

Coolant Heaters

Valeo Thermo E + 320

Diesel
12 Volts
24 Volts

Installation and Operating Instructions



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



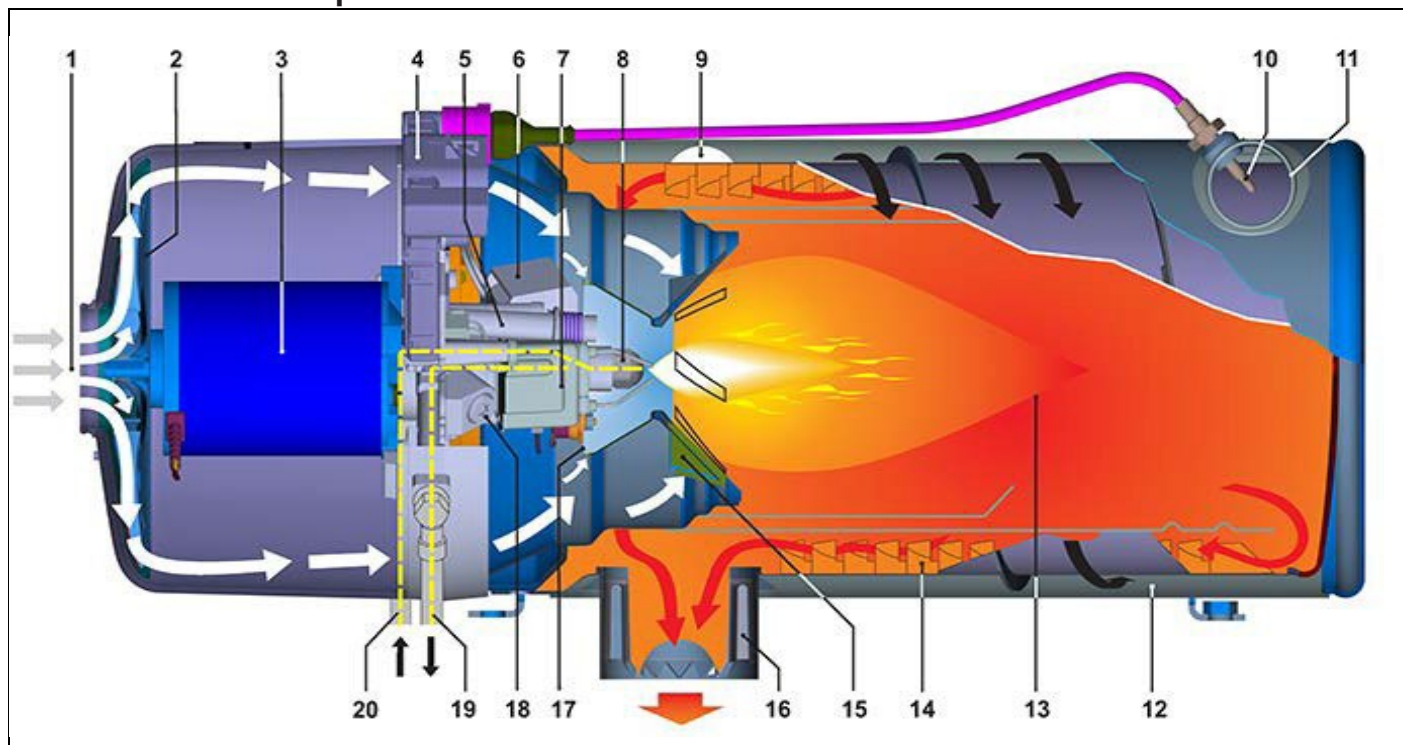
WARNING: Cancer and Reproductive Harm
www.P65Warnings.ca.gov

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1. Introduction

1.1 General Description



1 Combustion air intake	6 Solenoid valve	11 Water outlet	16 Exhaust outlet
2 Combustion air fan	7 Electronic ignition unit	12 Heat exchanger	17 Disk / photo eye
3 Fan motor	8 Fuel nozzle	13 Combustion chamber	18 Pressure adjustment
4 Electronic control unit	9 Water inlet	14 Heat exchanger fins	19 Fuel return
5 Dust protection tube	10 Temperature sensors	15 Swirl plate	20 Fuel supply

Fig. 101: Thermo E+ 321 Heater

The Thermo E+ 320 Heater is designed to:

1. **Preheat the engine** for easy start up in cold weather and to reduce cold-start wear and emissions (white smoke).
2. **Provide supplemental heat** for the vehicle interior and occupants with the engine running.
3. **Increase Driver Visibility** in poor weather conditions by providing higher levels of heat for quick defrosting/defogging of windshield and side glass.

1.2 Legal provisions

Heater installation must be performed in accordance with the manufacturer's installation instructions. Meets FMCSA Motor Vehicle Heater Requirements when installed in accordance with 49 CFR 393.77. For more information visit <https://www.govinfo.gov/content/pkg/CFR-2012-title49-vol5/pdf/CFR-2012-title49-vol5-sec393-77.pdf>

Any deviations from these instructions are only permitted with written approval from Webasto. Installations not complying with the installation instructions will release Webasto from any product liability. OEM installations must be approved by Webasto.

It is the responsibility of the user and/or installer to ensure that all local regulations are adhered to

1.3 Meaning of Warning, Caution and Note**WARNING**

This heading is used to highlight that non-compliance with instructions or procedures may cause accidents leading to severe injury or death.

CAUTION

This heading is used to highlight that non-compliance with instructions or procedures may cause damage to equipment.

NOTE

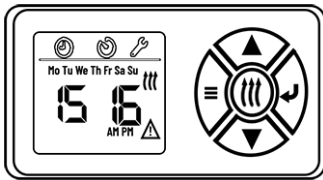
This heading is used to highlight and draw specific attention to information.

2. Operating your Heater

Before switching the heater on, set vehicle heating system to the "heat" position and open any coolant shut-off valves.
Depending on the type of control installed in the of the vehicle, the heater can be operated by the following methods.

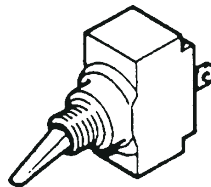
2.1 Switching On

Using a timer:



Timer

Using a switch:



Switch

When switched ON, the operating display is illuminated, the control unit starts controlled operation and checks the coolant temperature. If the coolant temperature is below the lower temperature threshold, the start-up cycle begins.

After approximately 12 seconds the motor starts, the ignition coil is energized, and the fuel solenoid opens. The fuel is injected through the fuel nozzle and is mixed with the air from the combustion air fan.

The mixture is ignited by the ignition coil and burned in the combustion chamber. The flame is monitored by a flame detector.

Approximately 5 seconds after a flame is detected, the control unit switches the ignition coil off.

The heater will cycle on and off until:

1. The heater is switched off.
2. Time has elapsed on the timer.
3. The vehicle battery voltage drops below 10V (12V system) or 21V (24V system).
4. The heater runs out of fuel.
5. A fault lockout occurs, indicated by the operating indicator light being off during the cool down cycle (i.e. overheat).

WARNING

Due to the danger of poisoning and asphyxiation the heater must not be operated in enclosed spaces such as garages or workshops without adequate exhaust extraction.

WARNING

The heater must be switched "OFF" while refueling and at fueling stations.

WARNING

Do not operate any heater in an area where toxic or explosive materials or fumes may be present.

2.2 Switching Off

When heating is no longer required, switch the heater off. The solenoid valve interrupts the fuel supply, combustion stops and the indicator light turns off. The combustion air fan and the water pump remain on for another 2-3 minutes (after run cycle) to cool the unit down and topurge the combustion chamber of any fumes.

2.3 Engine Pre-heating

1. Set the timer 30 min. to 1hr. before you want to start engine. The heater will start up at the set time. (See Operation beginning on page 203).
Or switch the toggle switch or "instant on" switch on your timer in the vehicle dash to "ON". The heater will start up.
2. When time is elapsed on your timer or engine preheat is no longer required, switch the heater "OFF". The heater will go through the after-run cycle.

2.4 Operation with 7-Day Digital Timer

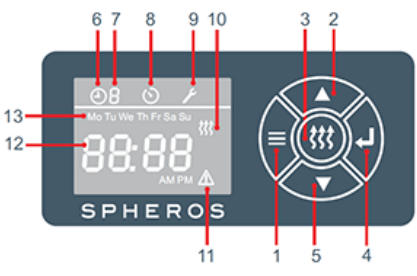
The digital timer enables the operator to reset the start of the heater operation up to 7 days in advance. It is possible to program 7 different start events, only one of which can be activated.

The activation of the preset time is limited to the same day and the following day with the following exception:

- Activation for Sunday and Monday are available on Friday.

When power is applied the display shows the current time and day of the week.

Component Description

	1 – Menu	2 – Selection down
	3 – Instant heat	4 – Confirmation
	5 – Selection down	6 – Preselection time
	7 – Timer event selected	8 – Operation duration
	9 – Settings	10 – Heater ON indicator
	11 – Error indicator	12 – Current time
	12 - Weekday	

Instant ON:

- With the ignition OFF press instant heat button for continuous operation.
- The heater ON indicator will flash momentarily, illuminating continuously when the heater sends a positive feedback signal to the timer indicating heating operation.

Setting run duration:

- With the ignition ON press instant heat button for continuous operation. The current run duration is displayed.
- Press the selection up or down buttons to adjust the time.
- Press the confirmation button to set the duration.

Fault codes:

- While the error indicator is flashing hold the selection up and selection down buttons.

For more information, please refer to the Thermo E+ 320 – Operating Manual for Timer found on www.techwebasto.com

3. Technical Data

3.1 Thermo E+ 320 Heater Data

Design		Coolant Heater with High Pressure Fuel Nozzle
Heat Output	BTU/hr (kW)	109,100 (32)
Fuel		Diesel #1, Diesel #2, Arctic and Kerosene
Fuel Consumption max.	Kg/hr (US. gal/hr)	3.2 (0.85)
Rated Voltage	(V)	12/24
Operating Voltage	(V)	10-15 / 20.5-30
Power Consumption without Water Pump	(W)	110
Permissible Ambient Temperature during Operation	°C (°F)	-40 ... +85 (-40 ... +185)
Storage Temperature	°C (°F)	-40 ... +90 (-40 ... +194)
Minimum Capacity of Cooling System	US. Gal (l)	6.6 (25)
Permissible Operating Pressure of Coolant	psi (bar)	29 (2.0)
CO ₂ in Exhaust Gas	% by Volume	10
Dimensions of Heater	L W mm (inch) H	23.4 (593 mm) 9.8 (249 mm) 8.82 (24 mm)
Weight of Heater	lb (kg)	38.1 (19)
Weight of Heater with Enclosure Box	lb (kg)	78.1 (34)

Table 301: Thermo E+ 320 Heater Data

3.1.1 Thermo E+ 320 Heater Dimensions

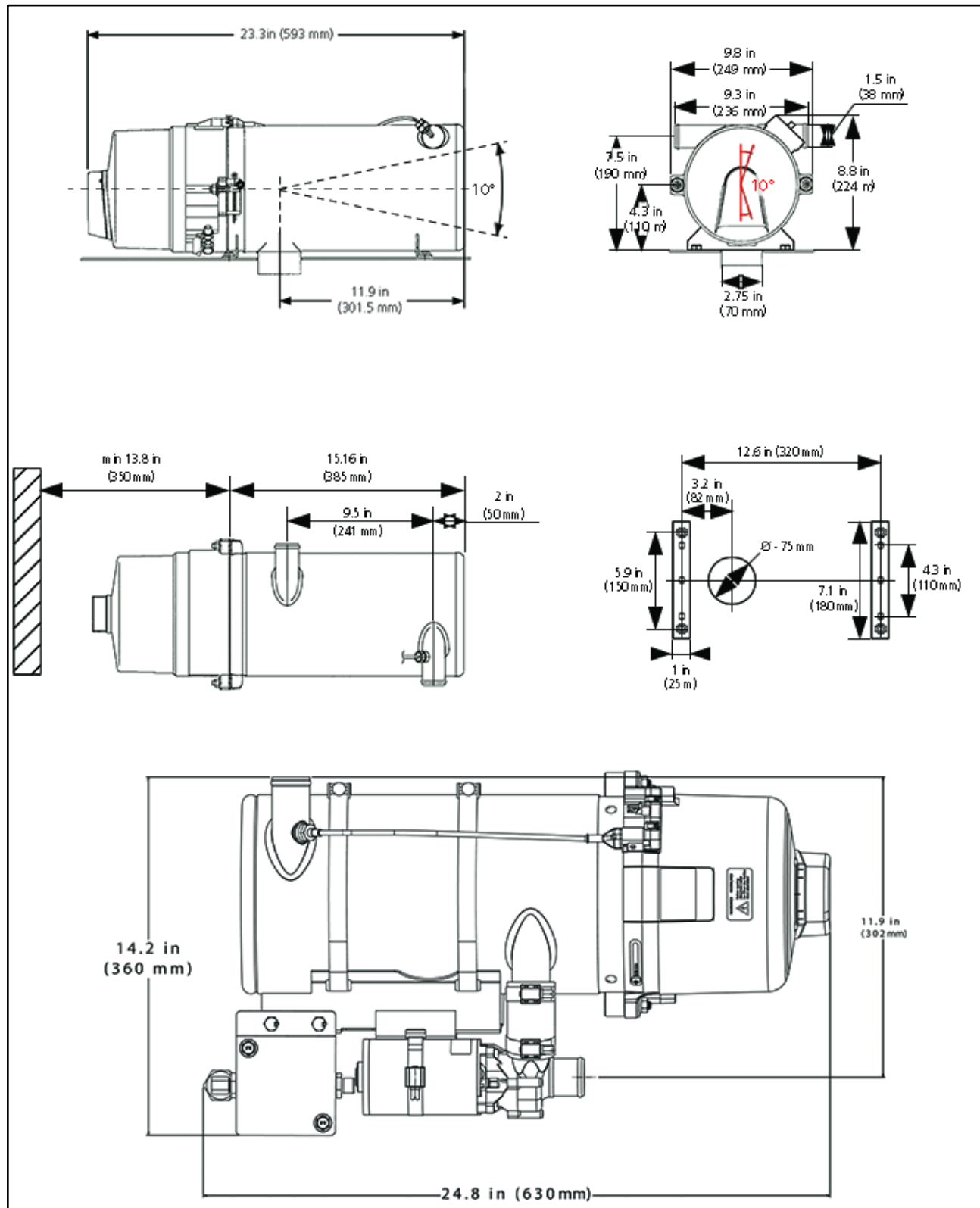


Fig. 301: Thermo E+ 320 Heater Dimensions

3.1.2 Thermo E+ 320 Heater Dimensions – Enclosure box

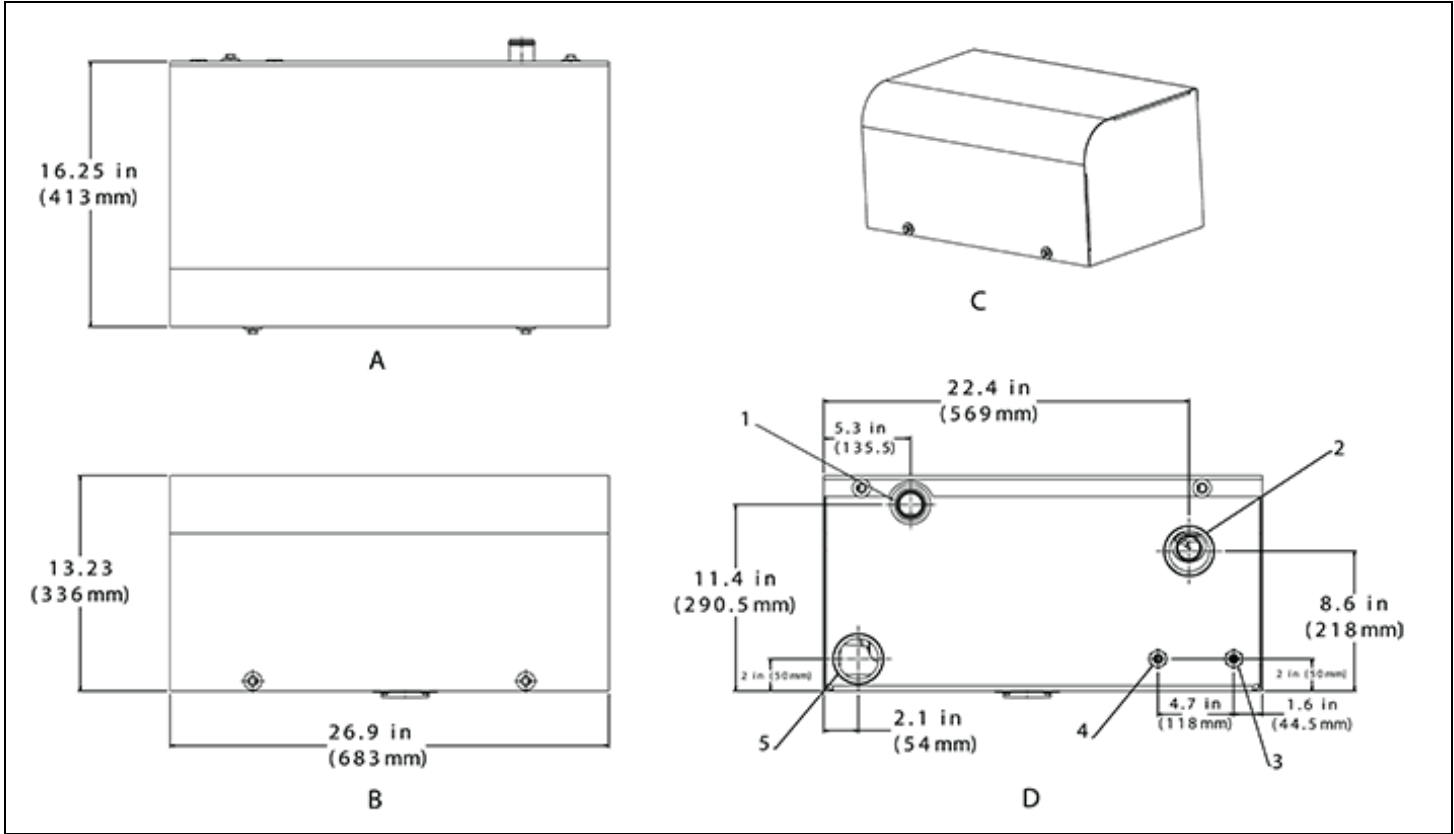


Fig 302: Thermo E+ 320 enclosure Box Dimensions

A	Top view	D2	Coolant out
B	Front view	D3	Fuel supply (in)
C	Isometric view	D4	Fuel return (out)
D1	Coolant in	D5	Wiring pass-through

3.2 Coolant Circulation Pump Data

Circulating Pump		U 4814
Flow Rate l/hr	l/h (gal/min)	5200 (22.9) against 0.2 mbar
Rated Voltage	(V)	12 / 24
Operating Voltage Range	(V)	10 – 15 / 20 - 28
Power Consumption	(W)	104
Dimensions	L	221 mm (8.7 in.)
	W	100 mm (3.94 in.)
	H	105 mm (4.14 in.)
Hose connection	mm (inch) O.D.	38.0 (1.5)
Weight	kg (lb)	2.1 (4.63)

Table 302: Coolant Circulation Pump Data

3.2.1 Coolant Circulation Pump Dimensions

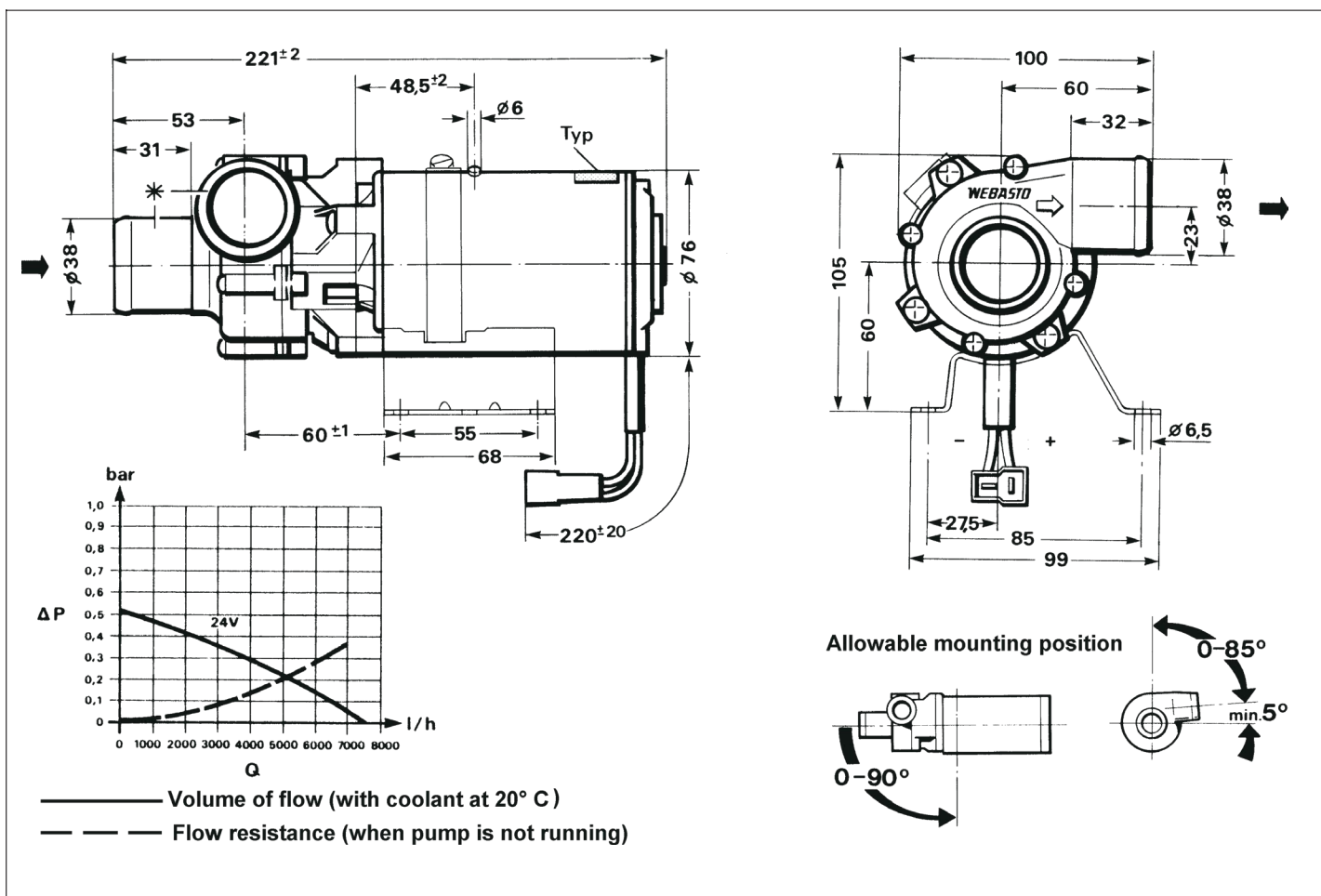


Fig. 303: Coolant Circulating Pump Assembly - U 4814

4. Installation

4.1 General Information

This manual will take you through the installation process to ensure successful operation for years to come. The installation must be performed in accordance with the installation instructions provided in this manual.

4.2 Installation Location

The heater and circulation pump are to be integrated into the vehicle's coolant system. The heater should be installed as low as possible in the coolant system to assure static bleeding of the heater and the circulating pump.

The heater is to be installed in a clean and dry environment, usually a separate compartment accessible for service, typically towards the rear of the vehicle. The heater may also be located in the engine compartment. The installation enclosure must provide adequate ventilation for combustion air requirements [4 in² (20 cm²)].

When installing the heater, make certain that the clearances required for accessing the unit for servicing are observed (e.g. removal of the combustion chamber). See figure 301.

4.3 Mounting the Heater

1. Drill all required holes to dimensions shown in figure 302. A minimum of 4 mounting holes are required.
2. Bolt heater rigidly inside enclosure or engine compartment.

4.4 Exhaust Pipe Connection

Rigid exhaust pipe is recommended in installations where the use of an exhaust deflector is not suitable. The exhaust pipe must have a minimum internal diameter no less than 2.75" (70mm) and a length no greater than 16' (5m). The pipe may have several bends totaling no more than 270° overall. Do not cut and weld pipe to make 90° angled corners.

NOTE

This manual does not cover all possible installations. For special applications use this manual as a general guideline only.

WARNING

The heater must not be installed in either the driver's compartment or in the passenger area of vehicles.

NOTE

The circulating pump is not self-priming.

WARNING

Exhaust pipes must be so routed that the possibility of exhaust fumes entering the vehicle is unlikely.

1. Install exhaust deflector on heater exhaust outlet or install exhaust pipe.
2. Route the exhaust system so that the possibility of discharged exhaust gasses entering the vehicle is prevented.
3. Direct the discharge opening of the exhaust system in such a way as not to be pointed in the direction of travel, and so located that the possibility of clogging caused by snow, mud or debris is prevented.
4. Any condensate collecting in the exhaust pipe must be discharged. If necessary, drill a drain hole at the lowest point to allow drainage.

WARNING

Route the exhaust system away from any parts of the vehicle that may be damaged by heat (i.e., brake lines, electrical wiring, hoses, and fuel lines). Use fire-resistant materials or heat shields when necessary.

4.5 Combustion Air Supply

Never draw combustion air from inside the passenger area of a vehicle, or from areas where exhaust fumes and other gasses can accumulate.

Where heater is installed in a sealed compartment, adequate ventilation for combustion air requirements [4 in² (20 cm²)] must be provided.

Combustion air can be drawn from a remote (protected) area in order to provide a clean air supply.

For installations requiring remotely drawn combustion air, use approved ducting with an unrestricted internal diameter no less than 2.25" (55mm) and a length no greater than 16' (5m). The ducting may have several bends totaling no more than 270° overall.

To connect combustion air intake ducting [2.25" (55mm)] to the heater, several types of fittings are available that snap directly onto the combustion air inlet of the heater. For options, refer to the Thermo E+ 320 service parts manual.

In the event there is insufficient room for a straight attachment, a 90° snap-on fitting and an adapter ring can be used. Simply snap them onto the combustion air inlet of the heater and attach ducting.

For installations where ducting is not required, the heater is factory equipped with a splash deflector that simply snaps onto the combustion air inlet.

WARNING

Never draw combustion air from inside the vehicle, or from areas where fumes or gases can accumulate

CAUTION

Combustion air ducting must be non-restrictive. Do not connect to existing vehicle air ducting or filtration systems.

4.6 Plumbing into the Coolant System

4.6.1 General Information

An efficient heating system must have an adequate supply of hot water to all heat exchangers. The amount of hot water available to a typical three or more heat exchanger system depends on the water pumps capability and the amount of restriction within the coolant system.

Coolant typically is routed out of the engine, through the pump, the heater, then through the vehicle's heating system.

A path for coolant flow must always be maintained while the heater is in operation. A bypass loop will be required if an uninterrupted coolant flow path cannot be assured due to valves being closed while the heater is in operation. The coolant circulating pump(s) must operate while the heater is "ON."

A minimum of 10% of a good quality antifreeze should be maintained in the cooling system at all times.

Heater and water pump fit 1.5" (38 mm) I.D. heater hose meeting SAE20 R3 specifications. Silicone hose requires special hose clamps.

4.6.2 Engine and Passenger Compartment Heating

A: Heat exchangers arranged in Parallel - Recommended (fig. 401)

A parallel heating system works in this fashion:

Heated water (coolant) from the engine travels through a common supply and return circuit, but unlike a series system, the heat exchangers are connected across the circuit at intervals along its length. Each core shares the available coolant and heat equally, resulting in increased heating efficiency and decreased coolant restriction.

PARALLEL PLUMBING

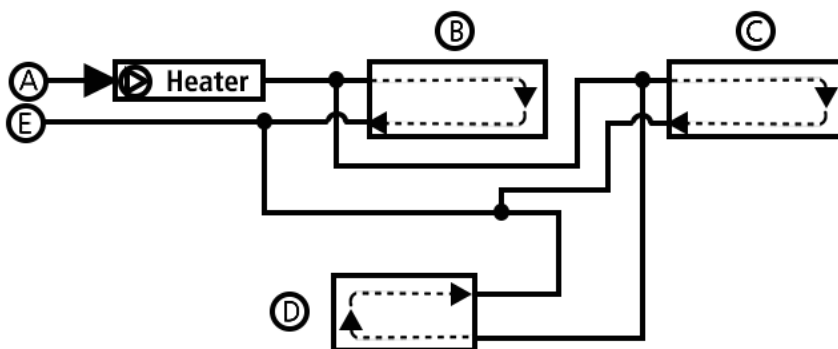


Fig. 401: Parallel Plumbing Circuit (Shown with heater installed)

A - Supply from engine
B - Hydraulic tank heat exchanger
C - Fuel tank heat exchanger
D - Cab heat exchanger
E - Return to engine

B: Heat exchangers arranged in Series (fig. 402)

WARNING

When working on the coolant system, allow the engine to cool down and open the radiator cap following the manufacturer's instructions.

CAUTION

The heater relies on coolant flow to transfer heat from the heater to the vehicle's heating system. The coolant pump(s) must be operating and there must be a path for coolant to flow or the heater will overheat.

NOTE

Heater hose must meet SAE 20 R3 specifications. Silicone hose requires special hose clamps. Hose clamps must be tightened to 45 in/lb. (5 Nm) torque.

CAUTION

A path for coolant to flow must be provided when heater is operating.

CAUTION

Water pump(s) must be operating when the heater is in operation.

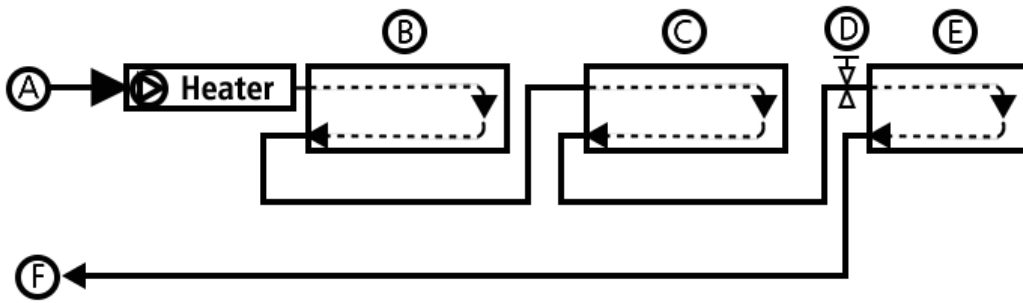


Fig. 402: Series Plumbing Circuit (shown with heater installed)

A - Supply from engine

B - Hydraulic tank heat exchanger

C - Fuel tank heat exchanger

D - Cab heat exchanger

E - Return to engine

F - Return to engine

A fuel fired coolant heater used in conjunction with a coolant pump can significantly increase the available heat and coolant volume supplied to both series and parallel systems increasing interior heating efficiency. With the addition of a timer, the above systems can also provide pre-heating capability.

C: Engine pre-heating (fig. 403)

This type of installation is used where engine pre-heating is required. The heater can be installed across the heating circuit before any of the vehicle heat exchangers, or installed independently of the vehicles heating circuit by plumbing directly from and returning back into the engine. Depending on how the heater is controlled (timer, switch, vehicle system), heat can be supplied for engine pre-heating and maintaining system operating temperatures.

WARNING

When working on the coolant system, allow the engine to cool down and open the radiator cap carefully.

ENGINE PREHEAT

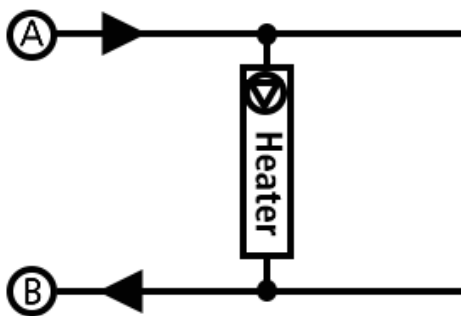


Fig. 403: Engine Preheat/Boost Heating Circuit

A - Supply from engine

B - Return to engine

Instructions for options A, B or C (Typical installations)

On typical systems, the coolant supply will originate at the engine. From there, it will travel through the supply hose to the heater's coolant pump (or vehicle manufacturer supplied boost pump), through the pump and into the fuel fired heater where the coolant is heated during operation. The heated coolant then leaves the heater at the outlet and continues on through the heating system and returns to the engine.

1. Identify the type of system you are working with to determine the appropriate type of installation as shown in figures 401, 402 or 403.
 - find and identify heating circuit supply hose. This is the starting point for determining the type of plumbing configuration you will choose.
2. Connect heater into the system according to the examples shown in figures 401, 402 or 403.

NOTE

Silicone hose requires special hose clamps.

NOTE

Heater hose must meet SAE 20 R3 specifications.

NOTE

Hose clamps must be tightened to to 45 in/lb.(5 Nm) torque.

4.7 Fuel System

4.7.1 General Description

The fuel is drawn from the vehicles fuel tank through a fuel standpipe. This standpipe can be utilized on vehicles with a spare threaded port as shown in figure 404.

NOTE

The heater is equipped with an internal self-priming fuel pump.

4.7.2 Fuel Supply

IMPORTANT!

Keep the submerged end of fuel standpipe at least 2" from bottom of fuel tank.

The fuel standpipe and fuel line must be installed according to these instructions to insure proper heater operation.

CAUTION

If the fuel tank is higher than the heater, the top of the tank may not be more than 20" above the heater.

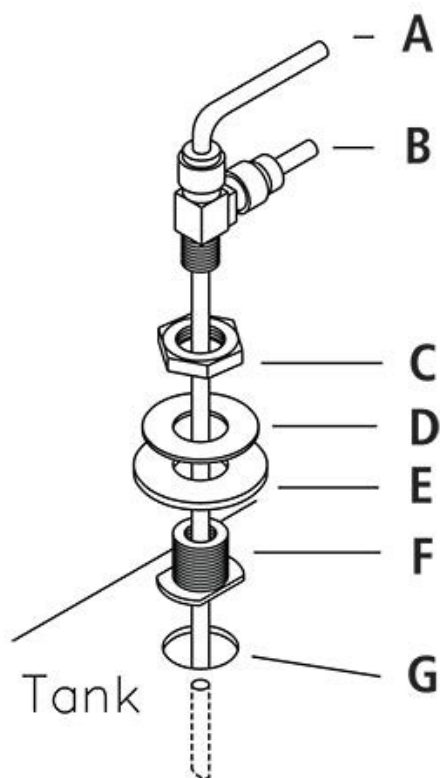


Fig. 404: Fuel Standpipe Installation

- | | |
|-----------------|-----------------------|
| A - Fuel supply | E - Rubber washer |
| B - Fuel return | F - Tank boss |
| C - Nut | G - 1 in. (25mm) hole |
| D - Washer | |

1. Cut fuel standpipe to length, approx. 2" off fuel tank bottom.
2. Install the fuel standpipe.
 - use 1/4" or 1/2" spare port on fuel tank (if available) and install fuel standpipe securely in fuel tank, use pipe thread sealant on all pipe threads.
3. Route and secure fuel lines from heater to fuel tank. Route according to applicable regulations. Use grommets to protect fuel lines whenever routed through holes.
4. Connect fuel lines to fuel standpipe and heater using 1/4" (6 mm) I.D. fuel line. Steel braided fuel lines are recommended for installations where the heater is located in the engine compartment.

NOTE

After fuel standpipe has been cut to length, remove any burrs.

CAUTION

Fuel line must be secured every 12" and kept away from hot exhaust and moving parts (drive shaft, wheels, etc.).

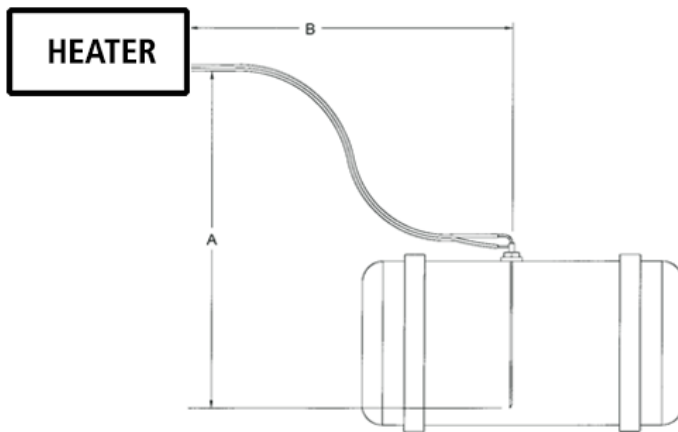


Fig. 405: Fuel Line Parameters

A = Suction height 3'3" (1 m)

B = Maximum permissible length of each suction and return line 49' (15m)

4.7.3 Fuel Filter

The heater is equipped with a fuel filter. Fuel filter requires changing at least annually and in cases of dirty fuel more often.

To prime the fuel filter prior to start up, remove the filter from the filter base with clean fuel. Priming instructions are printed on the filter cartridge.

NOTE

Change the fuel filter at least annually.

CAUTION

To prevent fuel nozzle failure, always use CLEAN fuel from a known CLEAN source for priming fuel systems and filters.

4.8 Wiring Connections

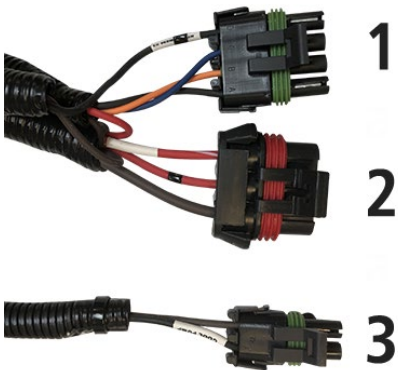
4.8.1 General Information

The control unit is equipped with low voltage protection, therefore it is imperative to keep vehicle batteries in good condition.

IMPORTANT: All power connections must be fused within 14" of the battery.

Thermo E+ 320 heaters are available in 12 or 24 volt configurations.

4.8.2 Heater Connections



NOTE

The heating system will not perform to your satisfaction with weak batteries.

CAUTION

If welding is done on the vehicle, the main battery cables must be disconnected from the battery to protect the electronic control unit.

Fig. 406: Heater connections

- 1 From switch or timer
- 2 From 12V or 24V power supply
- 3 Not used

4.8.3 Timer and Switch Connections

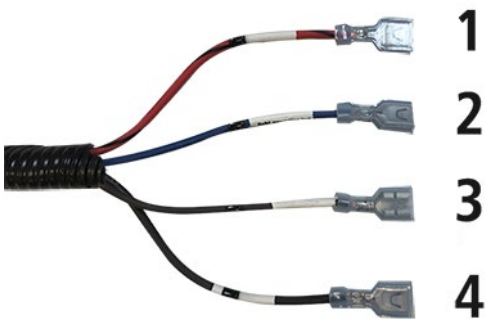


Fig. 407: Timer connections

Harness from heater		Timer		Vehicle
1 - Red	→	1- Red		
		2		
2 - Blue		3 – Gray		
		4 – Yellow	→	Instrument panel illumination *optional
3 - Brown		5 – Brown		
4 - Black		6 – Black		
		7		
		8		
		9 - Purple	→	“Hot in Run” signal

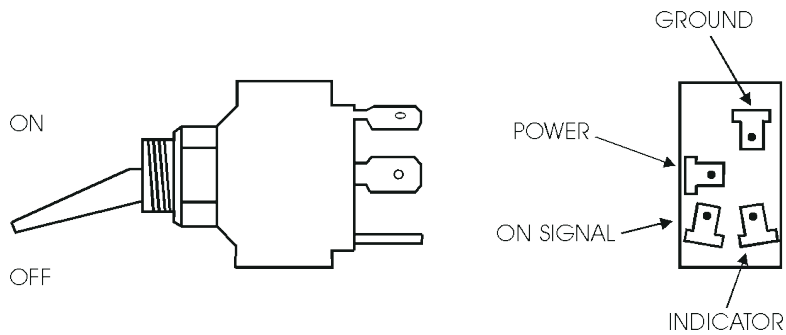


Fig. 408: On/Off Switch

4.8.4 Timer or Switch Installation

1. Select a suitable location in the vehicle for the timer or ON/OFF switch.
2. Connect the harness to the timer, or switch.

4.8.5 Battery Connections

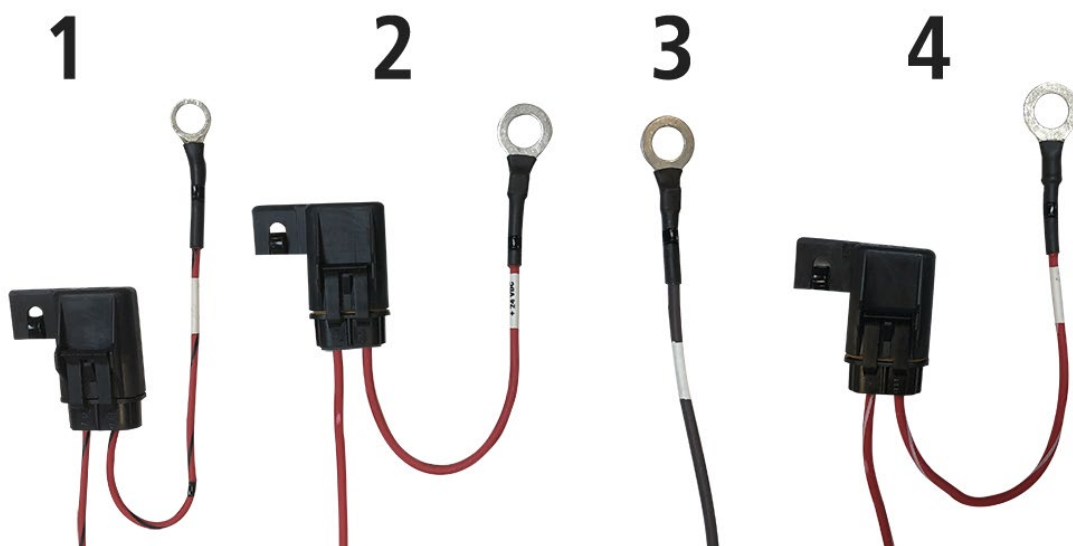


Fig. 409: Battery connections

- | | | | | | |
|---|-----------|-----------------------------|---|-----------|--|
| 1 | Red/Black | 5 amp (battery connection) | 3 | Brown | Ground (vehicle ground point)
25 amp (battery connection) |
| 2 | Red | 25 amp (battery connection) | 4 | Red/White | |

4.8.6 Harness Integration Information

Webasto Connector		Mating Components	
Connector X1		Description / Quantity	Part Number*
	A = Ground	→ 1 X Plug Housing	Delphi – 121214685
	B = Power	→ 2 X Terminal	Delphi – 12052456
	C = Not used	→ 2 X Seal	Delphi – 15324994
Connector X2		Description / Quantity	Part Number
	A = ON signal	→ 1 X Plug Housing	Delphi – 12015797
	B = Not used	→ 2 X Terminal	Delphi – 12124580
	C = Status Indicator	→ 2 X Seal	Delphi – 15324984
	D = Not used	→	
Diagnostic Connector		Description / Quantity	Part Number
	Diagnostic Connector (w/dust cap)	→ Valeo Diagnostic Interface	See Thermo E+ Service Parts documentation

* For current part numbers refer to Delphi.

Fig. 410: Webasto connectors with mating component connectors

4.8.7 Wiring Diagram - with Switch

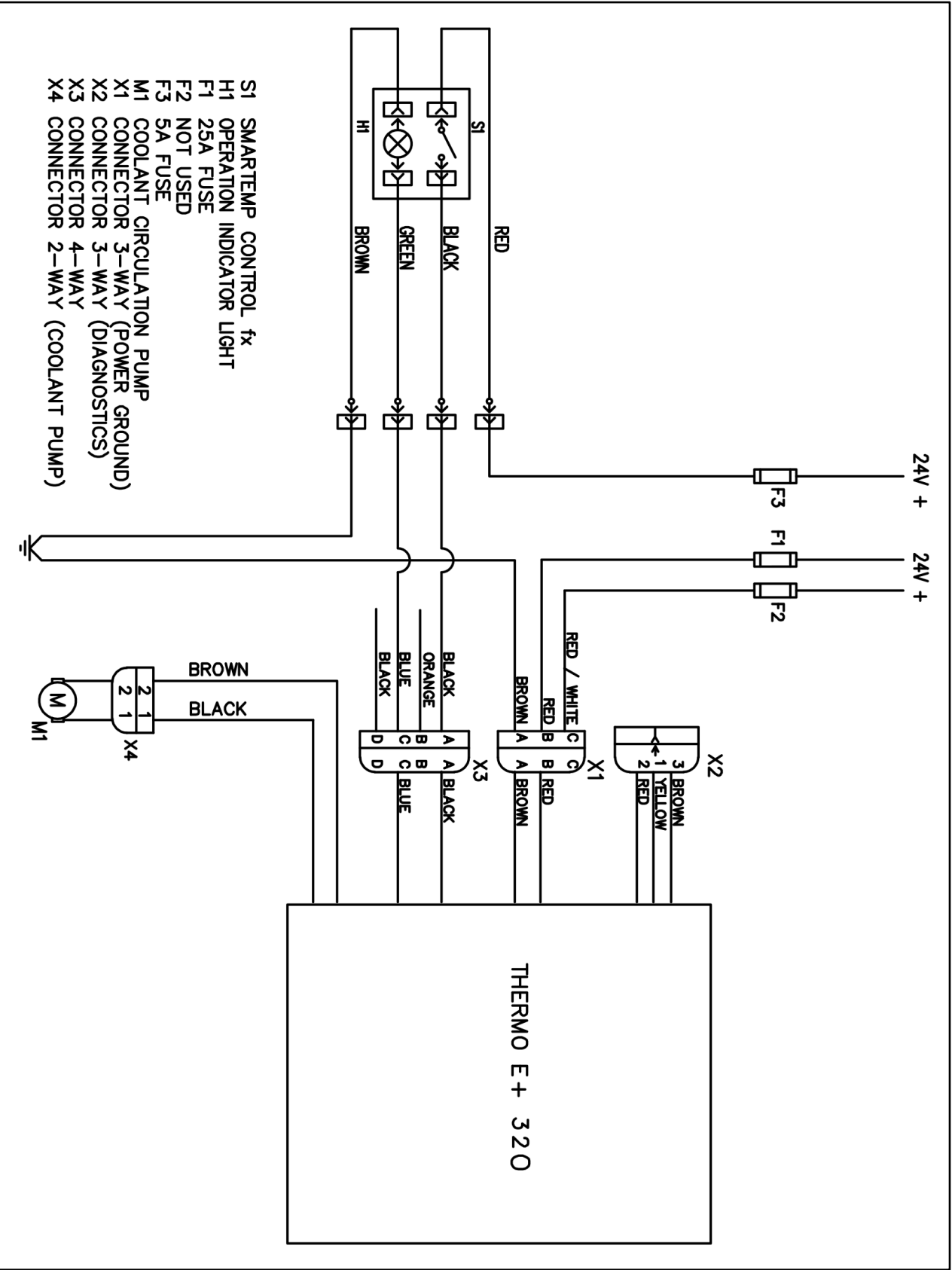


Fig. 411: Wiring Diagram with ON / OFF Switch

4.9 Initial Operation



HEATER MUST BE SWITCHED "OFF" WHEN REFUELING AT FILLING STATIONS AND/OR WHILE LOADING OR UNLOADING FLAMMABLE MATERIALS FOR TRANSPORT, TO PREVENT THE RISK OF EXPLOSION. PLEASE REVIEW OWNER'S MANUAL FOR SAFETY AND USE INSTRUCTIONS.

Prior to starting heater for the first time, completed the checklist below.

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

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

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

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

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

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

HEATER FUNCTION		Complete (Yes/No/Comments)
1	Ensure heater starts and runs for a minimum of 20 minutes.	
2	Ensure timer (control device) is functioning.	

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

NOTE:

Installation with long fuel lines may require a second start attempt to initially prime the fuel system. Cycle ON/ OFF switch or timer to reset control unit.

NOTE:

Coolant temperature must be below 158° F (70 °C) to start up heater.

NOTE:

The engine temperature gauge may read a lower temperature than actual coolant temperature at heater outlet. This difference depends on the location of the temperature sensor on the engine in relation to coolant flow.

5.0 Maintenance of the Heater

5.1 Annual Maintenance

The heater requires a minimum of maintenance to operate. To keep your heater in service the following maintenance procedures should be performed annually before each heating season:

Enclosure Area

- clean the heater and enclosure area from any accumulated debris or dust with compressed air
- inspect all components for wear and damage

NOTE

For major repairs and spare parts, return to your authorized service center.

Electrical System

- check wiring harnesses for damage, fix or replace if required
- check condition of the batteries and connections.
- Load-test batteries and replace if necessary.

NOTE

The heater will not function properly with weak batteries.

Exhaust System

- check the exhaust system carefully for restrictions or corroded areas. Replace exhaust pipe if necessary.

Fuel System

- change fuel filter and inspect fuel lines for wear and damage. Repair or replace if necessary.

Burner System

- remove the burner head, clean flame detector (photo eye), pull out combustion chamber and inspect and clean heat exchanger. Replace nozzle if necessary (annually). Re-install combustion chamber and reinstall burner head.

NOTE

Operate your heater at least once a month for 20 minutes.

Operation Test

- Run your heating system for at least 15 minutes.
- Check water and fuel connections for leakage. Re-tighten clamps and fittings if necessary.

6. Basic Troubleshooting

6.1 General Information

This section describes troubleshooting procedures for the Thermo E+ 320 coolant heater.

Troubleshooting is normally limited to the isolation of defective components.

CAUTION

Troubleshooting requires profound knowledge about structure and theory of operation of the heater components and should only be performed by skilled personnel.

NOTE

After any correction of a defect a functional test has to be performed in the vehicle.

NOTE

Coolant temperature must be below 162°F (72°C) to start up.

Before troubleshooting, check for and eliminate these defects:

- **fuel supply (plugged fuel filter)**
- **corrosion on battery terminals**
- **blown fuses**
- **corrosion on electrical wiring, connections and fuses**
- **loose contacts, or improper crimping on connectors**
- **shut down initiated by temperature limiter thermostat (automatic reset)**

6.2 Operational Failure Symptoms (reading the flash code)

A flash code will be generated on the indicator light of the control Switch or timer in the event of an operational failure. In order to make a correct analysis it's necessary to understand the flash code event. The flash code event is only visible during the after-run (cool down) period of operation.

During the flash code event you will see the following:

Five quick flashes followed by a slower sequence of flashes, the slower sequence of flashes is the fault code. The first five quick flashes are only an indication that a fault code has been registered and will be displayed. Count only the slower sequence of flashes to obtain the current fault code.

For example (flashes = □):

Fault code 3X (F 03): □□□□□ ... □ ... □ ... □ ... □□□□□ ... □ ... □ ... □

The flash code sequence will be repeated during the Thermo E+ 320 after run (cool down) period and will remain visible once heater stops in the lock out mode. Once the heater is cycled "OFF" and "ON" the fault code will no longer be visible on the indicator light but will be stored in memory.

6.2.1 Storing a Fault Code in Memory

Once the Thermo E+ 320 completes the after run (cool down) period initiated by a failure event, the current flash code will be downloaded (stored) in memory.

The Thermo E+ 320 can store up to ten fault codes.

Once the memory is "full", any additional fault code will replace the earliest code stored thereby continually updating the fault codes stored in memory with the four most recent faults.

CAUTION

Troubleshooting requires profound knowledge about structure and theory of operation of the heater components and may only be performed by skilled personnel.

6.2.2 Heater Lockout Reset Procedure

The control unit continuously monitors the heater operation. The control unit identifies errors on individual heater components and faults during operation. Should the control unit experience component errors and operational faults, the heater may be shut down.

NOTE

After any correction of a defect a functional test has to be performed in the vehicle.

Heater Lockout Reset Procedure without Diagnose Thermo Test (DTT):

1. Correct the cause of the lockout condition
2. Switch the heater ON (if not already on)
3. Disconnect the power supply for at least 10 seconds.
4. Reconnect the power supply
5. Switch the heater OFF and then ON again
6. Repeat steps 3 and 4

NOTE

Do not disconnect the power by disconnecting the X1 plug. Disconnect the power and/or ground from the battery.

The heater is now ready for service.

6.3 Operational Failure Symptoms via Fault/Flash Code

The following table lists the possible faults which can be read by flashing code or read directly off of an appropriate timer or with the DTT diagnostics kit.

Failure Symptom (flashes)	Error	Error Description
0X Flash (F 0)	Control device error	- Control device error
1X Flashes (F 01)	No start within safety period	- No start within safety period
2X Flashes (F 02)	Flame interruption	- Flame interruption in burner operation, repeated start unsuccessful
3X Flashes (F 03)	Low voltage / high voltage	- High voltage (> 30V [15V]) for at least 6 seconds - Low voltage (<20.5V [10V]) for at least 20 seconds
4X Flashes (F 04)	Extraneous light in initial or purge cycle	- Extraneous light (flame detector 'bright' in purge cycle 2)
5X Flashes (F 05)	Defective flame detector	- Flame detector short circuit - Flame detector interruption
6X Flashes (F 06)	Defective temperature sensor	- Temperature sensor short circuit - Temperature sensor interruption - Temperature sensor / overheat protection non-plausible - Overheat protection short circuit - Overheat protection interruption
7X Flashes (F 07)	Defective solenoid valve	- Solenoid valve short circuit - Solenoid valve interruption
8X Flashes (F 08)	Defective combustion air fan motor Nozzle block preheater defective	- Combustion air fan motor short circuit - Nozzle block pre-heater short circuit or incorrect pre-heater installed
9X Flashes (F 09)	Defective circulation pump motor	- Damaged wiring, open or short circuit
10X Flashes (F 10)	Overheat protection triggered	- Overheating – at or greater than 284 °F (140 °C)
11X Flashes (F 11)	Defective electronic ignition coil	- Electronic ignition unit short circuit - Electronic ignition unit interruption
12X Flashes (F 12)	Heater lock-out	- Flame interruption counter threshold exceeded - Heater lock-out – release required - Malfunction counter threshold exceeded

Table 601: Operational Failure Symptoms

6.4 Reading and Removing Fault Codes Stored in Memory with the PC Diagnostics Kit and Adapter

It is possible to read and remove (reset) stored fault codes from the Thermo E+ 320 memory using the diagnostic interface connected to the Thermo E+ 320 and a compatible computer with the necessary software installed.

The diagnostic kit comes with software and instructions for use with the Thermo E+ 320.

CAUTION

Diagnostics equipment is intended for use by trained personnel at an authorized distributor, dealer, and end user service facilities.

System requirements:

- Windows 98, 2000, ME, Vista, Win7 or higher
- USB port, 1.1 or 2.0
- 20MB free hard disc space
- CD-ROM drive
- monitor, keyboard (mouse or other pointing device recommended)

In addition to working with stored fault codes, the diagnostic kit allows you to do several other functions such as reading values while the heater is in operation or testing individual components. Printing out fault codes is also available (user-supplied printer required).



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