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## **PREFACE**

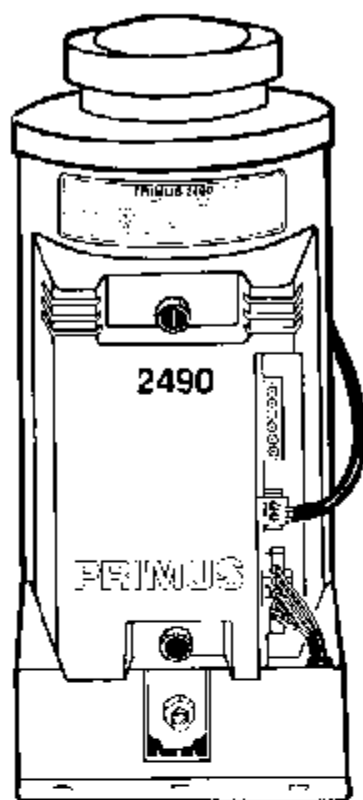
This manual has been produced to help you in servicing and fault tracing Primus Central Heating Systems installed in caravans and mobile homes.

A large number of clear illustrations have been provided to make your job easier. The manual is arranged on the system concept, with separate sections covering Systems 2410, 2450, 2470, 2480 and 2490. The boiler itself forms the base of each system. Most makes and models of caravan currently available on the market fit into this concept.

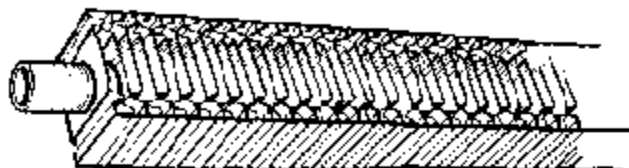
In addition to service information about the various systems, the manual contains information of a more general nature about LPG, LPG installations, mains power supplies, 12V power supplies, caravan heating radiator systems and use of remote control.

## FLUID-BORNE HEATING SYSTEMS IN GENERAL

Fluid-borne heating systems are divided into three main sectors:



HEAT SOURCE: LPG Boiler



HEAT EMISSION: Convection Radiator



HEAT CONTROL: Control Panel and Thermostat

**HEAT SOURCE** is always an LPG fired boiler, but many caravans are also fitted with electrically powered heat sources normally known as mains electric in-line heaters.

**HEAT EMISSION** is almost always via convection radiators. In some cases caravans are fitted with panels on the walls or the floor. Many caravans are also fitted with indirect cylinders (for domestic hot water).

**HEAT CONTROL** inside the caravan is with the help of a thermostat. Both mechanical and electronic thermostats are available.

The thermostat is connected to a control panel from which various different functions can be selected. Electronic thermostats have thermistors that operate as temperature sensors.

The boiler operates on LPG (propane). The heat emission system consists of the radiators, indirect cylinder (for a supply of domestic hot water) and circulating pump.

## FLUID-BORNE HEATING SYSTEMS FROM PRIMUS

Primus fluid-borne heating systems have the following characteristics:

1. The boiler is always located **outside** the living accommodation, in a separate compartment.
2. The boiler is both small and light.
3. The operating pressure of the LPG supply to the boiler is 0.5 bar (7 psi).
4. The boiler operates automatically, with electric ignition.

### THE HEAT SOURCE

The fuel supply is from an LPG cylinder. With a mains electric in-line heater, the supply is from the electricity mains. The various types of gas boiler and in-line heater are described in the sections devoted to the respective systems. In addition to either LPG or a mains power supply, both gas boilers and electric in-line heaters require a 12V DC power supply in order to function. What follows is a description of LPG, LPG installations, the mains power supply and the 12V DC power supply in general terms.

#### LIQUID PROPANE GAS (LPG)



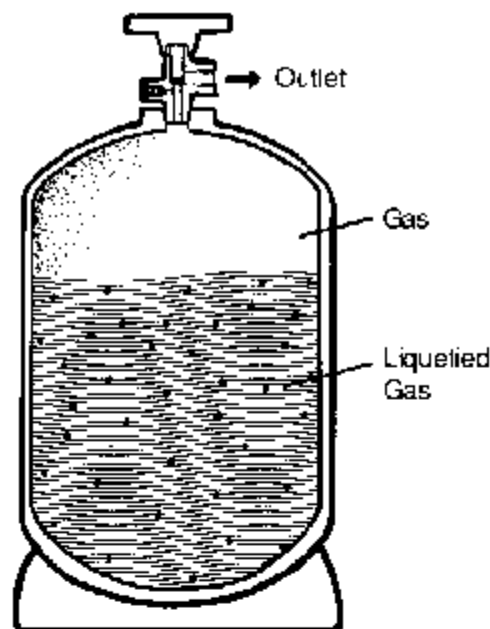
## LIQUID PROPANE GAS (LPG)

Under normal pressure and at normal temperatures, propane is a gas. Inside a gas cylinder, however, the gas is compressed and is in liquefied form. When full, a gas cylinder contains 80% LPG in liquefied form by volume. When the valve on the cylinder is opened, the gas flows through the regulator and pipe or hose leading to the appliance connected to the system.

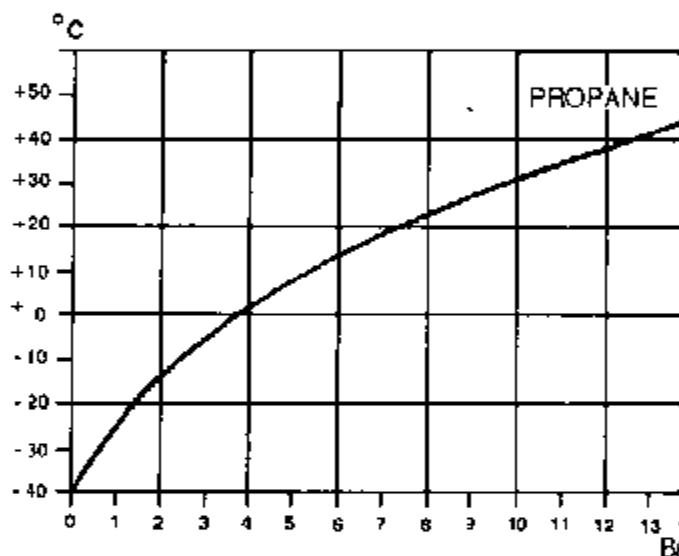
As a result the pressure inside the gas cylinder begins to fall, and more gas is formed, with the volume of liquefied gas reverting to its gaseous form equalling the volume of gas that has been released. The process continues until the last drop of liquefied gas has reverted to its gaseous form.

The most important characteristics of LPG are as follows:

- LPG is not harmful to the environment, does not create soot deposits and does not result in harmful exhausts
- LPG is non-toxic, and is completely free from pollutants and poisonous additives
- LPG has a smell that acts as warning in the event of a leak occurring
- LPG can be stored for any length of time without any deterioration in quality
- LPG is heavier than air, and will mix with the ambient air when released
- LPG can be safely stored in gas cylinders of approved type, subject to regular inspection in accordance with local regulations
- LPG is easy to store in gas cylinders, and can be taken with you and used wherever and whenever required



Cross-sectional diagram of a full LPG gas cylinder



Pressure in gas cylinder at different temperatures

## NEW AND REFILLED GAS CYLINDERS

New gas cylinders, and, **sometimes**, refilled gas cylinders contain a small amount of air, which forms a cushion inside the top of the cylinder. The air may cause problems in starting the boiler, as the result of the boiler reverting to safety mode before an ignitable mixture of gas and air has been created.

The cushion of air inside the top of a gas cylinder must be bled off before the cylinder is connected to the gas regulator. The cushion will expand when the outdoor temperature falls, which means that it takes longer to bleed off when the cylinder is cold.

The valve on the top of a cylinder should be fully open for 5 seconds.

**WARNING:** Bleeding the cylinder should be done with great care. Never point the outlet at anyone, and do not carry out the operation in the vicinity of a naked flame, lighted candles, etc.

## LPG INSTALLATIONS FOR PRIMUS BOILERS

There are separate sets of Instructions for Assembly and Maintenance for each type of Primus boiler.

The following summary contains general instructions and advice relating to LPG installations.

As already mentioned, the pressure in a gas cylinder at any time is affected by the ambient temperature. For propane it is always relatively high.

Primus boilers operate with gas pressures of between 0.2 bar (3 psi) and 0.5 bar (7 psi), while cookers and refrigerators operate with a pressure of 0.03 bar (0.5 psi). The pressure in a gas cylinder is reduced to the operating pressure of the apparatus connected to the system by a gas regulator.

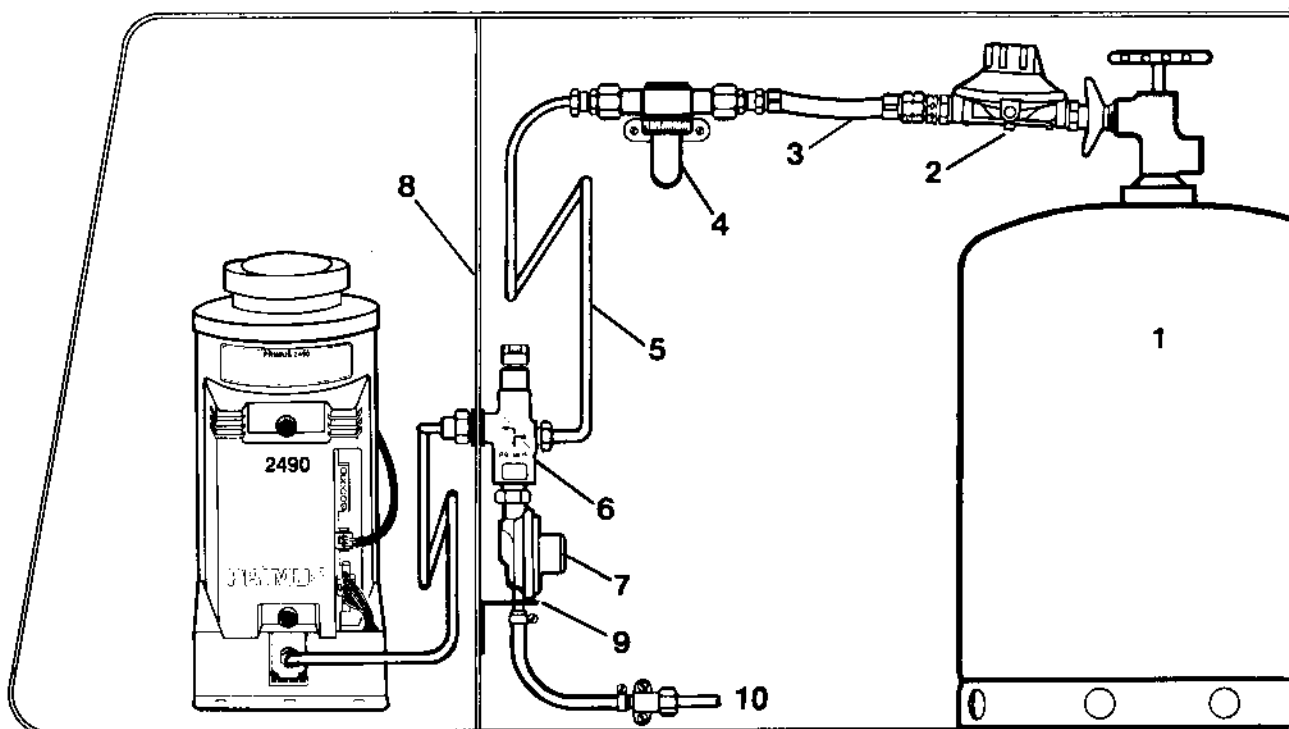
The gas regulator for a Primus boiler is connected directly onto the gas cylinder. The regulator for the cooker and refrigerator is fitted in the gas manifold (please see diagram).

**MAKE SURE THE REGULATORS ARE CONNECTED CORRECTLY!**

- Use only original Primus parts, as approved by the authorities
- Always make connections using Primus approved hoses
- Never use unnecessary force when tightening up connections
- Note that all grooved nuts have left-hand threads
- Always fit copper piping with expansion loops to take up any vibration
- Fit a Primus leak detector on a firm base, and in such a way that its container can be tilted upwards when gas cylinders are in position
- Check that the regulator is always gastight when changing gas cylinders
- Replace any LPG hoses in which cracks have developed in the rubber
- Make a regular check for leaks with the leak detector, brushing connections with soapy water or using a leak spray for the purpose

**NEVER USE A NAKED FLAME IN LOCATING POSSIBLE LEAKAGES**

LPG Installation for Primus Boiler



- |  |         |   |         |
|--|---------|---|---------|
| 1. LPG gas cylinder                    |         | 6. Gas manifold and shut-off valve                      | 7145 01 |
| 2. Regulator, 7 psi (adj 200/500 mBar) | 7190 01 | 7. Regulator, 0.5 psi (30 mBar)                         | 7113 11 |
| 3. LPG hose                            | 7126 50 | 8. Partition wall                                       |         |
| 4. Leak detector                       | 3580 98 | 9. Regulator bracket                                    |         |
| 5. Copper pipe and expansion loop      | 7103 53 | 10. Low pressure connection to cooker, refrigerator etc |         |

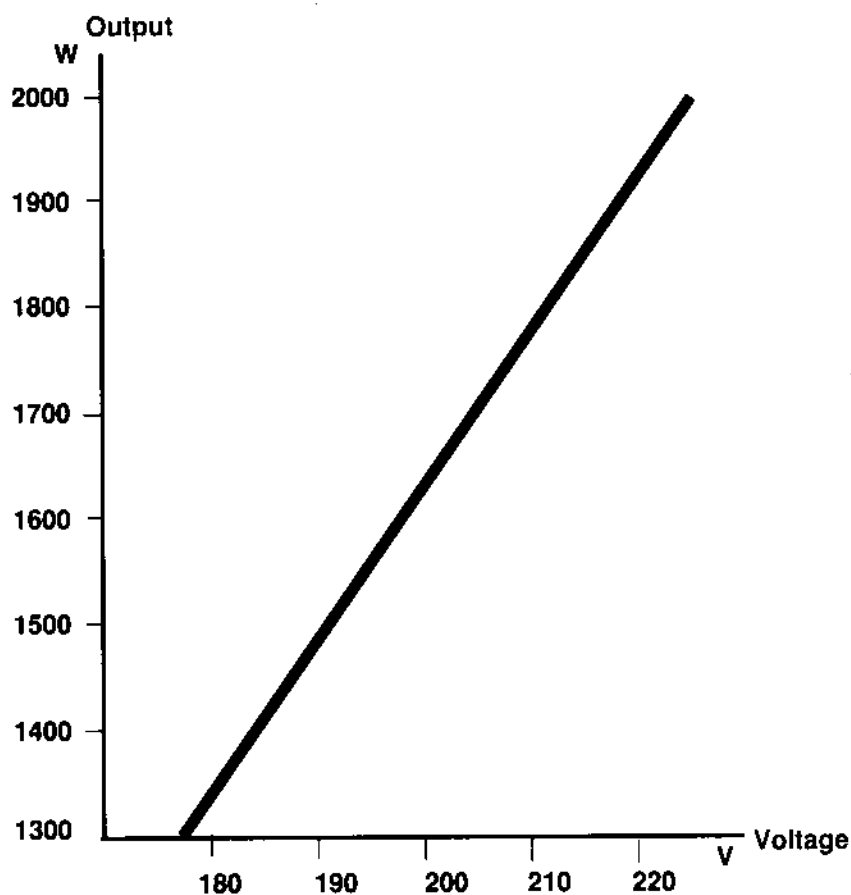
## THE MAINS POWER SUPPLY

An electric in-line heater requires a mains power supply in order to operate.

The in-line heater's output depends on the voltage. A mains power supply will normally be available but, depending on the load on the mains and the length of the connecting cable, there may be a drop in voltage, and this will reduce the in-line heater's output. When comparing output, the actual operating voltage available should always be measured.

The in-line heater installation 220-240 volt is carried out by the caravan manufacturer, and any repairs to it should only be carried out by a qualified electrician.

## IN-LINE HEATER OUTPUT



## THE 12V DC POWER SUPPLY

Primus heating systems require a direct current voltage, which is used as the control voltage for the various operations. The power supply is normally obtained from the caravan's 12V battery, which is charged by a battery charger when the caravan is connected up to the mains supply or by the towing vehicle's alternator while under way. (vehicle fitted with split relay)

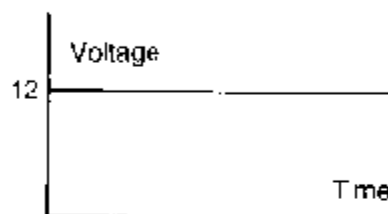
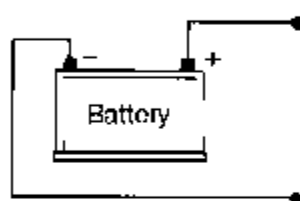
A battery on its own delivers a DC power supply (Fig. a).

A battery charger on its own delivers a pulsed DC power supply with a top value of 18V-20V (Fig. b).

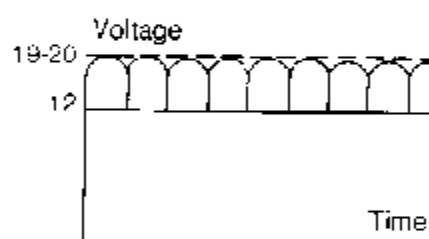
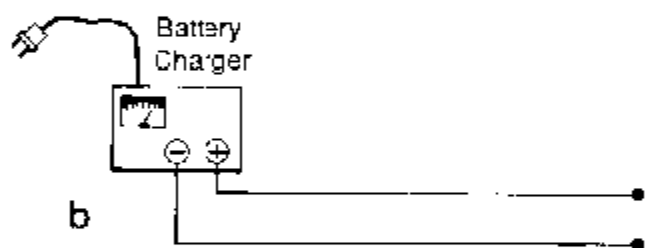
A battery in good condition when connected to a battery charger will deliver a DC power supply that will increase so long as the battery charger is working. The battery functions as a filter (condenser) for the pulsed DC power supply (Fig. c).

A battery in poor condition when connected to a battery charger will not filter effectively. The DC power supply will be somewhat pulsed, and will have a high value (Fig. d).

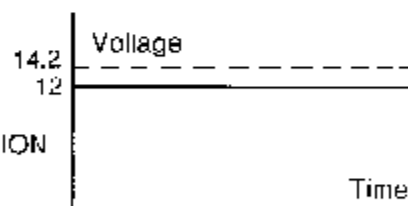
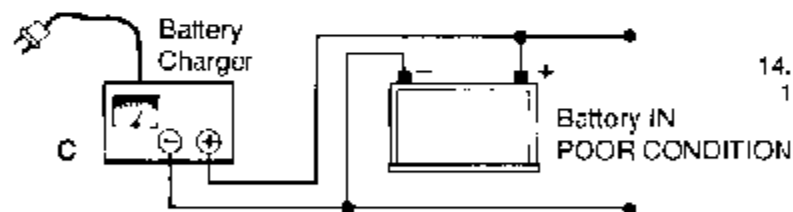
a



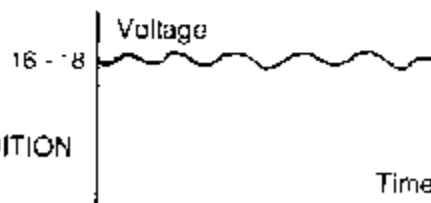
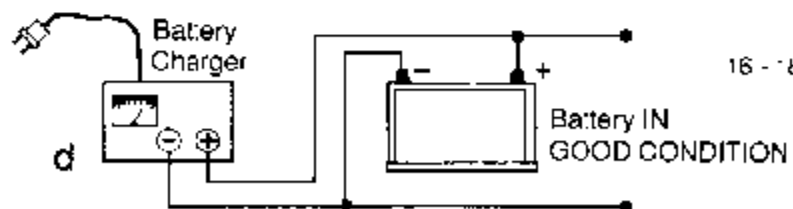
b



c



d





Most Primus boilers are fitted with electronic control units. These require a DC power supply that can vary between 10.5V and 14V. There are usually a number of other electronic appliances in a caravan, and these too require a DC power supply. Never use a caravan without making sure that a battery in **good condition** is connected.

**Never connect appliances directly to a battery charger, as this may damage the electronics.** The only exception to this is the Primus 2490 boiler.

Where a caravan is to stay parked for a long period of time, the battery should not be disconnected if the mains power supply is to be connected later, i.e. when the only power source is a battery charger.

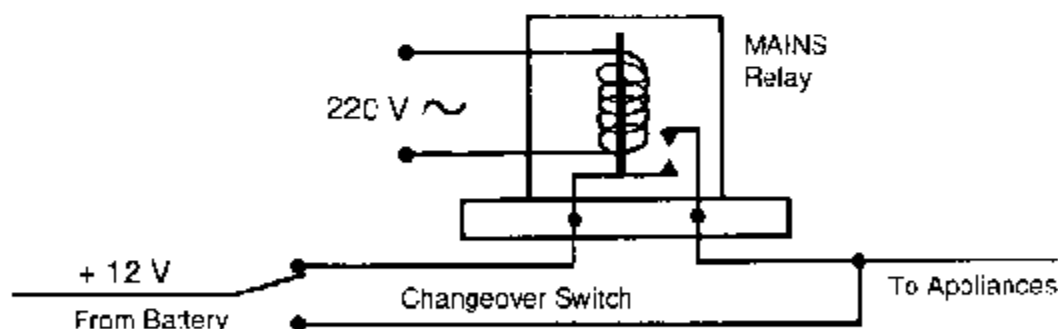
Fully charged batteries not connected to any appliance may be stored without any problems, even in extremely cold conditions. Changeover connections as described below should therefore **always** be used during long-term parking.

## REMOTE CONTROL

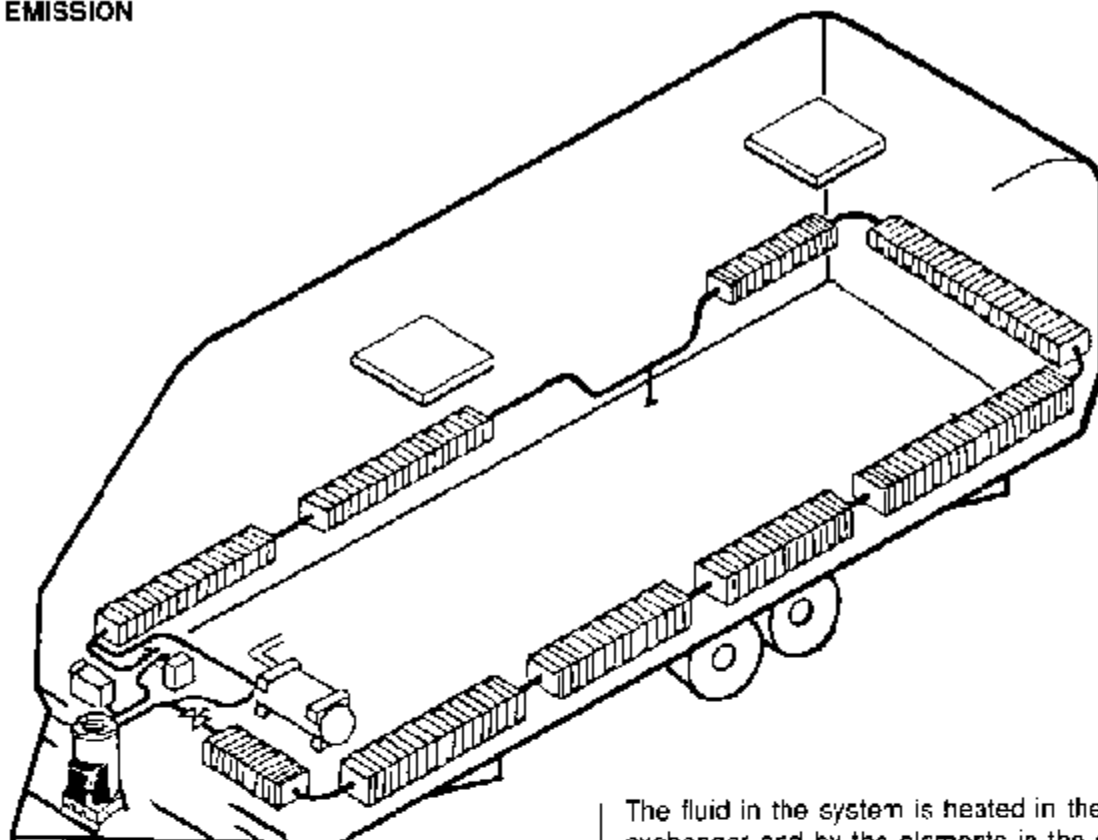
Where a caravan remains parked for a long period of time, and heating is to be connected from outside via a mains cable, the caravan should be fitted with a changeover connection that will bring in the 12V power supply only when the power supply is connected.

The reason is that the 12V relays, for example those in control panels and electric in-line heaters, will run the battery flat if it is left uncharged for any length of time. Many caravan manufacturers have produced changeover connection kits for this purpose, and these should be used.

Where no changeover connection kit is available, use the connection illustrated below. Connection is via the mains cable from the battery's + terminal.



## HEAT EMISSION



Heat emission systems include convection radiators, indirect cylinders, circulating pumps and header tanks. Indirect cylinders and circulating pumps are dealt with in the sections devoted to the respective systems.

**Convection radiators and heat sources are connected in series** along a single-pipe system. **Indirect cylinders are connected in parallel** with the heat sources.

The **highest point** in a system must be the header tank, which takes up the fluid's expansion when it is heated. The fluid is usually a 60:40 mixture of water and glycol, and is circulated through the system with the help of a circulating pump that provides a rate of flow of approx. 3.6 litres per minute, depending on the size of the system.

The pump is usually located in the boiler return line.

The **lowest point** in a system is at the drain, which can be used for both draining and filling. For the system to function properly, **the convection radiators must be installed level**, with the high points connected to the header tank so that the system can be vented automatically. If there is a high point in the system that cannot be connected to the header tank, a bleed valve must be fitted.

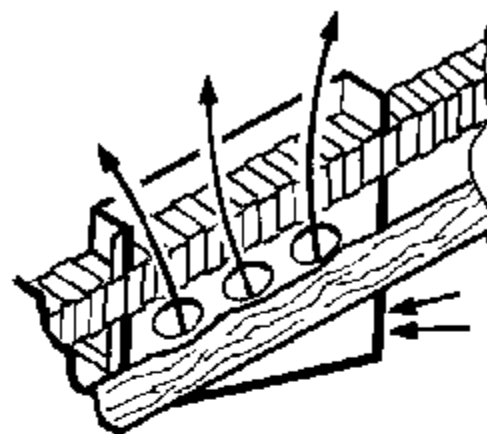
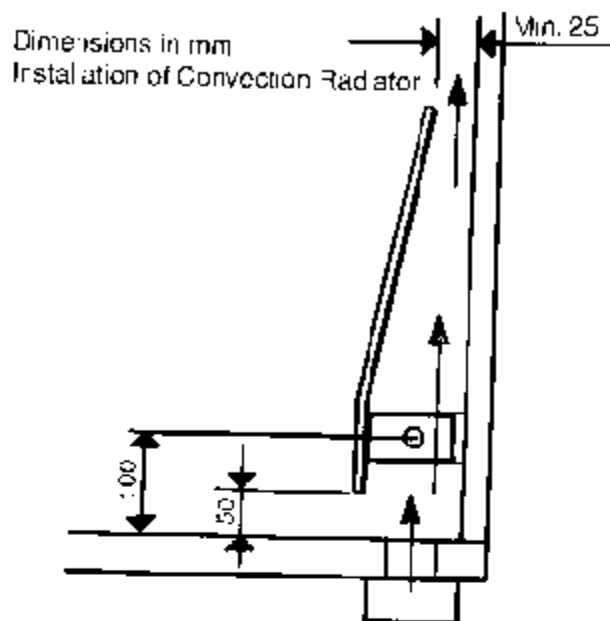
The fluid in the system is heated in the boiler's heat exchanger and by the elements in the electric in-line heater. The heat is emitted via the convection radiators. These heat up, and then heat the surrounding air. The warm air rises, and the cold air that takes its place is heated in its turn, thus creating a flow of air through the radiators.

The air needs to be free to flow along the floor and walls and through the convection radiators without encountering any obstruction. Check that ducts are clear from the floor of the caravan to its roof, to ensure that the heating system functions as it should (please see diagram overleaf).

Fresh air enters the caravan through the floor, and should pass through a convection radiator before mixing with the air inside the caravan, to avoid cold draughts (please see diagram overleaf).

### TECHNICAL DATA: HEAT EMISSION

Fluid	Water-Glycol	60:40
Fluid Volume:	Radiators	0.3 litres per metre
	Boiler	1.5 litres
	Electric In-line Heater	1.5 litres
	Header Tank	1.5 litres (fill to 0.75 litres)
	Indirect Cylinder	0.5 litres
Operating Temperature:	75°C - 80°C	
Rate of Flow:	3-3 litres per minute	



Fresh Air Intake

## SETTING THE TEMPERATURE

Caravans fitted with central heating systems are also fitted with thermostats with the help of which the occupants can set the room temperature at the level required. The thermostat controls the operation of the heat sources.

In caravans fitted with indirect cylinders there is also a thermostat on the indirect cylinder that controls the temperature of the water at 70°C.

Primus central heating systems have **two types** of room temperature thermostat, one **mechanical** and the other **electronic**.

With **mechanical thermostats** the fluctuations in temperature are approx.  $\pm 2^{\circ}\text{C}$ . The boiler will operate intermittently.

**Electronic thermostats** have separate temperature sensors (thermistors), and regulate the temperature on a time proportional basis, resulting in very small fluctuations in temperature levels (approx.  $\pm 0.5^{\circ}\text{C}$ ).

The boiler will operate intermittently, providing an accurate temperature level. Since regulation is on a time proportional basis, running times can sometimes be very short (1-2 minutes).

Whether mechanical or electronic, a thermostat forms part of the system's control panel, from which it controls all the heat sources.



Electronic Thermostat



Mechanical Thermostat

## FAULT TRACING: GENERAL

Always start by finding out which system a caravan is fitted with. Then use the section of the manual devoted to the system in question.

Occasionally, the installation may be a combination of different systems. Reference to the relevant sections of the manual will nevertheless enable you to trace any normal fault.

Next, try to establish as quickly as possible in which of the system's three main sectors (heat emission, heat source or heat control) the fault has developed:

Follow this routine:

### SYMPTOM

The boiler starts, but the fluid remains cold

The boiler starts, but the fluid boils

The boiler starts, but stops after 10 seconds to 2 minutes

The solenoid valve keeps opening and closing

The warning LED in the white triangle is lit but the gas has not run out

The boiler does not start when the START button is pressed

The LED's on the thermostat panel flicker or hum

The LED's on the thermostat panel are lit without the functions being selected

### CHECK:

Heat Emission

Heat Emission

Heat Source

Heat Source

Heat Source

Heat Source

Heat Control

Heat Control

The above list describes some of the more common symptoms, but obviously does **not** cover all the symptoms that may occur.

By establishing in which of these sectors the fault has developed, you will be able to save yourself time in tracing the fault itself.

## SERVICE HINTS

When in doubt, you will find these service hints useful. Follow them, and you will find it much easier to identify the fault.

### HINT NO. 1

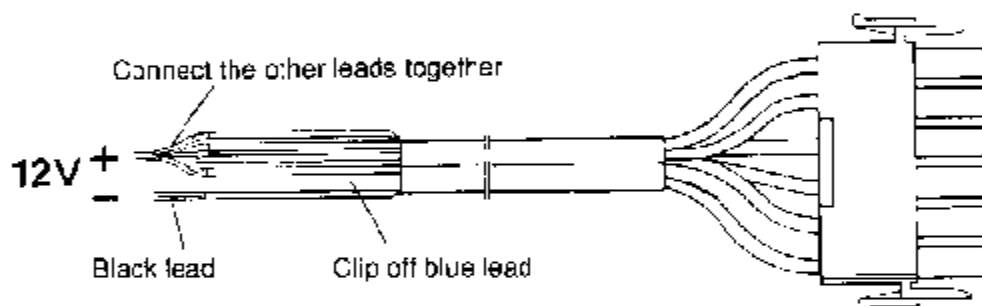
If you suspect that the problem in the system lies with the boiler itself, apply the following test:

- Check that there is still a supply of gas in the gas cylinder (new cylinders should be bled as already described), and that the power supply from the battery is the correct voltage
- Connect the mains power supply from a separate battery (NOT A BATTERY CHARGER) direct to the boiler
- For Systems 247C, 2480 and 2490 use a connecting cable of the type shown below

If you do not have a cable of this type available, order one from your Primus agent (Part No 7303 12).

If the boiler starts when you connect it directly to the separate battery, the defect is in the 12-volt control system. Continue trying to trace the fault in this part.

If the boiler does not start, the defect is in the boiler itself. continue trying to trace the fault by reference to the schedule for the type of boiler in question.



### HINT NO. 2

If you are not immediately certain whether the fault lies in the pump, the following check is useful:

Many caravans are fitted with a plastic bleed hose that runs from the boiler's vent to the header tank.

Start the boiler, and then disconnect the pump cable. The level of fluid in the bleed hose should now drop. Reconnect the pump cable, and check to see whether the level of the fluid rises. If it does, there is nothing wrong with the pump.

Some caravans have the header tank inside the caravan, which means that this check cannot be carried out. Where this is the case, fit a length of plastic hose onto the boiler vent. Lift the other end of the hose so that it is higher than the level of the fluid in the header tank. Then check the level of the fluid, as above.

### HINT NO. 3

With an electronic thermostat it is easy to check whether the thermostat itself is defective, or whether the fault lies in the thermistor, by pressing the HOT WATER button on the control panel. If the boiler then starts, it is almost certain that the fault lies in the thermistor.

You can carry out this check even if the caravan is not fitted with an indirect cylinder.

### HINT NO. 4

If none of the parts operate and the system appears to be dead, the fault is usually a very simple one. Always start by checking the power supply, fuses etc.

If after following these hints you have still not been able to remedy the fault, refer to the fault tracing schedule for the relevant system.