Water Heaters – Troubleshooting and Technical Guide

1. INTRODUCTION

The following sections discuss water heaters specifically, but are also applicable to combi boilers.

For a water heater to function to its full potential it is essential that it is connected to an adequate gas and water supply. It must also have adequate ventilation and flueing and be protected from sources of contamination which can be airborne or waterborne.

A water heater is a relatively powerful appliance whose output is easily measured by the end user (i.e. how hot the water is). Any drop in performance will be noticed and blamed on the water heater. In reality the cause of the problem will often lie in the quality of water or gas supply to which the appliance is connected.

Only competent Corgi registered installers should be employed to work on a gas installation. This is for the safety of the consumer and any work carried out by an unregistered, unqualified fitter may be in breach of the Gas Safety (Installation & Use) Act 1998.

2. GAS SYSTEM DESIGN

PIPEWORK

It is important to use the correct size of pipe to avoid excessive (more than 2.5mbar) pressure drops as this will result in poor performance. For example, a heater which is supposed to be running on propane at 37mbar may, due to the pipe work being too small and restrictive, be receiving only 30mbar pressure when the main burner is operating. This means it is receiving only two thirds of the gas it requires. In other words, a boiler which should be producing 11.1 kilowatts is now firing at only 7.4 kilowatts. As a result it will produce only warm water instead of hot.

There are accurate pipe-sizing charts published in the Corgi handbooks which give a guide as to how many kilowatts can be carried by any given length and diameter of pipe for a certain pressure drop. Remember to include the kilowatt input of other appliances in the system such as gas fires and cookers.

PIPEWORK LAYOUT

This is important. Avoid putting the water heater at the end of a long gas pipe run as this will cause two possible problems:

- Large bore pipe may be needed
- It will take a long time to purge the air from the long pipe run when trying to light the pilot.

The ideal layout is to put the water heater first in line from the gas inlet. This means the largest bore pipe (which has to carry gas for the water heater, cooker and fire etc.) has the shortest run.

Gas can be purged through the system quickly and easily past the tee to the water heater, by lighting a cooker burner. It will then take the minimum possible time to light the pilot as there is only the short pipe run from the supply pipe branch to the water heater to purge.

REGULATOR SELECTION

There are two types of gas supply:

- 1. For bulk tank installations the final stage regulators and safety devices will be specified and installed by the contractors. The end user or commissioning engineer will have little or no choice.
- 2. For a bottle installation there is a wide choice available from very cheap single appliance types to expensive automatic changeover regulators.

There are three main parameters when specifying a regulator:

- 1. Gas type e.g. Propane
- 2. Pressure, for Propane this is 37 millibar
- 3. Capacity or flow rate. This may be stated in:
 - Kg per hour
 - cubic feet per hour
 - Cubic metres per hour.

A suitable size for a Caravan Holiday Home is 4kg per hour (75 cu. ft. per hour, or 7.5 cu. m. per hour).

The outlet should be 3/8 inch BSP and not a molded hose tail. Anything with a molded hose tail will be a small capacity, say 1.1 kg/hour, and designed for use with a single appliance.

REGULATOR CONNECTION

Over the past years it has been common (and incorrect) to use a low pressure rubber hose and a pair of hose nozzles to connect a bottle/regulator to a Caravan Holiday Home. This will give a typical pressure drop with a small water heater of 3 to 4 millibars depending on nozzle size. Because all appliances are not normally run simultaneously there may be no noticeable lack of performance in practice, but there will most definitely be if this system is employed where an 11 litre boiler or a combi boiler is fitted, as these consume more gas.

GAS SYSTEM PERFORMANCE CHECKS

If the system has been designed and installed correctly there will be a 2.5 millibar (or less) pressure drop at each appliance. This is when all are working simultaneously at full power. This depends on the following factors being correct:

- Pipe Sizing
- Absence of Restrictions or Blockages (caused by jointing compound etc.) Correct Regulator Selection
- Correct Regulator/Bottle Installation

To test the system:

- 1. Carry out a standing pressure test with only the water heater pilot burner lit.
- 2. Adjust the regulator if necessary
- 3. Then light all the burners and set the boiler running at its maximum setting.

There should be no more than a 2.5 millibar pressure drop at the water heater. A greater pressure drop will cause a noticeable drop in performance of the water heater. Performance will continue to worsen as the pressure drop increases.

3. WATER SUPPLY

INTRODUCTION

The water heater requires a clean potable (i.e. drinking quality) water supply at sufficient pressure to give a minimum operating pressure at the inlet of 1 bar, and a maximum standing pressure of 10bar.

Any contamination such as calcium carbonate (hard water) or other dissolved salts (as in bore water) will shorten its working life.

Any physical contaminants such as sand, gravel, rust flakes, jointing compound, silicone sealant, swarf etc. may cause catastrophic damage, resulting in the water heater mechanism jamming. (There is an effective water filter fitted to all Morco water heaters, but you should check it is not lost during installation).

Likewise, high standing pressure of over 10bar, which may cause hydraulic shocks when shower levers and taps are operated, can also cause severe damage and jamming.

Low water pressure will not cause any danger, but the water heater may not operate correctly.

In areas of high water pressure (over 6bar) where the standing water pressure could easily exceed 10Bar during periods of low draw off, we recommend the fitting of a pressure reducing regulator (PRV).

A PRV will protect the system from excessive pressure, save water, reduce initial surge, eliminate excessive noise and banging in the pipe work and stop the water jumping out of the basin into your face. They are inexpensive and easy to fit in line on the mains 15mm feed. **NOTE:** Turning the stopcock nearly off is not the same; it will reduce the flow rate but not the standing pressure.

CHECKING AVAILABLE WATER PRESSURE

Just like the gas system there are two measurements to take:

- 1. Static pressure (head)
- 2. Operating pressure.

Static pressure may be measured using a gauge clamped onto a cold tap. The cold tap is opened and a reading obtained.

Operating pressure is more difficult, and requires a tee piece inserting at the cold inlet union of the water heater. When the hot tap is switched off, a static pressure can be read but when the hot tap is open, the pressure will invariably drop and the operating pressure is revealed.

In general the higher the static pressure, the smaller the pressure drop on operation conversely, the lower the static pressure, the bigger the operating pressure drop.

If you come across very high static pressure with a massive pressure drop on operation, this indicates undersize or scaled up mains/supply pipe work (or blockages due to sludge etc). It may be that as the park has expanded and the underground supply pipes have been extended, but not increased in size. To combat the poor flow rate, the local water authority will have been obliged to increase the standing pressure dramatically to improve the flow rate!

CONSEQUENCES OF HIGH/LOW WATER PRESSURE

The main results of extremes of pressure are that the water heater may extinguish when other cold taps are opened, or the shower mixer tap is operated. Very often it will be the performance of the boiler when running the shower which is affected most of all. A large water heater is more likely to be affected by low water pressure than a small water heater. Indeed, a water supply which is adequate for a small boiler with a draw off of only five or six litres per minute may be inadequate to run a large boiler of ten or eleven litres.

LOW PRESSURE

A water heater provides a certain resistance to flow. If the mains pressure is low, it may only be just enough to achieve the minimum flow through the water heater to make it operate. Opening a cold tap, which has little or no resistance, will cause a dramatic reduction in flow through the water heater causing the main burner to extinguish. This is because the limited water supply will follow the path of least resistance through the cold outlet. The only solution is to fit a service valve in the cold tap feeds, so that they can be partially closed to equal the resistance of the cold tap to that of the water heater. In cases of extremely low pressure this will not work, as the available head of water may only be enough to operate the water heater alone. In this case the mains supply will need to be improved, or it may be possible to fit a smaller water heater.

HIGH PRESSURE

This will mainly affect the shower. Assuming the water heater temperature selector is on its hottest setting, some cold will need to be mixed. However the hot water is at low pressure as the regulator inside the water heater has throttled the flow rate considerably, so it will achieve the correct temperature. Turning the cold mixer tap on will create back pressure to the water heater, as both hot and cold compete to escape through the shower rose. Depending on the cold supply pressure and the resistance of the shower rose, the back pressure may inhibit the flow through the water heater enough to make it extinguish before the correct temperature is achieved. The solution may be to use a shower head of less resistance (it may just need descaling if it was working previously), or to fit a service valve to the cold supply to the shower to equal the resistance to that of the hot side. The best solution is to fit a PRV, as the service valve solution may not be able to accommodate any changes in the mains pressure.

4. AIR SUPPLY

GENERAL

There must be an adequate fresh air supply to allow air for combustion and cooling. It should be free of airborne contaminants such as lint etc. For example, avoid pets sleeping in close proximity or storing brushes and cleaning equipment which will provide a source of fluff. A water heater draws in hundreds of cubic feet of air for combustion per hour and could easily become fluffed up in a poor environment. When fitted in a cupboard appropriate warning notices should be posted. Beware also of insect contamination, especially in a unit not used all year round. (See also servicing section.)

VENTILATION

Specific requirements are detailed in the installation manuals - please read these carefully.

5. COMBUSTION GAS REMOVAL (FLUEING)

GENERAL

Specific requirements are detailed in the installation manuals - please read these carefully.

Water heaters should always be connected to a flue and never positioned anywhere where incomplete combustion may be foreseeable, such as adjacent to an unflued appliance or cooker. In Caravan Holiday Homes they should not be installed in bedrooms that are principally designed for sleeping, bathrooms, shower rooms or toilet areas. They may be fitted in principal habitation areas, even those that may occasionally be used for sleeping. Large water heaters, over 14 kilowatts, must not be installed in any room used for sleeping or in a cupboard adjacent to such a room. Refer to the Gas Safety (Installation and Use) Act 1998 for further guidance.

5. COMISSIONING AND TESTING GUIDELINES

INTRODUCTION

Because it is the law that only competent Corgi registered installers should commission a gas installation, no attempt has been made to write a set of commissioning and testing instructions in this document. If you need detailed instructions you are not classified as competent. If you need your memory refreshing then refer to your Corgi or CITB manuals.

CHECKLIST

You should perform the following basic checks. This list is only a guide and assumes the installation is in a Caravan Holiday Home.

- Gas Soundness Test
- Standing Pressure Test
- Operating Pressure Test
- Smoke Spillage Test Of All Flues
- Visual Check For Integrity Of Flues
- Correct Installation and Operation Of All Appliances Correct Ventilation Position and Sizing

COMMENTARY

An operating pressure test is absolutely essential to determine whether a water heater will perform or not. So often we discover that engineers are unfamiliar with this test and do not understand its importance.

Since 1996 when they became CE marked, all open flued appliances contain a device to switch off the gas supply in the event of the flue not clearing the products of combustion. For a blocked flue this device should operate within 3 minutes. Both the pilot and main burner will extinguish and it will not be possible to re-ignite the pilot for several minutes after a shut down. This is because the device is heat sensitive and needs to cool considerably before automatically re-setting itself.

Each appliance should be operated normally and visually inspected by the installer/commissioning engineer. On the water heater special care should be taken to check for any gas/water leaks during operation. The colour and pattern of the burner flames should be checked. On Propane the flame will be near perfectly blue with orange tips, but on Butane the flame colour may be much more orange with some yellow tipping. The flame pattern should be fierce with no laziness at all. There may be some flame lift especially towards the rear of the burner (up to 1/2 inch) which is normal and should reduce as the burner heats up. Lazy yellow/white flames indicate a blocked venturi and should be investigated. If you suspect this check the heat exchanger fins by looking up through the burners. If any soot is forming on the fins as a result of incomplete combustion they will glow red.

6. SERVICING

INTRODUCTION

Annual servicing is more accurately described as an annual check for safe operation. This may result in carrying out a servicing operation if defects are found in the safety check.

Where the unit is fitted in a Caravan Holiday Home it is essential that the annual safety check is carried out at the beginning of the season (for reasons which will become apparent),

An annual safety check is a legal requirement where a unit is hired out or sublet. (Refer to Gas Safety (Installation and Use) Act 1998).

The amount of use an appliance receives does not influence the required frequency of checks. Key influences on the safe and efficient operation of the heater are periods of disuse, such as winter, when it is exposed to:

- Insect (spider) contamination,
- Water ingress
- Damp and freezing conditions

Therefore it is pointless checking an appliance in November (for use in May) when it is most at risk from winter conditions.

WATER HEATERS: WHAT TO LOOK FOR

PILOT

Check correct operation of the ignition system and the condition of pilot flame. The flame should generally be blue, firm, and fully enveloping the thermocouple tip. A short, lazy, or yellow flame will indicate that cleaning of the pilot burner tube and or jet is required.

THERMOCOUPLE

Check that the tip is not encrusted or cracked and that it is enveloped by the pilot flame. Check that the connections are tight. Check for correct operation: The magnetic valve should be released (a click will be heard) within one minute of the pilot being extinguished. Normally it will operate within 20-40 seconds. A gas soundness test should then be carried out to check the integrity of the safety valve seal.

MAIN BURNER/HEAT EXCHANGER

Check both units visually for soot deposits, debris and cracks, leaks etc. Run the water heater and check the flame pattern and colour of the burner. Check for excessive noise and reduced flow rate which may indicate scaling.

Both units may be removed from the water heater without disconnecting it from the wall. Be careful not to lose the brass restrictor washer from the manifold. When replacing this it is best to stick it back into the manifold with a little spit! Otherwise it is a devil to position correctly!

The best way to clean a sooted up heat exchanger is with a pressure washer or outside hose pipe.

When checking the burner venturis the obstruction may be obvious or, in the case of a spider's egg sack, it will be half way down the venturi, may only be 1 mm thick and adhered to the side wall. You will have to look very carefully to spot them. If the heat exchanger is really badly sooted up then the burner flames may have been flowing back around the burner and up the outside of the heat exchanger. The burner will have got very hot and the obstruction may have burnt away. **NOTE:** A blocked venturi restricts the <u>primary</u> air supply and causes sooty yellow burner flames. A blocked or sooted up heat exchanger restricts <u>secondary</u> air and also causes sooty yellow flames on all the burners. You must check and clean both at the same time.

OPERATION AND PERFORMANCE

Check the correct operation of all the controls and check that the water heater ignites and shuts down correctly when the hot tap is operated.

Check the performance against its specification. To do this, first carry out an operating pressure test on the gas system. You should use the inlet pressure nipple on the water heater and check for a pressure drop when the heater is firing on full power.

The temperature rise may be checked with a thermometer.

The best way to check the flow rate is to fill a container with an appropriate amount of water from a measuring jug so a level line can be marked. Set the heater running and place the container under the tap and record the time it takes to fill to the line. For example, to check a five litre boiler which has a flow rate of 2.5 litres/min at the hot setting, it should fill a 2.5 litre container in 1 minute. You should expect an accuracy of plus or minus 5 seconds.

FLUE

Check the flue for signs of deterioration damage or blockage. Run the water heater at maximum power for 15 minutes and carry out a smoke spillage test. If a room extractor fan is fitted repeat the test with all the windows and doors closed and the extractor full on.

Check the operation of the combustion products discharge safety device (C.P.D.S.D) by blocking the flue with a plate. The water heater must shut down within 3 minutes. Normally for a Morco it will take 11/2 minutes and a Paloma 1 minute 15 seconds. Wait until the device has cooled down and reset itself and check that the heater works normally once again.