altitude in m*	Inner Ø in mm	Length in m	Inner Ø in mm	Length in m
Thermo E+ 320	up to 1.500	55	max. 5.0**	55	max. 5.0**
	above 1.500	55	max. 1.5	55	max. 0.7
Thermo E+ 200	up to 1.500	55	max. 1.5	55	max. 0.7
	from 1.500	55	max. 1.5	55	max. 0.7
Thermo E+ 120	up to 1.000	55	max. 2.0	38	max. 1.5
	above 1.000	55	max. 1.5	38	max. 1.5
	über 1.000	55	max. 2.3	38	max. 0.7

* If operation above this altitude is predominant, the CO₂ value of the heater must be readjusted according to the specified technical data.

** The total length of the combustion air intake line and exhaust pipe together must not exceed 5.0m.

The permissible total bending angle of the air and exhaust gas applications together must not exceed 270°.

The combustion air intake must not be routed above the exhaust outlet. Deviations must be approved by Spheros.

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.

Only by Spheros approved combustion air intake lines may be used.

When the heater is installed in the vicinity of the vehicle tank in a common installation space, combustion air must be drawn in from the outside of the vehicle and the exhaust gas be discharged into the atmosphere. Lead-through openings must be splash-proof.

If the heater is located in an enclosed installation housing, an effective ventilation opening is required with a cross section of at least:

Thermo E+ 120: 30 cm²

Thermo E+ 200: 30 cm²

Thermo E+ 320: 40 cm²

Verify by checking the CO₂ values whether the ventilation is effective and sufficient.

If the temperature in the installation housing exceeds the permissible ambient temperature of the heater (see Technical Data), the ventilation opening must be enlarged subject to prior consultation with Spheros.

ATTENTION:

If permanent ambient temperatures above 65 ° C are to be expected, the opening of the air intake line must be routed to an area with lower temperature.

With permanent intake air temperatures above 65° C, a reduced service life of the heater (in particular motor and control unit) can be expected.

9 Exhaust pipe*

The opening of the exhaust pipe must be point perpendicular downwards and must not become clogged with dirt or snow.

The outflowing exhaust gas must not be re-sucked in as combustion air. The exhaust gas must be routed to the outside / into the atmosphere.

The exhaust pipe must be fixed at least once every 50 cm.

Rigid pipes made of unalloyed or alloyed steel with a minimum wall thickness of 1.0 mm, or flexible tubes of alloyed steel are to be used. The exhaust pipe is to be secured to the heater, e.g. by means of a clamp.

Accumulations of condensate must be drained, if necessary, a condensation water drain hole Ø 4mm must be implemented.

For further requirements see statutory regulations.

Permissible dimensions of the exhaust pipe:

		Combustion air intake line		Exhaust pipe	
	Operation altitude in m*	Inner Ø in mm	Length in m	Inner Ø in mm	Length in m
Thermo E+ 320	up to 1.500	55	max. 5.0**	55	max. 5.0**
	above 1.500	55	max. 1.5	55	max. 0.7
Thermo E+ 200	up to 1.500	55	max. 1.5	55	max. 0.7
	from 1.500	55	max. 1.5	55	max. 0.7
Thermo E+ 120	up to 1.000	55	max. 2.0	38	max. 1.5
	above 1.000	55	max. 1.5	38	max. 1.5
	über 1.000	55	max. 2.3	38	max. 0.7

* If operation above this altitude is predominant, the CO₂ value of the heater must be readjusted according to the specified technical data.

** The total length of the combustion air intake line and exhaust pipe together must not exceed 5.0m.

The permissible total bending angle of the air and exhaust gas applications together must not exceed 270°.

Routing in vertical direction max. 1m

Deviations only after approval by Spheros.

NOTE:

If there is a risk of contact with the exhaust pipe during intended use, it must be secured accordingly to prevent this.

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

ATTENTION:

- The exhaust gas temperature can reach over 400 °C depending on the heating capacity class.
- The exhaust pipe must end in the open air.
- The exhaust pipe must be sloped down, arising condensate must be able to drain away.
- Because of the temperatures involved, sufficient distance from heat-sensitive or flammable materials must be ensured.
- Outflowing exhaust gas must not be re-sucked in as combustion air.
- If the exhaust outlet is under the vehicle floor, blowing straight down, a radial exhaust gas deflection, e.g. 84970_ is absolutely necessary.

10 Electrical connections

 Warning!	High Voltage! Danger to Life!
---	--

To hook-up the heater its opening is not required. Maintenance and repair work on the heater must be carried out in accordance with the Thermo E + Workshop Manual.

10.1. Prerequisites for hook-up

10.1.1. Ripple voltage

Before heater installation the **ripple voltage level** at the interface to the heater shall be checked. It must not be higher than 2 V_{ss} (V_{ss} - peak to peak). Otherwise a reduced service life of the electric and electronic components must be expected.

10.1.2. Load dump protection

The heater may be used for full load dump protection only in vehicles with a central voltage limiter.

Table: Tested parameter load dump, test pulse 5b, acc. to
ISO 16750-2 (Issue 2010-03), para. 4.6.4

Parameter	U _N = 12 V	U _N = 24 V
U _S ^a in V	101	202
U _S [*] in V	35	65
t _d in ms	40 ≤ t _d ≤ 400	100 ≤ t _d ≤ 350
t _r in ms	10 ₋₅	10 ₋₅
R _i in Ω	4	8
number of test pulses	5	5
time between pulses in min	1	1

10.1.3. Battery

The heater is intended exclusively for use with a car starter battery, so among others short-term higher starting currents can be provided.

10.2. Heater hook-up

The hook-up of the heater is to be performed acc. to the hook-up diagram shown in Figure 9. The interfaces are located outboard on the control unit.

ATTENTION

- The watertight plug-in connection to the heater is to be manufactured only with the original plugs, contacts and single-wire seals.
- The heater must be connected directly to the battery (without a battery disconnect switch), so that a correct switch-off with a run-down is always ensured.
- Route the electrical cables so their insulation will not be damaged (i.e. wedging, temperature exposure, kinks, chafing).
- Unused connectors must be protected by dummy plugs / caps.
- All cables should be fastened at intervals of approximately 25 cm by suitable means (e.g. cable ties).
- Circulating pump connection (see Figure 9)

A short circuit of the positive lead of the CP against another plus or a third or backfeed supply can lead to potential shifts, functional impairments and component damage in the control unit and is therefore not permitted.

10.2.1. Cable cross sections control cables (Connector C, Pin A,B,C,D)

For vehicle cable lengths up to 7.5 m, at least the prescribed cable cross-sections in Fig. 9 shall be used. For vehicle lengths of 7.5 m to 15 m, the cable cross-sections in the vehicle must be designed larger. At least the cable cross-sections given in the table must be used. Please note that the cable cross-section at the heater must not exceed 1 mm². In the case of larger cable lengths, a cross-section reduction must be carried out before the heater. The generally valid electrotechnical rules apply.

Cable length <7.5m	Cable length 7.5 - 15m
0.75 mm ²	1.5 mm ² (Attention, at the contact max. 1mm ²)

10.2.2. Cable cross sections power supply cables (Connector C, Pin E and G)

Please ensure that the voltage drop (forward plus backward) is less than 1V. Smaller voltage drop is better (see following tables). The maximum cable cross section to the heater connector (Pos. E and G) is 5mm². If a greater cable cross section is required, it is to be reduced shortly before the heater.

Table 1: Voltage drop (forward plus backward) at **12V**, up to 85°C ambient temperature (without consideration of further crossing resistors, aging, dirtiness)

In=20A	3m	4m	5m	6m	7m
4mm ²	permitted**	permitted**	not permitted	not permitted	not permitted
5mm ²	permitted**	permitted**	permitted**	not permitted	not permitted
for larger cable cross-sections a reduction before the connector is required					
6mm ²	permitted**	permitted**	permitted**	permitted**	not permitted
10mm ²	permitted**	permitted**	permitted**	permitted**	permitted**

Table 2: Voltage drop (forward plus backward) at **24V**, up to 85°C ambient temperature (without consideration of further crossing resistors, aging, dirtiness)

In=15A	3m	4m	5m	6m	7m
2.5 mm ²	permitted*	not permitted	not permitted	not permitted	not permitted
4mm ²	permitted**	permitted**	permitted**	permitted**	not permitted
5mm ²	permitted**	permitted**	permitted**	permitted**	permitted**
for larger cable cross-sections a reduction before the connector is required					
6mm ²	permitted**	permitted**	permitted**	permitted**	permitted**

* connector package 2.5mm² (Connector C), 11123483_

** connector package 3-5mm² (Connector C), 11126246_

10.2.3. Plug connections at the heater**NOTE:**

The mating connectors to be used can be ordered from Spheros, including the required contacts and single-wire seals. The spare parts list for your device can be found in the download center under www.spheros.com.

**10.3. Connecting the controls**

The heater can be switched on and off using the Spheros controls, switch or pre-selection timer. In addition, control via the vehicle's own climate control is possible.

The control device is installed in the heater.

10.4. Operation indication

To monitor the operating status an output for an operating indication is provided. The operation indication has two display modes. First the pure switching mode and further a flashing mode. In the flashing mode this output displays the error flash codes by the operation indication. Two functions are indicated:

- a) the device is switched on or off
- b) error indication by a special flash code

The output is designed for the control of up to two lamps with a power of 2W or a single lamp with 5W.

10.5. Connection to the diagnosis

To connect the diagnosis, an additional adapter harness (11123550_) can be purchased. Alternatively, a connection can be realized by the customer as shown in Figure 9.

10.6. Hook-up diagram (see fig. 9)**10.6.1. Legend for hook-up diagram:**

Item	Description
F1	Car flat-type fuse 30A at 12V / 25A at 24V acc. to DIN 72581 part 3 or ISO 8820-3
F2	Car flat-type fuse 5A acc. to DIN 72581 part 3 or ISO 8820-3
BA	Operation indicator max. 5 W
UP	Circulating pump
HS	Main switch
UPFA	Circulating pump external control
T	Connector/connection of temperature sensors
C	Connector/connection to vehicle
P	Connector/connection circulating pump

Legend for hook-up diagram

NOTE:

The vehicle fuses must be installed in such a way that their ambient temperature does not exceed 60 °C.

10.6.2. Connector to the heater

Only the following mating plugs may be used:

NOTE:

The single-wire seals must be carefully selected, properly and tightly processed.

Connector „C“ (customer interface)

Connector package Spheros ID 11123483_ for cable cross section 2.5mm² (for 24V only), or

Connector package Spheros ID 11126246_ for cable cross section 3.0...5.0mm² (for 12 or 24V), alternatively:

Housing Delphi Connection Systems P.N. 12059472

150 series contacts for MS (D), UPFA (C), BA (A) and S-Bus (B):

12V and 24V versions:

4ea Delphi female contact No. 12048074, 0.75...1mm² with single-wire seal No. 12089678

480 series contacts for terminal 30 (G) und terminal 31 (E):

24V versions:

2ea Delphi female contact No. 12048451, 2.5mm² with single-wire seal No. 15324988

12V or 24V versions:

2ea Delphi female contact No. 12052139, 4...5mm² with single-wire seal No. 15324989

Seal plug for F and for C, A or B if not used:

Delphi Metri Pack 150 seal plug No. 12059168

Connector „P“ (Circulating pump)

Connector package Spheros ID: 11114939_ or blind plug: Spheros ID: 11113969_, alternatively:

Housing FEP 42121100

2ea Tyco female contact No. 964273-1 with single-wire seal No.

963293-1, for 1.5m², insulation diameter: 2.2...2.7mm, or

963292-1, for 2.5m², insulation diameter: 2.7...3.0mm

ATTENTION:

If no circulating pump is connected to the heater, a blind plug must be used on this connection.

10.6.3. Diagnosis connector (optional)

To connect the Diagnosis Thermo Test or the blind plug (see Fig. 9):

Housing, producer: Lear No. 17218.00.001

3 ea contact 0.75mm², producer: Lear No. 26628.331.179

3 ea seal 0.75mm², producer: Lear No. 16695.627.642

Blind plug

Housing, producer: Lear No. 16698.501.699

3ea blind seal 0.75mm², producer: Lear No. 16237.627.626

Plug-in cycles

We refer to the max. number of 10 plug-in cycles. After exceeding or obvious shortages, the affected contacts have to be renewed.

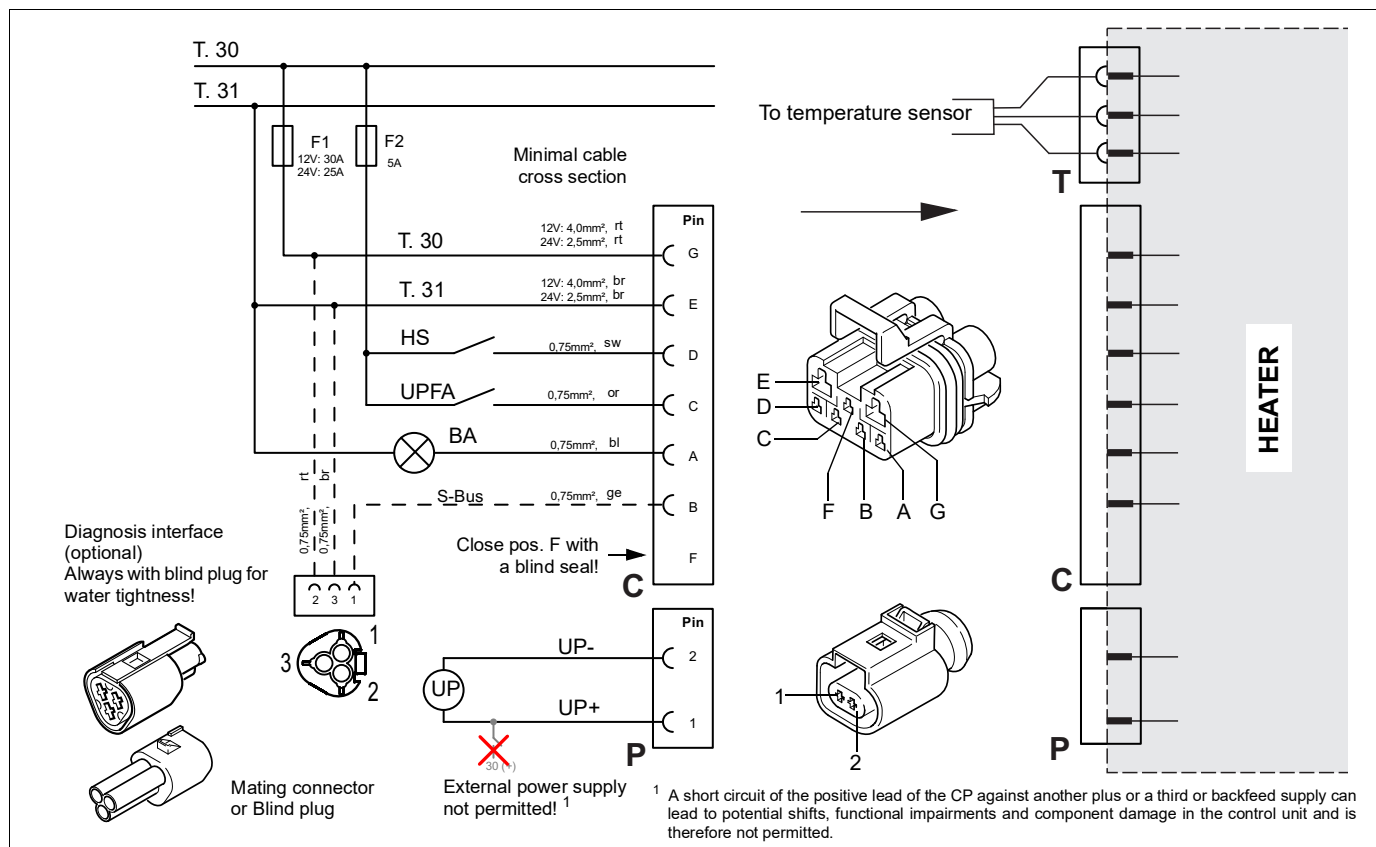


Fig. 9: Hook-up diagram for the heater Thermo E+ with switch, legend see page 19

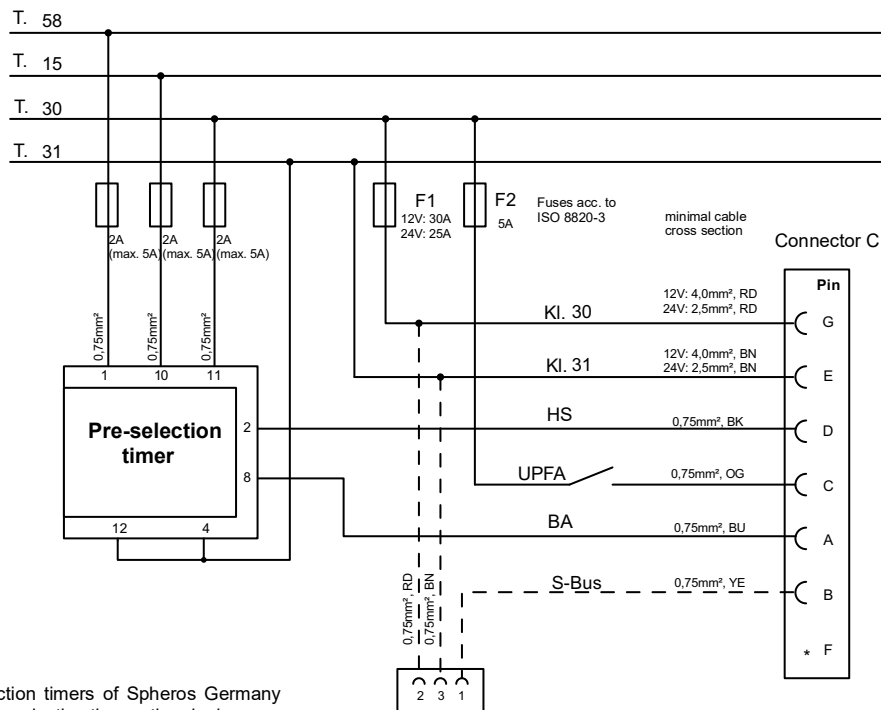


Fig. 10: Connector C pin assignment when the Spheros pre-selection timer is used, legend see page 19

11 Initial start-up

ATTENTION:

The operating and service instructions of the heater should be read before commissioning.

It contains general operating information, operation hints and as well as maintenance and safety instructions.

It provides information how to recognise malfunctions as well as measures for their elimination.

ATTENTION:

The CO₂ value must be readjusted in accordance with the specified technical data if this is necessary for applications on the intake or exhaust side or the predominantly intended use of the heater.

With continuous use above 1,500 m (Thermo E + 120: 1,000 m), the CO₂ value must be readjusted because the lower air density leads to a negative change in the exhaust gas values.

Information and the procedure for adjusting the CO₂ value are contained in the Thermo E + Workshop Manual Id. No. DOK50059.

After heater installation, bleed the water system and the fuel supply system carefully. In this process it is mandatory to fill the suction line and the fuel filter of the heater completely. Spheros recommends the usage of a separate bleeding unit. Follow the appropriate instructions provided by the vehicle manufacturer. Verify the fuel supplied to the heater is bubble-free.

ATTENTION:

The fuel pump must not be used to fill the fuel system!

Generally, the hook-up of the heater to the vehicle power grid must be done only after filling the fuel system in order to prevent a premature start of the fan motor/fuel pump.

Conduct a test run 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 according to given in the workshop manual instructions.

ATTENTION:

In the event no fuel comes to the fuel pump during initial start-up (dry running), there is a risk that the fuel pump will be damaged!

12 Maintenance

Periodic service activities have to be performed in accordance with the Workshop Manual.

13 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 $+20\text{ }^{\circ}\text{C}$ and at the rated voltage.

NOTE:

The assignment of circulating pumps to heaters must be made considering the water-side resistances.

13.1. Fuel

The following table lists the by Spheros approved fuels for this device and their specifications.

Fuel	Requirements acc.	Remarks
Summer Diesel	DIN EN 590	
Winter Diesel	DIN EN 590	
Arctic Diesel and Diesel for a strong winter climate	DIN EN 590	
Bio Diesel (FAME)*	DIN EN 14214	max. 20% see TI Fuels
Paraffinic diesel fuel from synthesis or hydro-generation (HVO)*	DIN EN 15940	only selected fuels see TI Fuels

- * Further information on approved fuels contains the TI (Technical Information) Fuels. It can be found in the download center under www.spheros.com.



In case of air temperatures below $0\text{ }^{\circ}\text{C}$ a commercially available winter Diesel fuel, at temperatures below $-18\text{ }^{\circ}\text{C}$ a Diesel for arctic climate conditions must be used.

ATTENTION:

While using the fuels, their operating limits must be considered and if necessary, suitable measures (nozzle preheating, electrical heated filter) should be applied.

Heater		Thermo E+ 120	Thermo E+ 200	Thermo E+ 320
ECE Type Approval Number	E1 122R 00	0539	0540	0541
Kind of construction		High pressure atomizer		
Heating flow (at ambient temperature of 20°C)	kW	12	20	32
Fuel		see para. 13.1		
Fuel consumption ¹	kg/h	1.2	2.0	3.2
Rated voltage	V =	12 / 24		
Operating voltage range	V =	10...15 / 20.5 ... 30		
Rated power consumption at 12/24V ²	W	45	55	110
Switching thresholds	°C	72 / 82		
Max. permitted combustion air intake temp. ³	°C	-40...65 / 85		
Permitted ambient temperature during operation	°C	-40...85		
Permitted storage temperature	°C	-40...90		
Max. operating overpress. in the coolant circuit	bar	2,0		
Capacity of the heat exchanger	l	1.4	1.8	1.8
Minimum volume flow of coolant ⁴	l/h	1200	2400	2700
Min. capacity of the coolant circuit	l	10	25	
CO ₂ in exhaust gas at rated voltage ⁵	Vol %	10.6	9.5	10.0
Heater dimensions with splash protect., LxBxH	mm	438x249x224	593x249x224	
Weight	kg	13.5	17.3	
Diameter coolant connection	mm	25	38	
Diameter exhaust gas connection	mm	38	70	

¹ at rated conditions (rated voltage, winter Diesel, 15 °C)

² without circulating pump

³ When permanently above 65 °C, a reduced service life is assumed (a combustion air intake temperature of 65 °C should not be exceeded)

⁴ Minimum volume flow of coolant at coolant temperatures above 50 °C

Below 50 °C a lower water flow is permitted, if the occurrence of vapor bubbles in the cooling system due to local overheating safely can be excluded.

⁵ For further CO₂ values vs. voltage, see Cha. 7 in the Thermo E+ Workshop Manual available on the Spheros website.

Circulating pump		U 4814 Aquavent 5000	U 4854 Aquavent 5000S	U 4855 Aquavent 6000C	U4856 Aquavent 6000SC	SPump 260
Delivery rate	l/h	5000 (against 0.2 bar)	5000 (against 0.2 bar)	6000 (against 0.4 bar)	6000 (against 0.4 bar)	6000 (against 0.5 bar)
Rated voltage	V =	12 oder 24	24	24	24	24
Operating voltage range	V =	10...14 / 20...28	20...28	20...28	20...28	16,5...32
Rated power consumption	W	104	104	210	210	260

Note: For further technical data e.g. dimensions, refer to the pumps documentation.

Optional Fuel Filter Heater

Filter heater		
Rated power consumption	W	350
Rated voltage	V -	24
Switch-on point	C°	2.0 ± 5
Switch-off point	C°	24 ± 3

14 Environment

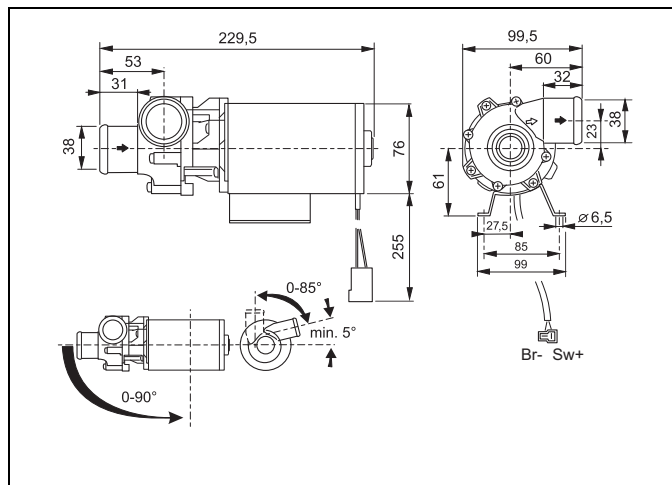
Recycling of heater parts

The correct disposal of the heater components determined by material groups for old appliances, damaged or defective parts and packaging material can be realized without problems. In the process the materials as steel, non-ferrous metals, plastics and electrical scrap (as motors, control devices, harnesses and sensors) are to be professionally and environmentally friendly disposed by the recycling plant.

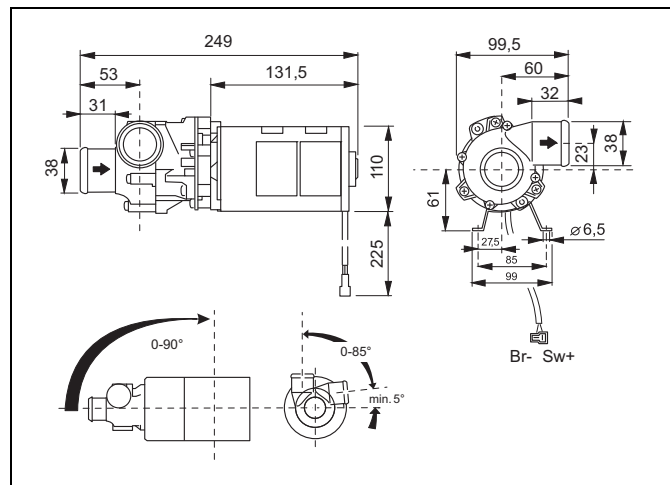
The heater disassembly is precisely described in the workshop manual. For the package the same recycling conditions applies as for paper and paperboard. Keep the package a defined period for a possible return shipment.

Annex

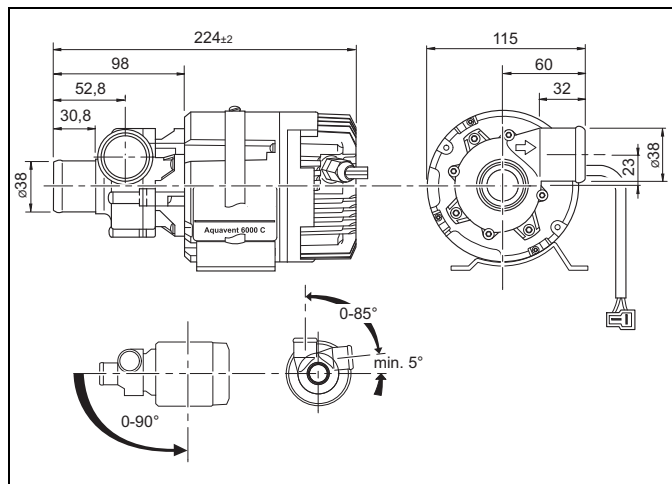
Circulating pumps installation positions



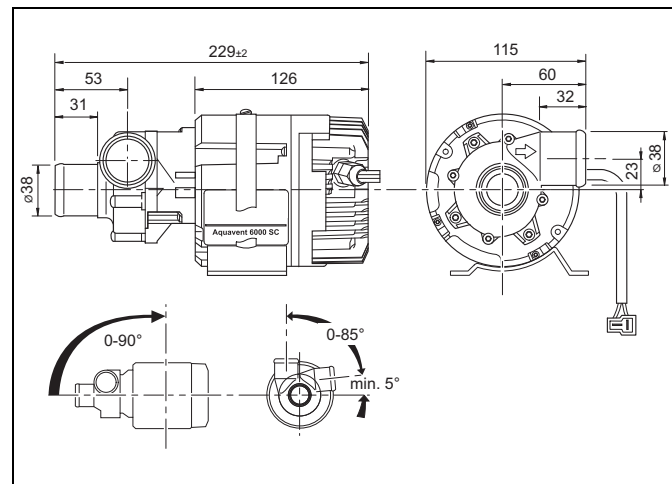
U 4814 Installation position



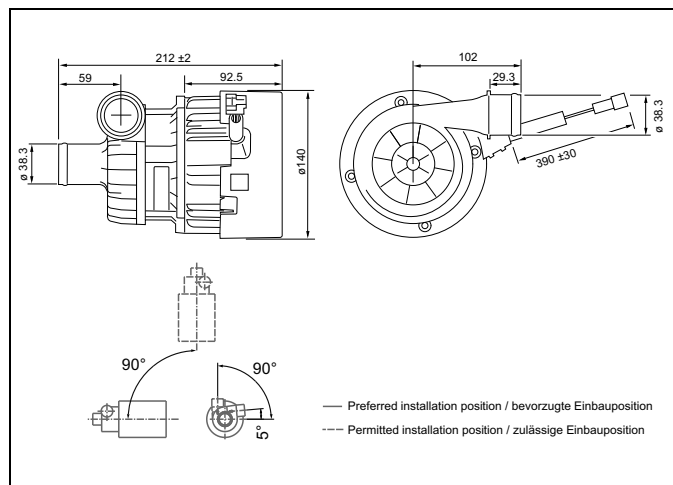
U 4854 Installation position



U 4855 Installation position



U 4856 Installation position

**SPump Installation position**

Notes:

memos _____
