

**IMPORTANT NOTE**  
**THESE INSTRUCTIONS MUST BE READ  
AND UNDERSTOOD BEFORE INSTALLING,  
COMMISSIONING, OPERATING OR  
SERVICING EQUIPMENT**



Heating *at work.*

# **Purewell VariHeat c Boilers**

**Cast Iron, Pre-mix, Condensing, Modular Boilers with  
Automatic Ignition for Heating and Domestic Hot Water  
Installations**

## **Installation, Commissioning and Servicing Instructions**

MODELS - 70c, 95c, 110c, 140c & 180c

*NATURAL GAS I<sub>2H</sub>*

**NOTE: THESE INSTRUCTIONS MUST BE READ AND UNDERSTOOD BEFORE  
INSTALLING, COMMISSIONING, OPERATING OR SERVICING EQUIPMENT.**

THE PUREWELL BOILER IS INTENDED FOR USE AS A COMMERCIAL APPLIANCE AND IS  
NOT CERTIFIED FOR USE IN DOMESTIC APPLICATIONS.

**THIS BOILER IS FOR USE ON GROUP H NATURAL GAS (2<sup>ND</sup> FAMILY) I<sub>2H</sub> PLEASE  
ENSURE RELEVANT INFORMATION REQUIRED WITHIN DOCUMENT IS FOUND  
BEFORE FIRING BOILER.**

THIS BOILER COMPLIES WITH ALL RELEVANT EUROPEAN DIRECTIVES.  
PRODUCT IDENTIFICATION No. 87BQ057

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## **1.0 INTRODUCTION**

**1.1** A competent person holding 'CORGI' registration or equivalent must install this boiler. All installations **MUST** conform to the relevant Gas Safety and Building Regulations. Health & Safety requirements must also be taken into account when installing any equipment. Failure to comply with the above may lead to prosecution.

**1.2** These instructions are for Group H Natural Gas (2nd Family) only. The information relating to Natural Gas firing is to be found in Appendix 'A'. Boilers **MUST NOT** use gas other than that for which they were designed and made.

**1.3** The Purewell VariHeat is a fully modulating, pre-mix condensing, gas fired boiler manufactured from horizontal cast iron sections, connected to an economiser located in the base of the boiler. The boiler is floor mounted and is intended for the heating of Commercial and Industrial premises. It may also be used to supply hot water for these premises via an indirect cylinder.

**1.3.1** Each boiler module has a dedicated microprocessor based boiler management system, controlling and monitoring all safety and functional aspects of the boiler performance and its integration with external system controls.

**1.3.2** The Purewell VariHeat boiler is delivered to site fully assembled fitted with its casing and controls. Care should be taken when manoeuvring the boiler into position to avoid damage.

**1.3.3** Each of the boiler models is designed for direct connection to a flue system. The flue system must be suitable for pressurised wet operation. The flue outlets from more than one unit may be connected to a single chimney. No draught diverter is fitted to the boiler nor is a fixed diverter required in the flue system. However a draught stabiliser is recommended for some installations—see Appendix 'C' (Page 44).

**1.3.4** The Purewell VariHeat has a low water content and minimum flow rates **MUST** be maintained above the recommended levels shown in Appendix 'E' (Page 48)

**1.4** If the boiler is to be connected to an un-vented (pressurised) heating system, care must be taken to ensure all extra safety requirements are met and that the relevant interlocks will shut down the boiler(s) should a high or low pressure fault occur.

The pressurisation unit must also incorporate a low level water switch, which protects the water pumps, and will directly or indirectly shut down the boiler plant should a low water condition occur.

Consideration should also be given to the maximum working pressure of the boiler as given in Appendix

'E'. Consult Hamworthy Heating Technical Department for help or assistance if in doubt.

**1.5** The Purewell VariHeat boiler is not suitable for direct connection to domestic hot water supplies or gravity fed heating systems.

**1.6** The Purewell VariHeat boiler can be installed with either reverse return water flow layout or with single pipe header layout (non HHL supply). See Appendix E for typical schematic layout.

**1.7** It is good practice in all heating installations to use some form of water treatment to reduce formation of lime scale and black iron oxide sludge. The high efficiencies produced by the Purewell VariHeat Boiler can easily be reduced by lime scale formation. If a pressurisation unit is used, it is prudent to include an hours run meter to give an indication of pump running time and hence raw water make-up. Any leaks should be attended to as soon as possible to avoid scale build up within the boiler's waterways.

**1.8** Each Purewell Variheat module is supplied with volt free contact outputs for Normal Run, Overheat and General Fault, and 0~10v analogue control input compatibility. In addition, the control system allows the connection of multiple boilers on an RS485 bus connection to enable Cascade control of up to 8 multiple boilers by the selection of Master/Slave configuration.

### **1.9 Options**

**1.9.1** Optional reverse return header kits are available in 2, 3 & 4 boiler configuration covering models 70c - 110c & 140c - 180c. These kits incorporate all necessary valves and interconnecting pipework. Refer to individual kit instructions for details.

#### **1.9.2 Controls peripherals**

**1.9.2.1** External Sensor - For single boiler installations, an external air temperature sensor is available to allow direct weather compensation on the boiler. For multiple boiler installations under Cascade control from the boiler controls, the same sensor may be connected to the Master to provide direct compensation on the Cascade.

**1.9.2.2** Cascade Flow Sensor - For multiple boiler installations under Cascade control, a mixed flow sensor is available to influence the modulation of the Cascade against the setpoint.

## **2.0 SUPPLY AND DELIVERY**

Your boiler is despatched to site as a pre-assembled and tested unit. Each boiler is delivered by a tail lift vehicle and lowered to ground level. It is the installers responsibility to convey the boiler to the plantroom.



**Figure 2.1 - Boiler Delivery**

The base of each boiler is specially designed to accept a standard pallet truck. This allows the boiler to be manoeuvred into position without any pallets to remove. Additionally the boiler is designed to pass through a standard doorway where access is restricted.

**NOTE:** The boiler is supplied with cardboard corner protection and shrink wrapped for protection during handling. However, when manoeuvring the boiler, care must be taken to avoid damage to the casing.

The boiler must be kept upright during handling. Care must be exercised to avoid toppling the boiler as this will result in damage.

The flue connection & condensate trap to the boiler are packaged separately to avoid damage. The flue components consist of an adaptor elbow, gasket and straight length of 150mm diameter flue pipe. The condensate trap is supplied loose beneath the front cover.

**Figure 2.2 - Boiler Packaged Dimensions**

Model	Depth	Width	Height	Weight
Purewell VariHeat 70c	1090mm	550mm	1190mm	170kg
Purewell VariHeat 95c				170kg
Purewell VariHeat 110c				170kg
Purewell VariHeat 140c				230kg
Purewell VariHeat 180c				230kg

### **Delivery Verification**

When taking delivery please ensure that you have received the correct number of boilers and ancillary packages to fulfil your order. If any item is missing please contact our after sales service team. Please provide details of your order such as order number and contract number as well as a detailed description of the missing item.

---

### **Reverse Return Header Sets**

Where reverse return header sets are used these are packaged separately from the boilers.

Ancillary items such as isolation valves and flexible boiler connectors are packaged in a cardboard box on the same pallet. The whole is shrink wrapped for security and basic protection.

Model	Configuration	Length mm	Weight kg
70c -140c	2 boilers	1250	57
70c -140c	3 boilers	1784	95
70c -140c	4 boilers	2318	133
180c	2 boilers	1250	112
180c	3 boilers	1784	178
180c	4 boilers	2318	300

**Figure 2.3 - Header Kit Packaged Dimensions**

### 3.0 SIZE AND SPACE REQUIREMENTS

3.1 The Purewell VariHeat boiler range has been designed to utilise minimum floor space, therefore it is important the plantroom has sufficient ceiling height to allow for installation and connection to the flue system.

A minimum distance of 50mm must be maintained from easily flammable materials

Also important is allowance for sufficient access at front, sides and rear of boiler for flue and pipework connections.

Ensure a minimum height of 150mm above the boiler for removal of the covers.

Do not run cabling through the top or display covers.

See Figure 3.1 below.

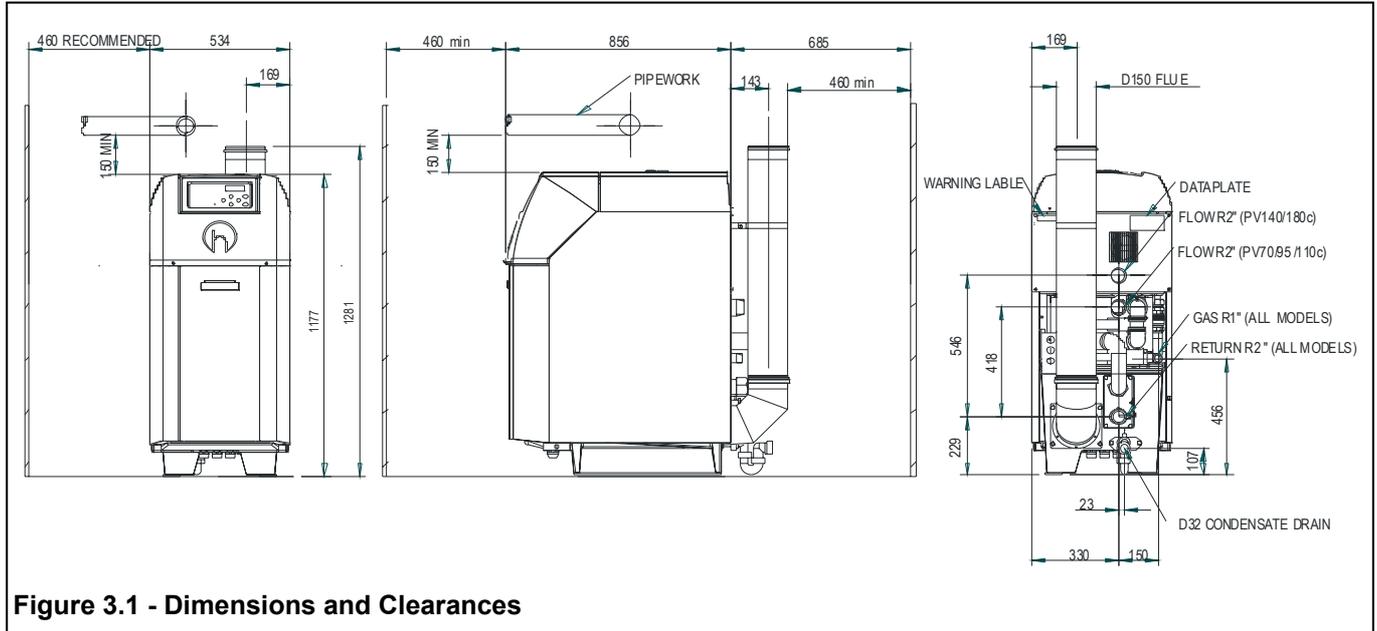


Figure 3.1 - Dimensions and Clearances

3.2 The Hamworthy Heating Ltd water manifold kit is designed to provide a compact solution for connecting the boilers to the gas supply and flow and return water connections. (Refer to the Manifold Kit Installer's Guide for specific details.)

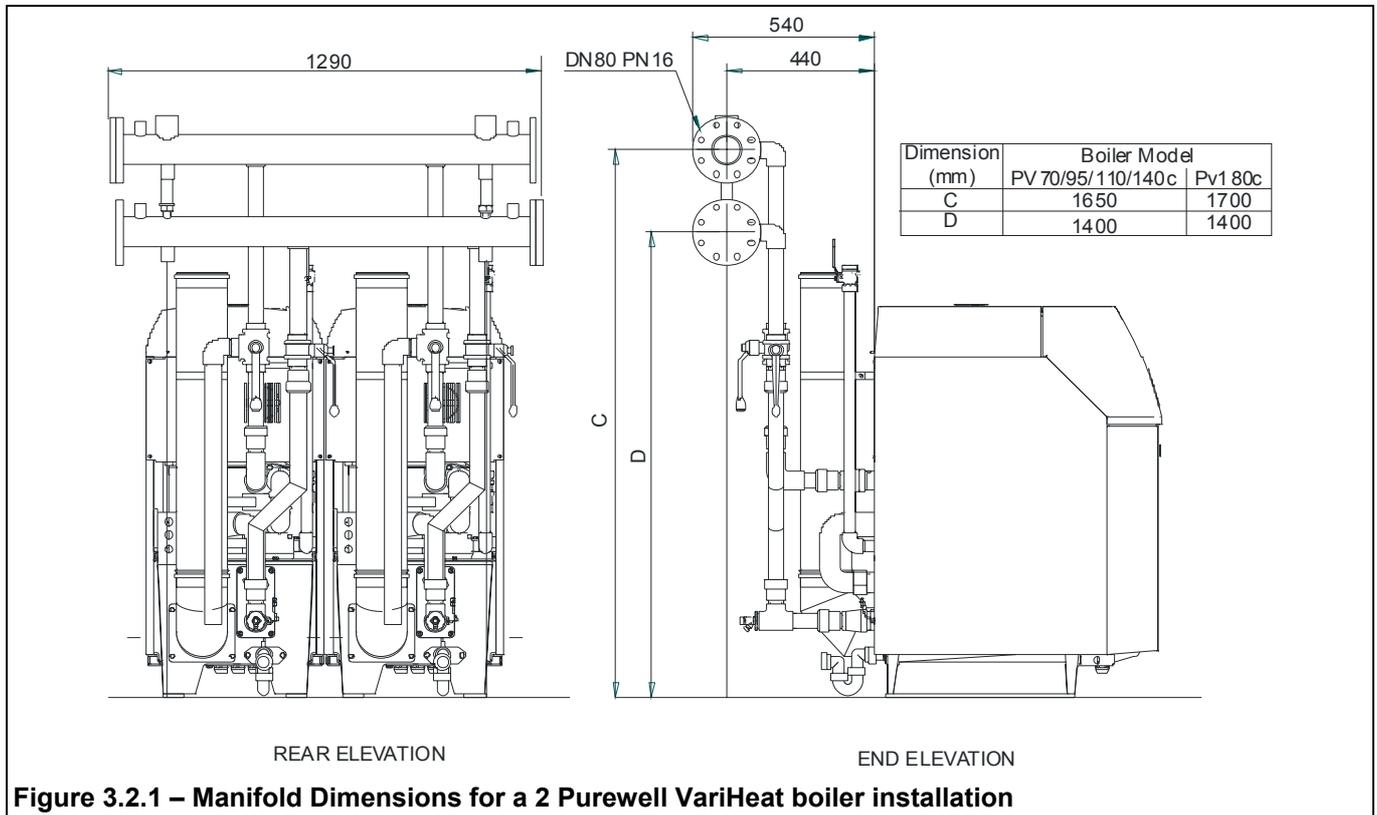
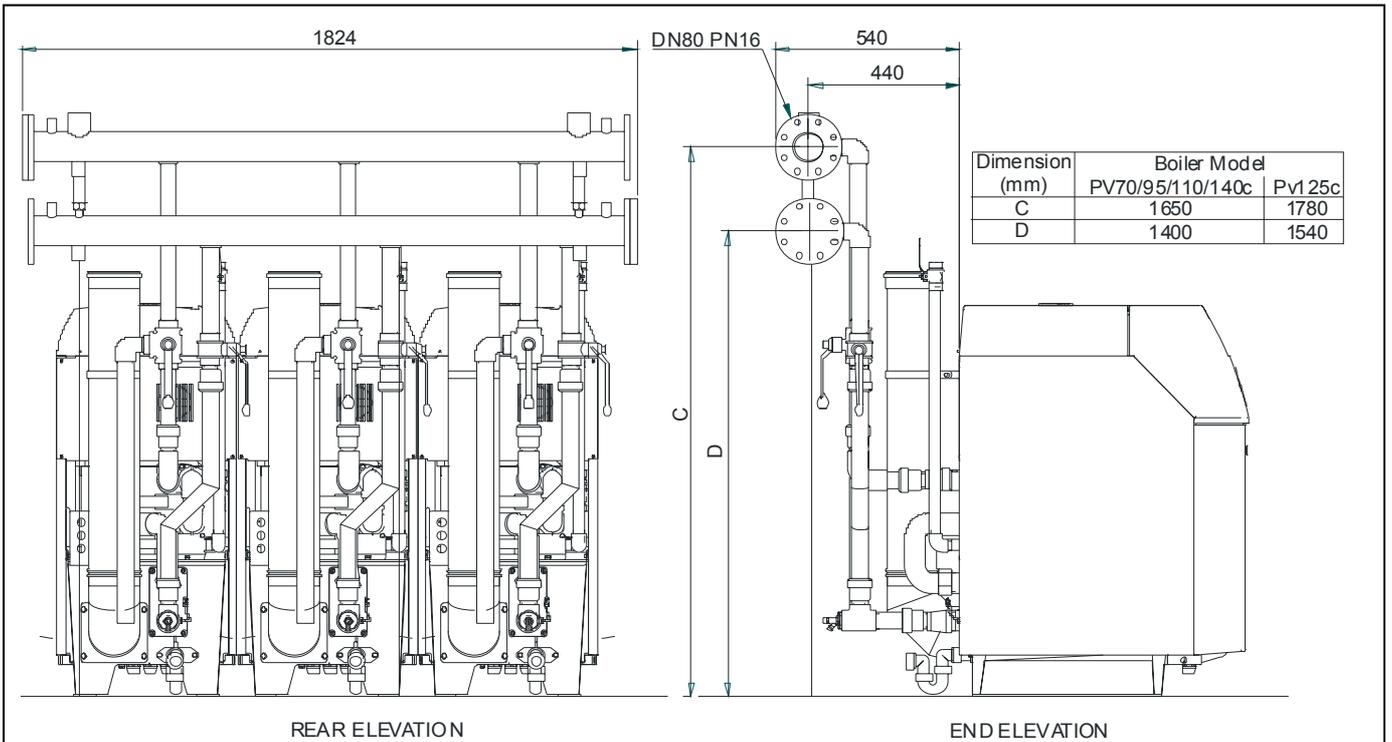
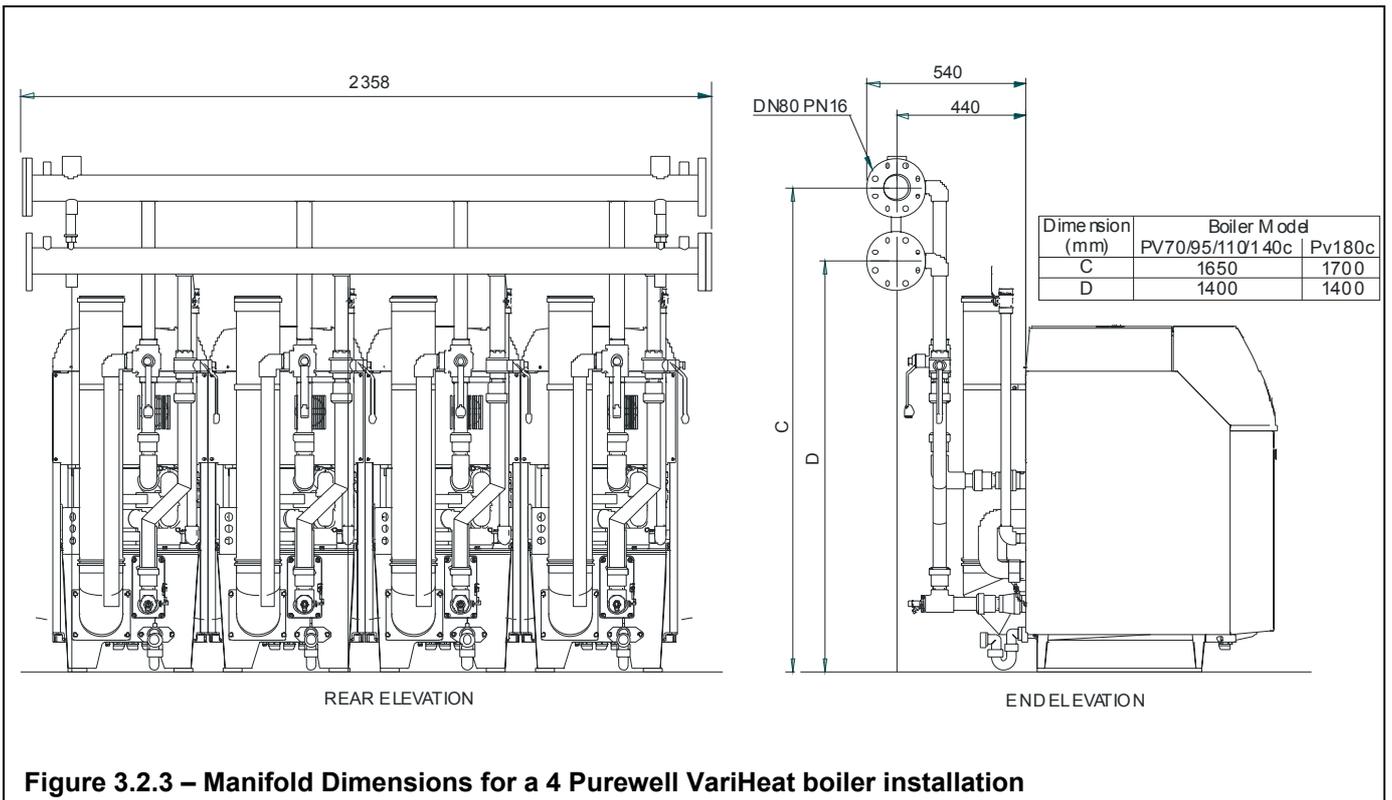


Figure 3.2.1 - Manifold Dimensions for a 2 Purewell VariHeat boiler installation



**Figure 3.2.2 – Manifold Dimensions for a 3 Purewell VariHeat boiler installation**



**Figure 3.2.3 – Manifold Dimensions for a 4 Purewell VariHeat boiler installation**

Safety Valve: As each kit is provided with a 3 port isolating valve for use on the flow pipe, individual safety valves are not required on each module and a common valve can be fitted in the combined flow pipe. However, each boiler has a Rp1” connection (plugged) in the rear of the boiler heat exchanger assembly for use on applications where module isolating valves are not of the 3 port type..

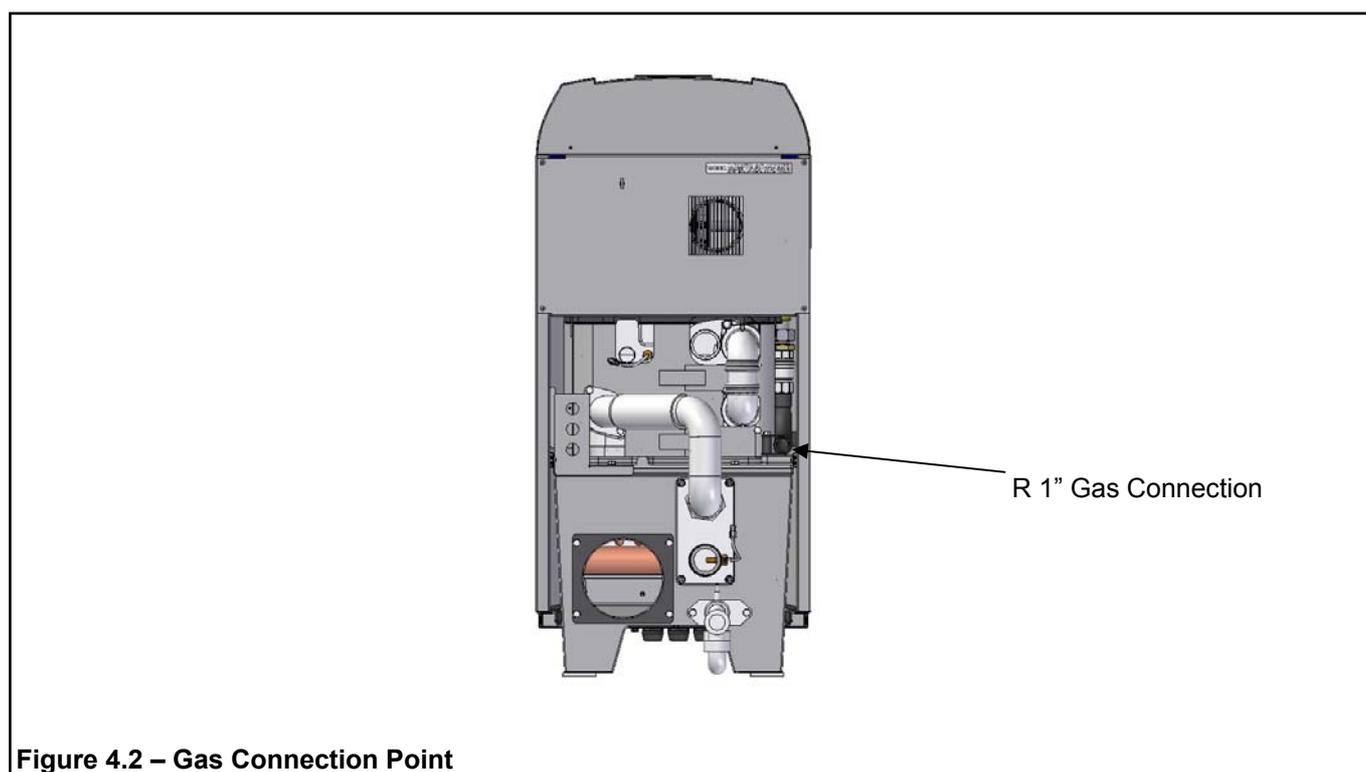
## **4.0 SITE LOCATION AND PREPARATION**

### **4.1 Site Location.**

- The floor or plinth for the boilers and water manifold kit must be both flat and level to ensure correct alignment of fittings and connections.
- The floor or plinth must be sufficiently strong to support the weight of both the boilers and manifold kit where used.
- The floor or plinth must be fireproof in accordance with BS 6644.
- The plantroom must have sufficient space for installation of boilers, manifold kits, pipework, pumps controls, flues ventilation, access and servicing and other items of plant.

### **4.2 Gas Supply.**

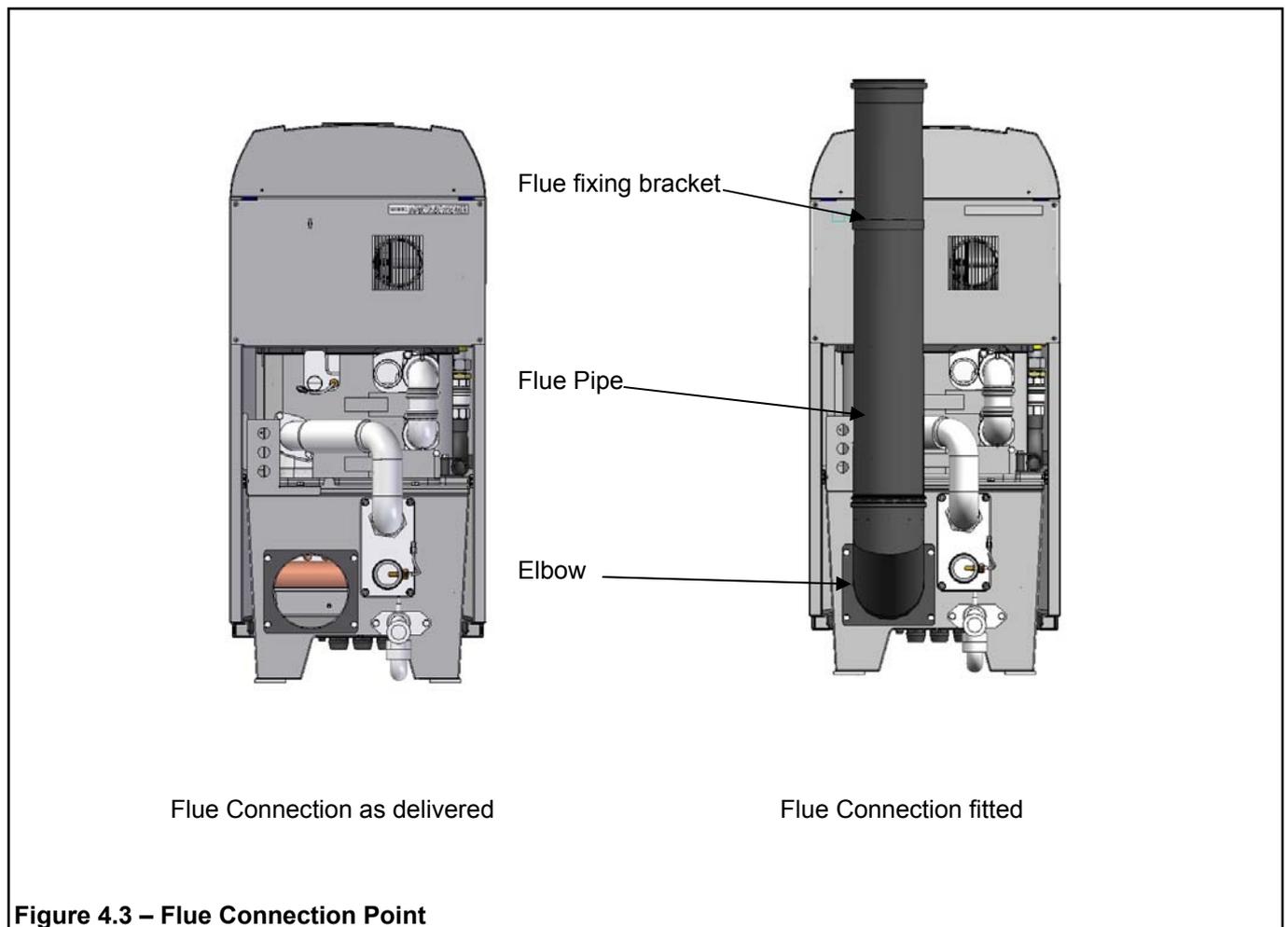
- Gas supply pipes must be in accordance with BS 6891 or IGE/UP/2
- Gas supply connection to the boiler must not be smaller than the connection on the boiler - R1”
- Gas installation must be soundness tested to BS 6891 or IGE/UP/1 & IGE/UP/1A.
- Gas installation must be purged to BS 6891 or IGE/UP/1 & IGE/UP/1A.
- Inlet gas pressure to boiler should be nominal 20mbar (minimum 17.5mbar) dynamic at the connection to the boiler.
- Boiler house gas isolation valve must be clearly identified and installed close to the entrance / exit.



**Figure 4.2 – Gas Connection Point**

### 4.3 Flues

- Flue termination, routing and construction must comply with the requirements of the Clean Air Act 1993—Chimney Memorandum, BS 6644 BS 5440 and IGE/UP/10.
- Any flue must be self supporting and separable from the boiler for servicing requirements.
- Due to the low flue gas temperature, 50°C (condensing) - 75°C (non-condensing), condensation will occur in the flue, flue materials must be non-corrosive and utilise fully sealing joints.
- Flue construction is recommended of a twin wall, insulated type to maintain buoyancy within the flue.
- Adequate facilities must be provided for draining the flue condensation.
- Horizontal flue runs must be kept as short as possible and be inclined at minimum 2° towards the termination.
- The flue system must be designed acknowledging that there may be a positive pressure of 100pa generated by the boiler combustion fan. Refer to Appendix C.



#### 4.4 Water Supply

- Feed and Expansion tanks to comply with static height requirements of BS6880 & BS6644.
- Cold feed and open vent pipes to comply with requirements of BS 6644.
- Pressurised system to comply with BS 7074.
- It is recommended that the system pipework is flushed twice before water treatment.
- In hard water areas precautions such as water treatment should be implemented to prevent the build up of sludge and scale.
- Leaks in the system pipework should be fixed to prevent dilution of water treatment.
- Maximum working water pressure is 6 bar.
- For minimum water pressure see Appendix 'E' - Water Data (Page 48)

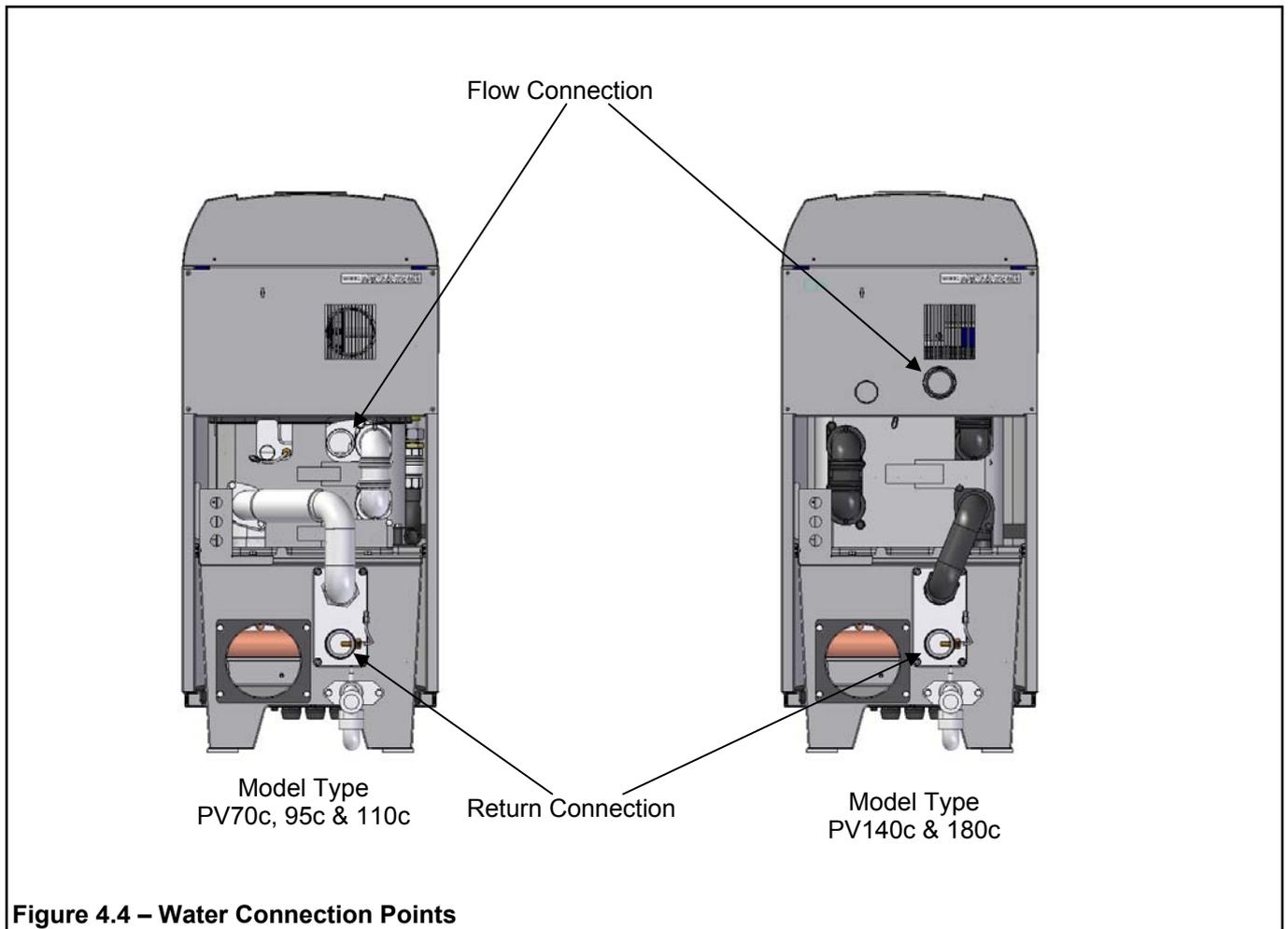


Figure 4.4 – Water Connection Points

#### 4.5 Condensate Connections

- Provision must be made for removal of condensate from the boiler and flue system.
- Condense is mildly acidic, typically pH 3 - pH 5.
- Condense pipework must be non-corrosive and not copper. Hamworthy recommend 32mm dia. Plastic waste pipe.
- Condense may be discharged to a standard drain subject to National or Local regulations.

- Location of condensate pipework should prevent freezing within tundishes, traps and pipework.
- Do not allow blockage or damage to the condensate trap.
- The connection to the boiler condensate drain accepts a straight push-fit coupling for 32mm i.d. plastic waste pipe.

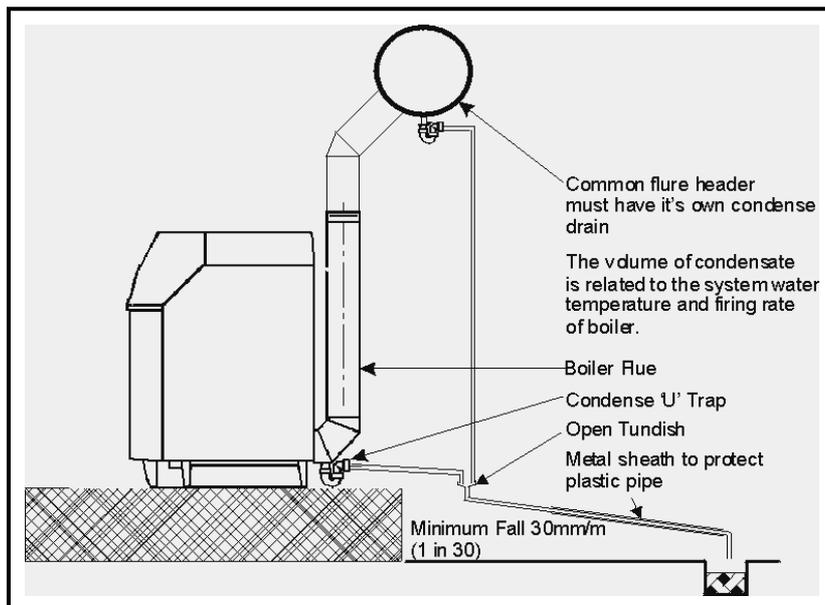


Figure 4.5.1 - Boiler Condensate Connection

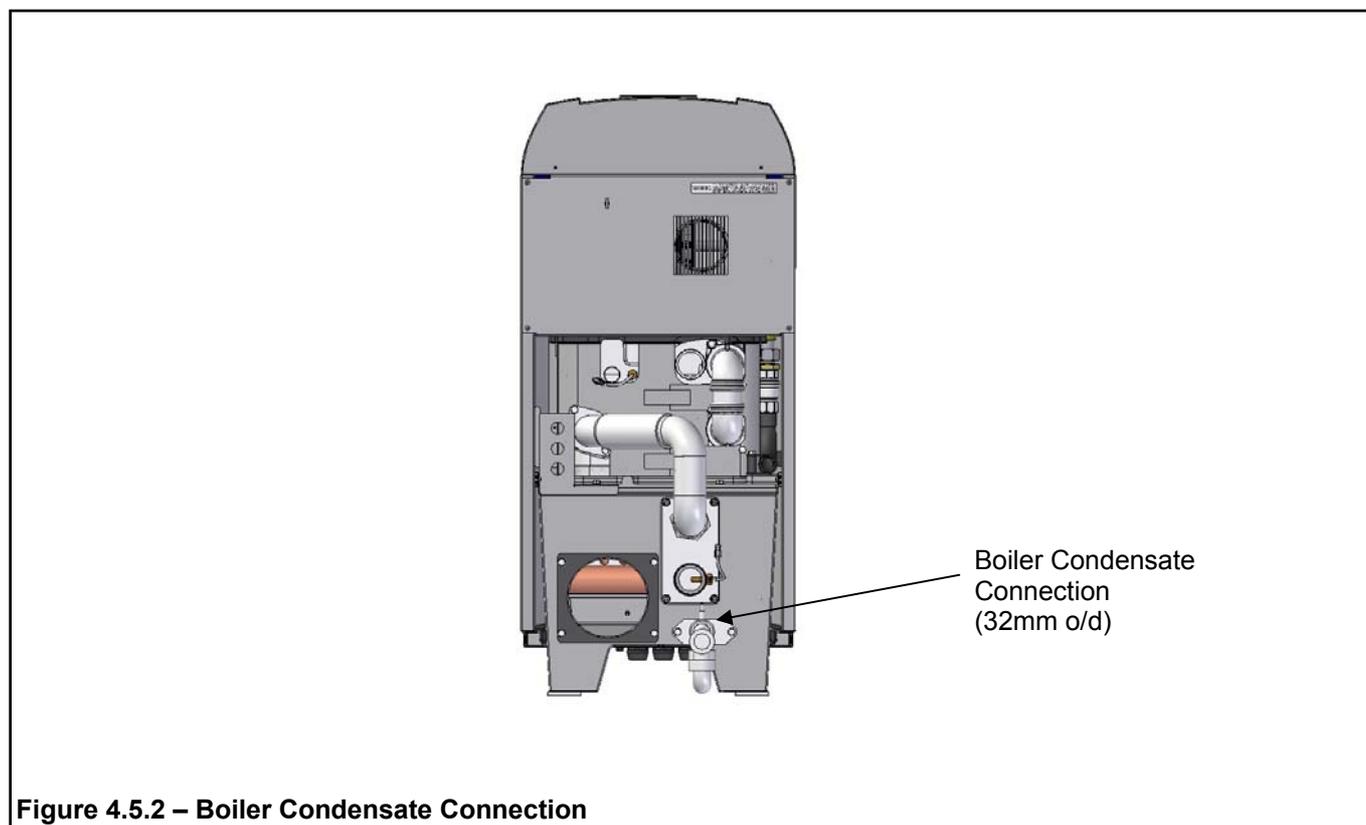


Figure 4.5.2 – Boiler Condensate Connection

## 4.6 ELECTRICAL SUPPLY

**WARNING! THIS APPLIANCE MUST BE EARTHED IN ACCORDANCE WITH IEE REGULATIONS**

- Boiler electrical supplies must not be switched by a time clock.
- Boilers are suitable for 230Volt, 50Hz supply.
- External fuses should be rated for 6 amps
- Wiring must be completed in heat resistant cable size 1.0mm<sup>2</sup> csa.
- Each module should have individual means of isolation.
- Electrical isolators must facilitate complete electrical isolation.
- Electrical isolators must have contact separation of minimum 3mm in all poles.
- Electrical isolators must be installed in readily accessible locations.
- Electrical supplies to boiler modules should only serve the boiler.
- Where volt free contacts are used, these too must be individually isolatable.
- Time clock control should be via the boiler modules Remote On/Off circuit (30V DC). Any circuit connected to the Remote On/Off **MUST** be volt free

**ADDITIONAL INFORMATION REGARDING ELECTRICAL SUPPLIES IS GIVEN IN BS EN60335, Part 1.**

**NOTE: The appliance MUST be isolated from the electrical supply if electric arc welding is carried out on connecting pipework.**

**FOR DETAILED WIRING INSTRUCTIONS SEE SECTIONS 5.3, 9.0 & APPENDIX B**

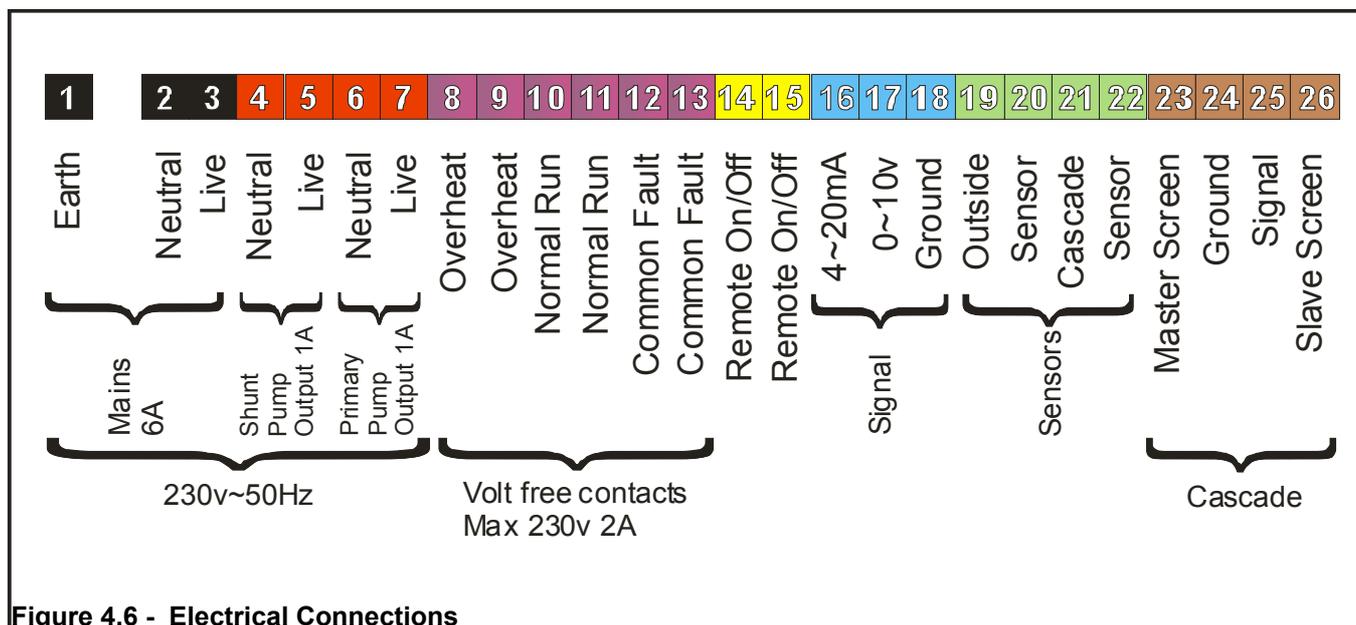


Figure 4.6 - Electrical Connections

## **5.0 BOILER ASSEMBLY**

### **General**

Boilers are despatched to site as fully assembled units. The flue pipe, chimney, condensate drain connection and pipework manifold set (where applicable) are the only items that will need assembling on site.

During assembly it is important to take care to prevent damage to the boiler casing. **DO NOT STAND ON THE CASING PANELS.**

Boiler positioning must allow the minimum clearances detailed in Section 3.0 to facilitate access for flue and pipework connections as well as maintenance. Boilers can be positioned side by side, no clearance is necessary.

### **5.1 Flue Pipe**

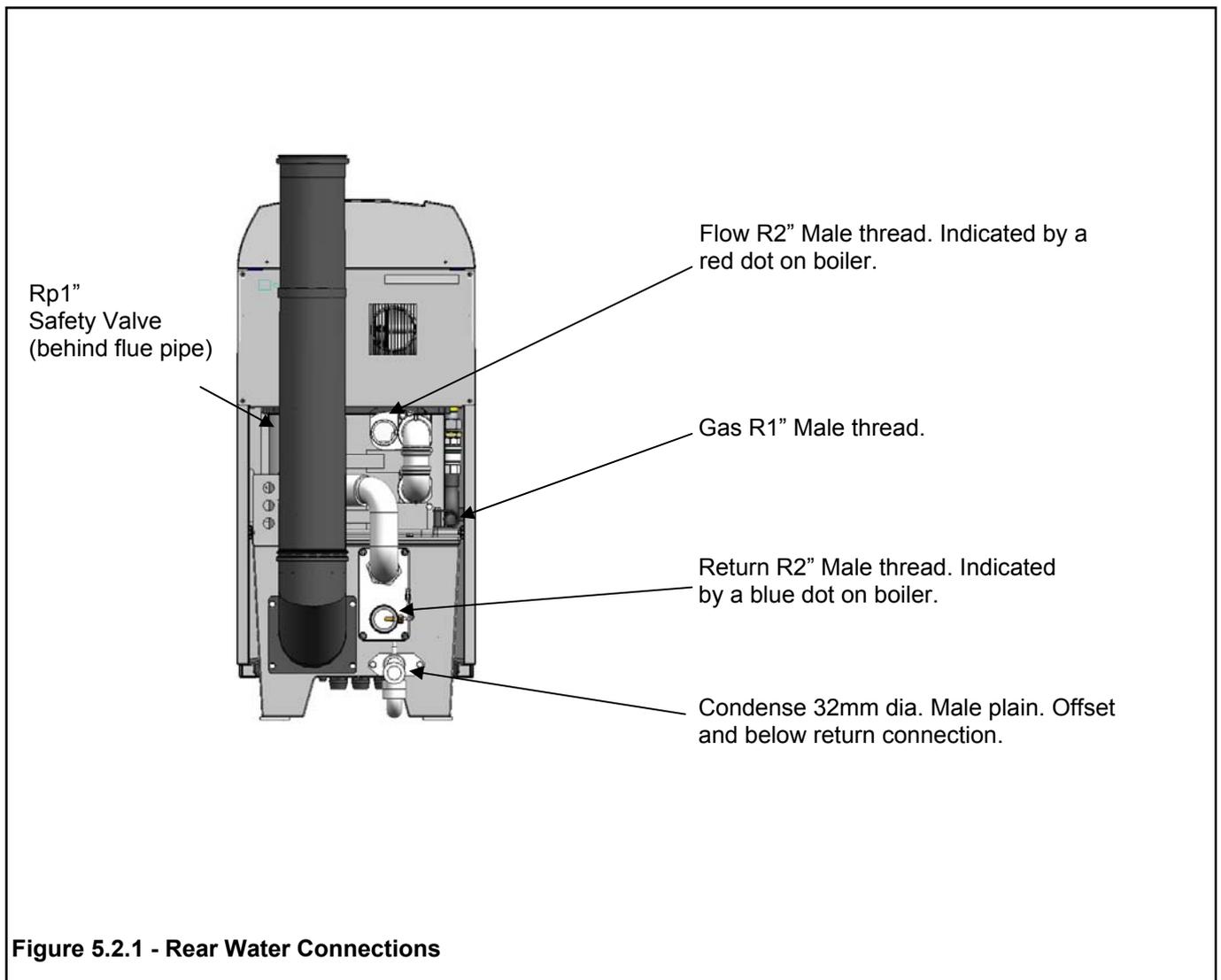
So as to avoid damage, the flue connecting pipe is supplied separately.

Fit the elbow to the base of the boiler and secure using the gasket and 4 - M8 nuts and washers. Moisten the lip seal and engage the flue pipe into the elbow. Secure the flue pipe to the boiler casing using the bracket supplied.

### **5.2 Water Connections:**

Connecting pipework must be self-supporting to avoid stress on the boiler connections. Local unions are recommended in the pipework to facilitate future servicing requirements.

**The following connections are provided on each boiler module;**



## **Open Vented Systems**

Boilers must not be capable of isolation from the vent pipe. Valves between boiler and vent pipe to be three way type such that when boiler is isolated from vent pipe it is open to atmosphere. Safety valves should either be mounted on the boiler by using the connection provided, or it should not be possible to isolate a safety valve common to more than one boiler from each boiler. BS6644 provides details.

## **Sealed Systems**

A boiler must not be capable of isolation from the individual or common safety valve. Valves between boiler and common safety valve to be three way type such that when boiler is isolated from safety valve it is open to atmosphere. The boiler is provided with a connection on the boiler for the safety valve .

Where using Hamworthy Heating Ltd pipework kits, assembly of these is detailed in the Instruction manual supplied with kit.

## **5.3 Electrical Connections:**

The following electrical connections are provided on each module on a rail at the base of the front of the boiler.

- Supply: Live, Neutral and Earth. See Section 4.6 for details.
- Live and Neutral connections for Shunt pump or Primary Pump
- Boiler Overheat Fault Alarm Signal Output
- Common Fault Alarm Signal Output
- Boiler Normal Run Signal Output
- Remote On/Off
- 0-10v Analogue Control Signal Input
- External sensors
- Cascade Management of Multiple Boiler Installations

## **6.0 PRE-COMMISSIONING**

The following checks must be carried out before the boiler is commissioned.

### **6.1 Gas Supply.**

Ensure that gas installation pipework and meter have been soundness tested and purged to IGE/UP/1 or IGE/UP/1A as appropriate. Test and purge certificates should be available for viewing.

### **6.2 Ventilation**

Ensure that ventilation and air supply to plantroom is correct - refer to Appendix D (page 46). Air supply around the rear of appliance is unobstructed.

### **6.3 Pipework, Valves and Pump**

Ensure that;

- Pipework and valve arrangement is installed to Hamworthy Heating recommendations.
- Circulating system is full of water, vented and pressurised appropriately.
- Circulation pump is fitted, working and interlocked where required.
- Pipework connections to boiler are fitted correctly.
- All necessary isolation valves are open.
- Safety valve is correctly sized and located.
- Condense connections on boiler and flue are connected and piped to drain.
- Heat load is available.

### **6.4 Flue**

Ensure that;

- Flue system is correctly designed and installed to suit boilers.
- Flue passages to chimney are clear.
- Fill traps with water.

### **6.5 Electrical**

Ensure that;

- Electrical connections are correct and isolatable.
- External controls are operational.

**WARNING: IF THE FRONT COVER IS REMOVED WHILST THE BOILER IS OPERATIONAL, CARE MUST BE TAKEN WITH ELECTRICAL COMPONENTS AND ACCESS TO PRIMARY INSULATION.**

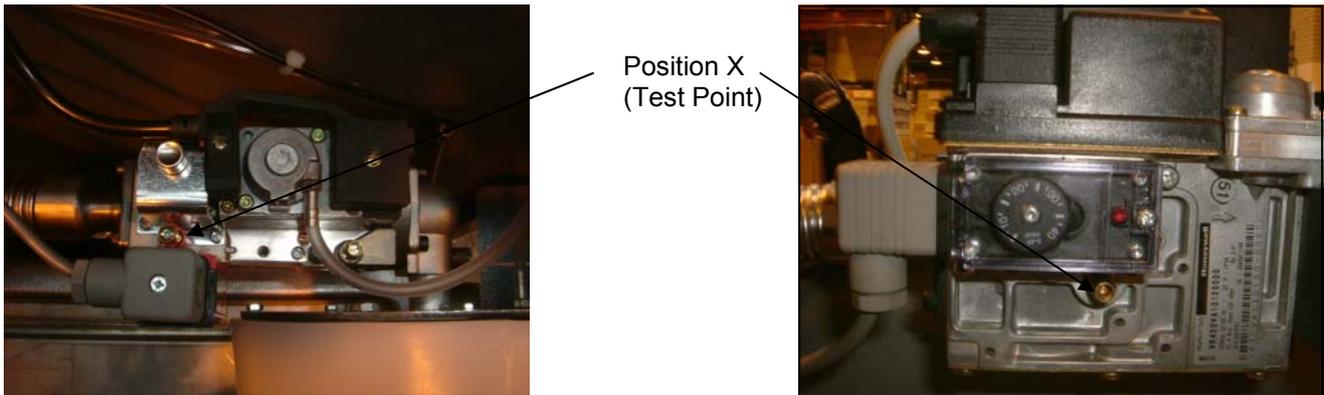
## 7.0 CHECKS PRIOR TO LIGHTING

**IMPORTANT: BEFORE PROCEEDING TO LIGHT THE BOILER, ENSURE THAT THE PRE-COMMISSIONING CHECKS HAVE BEEN CARRIED OUT AND THE RESULTS SATISFACTORY.**

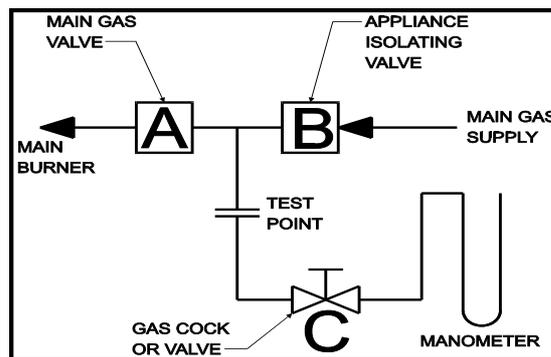
### 7.1 Boiler Gas System Leak Check

Ensure that the appliance manual gas service valve is in the OFF position. Although the boiler receives a gas leak check and gas train component integrity check prior to leaving the factory, transport and installation may have caused disturbance to unions.

A procedure guide is given below. Care must be taken not to allow leak detection fluid on or near any electrical parts or connections.



**Figure 7.1.1 - Test Point Locations On Gas Valves**



**Figure 7.1.2 - Gas System Leak Check Diagram**

**Note:** - Main gas supply pressure - G20 - 20mbar

#### **To Check Valve B**

- 1) Turn off the electrical power and gas to the appliance.
- 2) By unscrewing screw at Position X of Figure 7.1.1 remove the red gas pressure switch (L.H.S picture) or loosen the test point valve plug (R.H.S picture).
- 3) Connect the manometer to gas valve test point.
- 4) With A, B closed open C and monitor manometer over a 2 minute period, a rise indicates a leak on valve B.
- 5) Reinstall red gas pressure switch or shut valve plug in test point.

#### **To Check Valve A**

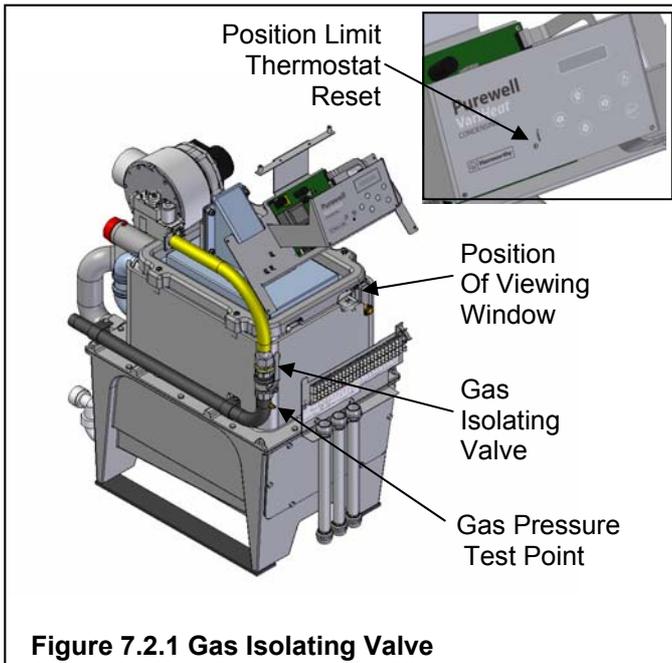
- 1) Repeat steps 1, 2, 3 & 5 above.
- 2) Open C.
- 3) Open B to produce the main gas supply pressure between A and B.
- 4) Close B
- 5) System may be considered sound if over a period of 2 minutes any drop in pressure is less than 0.5 mbar (0.2" wg.).

**NOTE:** Allow a manometer stabilisation period of approximately 1-minute before each 2 minute check period. Following soundness tests close valve B and remove manometer connections and tighten test points.

## 7.2 Checks Prior to lighting the boiler

**NOTE!** Refer to Appendix A for Natural Gas maximum gas inlet pressure for normal operation.  
**The following checks must be made prior to lighting the boiler.**

- 1) Ensure that the gas supply is connected but turned to the "off" position. Any unions or fittings are correctly tightened, test points are closed, and that the ignition and probe leads are connected correctly.
- 2) Ensure the electrical mains supply is correctly connected but the boiler module isolator(s) are switched off. Check all wiring loom connections such as fan and gas valve, are correct and secure. Test the operation of the safety temperature limit thermostat (Limit Stat) by removing the clip & bulb from the pocket in the front of the heat exchanger, and carefully apply a heat source to the bulb. The Limit Stat reset button should lift & protrude through the hole in the controls fascia. To reset, firmly press the button through the access hole in the controls fascia using a terminal screwdriver.



If satisfactory, refit the bulb in the pocket and secure with the clip. Ensure that all thermostat bulbs/sensors are fully inserted into the pockets. The flow and return temperature sensors are located at the rear of the boiler in the flow and return pipes.

- 3) Check setting of both temperature limit thermostat and control thermostat. The limit thermostat is set at 95°C. To remove the limit thermostat, found on the rear of the display fascia bracket removing the plastic display cover and unscrew the fixing screws securing the thermostat from its mounting plate.

The control thermostat is factory set to a flow temperature of 85°C and must be re-set to suit the application, using the display screen & buttons as detailed in **section 8.7.1.2 - Controls Operation**

- 4) To ensure correct ignition of the boiler it is recommended to check the resistance of the hot surface igniter. This should be checked cold, using a suitable ohmmeter, by disconnecting the igniter from the control panel cable and measuring the resistance across the pins of the 2 way connector. The reading should be between 70 and 110 ohms.

## 7.3 INITIAL LIGHTING

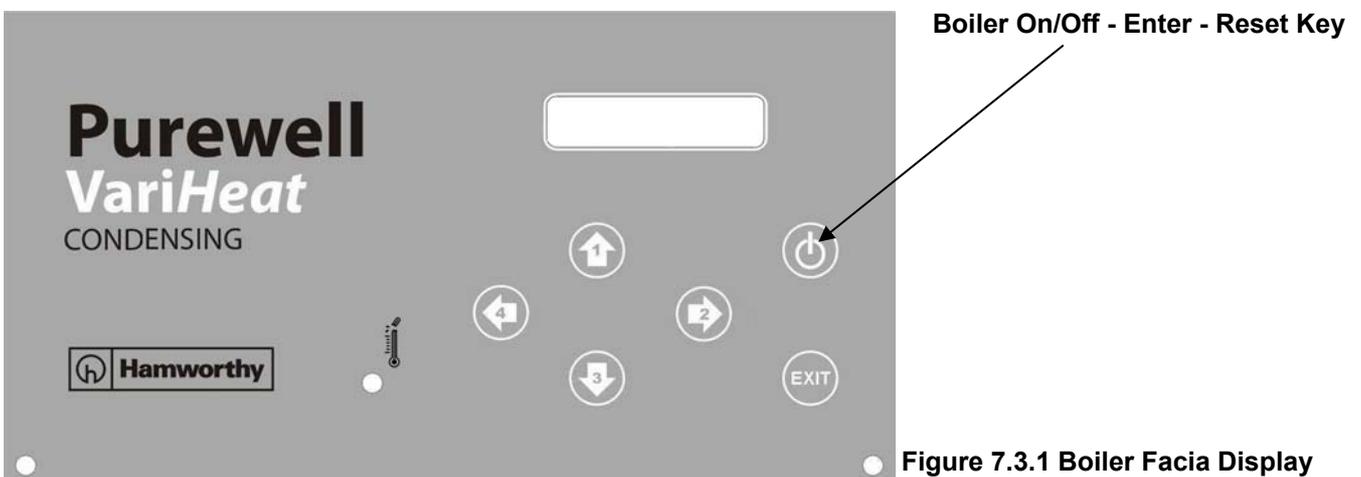
Only competent persons registered for working on non-domestic gas appliances should attempt the following operations. Before attempting to commission any boiler, ensure that personnel involved are aware of what action is about to be taken.

Record all readings for future reference on relevant commissioning sheet.

Allow system to warm up sufficiently to check operation of control thermostat.

A combustion check must be taken when first commissioning the boiler. A sampling point is provided in the base of the boiler.

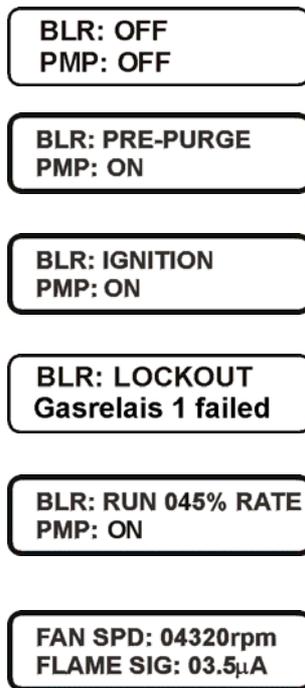
**NOTE!** Care should be exercised when the boiler is firing as the flue components can achieve temperatures, which could cause injury if touched.



**Figure 7.3.1 Boiler Facia Display**

### 7.3.1 Lighting the boiler

- 1) Ensure that both gas and electrical supplies are isolated from the boiler.
- 2) Disconnect the electrical plug to the gas valve by loosening the securing screw(s) and pulling off.
- 3) Turn on the gas (see Figure 7.2.1) and electrical supplies to the boiler. A gas supply pressure above 12.5 mbar will remove the Low Gas Pres block and the fascia display will read BLR:OFF  
PMP:OFF
- 4) To initiate the start-up sequence, press the On/Off (Enter) button. The boiler will run through it's start-up sequence and the display will change as per figure 7.3.2 providing that the remote on/off contact is made and/or the BMS system is in demand.
- 5) Check that the Hot surface Ignitor begins to glow, by looking inside the boiler through the oval viewing window within the recess at the top right hand side of the boiler. (At this point, no gas is present in the boiler so no ignition occurs).



6) On Failure to sense presence of a flame the boiler will go to lock-out.

7) Turn off the gas & electrical supplies to the boiler.

8) Carefully reconnect the electrical plug to the gas valve and secure with the appropriate screw(s)

9) Turn on the gas and electrical supplies to the boiler & press the reset (Enter) button to remove the 'lock-out' condition. The boiler will commence the ignition sequence. This time when the gas valve is energised, the gas will light.

- At the end of the 5 second ignition proving period, the hot surface igniter will be switched off and the fascia display will change to " BLR:RUN" .
- After a period of 15 seconds the fan will alter speed and the burner modulation will be set according to the heat load.
- If after the 5 second flame proving period the flame signal is below 1µA the boiler will shut down and attempt one restart.

As the boiler comes to temperature, the % rate will reduce on the screen from 100%.

Figure 7.3.2-Start Up Display Sequence

### 7.3.2 Safety Checks

7.3.2.1 To check for correct operation of the controller, with the boiler running, carefully disconnect the flame probe lead from the flame probe.

The boiler will shutdown, attempt to relight once & then lock out causing 'no flame ign' to appear on the display. Carefully reconnect the probe lead then press the reset (Enter) button to recommence the light-up sequence.

7.3.2.2 With the boiler firing, turn off the gas isolating valve and the boiler will shut down in 'Blocked' ' mode showing 'BLR:Low Gas Pres' on the display. Wait at least 30 Seconds before opening the gas Isolating valve when the block will clear and the boiler will recommence the light-up sequence.

### 7.3.3 Flame Signal Assessment

The flame ionisation signal generated whilst the boiler is firing, can be viewed directly from the display screen. The value is set to read dc µA. Refer to 8.7.1.3.

### 7.3.4 - Adjusting the settings of the boiler

The desired Flow temperature setpoint can be set as follows:

With the boiler showing one of the Status Screens, by pressing the Up / Down key a further screen is presented showing the actual setpoint (factory set to a maximum flow temperature of 85°C). Further pressing of the Down / UP keys will increase or decrease the setpoint in 0.5°C increments within the limits set in the program.

After changing the setpoint to the desired value the 'Enter' key must be pressed to store the value.

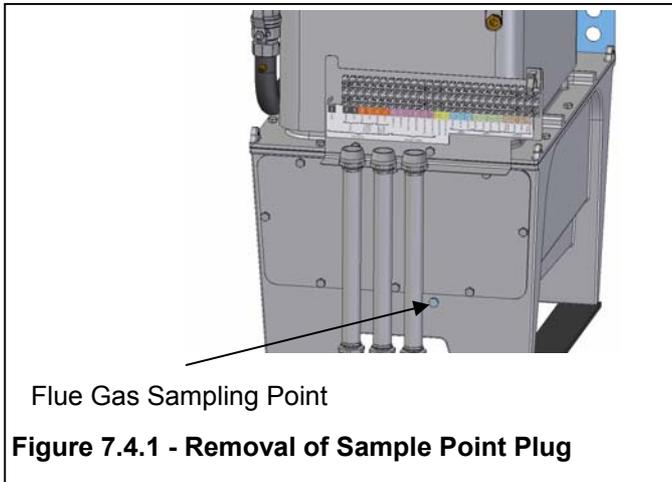
**Note:** the screen will revert back to the normal Status Screen after a few seconds.

**Should a set point higher than 85°C be required, please contact Hamworthy Heating, as programming for a higher maximum outlet temperature is restricted by a factory set access code.**

## 7.4 Combustion Checks

The boiler is factory preset, however, where checks need be undertaken during servicing to confirm correct performance within the installation.

- 1) Put boiler into service mode (**Section 8.5.1** Page 21) to enable the High & Low CO<sub>2</sub> figures to be measured.
- 2) Remove the sample point plug from the front of the base of the boiler.



- 3) Ensure that an insertion distance of 100mm is set on the combustion analyser probe.

**NOTE: THIS DISTANCE MUST BE SET TO ENSURE ACCURATE ANALYSIS OF THE FLUE GASES.**

- 4) Insert the probe into the base up to the set stop position .

- 5) For Low Fire & High Fire Target CO<sub>2</sub> figures see table below.

- 6) CO = 0-50ppm: however figure should not exceed 200ppm under normal operating conditions.

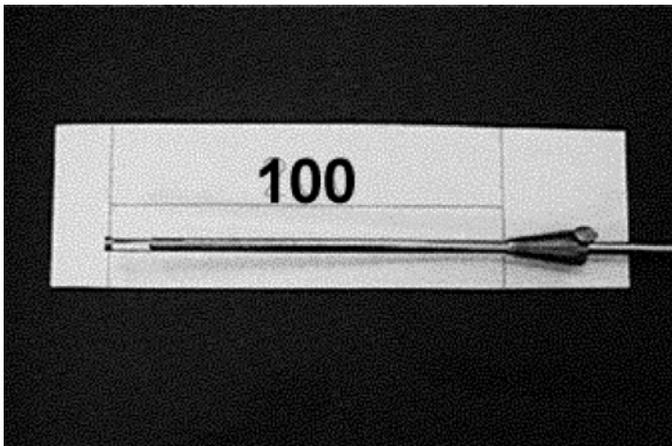
- 7) If the combustion readings fall within the required range, the boiler is set and operating correctly.

- 8) Remove the combustion analyser probe & replace the sample point plug in the front of the base of the boiler.

- 9) If the combustion readings fall outside the required range **DO NOT** adjust the gas valve settings .

**CONTACT HAMWORTHY HEATING SERVICE DEPARTMENT.  
(Contact details on page 36)**

- 10) Tampering with any sealed component may result in loss of warranty on the appliance.

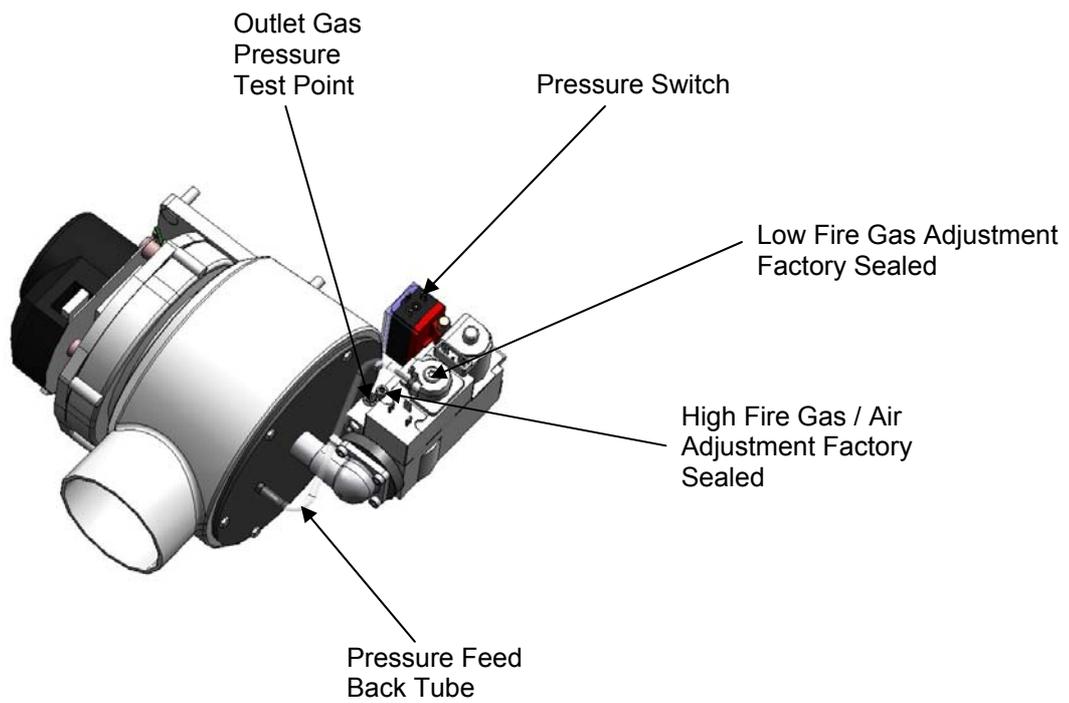


BOILER MODEL	% CO <sub>2</sub> +/- 0.25%	
	HIGH FIRE	LOW FIRE
PV70c PV95c PC110c	9.5	9.5
PV140c PV180c	9.0	8.5

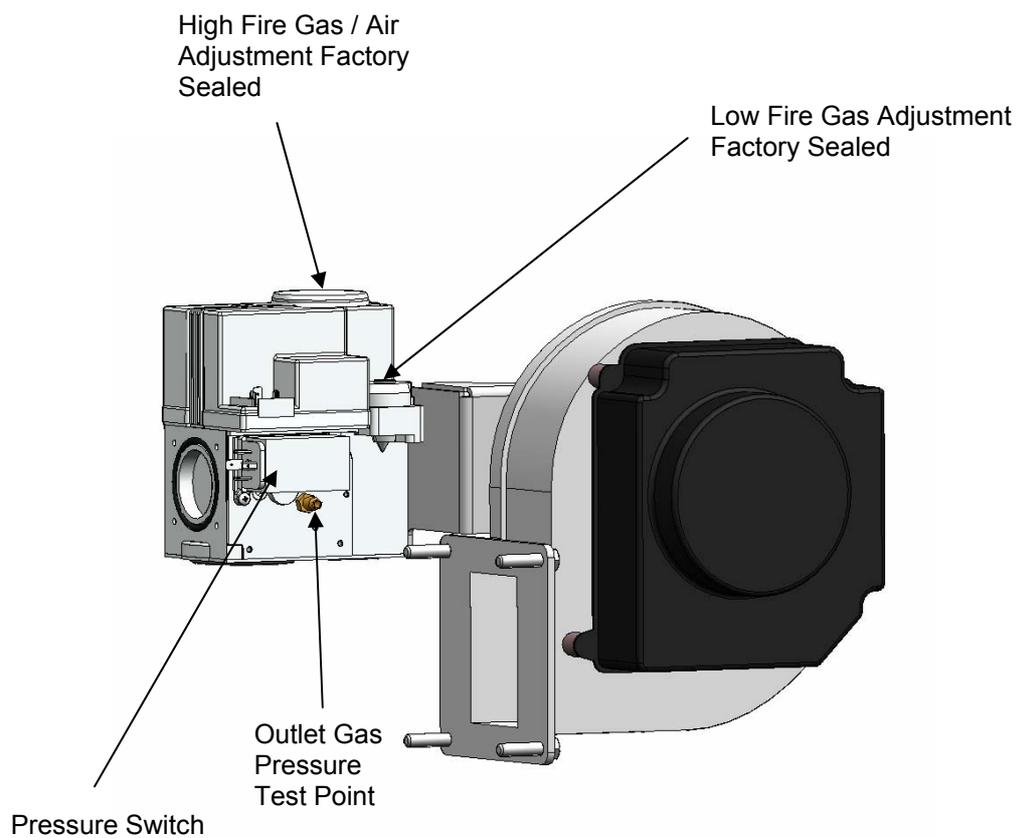
- 11) Refer to **section 8.0 - Controls Operation**, to set the relevant boiler parameters and timings specific to the installation.

## 7.6 User's Instructions

The boiler owner or their representative should be made aware of the lighting and operating instructions. A practical demonstration should be given describing each functional step. This Installer's Guide and User's Instructions should then be handed over & kept in a safe place for easy reference.



**Figure 7.4.3 - Fan Assembly PV70/95/110c**



**Figure 7.4.4 - Fan Assembly PV140c & PV180c**

## 8.0 CONTROLS OPERATION

### Overview

The Purewell VariHeat control system is a self contained, microprocessor based package (BIC930), controlling and monitoring all safety and functional aspects of the boiler performance and it's integration with external system controls.

Access to boiler performance information is via the DU930 display screen consisting of 2x16 character backlit LCD unit and 6 buttons for operation and setting of the boiler.

The system is compatible with BMS (or other) external controls via an enable or 0~10V DC input signal. The optional outside and mixed flow sensors are supplied by Hamworthy Heating Ltd to ensure safe and reliable operation.

The system provides as standard 3 volt free contacts for external fault indication - Normal Run, High Temperature Overheat & General Fault.

The BIC930 control system allows the connection of multiple boilers on an RS485 bus connection (twisted pair) to enable Cascade control of up to 8 multiple boilers by selection of Master/Slave configuration.

**Note:** To ensure safe and reliable operation, all wiring between sensors & master/slave boilers must be separated from mains voltage wiring.



Figure 8.0 - Boiler fascia panel

### General Description of Controls Functionality

#### 8.1 Starting Up

During the first 3 seconds of any start-up, the internal micro-processor carries out a self-test to ensure correct operation, prior to the fan commencing the Pre-Purge period at the defined speed. If a test fails, the control will go to lockout.

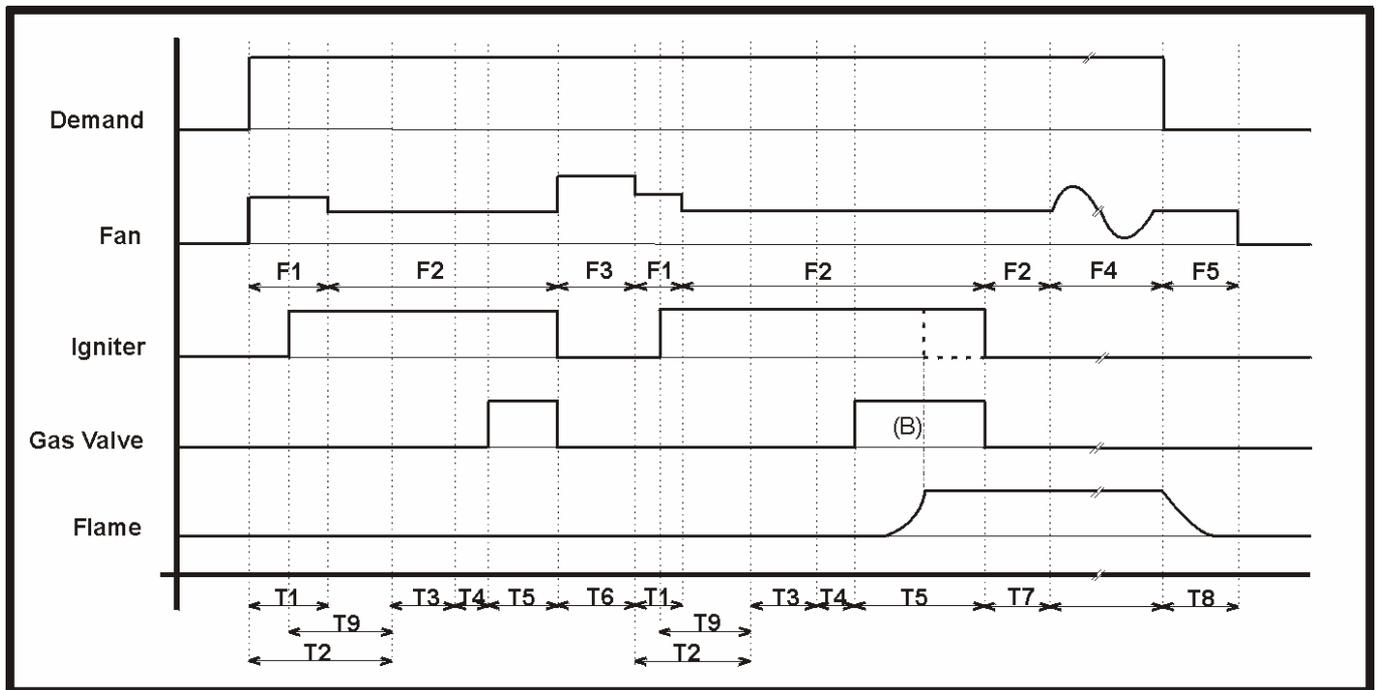
If the flame signal is lost during any 'Demand' period, the gas valve will close immediately and if the flame cannot be re-established after one attempt to relight, the boiler will go to lockout.

In the case of a lockout caused by ignition failure or overheat temperature, the fan will continue to run for a period after the lockout has been instigated.

Ignition will start after the Post Purge time. Once the ignition speed has been achieved, the Hot Surface Igniter (HSi) will be powered up to ensure that it is up to temperature when the gas valve is opened.

#### 8.2 Stand-By

In Stand-by mode the boiler can still be programmed either through the display or PC tool software



**Legend**

F1: Fan High Speed  
 F2: Fan Ignition Speed  
 F3: Fan Max. Speed  
 F4: Fan Free Modulation  
 F5: Fan Post Purge

T1: Fan High Time  
 T2: Pre-Purge Time  
 T3: Pre-Ignition Time  
 T4: Relay Test Time < 0.8s  
 T5: Safety Time

B): Ionisation current switches off HSi  
 T6: Post Purge Time  
 T7: Flame Stabilisation Time  
 T8: Flue Gas Purge Time  
 T9: Warm up Time HSi

**Figure 8.1 - Burner Control Logic Diagram**

With no heat demand, the pump (if connected) can either be running (pump overrun time) or 'kicking', once every 24hrs, to prevent pump seizure.

**8.3 Pump Kick**

The kick time is programmable. If the control is set as a Master in a cascade multiple boiler arrangement, the kick function will operate the 'primary pump'.

**8.4 Lockout**

The micro-processor is able to distinguish two types of 'Lockout', namely;

- LOP. "Lockout Processor"

When the control detects a serious internal fault (due to corrupt parameter from EEPROM, corrupted flash memory, too many restarts after detecting a fault..etc) the control will lock-up and nothing will work including reset, with the display registering the last message. The only way to reset is to switch off the mains power for at least 5 seconds. Should this procedure have to be repeated several times without resolving the problem, it is advisable to replace the control.

- LOF. "Lockout Functional"

When the control detects a serious functional fault, the control will go to lockout and nothing will work except the reset button. In certain lockouts, the fan will be driven to High speed for 1 minute;-

- Safety Limit Thermostat or Overheat Limit Thermostat activated
- Loss or lack of flame during running or ignition
- Gas Valve fault

In other lockout modes, the fan will not be switched on. In cascade mode, the primary pump will run for the pump overrun time.

If there is a power failure during a lockout, the control will return to lockout when the power is returned.

The alarm relay is only powered in the event of an alarm situation. During normal operation, the alarm relay is not powered.

## 8.5 Heat Demand

Depending upon the setting of parameters, the demand can be activated under the priorities detailed in figure 8.5.1

During normal operation, if the flow temperature exceeds it's maximum setting, all further demands are blocked and a programmable anti-cycling timer starts. The block will be removed when the flow temperature has dropped below the offset maximum value. In addition, there is a hysteresis band on the return temperature at the instigation of the block, which ensures that the boiler will be blocked, should the flow temperature drop very quickly, until the return temperature is outside of the hysteresis band - see figure 8.5.2.

Each heat demand (Cascade, BMS, Heating etc.) has it's own set of parameters for setting the offset and hysteresis.

Heat Demand	Activated by	Mutual Priority
Service Mode	Display Screen	1
Cascade	RS 485 Protocol	2
Boiler Management System	Analogue Input (0~10 Vdc)	3
Heating	Remote On/Off or Thermostat	4
Frost Protection	Low return temperature	5

Figure 8.5.1 - Priority Heat Demands

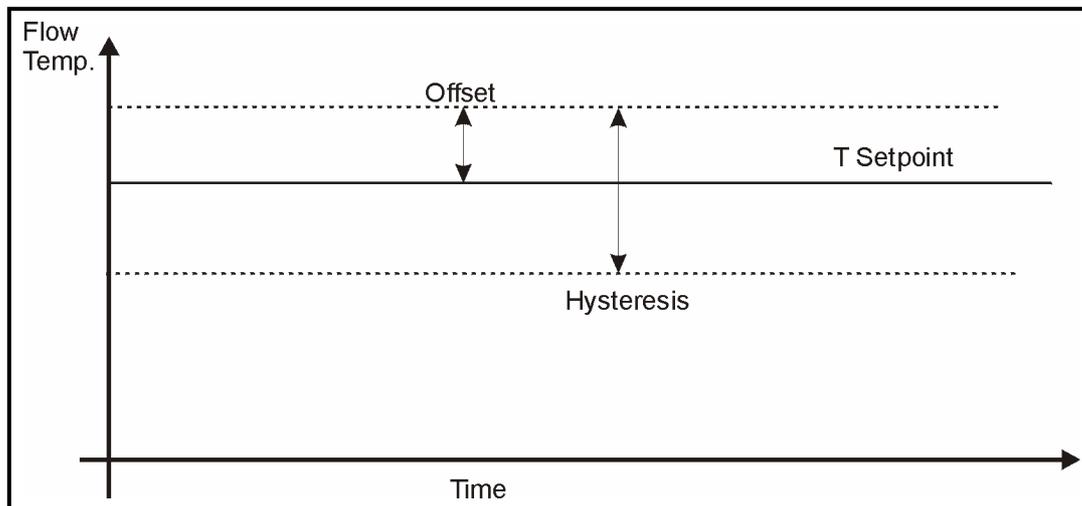


Figure 8.5.2 - Temperature Offset and Hysteresis

### 8.5.1 Service Mode

The Service Mode can be only accessed if the boiler does not display a 'lock-out'. To clear a 'lock-out' press the enter button to reset the boiler. To access the service mode press the 'Exit Button' for 5 seconds. A four digit numerical code must be entered to enable the engineer to access the programming functions necessary to commission the boiler. Use the buttons with vertical arrows to select each number (from 0-9) in the 4 digit code required. The horizontal buttons enable a position in the four digit sequence to be selected. As soon as the correct code has been entered, the Service Mode will start (refer to Hamworthy Heating Ltd). To exit the Service Mode press the on/off (Enter) button. If during Service Mode operation, no buttons are pressed, after 40 minutes the boiler will revert back to normal operation under the previous demand. Activation of the Service Mode overrides all other heat demands. During Service Mode, all safety devices remain active with the flow temperature controlled to the maximum setpoint.

When entering the Service Mode, the fan speed will be held at the level prior to entering Service Mode and if in Standby, will be held at the ignition speed. During the Service Mode function, the fan speed can be adjusted by pressing buttons 1 or 3 to achieve the desired level (in increments of 10 rpm). After changing the fan speed, the screen will display the new setpoint for 3 seconds and then revert to the boiler ON Status Display screen—see figure 8.7.

**8.5.2 Cascade**

This function is only operational when the relevant parameter has been set. The BIC930 control can operate upto 8 modules in cascade control with one module having to be designated Master and the others as Slaves. Each module will require setting up.

**8.5.2.1 Communication**

When a Slave has been connected to the bus, the Master (0) detects the connected Slave by it's unique address( 1...7). Should a connected Slave be at lockout or not recognised by the Master, it will not participate in the cascade. However, if the Slave is switched Off by the On/Off button, it will still participate and the Master will adjust the cascade acknowledging the loss of capacity.

In communication between the Master and Slaves, having sent a message, the Slave will respond within 0.5 seconds. If the response fails the first time or the response is corrupted, the Master will resend the message. If the response fails again, the Master will remove the Slave from the cascade and adjust the capacity amongst the Slaves responding. The Master will then check for a correct response from all Slaves every 15 seconds.

**8.5.2.2 Cascade Regulation**

Regulation of the heat demand is based upon the actual flow temperature and the desired set-point, calculated by the heat curve and User setting. Should there be no mixed flow sensor fitted, the Master will allow all Slaves to operate at maximum power

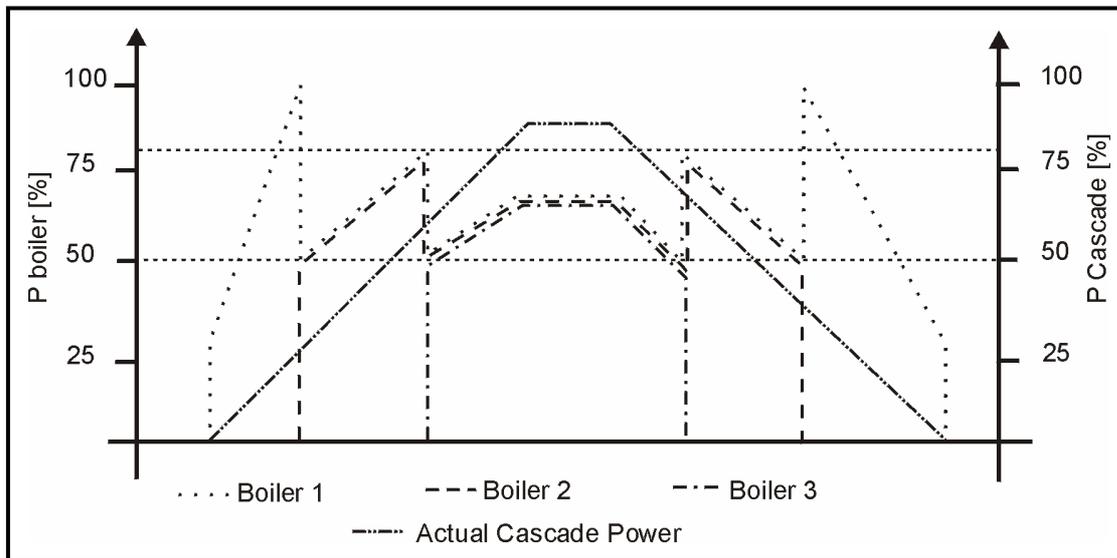
Adjustment of the proportional band and integral gain parameters is possible depending upon the installation. With the cascade running two or more boilers, should the flow temperature exceed the set-point, the cascade will try and manage the temperature to the set-point by switching off the boilers until only one boiler is firing. At which point the blocking function will be implemented until the flow temperature is below the hysteresis level. Should a Slave not receive a message from the Master (due to a problem with that boiler) within 20 seconds, provided that the Remote On/Off input is closed, the Slave will allow the boiler to operate as a stand alone boiler on it's own thermostat set-point.

**8.5.2.3 Cascade Sequence**

The cascade sequence is changed every 24 hours to spread boiler running hours . However during the first 48 hours from initial switch on, the sequence is changed every hour to prevent deposition in any one boiler - see figure 8.5.2.3.

Day	Switch ON Sequence	Switch OFF Sequence
Day n	M-S1-S2-S3-S4-S5-S6-S7	S7-S6-S5-S4-S3-S2-S1-M
Day n+1	S1-S2-S3-S4-S5-S6-S7-M	M-S7-S6-S5-S4-S3-S2-S1
Day n+2	S2-S3-S4-S5-S6-S7-M-S1	S1-M-S7-S6-S5-S4-S3-S2
Day n+3	S3-S4-S5-S6-S7-M-S1-S2	S2-S1-M-S7-S6-S5-S4-S3
-- etc.--	-- etc.--	-- etc.--

**Figure 8.5.2.3 - Cascade Sequence**



**Figure 8.5.2.4.1- Dividing cascade power over 3 boilers**

### 8.5.2.4 Managing the Cascade

The cascade divides the power over all identical connected boilers by programming the Master with the following information:

- Actual power that the cascade needs based upon the Outside temperature and desired heat curve (when an outside sensor is connected), and the User temperature setting for the thermostat input.
- Maximum Power ( $P_{max}$ ) that each boiler connected to the cascade can provide.
- Switching Up Power ( $P_{up}$ ) determines when the next boiler should be turned on if the other boilers run at this power or higher.
- Switching Down Power ( $P_{down}$ ) determines when the last boiler should be turned off if all boilers run at this power or less.
- Minimum Power ( $P_{min}$ ) that each boiler connected to the cascade, can at least provide.
- Time delay switching on & off a boiler.

#### 8.5.2.4.1 Example of 3 boiler cascade

When there is a demand for heat, the first boiler ignites and provides as much power as the cascade demands. When the cascade power increases to a point above  $P_{up}$ , the next boiler ignites and the total cascade power is divided between the firing boilers. When all boilers in the cascade are on and the cascade power increases more, all boilers will provide more power until they reach their maximum outputs. When the cascade power decreases, and the power of each boiler becomes less than  $P_{down}$ , then the last boiler switched on is switched off and the power divided between the firing boilers - see figure 8.5.2.4.1

#### 8.5.2.4.2 Boiler switching On/Off

The description above is theoretical as when a boiler is switched on and the new divided power for firing boilers is set below  $P_{down}$ , it is unacceptable that a boiler is switched off immediately. Therefore to correct this, the divided power should be higher than  $P_{down}$ , before a boiler is switched off when the divided power is less than  $P_{down}$ . However, if the divided power won't increase until it reaches  $P_{down}$ , the total power of the cascade will decrease, a boiler will be switched off as soon as the divided power reaches  $P_{min}$ . Similarly, if a boiler is switched off and the new divided power is less than  $P_{up}$ , it would be unacceptable for a boiler to switch on immediately. Therefore to correct this, the divided power should be less than  $P_{up}$  before another boiler is turned on. If however the divided power reaches  $P_{max}$ , the next boiler should be turned on.

**For example** - suppose:  $P_{max} = 100\%$ ,  $P_{up} = 80\%$ ,  $P_{down} = 60\%$ ,  $P_{min} = 50\%$ . One boiler is on and the power needed by the cascade is increasing.

As soon as the divided power reaches 80% the next boiler may be switched on, but it won't, because the new divided power will be less than  $P_{min}$ . 1 boiler on 80% = 2 boilers on 40% (<50%) In this case the divided power will rise until  $P_{max}$ , before the second boiler ignites.

1 boiler on 100% = 2 boilers on 50%. When in this example  $P_{down} = 60\%$ , the first boiler will stay on 100% and the second boiler would switch on as soon as the total power reaches 120% ( $2 * P_{min}$ ).

Similarly, if 2 boilers are on and providing less power than  $P_{\text{down}}$  ( $2 * 60 = 120\%$ ), the 2 boilers will stay on and modulate further down until the divided power reaches  $P_{\text{min}}$  (or the divided power  $\leq 100\%$  for 1 boiler)

#### **8.5.2.4.3 Blocking timer**

When a boiler is switched ON, a 'blocking off' timer prevents the boiler from immediately switching OFF. Within this time, another boiler can switch ON, but a boiler can only switch OFF when the timer has expired. Similarly, when a boiler is switched OFF, a 'blocking on' timer prevents the boiler from immediately switching ON. Again within this time, another boiler can switch OFF, but a boiler can only switch ON when the timer has expired.

These rules are ONLY overridden when the power of the cascade becomes 0 (eg. open circuit on Remote On/Off). In this situation all boilers will be switched OFF regardless of 'blocking timer' settings.

#### **8.5.2.5 Control of Cascade (Primary) Pump**

When a primary pump is used, it must be connected to the Master. By setting the relevant parameter, it is possible to control the primary pump as follows:

- Pump runs continuously, even with no heat demand, or

- Pump Off. Normally this is used when the Primary pump is under external control, or

- Pump runs according to the heat demand and switches Off after the pump overrun time has elapsed.

Frost protection of the Primary Pump is **not** provided by the Master.

#### **8.5.3 Boiler Management System**

This mode of operation relates to a 0~10V dc control signal from a BMS to individual boiler modules, and by setting the relevant parameter, the level of modulation is determined by the control signal, with only the Frost Protection function remaining active in the boiler control. Two modes of control are possible;

- Temperature control - the modulation is a function of the setpoint temperature.

- Power control - the modulation is a function of the determined power requirement of the cascade.

##### **8.5.3.1 Flow Temperature Control (BMS)**

The analogue input signal is translated to a setpoint for the flow temperature. Translation is done by setting the relevant parameters according to a linear line between 0-10V and a temperature range between 0-100°C. ( Maximum flow temperature is factory set to 85°C ).

When the Remote On/Off input is open circuit, the burner stops and will start again when the Remote On/Off circuit is closed.

##### **8.5.3.2 Power Control (BMS)**

The analogue signal is translated to a setpoint for the combustion fan speed (boiler input) by setting the relevant parameters according to a linear line between points A & B - see Figure 8.5.3.2

When the input voltage is less than A, the burner stops. When the input voltage is higher than A + Hysteresis, the burner starts. Should the flow temperature exceed the setpoint + it's Offset, the heat demand is 'blocked' and the anti-cycling timer starts. The 'block' is removed as soon as the flow temperature has dropped 10°C and a start will resume when the anti-cycling timer has expired.

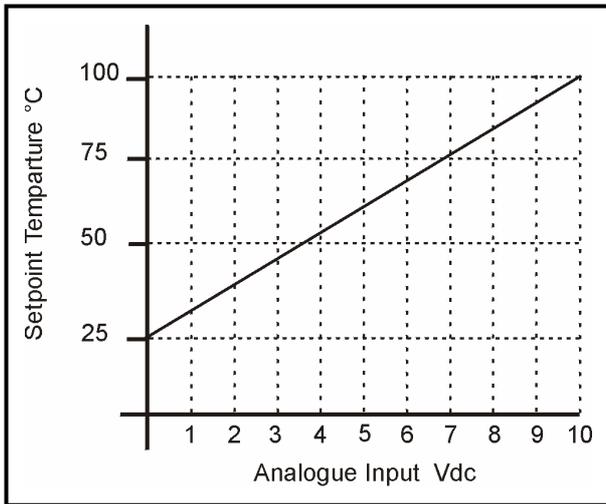


Figure 8.5.3.1 - Flow Temperature Control

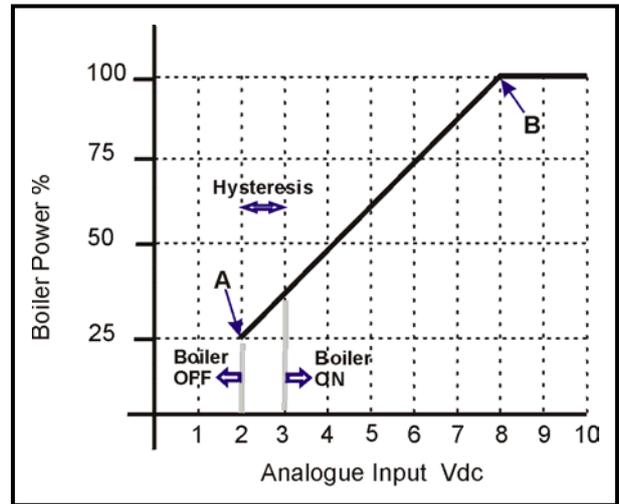


Figure 8.5.3.2 - Power Control

#### 8.5.4 Central Heating Program

To activate this mode of demand, the relevant parameter must be set to Remote On/Off or Switched Live On/Off. The central heating demand is detected when the Room Thermostat or Switched Live input closes. If an outside sensor is fitted, the water temperature setpoint depends on the outside sensor value and the selected heating curve (to be set during commissioning).

Modulation during this mode of operation is based upon the measurement of flow sensor S1. The selected heating curve will determine the control setpoint. The user can limit the maximum setpoint.

If the outside sensor is not connected, the setpoint is determined by the user.

If the outside air temperature exceeds 32°C the demand is switched OFF, and will be re-instated when the outside temperature has dropped by the hysteresis setting –see figure 8.5.4.

As soon as the flow temperature exceeds the setpoint by the hysteresis value, the burner will switch OFF, the pump will continue to run and the anti-cycling timer will start. As soon as the flow temperature has dropped below the hysteresis value and the anti-cycling timer has elapsed, the burner will switch ON.

The regulation is based upon PI -control, but the maximum capacity of the boiler can be limited by step modulation - refer to section 8.5.7.3.

#### 8.5.5 Frost Protection

Individual boilers are capable of two stage frost protection by setting the relevant parameters.

If the return temperature (sensor S2) drops below the first level protection temperature, the pump is activated. If the temperature continues to fall below second level protection temperature, the burner is switched ON and the fan speed is held at minimum firing rate. The pump and the burner remain ON until the temperature rises above the temperature On Offset.

Should an outside sensor be fitted, by setting the relevant parameters, the pump is switched ON if the outside temperature is below the minimum frost setting, and it will switch OFF outside of the Hysteresis band.

Should the boiler be switched OFF on the display screen, the frost protection function is still active.

**Note:** - Frost protection is **only** available on the Shunt Pump.

#### 8.5.6 Stand-by

Logging data - the control will log data to provide information for both User and Service Engineer. This logged data can be used to correct an error or block and consists of:

- Total gas consumption
- Running hours, with power equal to or less than 50% of its maximum setting.
- Running hours with power greater than 50% of its maximum setting.
- Total ignition attempts
- Fault ignition
- Last 10 errors/blocks

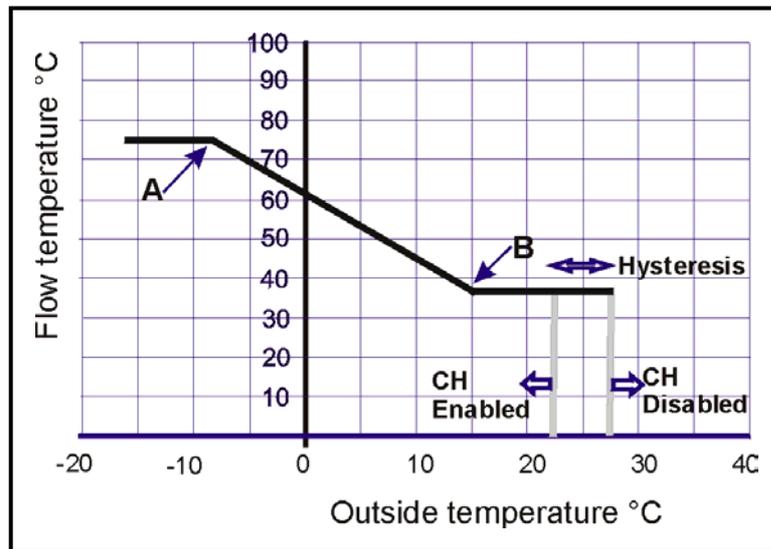


Figure 8.5.4 - CH heat curve

## 8.5.7 Special Boiler Functions

### 8.5.7.1 Anti-cycling

This function is used to limit the switching ON of the boiler in the case of poor heating system design or during instances of low demand. The anti-cycling function can block a heat demand for a specific time by setting the relevant parameter and is enabled as soon as the block is instigated due to excessive flow temperature. When enabled, any further demands for heat will be blocked and displayed on the screen.

When the heat demand is blocked due to excessive flow temperature and as a result, the flow temperature drops too quickly during the anti-cycle time, the block can be released before the pre-set time if the return temperature has dropped by at least the offset based on the return temperature at the start of the block.

### 8.5.7.2 Control of flow temperature gradient.

The flow temperature gradient is activated by the following heat demand:

- BMS based on temperature
- Remote On/Off

After switching ON the boiler, if the flow temperature rises too fast (gradient of the flow temperature too high), the control will set the fan speed to the minimum firing rate. Normally the PI - control should cope with this problem, but this function will prevent overshoot of the flow temperature when almost no power is required. The maximum gradient allowable will vary with the actual water temperature reading such that a lower maximum is allowed as the flow temperature set point is approached - see figure 8.5.7.2 .

Below the Hysteresis line, the fan speed control is based on the PI- regulation. Above the Hysteresis line, the fan speed is set to its minimum.

The gradient function is determined by points A & B, by setting the relevant parameters.

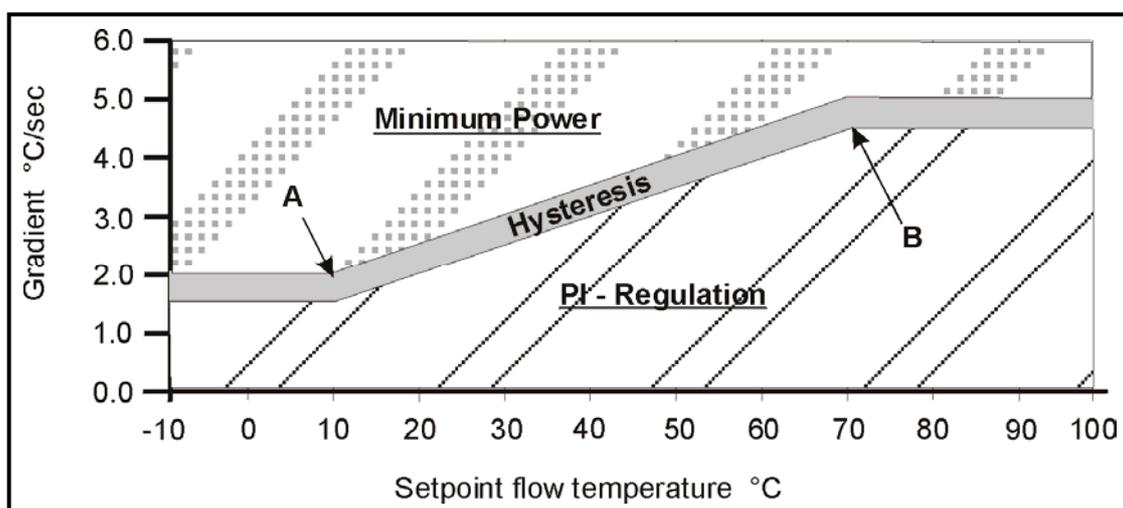
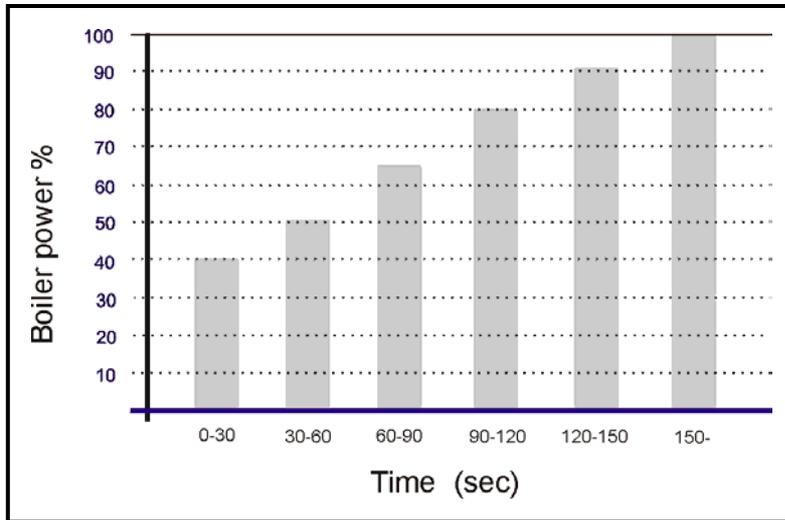


Figure 8.5.7.2 - Control of flow temperature gradient

### 8.5.7.3 Step Modulation

This function is particularly effective in avoiding too many firing cycles where the boiler power is relatively high compared to the minimum heat load. By setting the relevant parameters, as soon as the CH demand is active, step modulation begins. When in operation, the step is increased over time. The duration of each step, as well as the power corresponding with each step, determines the rate of increase / decrease in the boiler power.

**Note:-** the sum of all individual time steps may not exceed 109 minutes.



**Figure 8.5.7.3 - Step modulation control**

### 8.5.7.4 Monitoring On/Off ratio remote control On/Off input

This monitoring function provides information about the number of On/Off cycles of the Remote On/Off input. This can indicate a poor controls philosophy. By setting the relevant parameters, the details will be logged and the message "BLR: Min CH Cycl" will be shown on the display. This message will be removed automatically as soon as the time between successive heat demands, within the last time frame, is higher than the minimum cycle time.

### 8.5.7.5 Blocking Inputs

The BIC 930 control is designed with the ability to programme each input function, open or closed circuit. Operation of the device on the input (combustion chamber pressure switch or low gas pressure switch), will result in a block on all heat demands, with corresponding message on the display screen.

### 8.5.7.6 Fan Speed Control

The fan will modulate to the setpoint determined by the PI—regulation based on the actual flow temperature. Proportional bandwidth as well as Integration time can be altered together with fan speed settings, by setting the relevant parameters.

The modulation is limited by the maximum and minimum fan speed settings.

During pre-purge and ignition, the fan speed is fixed at different levels according to the specific boiler. During post purge, the fan speed is set to the last fan speed achieved with the boiler firing. When no flame is sensed after ignition, the fan speed is set to the flue gas purge time.

If the desired fan speed is not reached within a specific time period, the control will block the heat demand with a corresponding message on the display. The fan speed is considered acceptable as soon as the actual speed is within 30% of its setpoint.

To avoid problems with flame ionisation during the increase/decrease of fan speed, the slope of the increase/decrease can be limited. During boiler firing, these limits are more important than non firing fan functions (pre-purge etc).

## 8.6 DATA LOGGING FUNCTIONALITY

### 8.6.1 Gas Consumption

Gas consumption based on fan speed and gas valve opening is logged from two points. The start point is cleared just before leaving the factory. The second start point can be cleared by the User or Service Engineer, in both

cases the clearing date and time is logged. It is therefore important that the time and date are set correctly. Both gas consumption values are accessible from the display or PC tool. The maximum value catered for on the display is 999,999.9m<sup>3</sup>.

### **8.6.2 Running Hours**

As soon as the boiler starts operation, two timers log the total running hours. One indicates the amount of hours that the boiler is running at a power level equal to or less than 50% of the maximum output. A second timer logs the amount of hours that the boiler is running at a power level more than 50% of the maximum output. Both values are accessible from the display or the PC tool.

### **8.6.3 Ignition Counters**

There are four ignition counters. The first counts total ignition attempts. The second counts total failed ignition attempts ( i.e. it increases with the failure to measure an ionisation current after an ignition cycle). The third and the fourth are copies of first and second, but can be reset by the User or Service Engineer. All counters are accessible from the display or the PC tool.

### **8.6.4 Servicing Notification**

When the boiler control determines that a scheduled service is due, the boiler status display will alternate the standard status screen with the message "SERVICE DUE", every 5 seconds. This notification is activated as soon as one of the following rules is met after installation.

- 1) The service interval time has expired since the last service.
- 2) The boiler hours run time has expired since the last service.
- 3) The boiler operations counter has elapsed.
- 4) Incorrect parameter (influence of EMC, fault of EEPROM).

As soon as servicing is complete, the Engineer should reset the interval counters from the menu. The interval counters can be set by the relevant parameters.

### **8.6.5 Error & Blocking**

The last 10 errors and the last 10 blocks, are stored in separate tables, together with the date and time which they occurred. Both tables are accessible from the display or the PC tool. When the table fills up, the oldest error or block is removed and replaced by the most recent. When an error occurs, it will index two counters. The first will be cleared at the factory and the second may be cleared by the Service Engineer.

## **8.7 DISPLAY SCREEN**

The BIC 930 control is designed to operate with a display, which consists of 6 keys and an LCD backlit 2 \* 16 character screen. The display must be connected to the control to ensure correct operation of the boiler. If the display is disconnected from the control, all heat demands are blocked until the connection is restored.

The control can be switched OFF by pushing the On/Off button (top right on the fascia panel). When turned OFF, the boiler will not respond to a heat demand other than frost protection, if the appropriate parameters have been set. In this mode, the boiler is not electrically switched OFF, as power is still available to the control to satisfy post purging of the fan and pump overrun.

When an actual measured temperature is shown on the display, the temperature reading is an integrated value, so as to dampen any fluctuations.

As soon as the control enters a 'lockout' state, the text will flash and the backlight is turned On.

### **8.7.1 Status Display Readings**

The display will show various run mode screens, depending upon the left / right button operation:-

- Boiler and Circulation Pump Status Screen
- Water Temperature Sensor Screen
- Fan Speed and Flame Ionisation Signal Screen
- Remote Control Status Input Screen
- Cascade Status and Cascade Pump Status Screen

A temperature reading is normally shown in °C. By setting the relevant parameter, this can be changed to read °F. When one of the above screens is showing, pressing the Up / Down key will add a sixth screen showing the

actual setpoint of the CH flow temperature. Subsequent pressing of the Up / Down key will increase / decrease this

setpoint in 0.5°C increments. After changing the desired setpoint, the On/Off key must be pressed to save the new setting. If the setting is not saved, the previous setting will become active after the next power down.

### 8.7.1.1 Boiler and Circulation Pump Operation / Fault Status Screen

This screen will be the default start-up screen, and the control will revert to this screen after 1 minute has elapsed following the last button to be pressed. Fig 8.7 below shows the various combinations of boiler & circulation pump

Status	Description	LCD Display
<b>Boiler OFF</b>	Boiler is 'Off' based on display On/Off button	BLR: OFF
		PUMP: OFF
<b>Boiler Standby</b>	Boiler is 'On' and no heat demand is active	BLR: STANDBY
		PUMP: OFF
<b>Pre-Purge</b>	Heat demand active	BLR: PRE-PURGE
		PUMP: RUN
<b>HSi On</b>	Hot Surface Igniter warm up period	BLR: IGNITER ON
		PUMP: RUN
<b>Gas Valve On</b>	Safety Time period	BLR: GAS VALVE ON
		PUMP: RUN
<b>Boiler Normal Run</b>	Flame stabilisation and normal modulation control	BLR: RUN 065%RATE
		PUMP: RUN
<b>Boiler Post Purge</b>	End of a firing or ignition sequence	BLR: POST PURGE
		PUMP: RUN
<b>Temperature Overshoot</b>	Blocking due to high flow temperatures	BLR: TEMP O/SHOOT
		PUMP: O/RUN 05MIN
<b>Low Gas Supply Pressure</b>	Blocking due to low gas supply pressure	BLR: LOW GAS PRES
		PUMP: OFF
<b>Condense Drain Trap Blocked</b>	Blocking due to blocked condense drain	BLR: DRAIN BLOCKD
		PUMP: OFF
<b>Flame Simulation</b>	Lockout due to simulation of the ionisation signal	BLR: FLAME SIMLTN
		PUMP: RUN
<b>Fan Fault</b>	Lockout due fan speed not being achieved	BLR: FAN FAULT
		PUMP: RUN
<b>Ignition Lockout</b>	Lockout due to no ionisation signal after ignition attempt	BLR: IGN LOCKOUT
		PUMP: RUN
<b>Overheat</b>	Lockout due to activated Safety Limit Thermostat	BLR: OVERHEAT
		PUMP: RUN
<b>Flow Temperature Sensor Fault</b>	Lockout due to short circuit or interrupted sensor input (S1, S2 or S3)	BLR: SENSOR FAULT
		PUMP: RUN
<b>Anti-cycling Function</b>	Blocking due to boiler cycle time	BLR: ANTI_CYCLING
		PUMP: RUN
<b>Service Mode</b>	Heat demand activated by Service Mode	BLR: SERVICE MODE
		PUMP: RUN
<b>Remote Control Fault</b>	Remote Control On/Off input operating too often. Message flashes.	BLR: REM CTRL FLT
		PUMP: RUN
<b>Servicing Notification</b>	Scheduled service is due. Message flashes	BLR: SERVICE DUE
		PUMP: RUN

Figure 8.7—Display Status Screens

### 8.7.1.2 Water Temperature Sensor Screen

This screen will appear as soon as the left button is pressed from the 'Boiler and Circulation Status Screen'. Should a temperature reading measured be outside the allowable range, the message will show "SENSOR FAULT"

Status	Description	LCD Display
Water Temperatures Flow and Return	Showing flow temperature and return temperature measured by S1 & S2. Also in brackets ( ) the setpoint of the flow temperature.	FLW:036.5°C(082)
		RTN:023.0°C

Figure 8.7.1.2 - Water Temperature Sensor Screen

### 8.7.1.3 Fan Speed & Flame ionisation Screen

This screen will appear as soon as the left button is pressed twice from the 'Boiler and Circulation Status Screen'. The actual fan speed is shown to the nearest 10 rpm. However, when the Service Function is active, and the fan setpoint has altered, the first line will show the new setpoint for 3 seconds. After which, the actual speed will be shown

The actual flame signal is shown to the nearest 0.5 µA

Status	Description	LCD Display
Fan Speed & Flame Ionisation Signal	Showing actual fan speed and ionisation current	FAN SPD:04320rpm
		FLAME SIG:03.5 µA

Figure 8.7.1.3 - Fan Speed & Flame ionisation Screen

### 8.7.1.4 Remote Control Input Status Screen

This screen will appear as soon as the left button is pressed three times from the 'Boiler and Circulation Status Screen'.

Status	Description	LCD Display
Remote Control On/Off Input	Showing the Remote Control Input & the Analogue Input signals	REMOTE I/O: OFF
		ANALOG SIG:00.0V

Figure 8.7.1.4 - Remote Control Input Status Screen

### 8.7.1.5 Cascade and Cascade Pump Status Screen

This screen will appear as soon as the left button is pressed four times from the 'Boiler and Circulation Status Screen' and the controller is configured as the Cascade Master. This screen will provide information about the status of the cascade and it's pump.

Status	Description	LCD Display
Cascade OFF	Cascade is 'Off' based on display On/Off button	CAS: OFF
		PUMP: OFF
Cascade Standby	Cascade is 'On' and no heat demand is active	CAS: STANDBY
		PUMP: OFF
Cascade No Slaves	The cascade Master is unable to locate Slaves.	CAS: NO SLAVES
		PUMP: OFF
Cascade ON	The cascade is active, with the cascade actual temperature and its setpoint.	CAS:ONS4 +setpoint°C
		PUMP: ON
Cascade without sensor S4	The cascade sensor S4, is not present. All connected slaves will get maximum power and calculated cascade setpoint.	CAS:S4NOT PRESENT
		PUMP: ON

Figure 8.7.1.5 - Cascade Status Screen

### 8.7.1.6 - Cascade Information Screen

This screen will appear as soon as the left button is pressed five times from the 'Boiler & Circulation Status Screen' and the controller is configured as a Cascade Master.

The first line will give information about the power given to each activated Slave followed by the total power controlled by the Cascade. This second value can reach more than 100%, when for instance 6 boilers are connected, the total power of the cascade is set to 600%.

The second line will give information about connected Slaves. The first number is the address of the Slave (or Master) which has the highest priority. When a "-" is shown, the corresponding number of that Slave which is not connected, or is 'locked out', is not available to the Cascade. When the number is flashing, that relevant Slave or Master, is participating in the heat demand.

Example: - a cascade configured with 6 boilers (addressed 0,1,2,4,5,7), the actual power is 65% and currently 3 boilers are turned on, boiler number 5 has the highest priority.

Status	Description	LCD Display
Cascade ON at 65% of a max of 600%	3 out of 6 boilers are turned On. Highest priority is set to boiler '5'. Boilers 6 & 3 are not connected or are in Lockout.	CAS POW:065%600%
		PRESENT:5-7 0 1 2-4

Figure 8.7.1.6 - Cascade Information Screen

### 8.7.2 Controlled Programming of Parameters from the Display

With the display, several parameter settings can be changed. There are three levels of access to the parameters:

- 'User' level. Parameters accessible by the User, are protected with a 4 digit code (default 0303), which is programmable by the User. To enter the 'Access Code', the User should press and hold the Exit key for 3 seconds.
- 'Engineer' level. Parameters accessible by the Engineer, are protected with a 4 digit code (refer to Hamworthy Heating Ltd). To enter the 'Access Code', the User should press and hold the Exit key for 3 seconds.
- 'Factory' level. Some parameters are only accessible by the manufacturer. To access these parameters, a PC tool is required.

#### 8.7.2.1 Code Input Menu

This screen allows access to the above security levels, such that parameters can be changed. After pressing the exit button for 3 seconds, the display shows a four digit sequence zeros. After entering the security number press enter again.

The code can be entered by moving to each digit in the sequence using the 'left / right' keys. A flashing digit indicates the position in the sequence to be entered. The 'up / down' keys can be used to increase or decrease the digit value. After selecting the correct code (User or Engineer), the Enter key must be pressed. If the correct code has been entered, the display confirms for a second the security level entered before going into the options menu within that level. When an incorrect code is put in, the display will return to the normal status screen.

Status	Description	LCD Display
Code Input Menu	Code Input Menu accessed by User	ENTER MENU CODE
		0303

Figure 8.7.2.1 - Access Status Screen

#### 8.7.2.2 Main Menu (Within The Security Level Chosen)

The main menu is shown as a list which can be scrolled by pressing the 'Up or Down' keys. Within the list are items which are accessible by entering the appropriate code.

The currently selected item on the list is identified by the '►' symbol. Pressing the 'Enter' key will select a sub-menu relevant to the currently selected item. Only selected items relevant to the code entered are displayed. To leave the main menu and return to the 'Boiler and Pump Status Screen', press the 'Exit' key.

After selection of a menu item, the display will show the description and an alternating menu number. By pressing the 'Up / Down' key the specific number can be selected. The value of that item will be shown as that item number is selected by pressing the 'On/Off' key. At this point the 'Up / Down' keys will change the value of the selected item. To save the new value, the Enter key must be pressed, and the value will be stored in the EEPROM, before returning to the 'Boiler and Pump Status Screen'. Should additional parameters require adjustment, by pressing the 'Exit' key after changing the value of the item, the screen will return to the 'Main Menu'. Once all values have been changed, the Enter key can be pressed to return to Boiler and Pump Status Screen'.

Should a changed value not be stored in the EEPROM, the control will revert to the original setting at the end of the current heat demand.



## **9.0 FAULT FINDING**

The Purewell VariHeat boiler is equipped with full self diagnostic fault indication, which is displayed on the screen - refer to **section 8.7 - Controls Operation**.

**Should a fault occur which cannot be reset, or a fault repeatedly occurs, contact Hamworthy Heating for assistance. Do not continue to operate or use the boiler as this may cause damage to the boiler or controls.**

### **9.1 Safety Features Summary**

#### **9.1.1 Safety Temperature Limiter**

The electronic control thermostat has several safety levels built in such that a controlled shutdown should occur before the safety temperature limiter is activated. Should these safety levels be overridden (say external pump overrun failure after shutdown) the safety temperature limiter will trip initiating a boiler shutdown, preventing the boiler from firing.

Should the control thermostat fail, causing an overheat condition, the safety temperature limiter will trip thus creating an immediate shutdown regardless of firing mode. An overheat message on the **controls fascia** will indicate that this condition has occurred. The safety temperature limiter is reset by depressing the reset pin protruding through the hole near the centre of the controls fascia. If, after pushing the pin in, the display screen does not reset and the boiler does not light up, it could be that the boiler is still too hot, i.e. the control thermostat has not re-set. An investigation should be carried out to ascertain the reason for the overheating. An obvious reason would be too low a water flow rate through the boiler.

The flame is under constant supervision by the burner logic controller. This is accomplished by measuring the flame's ability to rectify an AC current. If the flame diminishes for whatever reason and the rectified current drops below the controllers minimum (1.2µA DC), the controller will make 1 attempt to re-light. If this attempt is unsuccessful a non-volatile lockout occurs which requires a manual re-set ('on/off button situated on the controls fascia) to re-start the control sequence.

### **9.2 Fault Finding Procedures**

If the boiler repeatedly "locks-out", an investigation must be made to ascertain the cause. General error messages are detailed in figure 8.7 to assist with general fault finding. If the boiler still cannot be operated satisfactorily after following the instructions, consult your local office of Hamworthy Heating for assistance.

### **9.3 Possible Causes of Boiler Lockout**

- 1) Ignition failure due to faulty igniter.
- 2) Ignition failure due to faulty gas valve.
- 3) No ignition due to faulty controller.
- 4) Ignition failure due to faulty flame probe or sensing circuit.

### **9.4 Conditions 'Blocking' Operation of Boiler**

- 1) Condensate trap blocked (differential pressure switch activated).
- 2) No or low gas supply pressure.

## **10.0 SERVICING**

**A competent person registered for working on non domestic gas appliances should check and ensure that the flue, its support and terminal, the ventilation to the boiler house, safety valve, condensate trap, drain, water filter if fitted, pressure gauge etc., are in a serviceable and working condition, and still comply with the relevant standards and codes of practice - see Section 4 & Appendices**

**10.1 Regular servicing is recommended**, preferably by a Hamworthy appointed person, and at least annually, to ensure trouble free operation.

For the Purewell VariHeat, Hamworthy would recommend an additional 6 monthly examination following commissioning, acknowledging site conditions and running hours.

Although cleaning of flueways may not be necessary on a yearly basis inspection of the flueways must be undertaken annually and it is important that all controls and safety features are checked for correct operation.

**NOTE!** Measuring flue gas CO<sub>2</sub> and gas temperatures will give an indication of the state of the boiler flueways and waterways. Results should be compared with previously measured values to establish possible loss of efficiency.

**Should remedial work be carried out on a module within a bank of boilers, then the non-firing module must be electrically isolated so as to prevent accidental operation., in the event that the installation is required for ongoing heating requirements.**

**10.2** The procedure detailed relates to a single boiler and must be carried out on all boilers within a bank. Before servicing the boiler, the following procedure must be carried out: -

**WARNING: Isolate the electrical supply and turn off the gas isolating valve to the boiler module being serviced.**

- 1) To remove the front casing door, turn the four 1/4 turn screws securing the fascia moulding clockwise a 1/4 turn.. Pivot the fascia moulding about it's bottom edge to 45 degrees and lift off. Store in a safe place to avoid damage. Turn the two 1/4 turn screws securing the front casing door by a 1/4 and lift off the door from the front brace. Turn the two 1/4 turn screws fixing the top panel and slide the panel in the direction of the rear of the boiler to disengage from the securing pins on the back panel.
- 2) Turn off gas service cock.
- 3) Disconnect the gas valve plug assembly from the gas valve & the low gas pressure switch plug. Disconnect the gas valve inlet flange from the gas valve. Disconnect the 3 & 5 way electrical plugs from the fan body.
- 4) Disconnect igniter and probe leads. Disconnect the fan/gas valve assembly from the burner body by removing the 4 M8 nuts securing the transition duct to the burner. Carefully place the fan/gas valve to one side.
- 5) Loosen the 4 - M8 nuts securing the burner clamping flange to the tie rods and carefully remove the clamp. The burner assembly can be removed by withdrawing upwards. Check condition of igniter assembly and probe for damage. Clean as required. Check burner surface and clean using a soft brush if required (if possible use compressed air to blow out the dust inside the burner. A damaged burner must be replaced.
- 6) Examine the non return valve located in the fan/burner duct for free operation and integrity of the foam seal. Replace if necessary.
- 7) Remove the screws securing the gas valve and discharge tube assembly to the air inlet box and carefully place to one side.
- 8) Inspect the fan impellor and clean using a soft brush and compressed air.

**10.3** The boiler flueways can now be cleaned as follows:-

**Prior to cleaning the flueways, the inspection panel secured to the front base of the boiler must be removed.**

- 1) Using a suitable brush, clean the vertical fins on the castings below the burner.
- 2) Using a torch, inspect the fin matrix of the secondary heat exchanger situated below the cast iron sections and clean using compressed air or a water hose. Any debris dislodged can be removed from the sump through the inspection panel.
- 4) Re-assemble the boiler in the reverse order to that shown above. Ensure a new seal is fitted to the top casting / burner joint to maintain a gas tight seal, (see spares list). Ensure that a new seal is fitted to the inspection panel. The boiler's operation may be affected if these seals are do not form a gas tight joint.
- 5) Re-assemble the burner and clamp plate to the top casting and secure using the M8 nuts and tie rods, ensuring that the joint is sound. Assemble the gas valve, fan, transition duct using new gaskets. Refit the gas inlet flange to the gas valve using a new 'O' ring. Check all gas connections are tightened securely before opening the gas service cock. Re-connect electrical connections. Switch on the electricity supply and re-light the boiler following the procedure detailed in section 7.3.
- 6) Take exhaust gas readings and compare with section 7.4. Ensure no gas leaks are evident from the gas connections, refer to section 7.1 for procedure. Check thermostat settings and adjust if required.

## **11.0 REPLACEMENT OF FAILED COMPONENTS**

There are a number of components listed below which can be replaced simply and quickly by following the given procedure. In each case carry out the appropriate part of the commissioning procedure & check the operation of each component replaced. See **Section 7.3:Commissioning and Testing**

**NOTE: Isolate electrical supply to the boiler and turn off the gas supply after removing controls cover and before commencing any servicing or component exchange procedure.**

### **11.1 Igniter and Flame Probe Assembly**

**Both Igniter and flame probe are secured in the same manner.**

Reference to Figure 11.1 shows position of igniter assembly. To remove assembly disconnect the plug/socket on the supply lead and remove the screw securing the igniter to the burner front panel. Figure 11.1 shows diagram of igniter assembly and relevant components. Renew components as required and generally remove any loose sooty deposits and clean as required. Ensure positions of components are as recommended in Figure 11.1.

### **11.2 Safety Temperature Limiter (Limit Stat)**

With the boiler front cover removed, the Limit Stat is situated on the rear of the control panel fascia bracket to the left hand side of the main PCB.

Remove the 'push on' spade connections from the temperature limiter body noting position of coloured cables. Remove plastic cover (if fitted) and unscrew holding nut to detach temperature limiter from housing. Gently feed the capillary back through the controls bulkhead. Re-set temperature limiter to 95°C. Check the operation of the device by carefully applying a heat source to the bulb. Re-assemble temperature limiter into controls housing ensuring correct cable notation. Refer to Figure 9.0.

### **11.3 Main Gas Valve.**

**NOTE!** Hamworthy Heating strongly recommend that a new gas valve assembly is fitted to ensure safe, reliable operation of the boiler. **The gas valve is supplied as a factory set component & must not be tampered with.**

1) Disconnect the gas valve electrical plug.

Remove the four socket head screws securing the gas valve inlet flange. Take the weight of the gas valve and remove the four socket head screws securing the gas valve to the discharge pipe assembly. Withdraw the gas valve.

2) Always fit new 'O' rings to both inlet and outlet when replacing the gas valve.

Always test for gas soundness after replacement parts have been fitted.

Refer to **Section 7.1**, if necessary for valve integrity check procedure.

3) Re-light the boiler using instructions on the inside of the door. Check for correct operation. If necessary, refer to **Section 7.4 Commissioning the Boiler**, for correct procedures.

### **11.4 Combustion Fan**

NOTE! To remove the fan, it is necessary to remove the gas valve and discharge pipe assembly.

1) Disconnect the gas valve plug assembly from the gas valve. Disconnect the gas valve inlet flange from the gas valve. Disconnect the 3 & 5 way electrical plugs from the fan body.

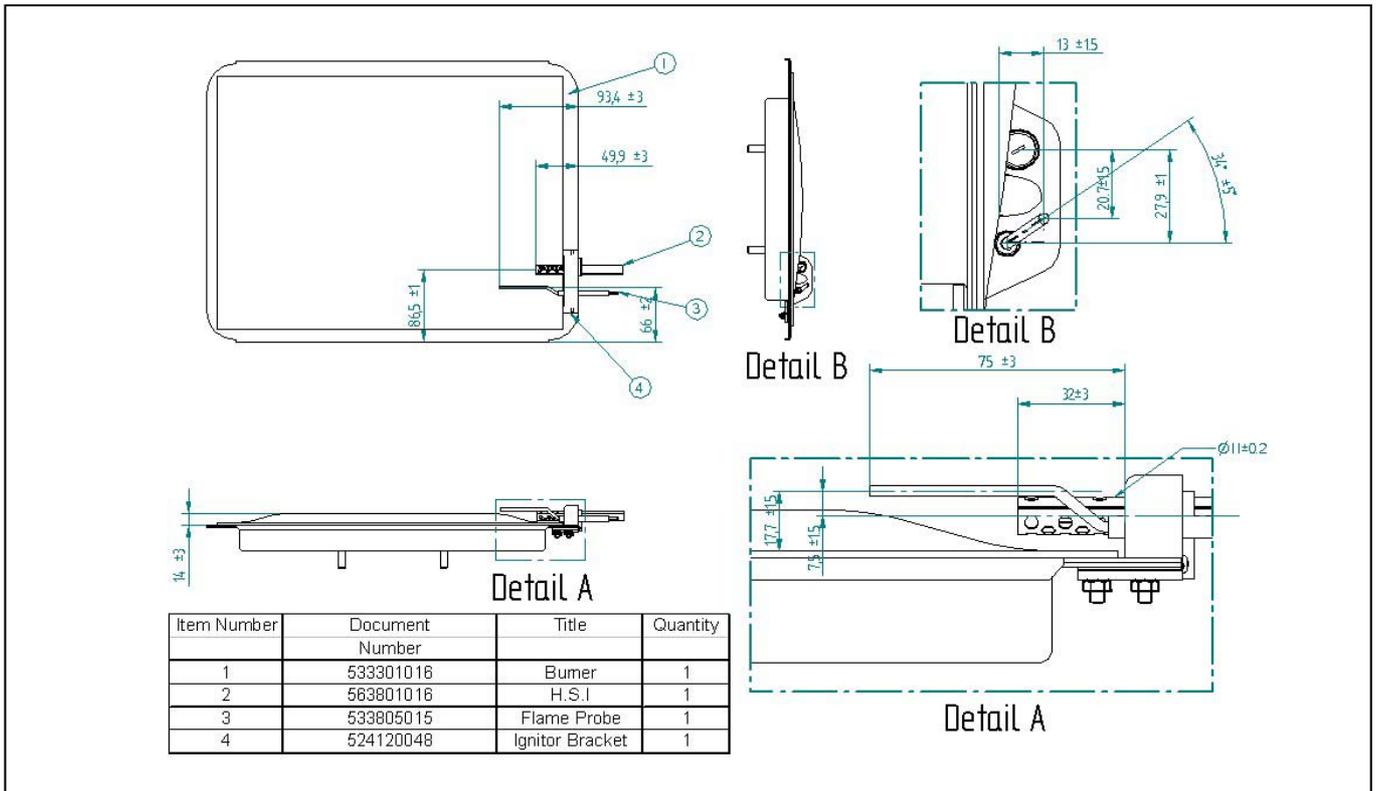
2) Disconnect the fan/gas valve assembly from the burner body by removing the 4 M8 nuts securing the transition duct to the burner.

3) Remove the screws securing the gas valve and discharge tube assembly to the air inlet box and carefully place to one side.

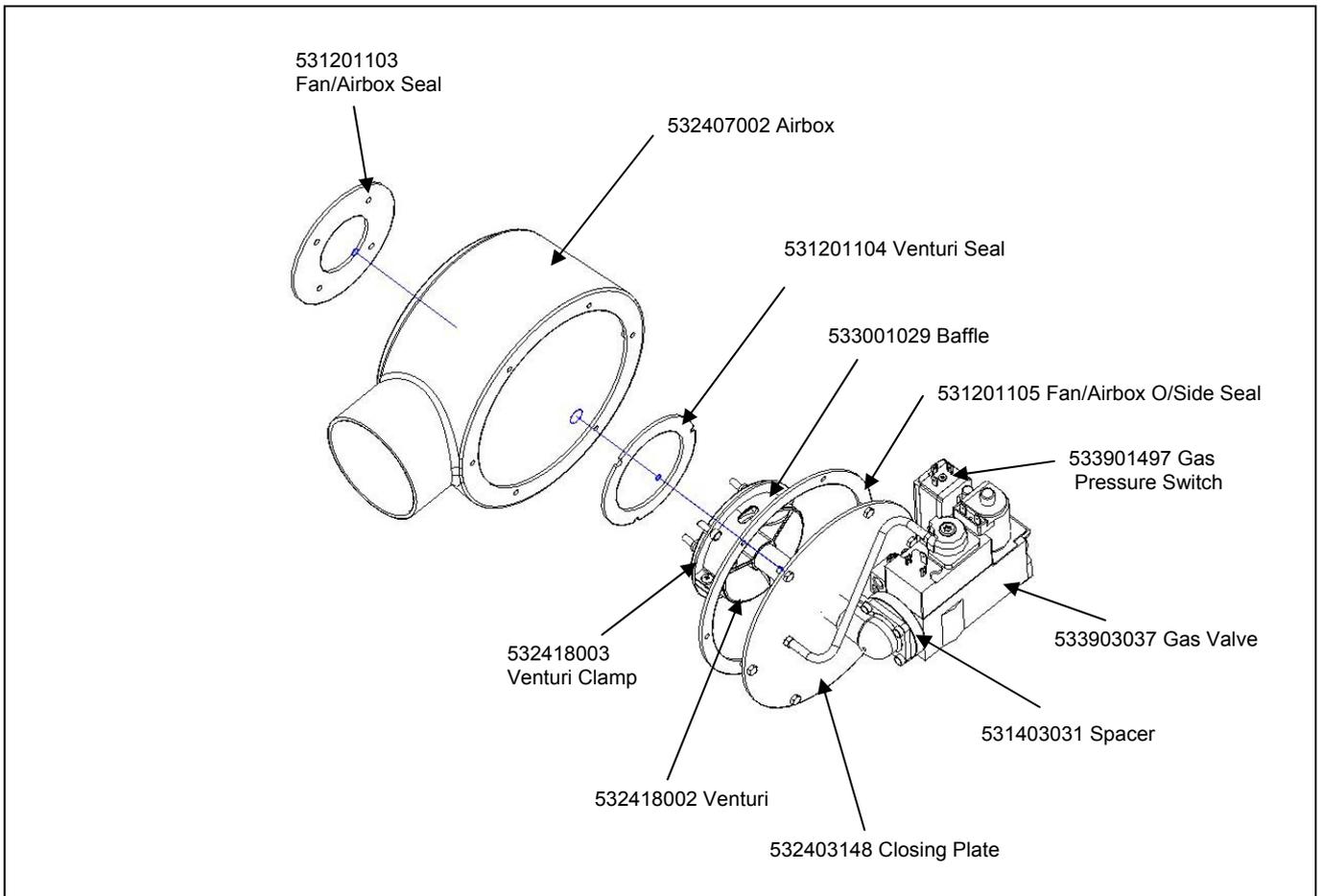
4) Remove the screws securing the air / gas mixing device to the fan and withdraw the air inlet box, carefully place to one side.

5) Remove the screws securing the fan outlet to the burner transition duct. Beware there is a non return valve fitted between these components.

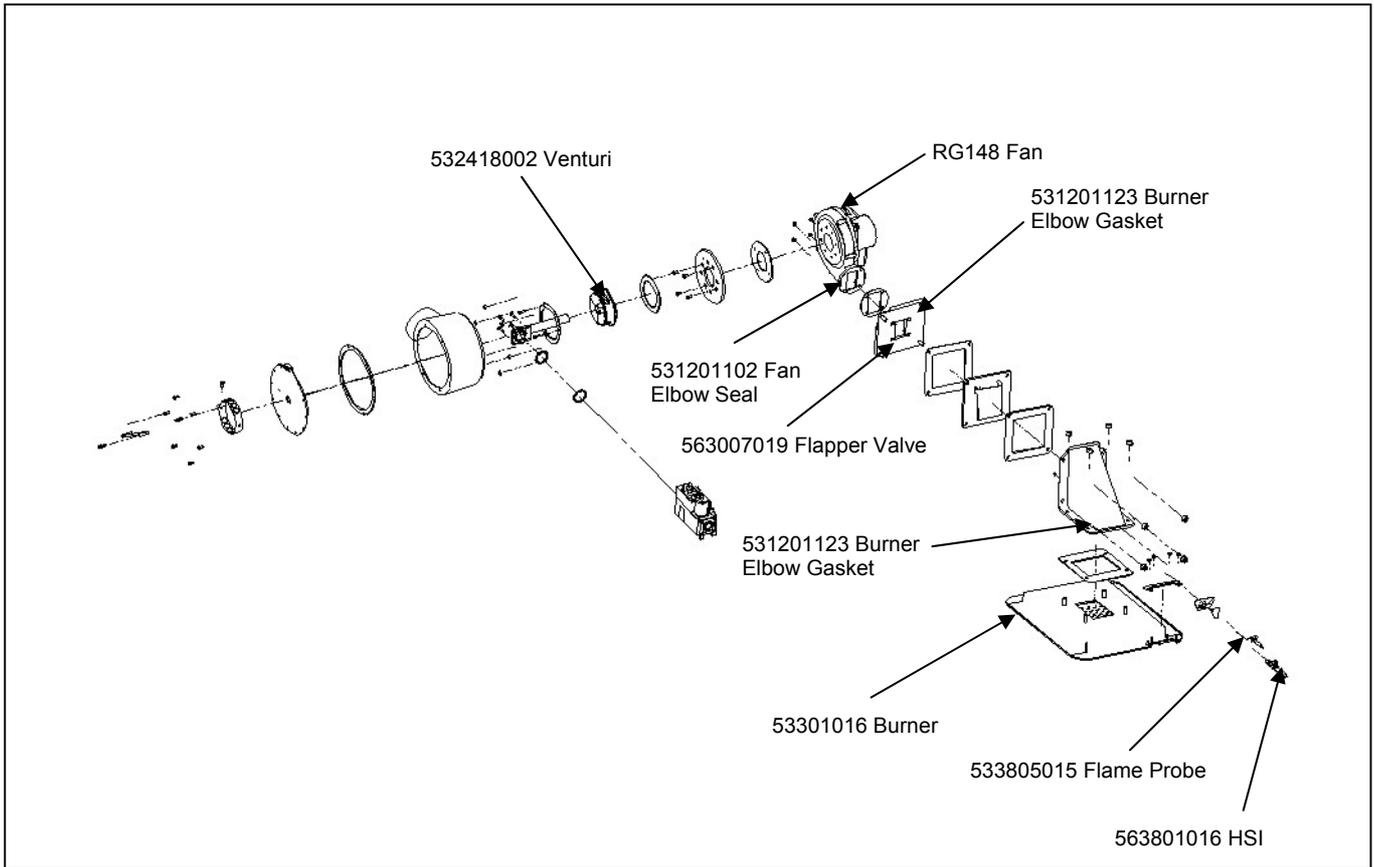
6) Re-assemble in reverse order using new gaskets where appropriate. After assembly and prior to re-fitting the assembly to the burner, check for correct and free operation of the non return valve in the burner transition duct.



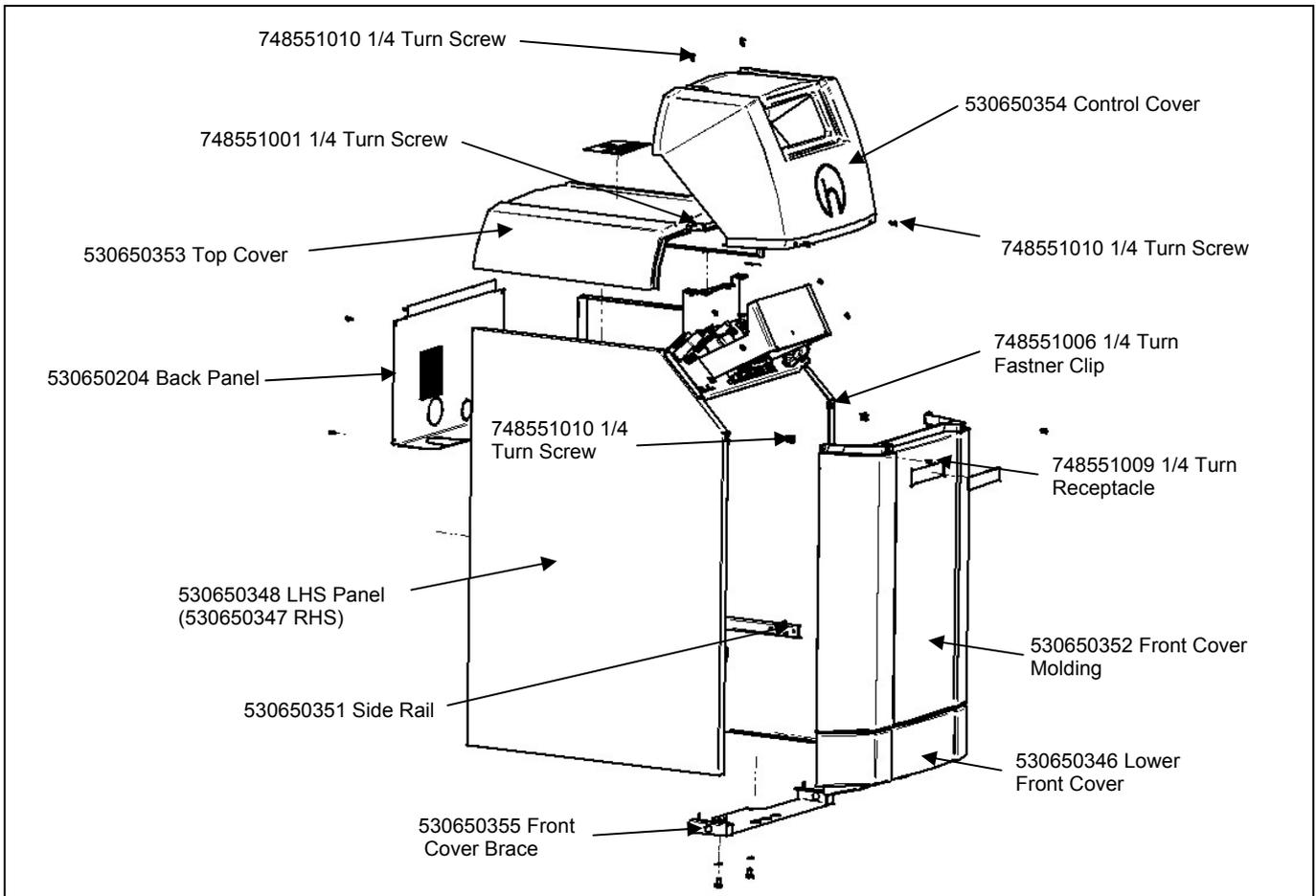
**Figure 11.1 - Hot Surface Igniter and Flame Sensing Probe Positions**



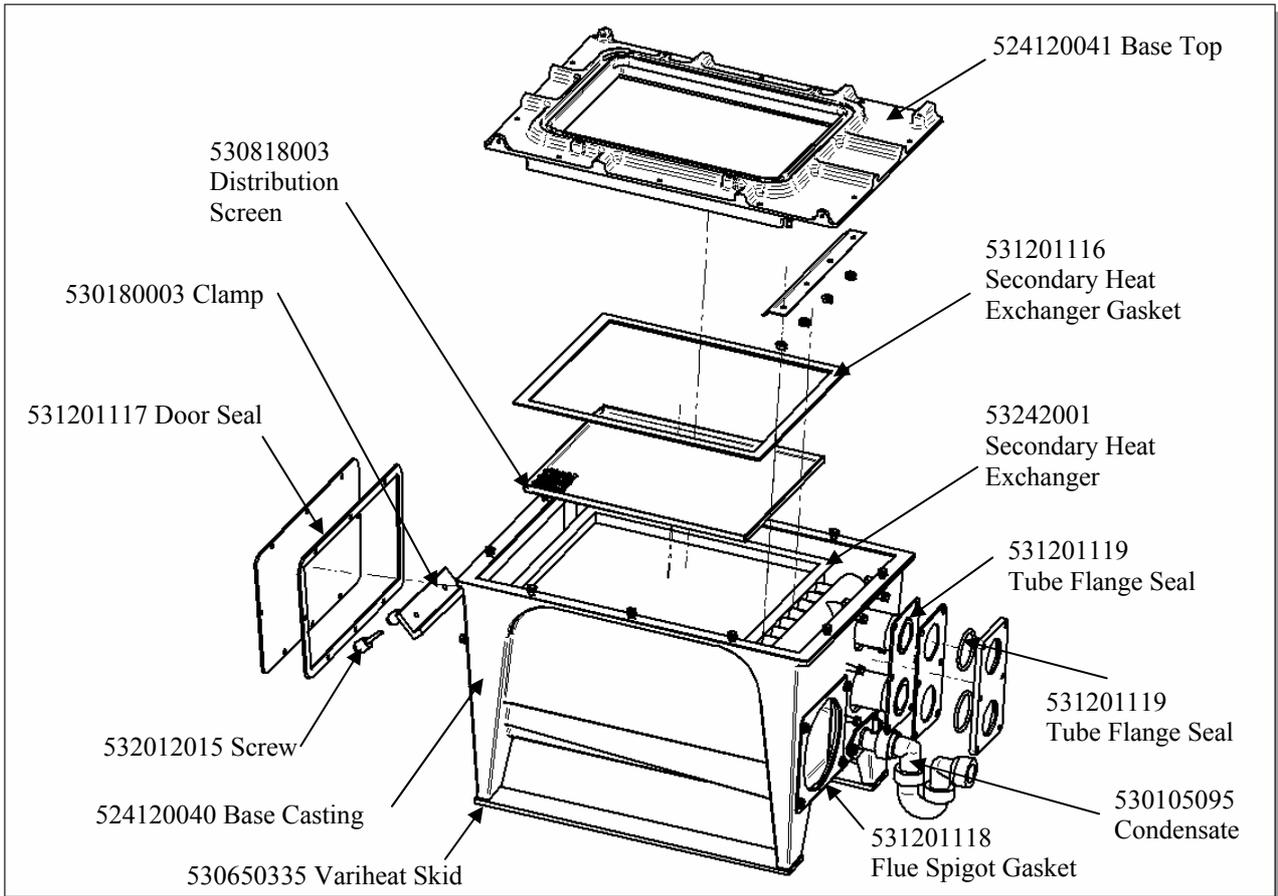
**Figure 11.2 - Gas Valve Assembly ( model 70c -110c shown for illustration)**



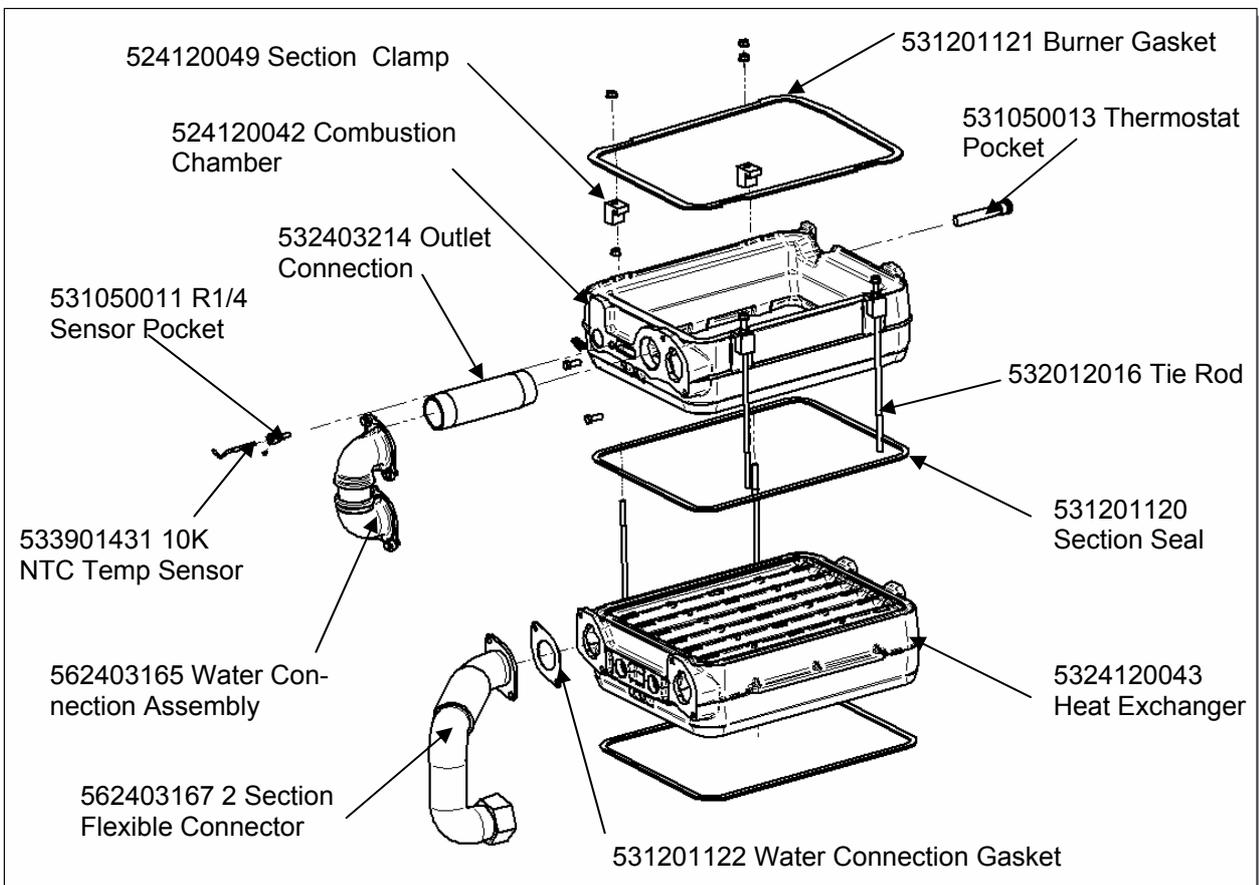
**Figure 11.3 - Combustion Fan Assembly ( model 70c -110c shown for illustration)**



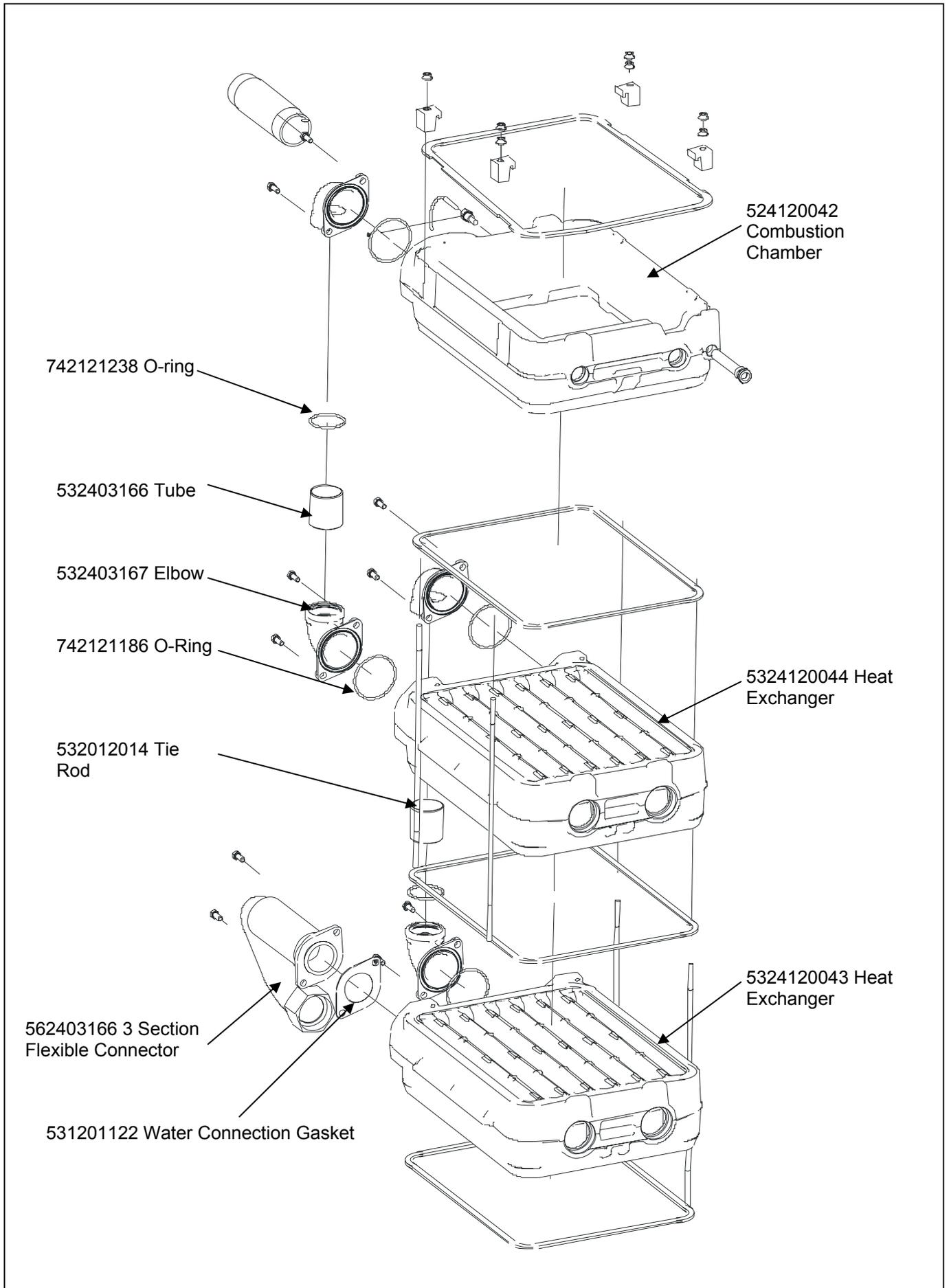
**Figure 11.4 - Casing Assembly**



**Figure 11.5- Secondary Heat Exchanger Assembly**



**Figure 11.6- Heat Exchanger Assembly ( model 70c—110c shown for illustration)**



**Figure 11.7 - Heat Exchanger Assembly ( model 140c -180c shown for illustration)**

## **12.0 RECOMMENDED SPARES**

**Please Note:-** To ensure the correct spare parts are despatched by our spares department, it is imperative that the complete Boiler/Module/Control Panel Serial Numbers are given. The Boiler and Module Serial Numbers are located on the Data Plates affixed to the front of the heat exchanger base casting The Electrical Serial Number is located inside the Control panel on the maximum power rating label. These numbers **MUST** be quoted when ordering spare parts.

### **SPARES ITEM**

### **PART No.**

#### **ELECTRICAL ITEMS**

BIC 930 Main PCB - 70c.....	533902040
BIC 930 Main PCB - 95c.....	533902041
BIC 930 Main PCB - 110c.....	533902042
BIC 930 Main PCB - 140c.....	533902043
BIC 930 Main PCB - 180c.....	533902044
DU 930 Display PCB.....	533902039
Flow / Return Sensor.....	533901431
Temperature Limiter.....	533901179
Hot Surface Igniter.....	563801016
Flame Sensing Probe.....	533805015
T2A 5x20 Fuse.....	533922002
T1.25A 5x20 Fuse.....	533922011
T3.25A 5x20 Fuse.....	533922005

#### **MECHANICAL ITEMS**

Burner.....	533301016
Gas Valve (70c - 110c).....	533903037
Gas Valve 'O' Ring (70c - 110c).....	531299018
Gas Valve (140c - 180c).....	533903036
Gas Valve 'O' Ring (140c - 180c).....	531299032
Combustion Fan (70c - 110c).....	533901376
Combustion Fan (140c - 180c).....	533704003
Air Pressure Switch.....	533901334
Low Gas Pressure Switch (70c - 110c).....	533901497
Low Gas Pressure Switch (140c - 180c).....	533925004
Set of Gaskets (Routine Service - combustion system).....	563605342
Set of Gaskets (Major Service - combustion system plus heat exchanger).....	563605343

For service or spares please contact :-

**Hamworthy Heating Limited**  
**Fleets Corner**  
**Poole**  
**Dorset BH17 0HH**

<b>Phone Number</b> .....	<b>01202 662500</b>
<b>Fax Number</b> .....	<b>01202 665111</b>
<b>Service</b> .....	<b>01202 662555</b>
<b>Spares</b> .....	<b>01202 662525</b>
<b>Technical</b> .....	<b>01202 662566</b>

## APPENDIX A - GAS DATA

### Natural Gas

GENERAL DATA Purewell VariHeat - non condensing mode		BOILER MODEL				
Model		70c	95c	110c	140c	180c
Boiler Input (maximum)	- kW (Gross)	72.2	98.39	114.98	151.33	194.58
Boiler Input (maximum)	- kW (Nett)	65.02	88.6	103.54	136.28	175.22
Boiler Output (maximum) 80/60°C	- kW	63.51	86.31	99.8	134.41	172.83
Boiler Output (minimum) 80/60°C	- kW	21.17	28.77	33.27	44.80	57.61

GENERAL DATA Purewell VariHeat - condensing mode		BOILER MODEL				
Model		70c	95c	110c	140c	180c
Boiler Output (maximum) 50/30°C	- kW	70	95	110	140	180
Boiler Output (minimum) 50/30°C	- kW	23.33	31.67	36.67	46.67	60.00

GAS DATA						
Gas Inlet Connection Pipe Thread Size		R1"				
Nominal Gas Inlet Pressure		20				
Maximum Gas Inlet Pressure		25				
Gas Flow Rate (maximum)		6.9	9.4	10.9	14.4	18.5
Target CO <sub>2</sub> % at High / Low fire ±0.25%		9.5 / 9.5		9.5 / 8.5		

Figure A1 - Gas Data

## APPENDIX B - ELECTRICAL CONNECTIONS AND CONTROLS

ELECTRICAL DATA						
Model		70c	95c	110c	140c	180c
Normal Supply Voltage		230V ~ 50Hz				
Power Consumption (maximum)*	-	W	554		667	
Start and Run Current (per boiler)	-	A	0.54		0.6	

Figure B1.1 - Electrical Supply

\*Where The max allowable power output from the IEC Outlet is 460 W (fitted with A T2A fuse).

**IMPORTANT: Individual boiler modules must be earthed.**

**The boiler must be isolated from the mains electricity supply in the event of electric arc welding being carried out on any connecting pipework.**

1.1 Wiring external to the boiler must be installed in accordance with the IEE Regulations and any local regulations which apply. Wiring must be completed in heat resistant 3-core cable of 1.0mm<sup>2</sup> cross sectional area. Boilers are normally supplied for connection to a 230 volts, 50Hz mains supply. The BIC 930 control is supplied with a replaceable fuse (T1.25A). External fuses should be 6A for all boiler modules.

1.2 3-Phase Electrical Supplies. Banks of VariHeat boilers and boilers installed in close proximity to each other **MUST NOT** be supplied from different phases of a 3 phase supply. The method of connection to the mains electricity supply must facilitate complete electrical isolation of the single boiler with a separation of at least 3mm in all poles.

1.3 A mains isolator must be provided adjacent to each boiler in a readily accessible position. The supply should only serve the boiler.

1.4 Volt free contact electrical supplies must be isolatable where fitted.

1.5 Further details regarding connection to the electricity supply are given in BS EN 60335, Part 1.

**WARNING: THE MAINS POWER SUPPLY MUST NOT BE SWITCHED BY A TIME-CLOCK CONTROL.**

**CAUTION: DO NOT FEED MAINS VOLTAGE ONTO THE TIMER TERMINALS**

1.6 The mains power supply must be maintained at all times. Each Purewell VariHeat boiler incorporates a remote stop/start loop, which can be used to operate the boiler(s) under a timed regime. The boiler controls provide a 30V DC signal that can be fed through a volt free contact for operation. Refer to BS 6644 for further information on installing the electrical supply.

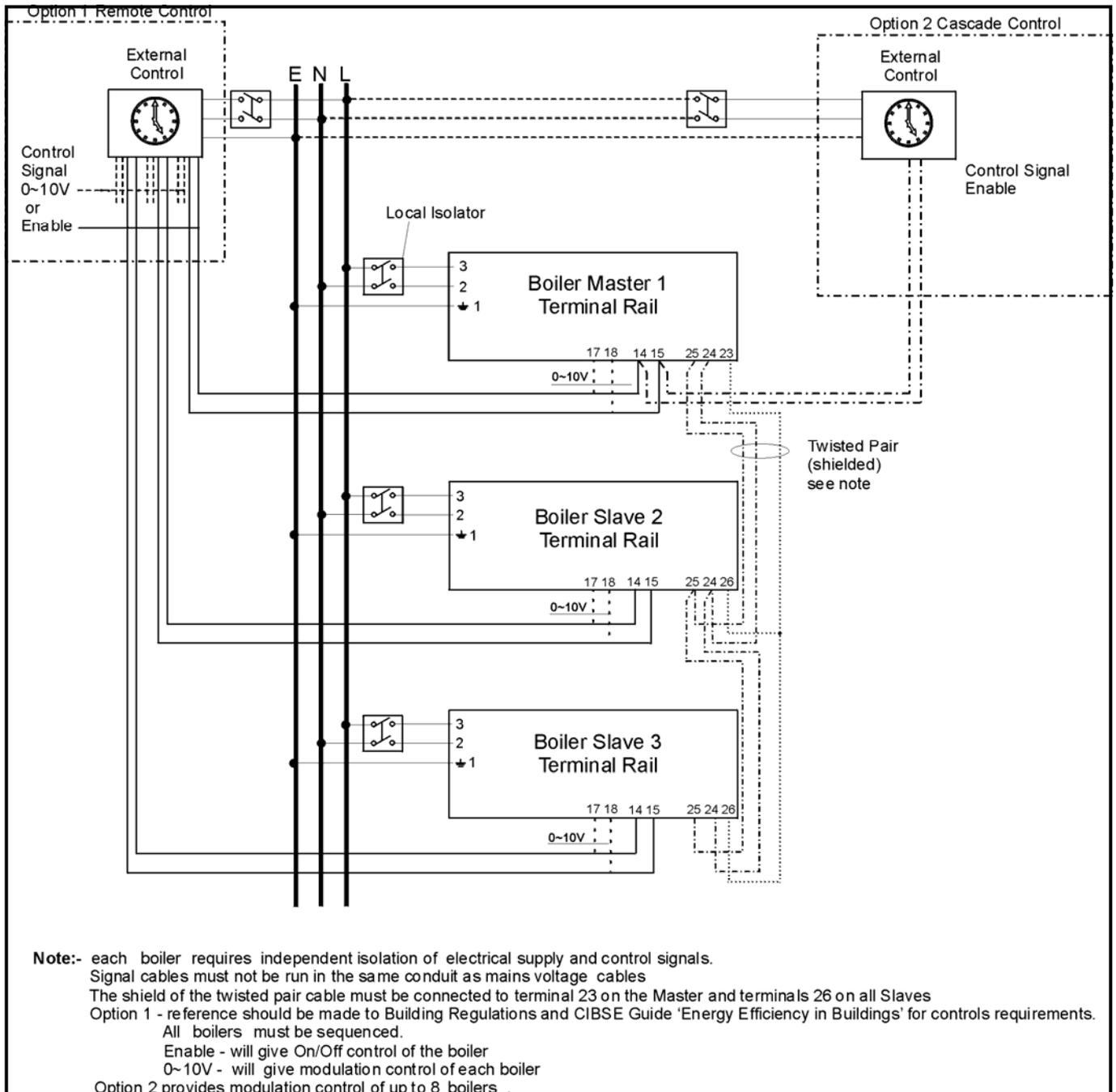
### NOTE:

**FOR ELECTRICAL CONNECTIONS TO BOILER SEE FIGURE 4.5 (Page 10)**

**FOR BOILER WIRING SCHEMATIC SEE FIGURE 9.0 (Page 32)**

**FOR MULTIPLE BOILER WIRING DIAGRAM SEE FIGURE B1.1 (Page 43)**

**FOR CONTROL WIRING SEE FIGURE E1.3.1 TO E1.3.4 (Pages 51 & 52)**



**Figure B1.2 - External Control Wiring For Multiple Boiler Installation**

## APPENDIX C - FLUE DATA

### Natural Gas

FLUE DATA						
Model		70c	95c	110c	140c	180c
Nominal Flue Diameter	- mm	150				
Pressure (Max) at the boiler flue outlet	- Pa/mbar	100 / 1.0				
Approx. Flue Gas Temperature 80/60°C	- °C (Gross)	60	60	65	70	75
Approx. Flue Gas Temperature 50/30°C	- °C (Gross)	40	40	45	50	50
Approx. Flue Gas Volume @ 9.5% CO <sub>2</sub>	- m <sup>3</sup> /h*	86	117	137	180	232

**Figure C1—Flue Data**

\* **Note:-** Flue gas volumes are corrected to a flue gas temperature of 15°C and barometric pressure of 1013.25mbar.

### C1.0 FLUE SYSTEM

1. Detailed recommendations for flue systems are given in BS 6644, and IGE/UP/10. All flue discharges for plant exceeding 135kW net input must comply with the third edition of the 1956 Clean Air Act Chimney Memorandum.

**WARNING: THE FLUE DISCHARGE FROM A VARIHEAT BOILER WILL GENERATE A PLUME AT THE TERMINAL EXIT. THIS MUST BE CONSIDERED WITH REGARD TO TERMINAL LOCATION AND ADJACENT BUILDING FABRIC.**

### C1.1 General Requirements

The Hamworthy Purewell VariHeat c series of boilers are designed to be used with natural draught flues. Flue systems should be designed in accordance with regulations and with reference to BS 6644 and IGE/UP/10. These boilers are Type B23 only (air intake from ventilated plant room and discharge via vertical flue) . See Fig C1.2.

The following points should be noted:

a. Due to the high thermal efficiency of the boiler condensation in the flue will occur. It is strongly recommended that twin wall or insulated flue pipe is used on all external flue installations.

b. Care should be taken to ensure that the flue is installed such that any condensation is continuously drained. All flues should have a maximum slope of 2° upwards in the direction of the exhaust gas flow (no horizontal sections). All joints should be such that any condensation is directed back down the slope to an open drain connection in the flue. The drain pipe must be manufactured from a corrosion resistant material and be at least 15mm diameter. It must also have a fall of at least 2-3° (approx. 30-50mm per meter) and connect to a drain via a waste trap.

c. Boiler flue outlet sizes -

The connection to the boiler is suitable for 150mm flue duct, for connection to an open flue (chimney) system . The resistance and maximum length of the flue system components is detailed in Figure C1.1

A flue system designed with the same diameter as the boiler flue outlet may not provide satisfactory performance in all applications. Consideration must be given to the correct calculation of the required flue size. If in any doubt consult Hamworthy Heating Ltd who can supply a full flue design and installation service.

### C1.2 Waste Gas Volume and Temperature.

It is recommended that the volume and temperature of the waste gases used for design of the flue system are as given in Table C1 above.

### **C1.3 Materials.**

Materials used for the flue system must be mechanically robust, resistant to internal and external corrosion, non-combustible and durable under the conditions to which they are likely to be subjected. Consideration must be given to avoid possible freezing of condense water traps and pipework

### **C1.4 Suction**

The flue system must be designed acknowledging that there is a positive pressure generated by the boiler combustion fan available to the flue system. It is recommended that a draught stabiliser is fitted to the flue system where the draught is likely to become –ve at the boiler connection.

### **C1.5 Disconnection**

Provisions should be made for disconnection of the flue pipe for servicing. It is advisable that bends are fitted with removable covers for inspection and cleaning as appropriate.

**WARNING: THE FLUE SYSTEM MUST BE SELF SUPPORTING AND NOT PRESENT  
A RISK TO PEOPLE IN OR AROUND THE BUILDING.**

### **C1.6 Flue Discharge**

The flue system must ensure safe and efficient operation of the boiler to which it is attached, protect the combustion process from wind effects and disperse the products of combustion to the external air. The flue must terminate in a freely exposed position and be so situated as to prevent the products of combustion entering any opening in a building. Where the flue diameter is less than 204mm (8") diameter a terminal must be fitted. Where the flue is of a larger size, consideration should be given to the fitting of a flue discharge terminal or grille to stop ingress of birds etc.

### **C1.7 Surface Temperatures**

Combustible materials in the vicinity of the boiler and flue shall not exceed 65°C during boiler operation. The flue shall not be closer than 50mm to any combustible material, except where it passes through such material with a non-combustible sleeve when the air gap may not be less than 25mm.

### **C1.8 Location**

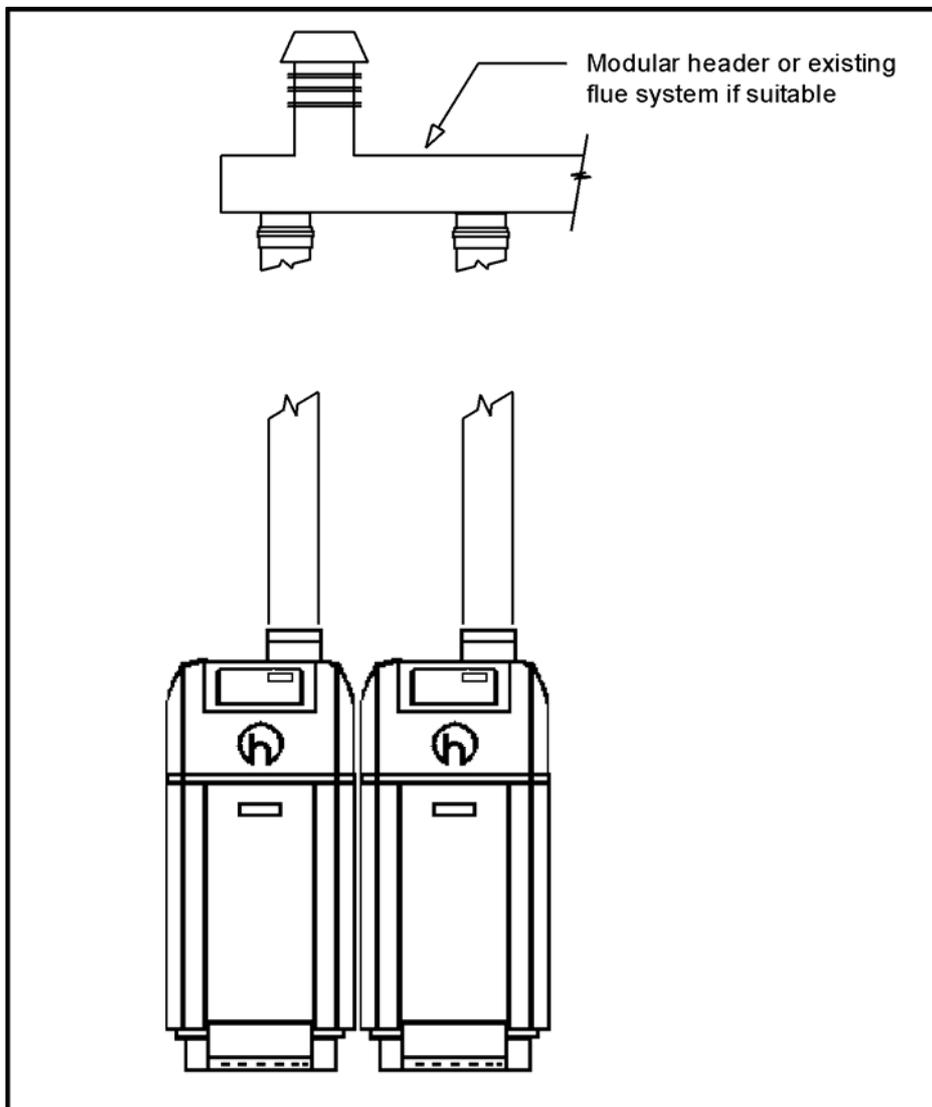
The flue system must not be placed or fitted where there is undue risk of accidental damage to the flue pipe or undue danger to persons in the vicinity. Check that the flue and chimney are clear from any obstruction. Purewell VariHeat boilers are suitable for installation in a balanced compartment in accordance with the requirements of BS 6644. Consult Hamworthy Heating Technical Department for help or assistance if in doubt.

### **C1.9. Condensate Discharge**

Due to the high thermal efficiency of the boiler, condensation will occur within the boiler casing during firing from cold conditions. A drain with an integral trap is fitted to the rear of each module suitable for connection to a 32mm plastic waste pipe (not Hamworthy Heating Ltd supply), which must be connected to a tundish (not Hamworthy Heating Ltd supply). Discharge piping from a tundish should be of synthetic material due to the mild acidity of the condensate (pH 3-5), with all discharge piping having a minimum fall of 30mm/m away from the boiler. Consideration should be given to possible freezing of condense water traps and pipework. This must be avoided at all times by routing pipework within the building, where possible. It is strongly recommended that on modular installations, the common header and chimney system must have separate drains for condensate disposal - **refer to section 4.5.**

Model					
Component	70c	95c	110c	140c	180c
Straight tube $\varnothing$ 150mm maximum length (m)	131	114	114	79	57
45° bend $\varnothing$ 150mm Equivalent tube length (m)	1.6	1.7	1.7	1.8	1.8
90° bend $\varnothing$ 150mm Equivalent tube length (m)	2.1	2.2	2.2	2.3	2.3

**Figure C1.1 - Flue Resistance**



**Figure C1.2 - Open (Natural Draught) B23 Flue System**

## **APPENDIX D - VENTILATION**

### **D1.1 Air Supply**

Detailed recommendations for air supply are given in BS 6644 and BS 5440 Pt 2. The following notes are intended to give general guidance. In all cases there must be provision for an adequate supply of air for both combustion and general ventilation, in addition to that required for any other appliance.

Combustion air for the boiler is drawn through the rear of the boiler casing. The area **must** be kept open and free from blockage at all times.

#### **D1.2.1 Air Supply by Natural Ventilation - Open Flue applications**

The boiler room must have, or be provided with, permanent air vents directly to the outside air, at high level and at low level. For an exposed boiler house, air vents should be fitted, preferably on all four sides, but at the least on two sides. Air vents should have negligible resistance and must not be sited in any position where they are likely to be easily blocked or flooded or in any position adjacent to an extraction system which is carrying flammable vapour. Grilles or louvres must be so designed that high velocity air streams do not occur within the space housing the boiler.

#### **Boiler house ventilation**

Low level (inlet) - 4cm<sup>2</sup> per kW of total rated input (Net)  
High level (output) - 2cm<sup>2</sup> per kW of total rated input (Net)

#### **Compartment ventilation**

Where the boiler is to be installed in a cupboard or compartment, permanent high and low level ventilation is required which must communicate direct to outside, for cooling purposes.

Low level (inlet) - 10cm<sup>2</sup> per kW of total rated input (Net)  
High level (output) - 5cm<sup>2</sup> per kW of total rated input (Net)

If the boilers are to operate during the summer months for 75% of the time a further 1 cm<sup>2</sup> or for 100% of the time a further 2 cm<sup>2</sup> should be added per kW to both high & low openings.

### **D1.3 Air Supply by Mechanical Ventilation**

Air supplied to the boiler room by Mechanical means should be as follows:

- 1) Mechanical ventilation must be interlocked with the boilers to prevent operation in the event of ventilation fan failure
- 2) Mechanical inlet and mechanical extract can be utilised providing the design extraction rate maintains the difference between inlet & extract flow rates shown in Figure D1.
- 3) Mechanical extract ventilation with natural inlet ventilation **MUST NOT** be used.
- 4) Additional rates may be required for summer operation.

### **D 1.4. Boiler House Temperatures**

The air supplied for boiler house ventilation shall be such that the maximum temperatures within the boiler house shall be as follows:

At floor level (or 100mm above floor level) = 25°C.

At mid-level (1.5m above floor level) = 32°C.

At ceiling level (or 100mm below ceiling level) = 40°C.

### D 1.5. General Requirements

The air supply should be free from contamination such as building dust and insulation fibres from lagging. To avoid unnecessary cleaning and servicing of the boiler modules, the boilers should not be fired whilst building work is being undertaken.

High and low level ventilation grilles shall be positioned as high and as low as practicably possible. Low level grilles should be located within 1 metre of the floor for Natural Gas and within 250mm of the floor for LPG. High level grilles should be positioned within 15% of the boiler room height from the ceiling. High and low level grilles shall communicate with the same room or space where compartment ventilation is used. Where grilles communicate directly with outside air, they shall be positioned on the same wall.

**Figure D1 Mechanical Ventilation Flow Rates**

Boilers Without Draught Diverters	Flow rate per kW total rated heat input (net)	
	Inlet air (Combustion ventilation)	Difference between inlet and extract air (Inlet minus extract ventilation)
	m <sup>3</sup> /h	m <sup>3</sup> /h
	2.6	1.35 +/- 0.18

Note \* : Where the associated air extraction is also by means of a fan, this shall be selected such as not to cause a negative pressure to develop in the boiler house and to maintain the difference between inlet and extract flow rates shown above.

The calculated extract flow rate is the actual inlet flow rate minus the appropriate figure in the table above.

## APPENDIX E - WATER DATA

WATER DATA							
Model			70c	95c	110c	140c	180c
Water Connections (Flow & Return)			R2" male				
Maximum Water Pressure	-	bar g	6				
Water Content (not including headers)	-	litres	8	8	8	11	11
System Design Flow Rate @ 11°C ΔT Rise	-	litre/s	1.5	2.1	2.4	3.0	3.9
Minimum Flow Rate @ 20°C ΔT Rise	-	litre/s	0.8	1.1	1.3	1.7	2.1
Waterside Pressure Loss @ 11°C ΔT Rise	-	mbar	96	176	244	442	731
Waterside Pressure Loss @ 20°C ΔT Rise	-	mbar	32	52	72	134	221

**Figure E1 - Water Data**

### E1.1 Water Circulation System

The Purewell VariHeat boiler has a low water content and the requirements of minimum water flow are given in the above table. Recommendations for the water circulation system are given in BS 6644.

The following details are of particular importance for the correct installation of the water circulation system:

- 1) In a combined central heating and hot water system the hot water storage vessel must be of the indirect cylinder or calorifier type. The hot water storage vessel should be insulated, preferably with not less than 75mm (3") thick mineral fibre, or its thermal equivalent.
- 2) Circulating pipework not forming part of the useful heating surface should be insulated to help prevent heat loss and possible freezing, particularly where pipes are run through roof spaces and ventilated cavities. Cisterns situated in areas which may be exposed to freezing conditions should also be insulated. Furthermore, insulation exposed to the weather should be rendered waterproof.
- 3) Drain valves must be located in accessible positions which permit the draining of the whole system, including the boiler and hot water storage vessel.
- 4) Each boiler module has R2" male flow (indicated with a red spot) and return (indicated with a blue spot) connections. Boilers should be connected by flow and return headers. Headers should be connected to the system in a 'reverse / return' arrangement (the water flow in each header is in the same direction) to ensure equal flow in each module, or with a 'single pipe header system'. Figure E1.2 on the following page show typical layouts.
- 5) Ideally, individual valves should be fitted to each module to enable isolation from the system, however, the arrangement must comply with the requirements of BS 6644.

### E1.2 Minimum System Water Pressure

To comply with guidance note **PM5 (Health and Safety Executive)**, the minimum pressure requirements at the boiler are given below as examples:-

- 1) Single installed boiler running at 82°C flow temperature. Minimum head required is not less than 2.0 metres or 0.2 bar.
- 2) Single installed boiler running at 90°C flow temperature. Minimum head required = 3.0 metres or 0.30 bar.
- 3) Modular boiler installation running at 82°C flow temperature and 11°C rise across system. Minimum head required = 4.4 metres or 0.43 bar.
- 4) Modular boiler installation running at 82°C flow temperature and 15°C rise across system. Minimum head required = 6.5 metres or 0.64 bar.

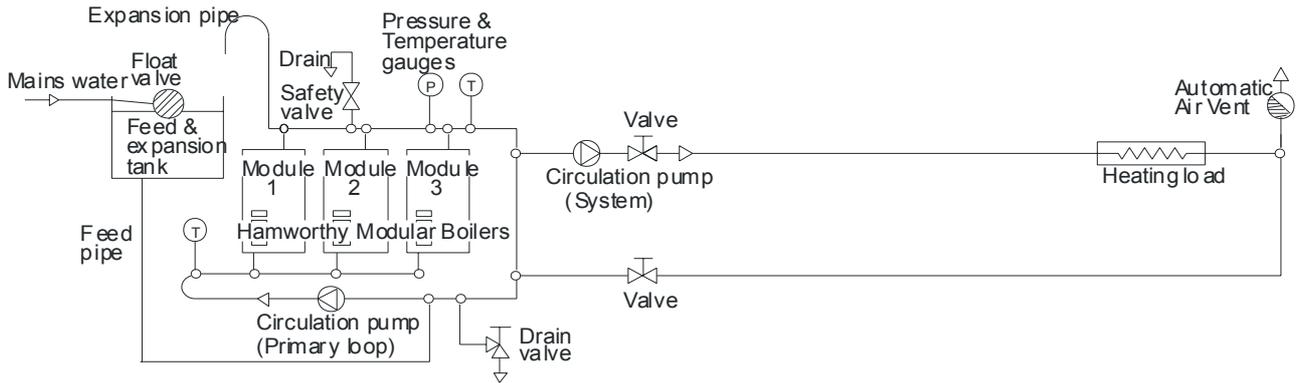
### E1.3 Pressure Relief Valve (Safety Valve)

The most important single safety device fitted to a boiler is its safety valve. Each boiler module is provided with a capped R<sup>3</sup>/<sub>4</sub>" stub pipe for the fitting of a safety valve (not supplied). BS 6644 provides comprehensive information for the selection and location of safety valves and attention is drawn to the higher capacity requirements of safety valves for pressurised hot water systems.

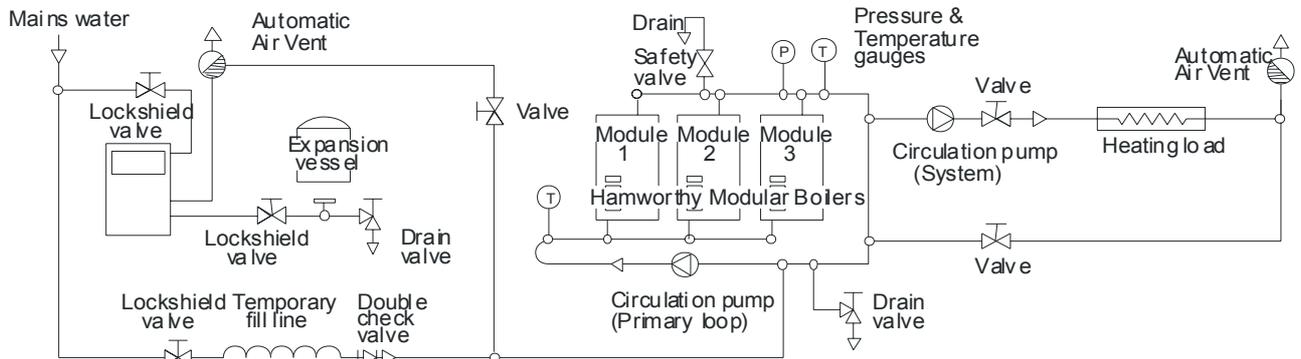
Boiler Output	Feed mm	Vent mm
60 - 150kW	25	32
150 - 300 kW	32	38
300 - 600 kW	38	50

**Figure E1.1 Cold Feed and Vent Pipe Sizes**

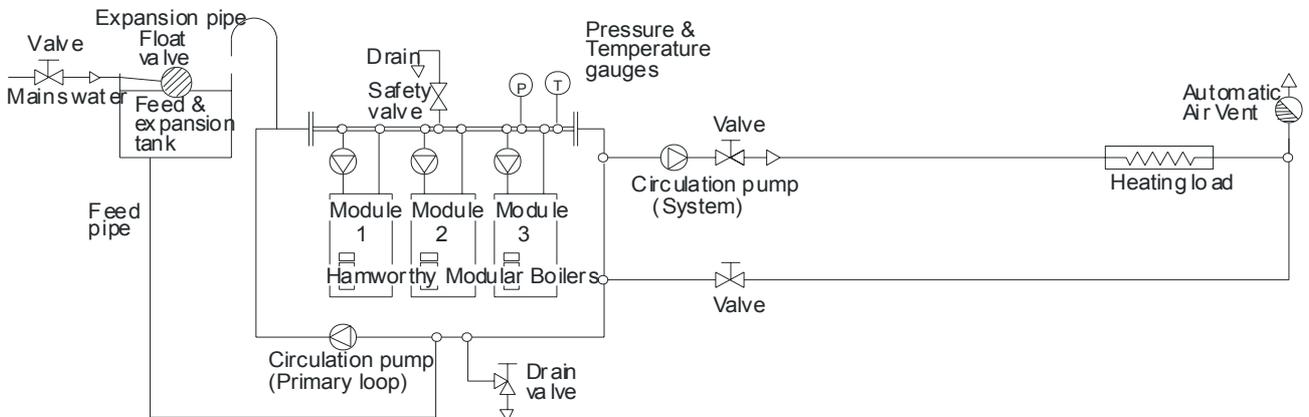
**Figure E1.2 - Typical Piping Layouts**



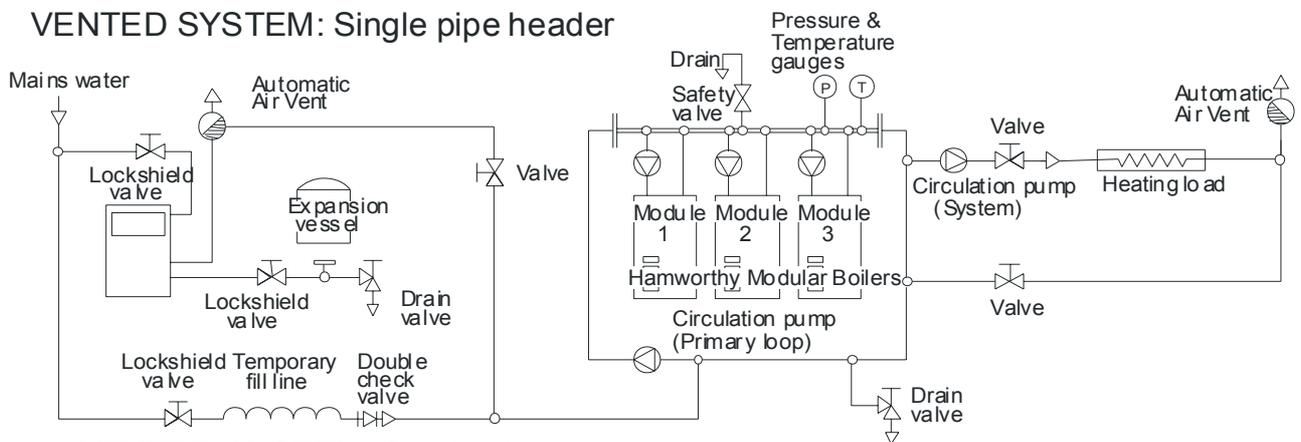
**VENTED SYSTEM: Primary loop, Hamworthy recommended system.**



**UNVENTED SYSTEM: Primary loop, Hamworthy recommended system.**



**VENTED SYSTEM: Single pipe header**



**UNVENTED SYSTEM: Single pipe header**

#### **E1.4 Open Vent and Cold Feed Pipe.**

Every boiler or group of boilers should have an open vent pipe and cold feed pipe installed between the boiler and the first water isolating valve. The minimum bore (mm) of these pipes per installation is shown in the table. The vent pipe must rise continually, any valve fitted between a boiler and the open vent pipe for maintenance purposes shall be of the 3 way type such that when closed to the vent pipe the boiler will be open to atmosphere. The vent pipe shall be protected against freezing where this might occur. See BS 6644 for detailed information on Open Vent and Cold Feed Pipes.

#### **E1.5 Altitude Gauge (Water Pressure Gauge)**

Every boiler or group of boilers should be provided with an altitude gauge complete with isolating valve. See Figure E1.2 for typical position.

#### **E1.6 Thermometer**

A thermometer complete with pocket should be fitted in the pipework to indicate water flow temperature. See Figure E1.2 for typical position.

#### **E1.7 Drain Valves**

Each boiler is fitted with a 15mm NB drain valve in the boiler return to drain the boiler only. The heating system in total should have drain valves as recommended by BS 6644. See Figure E1.2 for typical position.

#### **E1.8 Circulating Pump**

One or more circulating pumps will be required to circulate water around the boilers and heating system. The pump should be sited to facilitate servicing. It is important that when Purewell VariHeat boilers are used to replace boilers on an existing system, the pumps should be checked for performance against the new boiler waterside pressure loss to ensure that the minimum flow rate can be obtained. It is also important that the existing system be flushed through twice to remove any loose matter which may have accumulated. If in any doubt regarding the cleanliness of the system, a coarse filter should be fitted in the return pipework to the boilers.

If boiler / system pump(s) are not controlled by the boiler, a pump overrun (not Hamworthy Heating Ltd supply) should be fitted which must run for a minimum of 5 minutes on shutdown of the last boiler.

#### **E1.9 Minimum Water Flow Rates**

Minimum water flow rates are shown in table at beginning of Appendix E. These flow rates should be maintained through the boiler at all times whilst the boiler is firing. If the water flow rate is allowed to fall below the minimum the boiler heat exchanger could fail due to the resultant scale formation. Particular attention should be paid to the restriction of external flow circuits during periods of low heat demand.

#### **E1.10 Waterside Pressure Drop**

The waterside hydraulic resistance (Pressure drop) is given in table E1 at beginning of Appendix E.

#### **E1.11 Water Flow Controls**

Any external mixing valve / shunt pump or similar controls MUST always ensure that the minimum water flow rate as given in table at beginning of Appendix E is maintained. If there is any doubt relating to site flow conditions it is suggested that a flow switch is fitted. The flow switch should be connected such that the boiler will shut down if insufficient flow occurs.

#### **E1.12 Frost Protection**

Consideration should be given to fitting a frost thermostat set at approximately 4°C

#### **E1.13 Unvented Systems**

Refer to Figure E1.2 for typical layout of an unvented (Pressurised) Hot Water System. For system design refer to BS 7074 Part 2. In order to correctly size a pressurisation unit for any heating system the following parameters

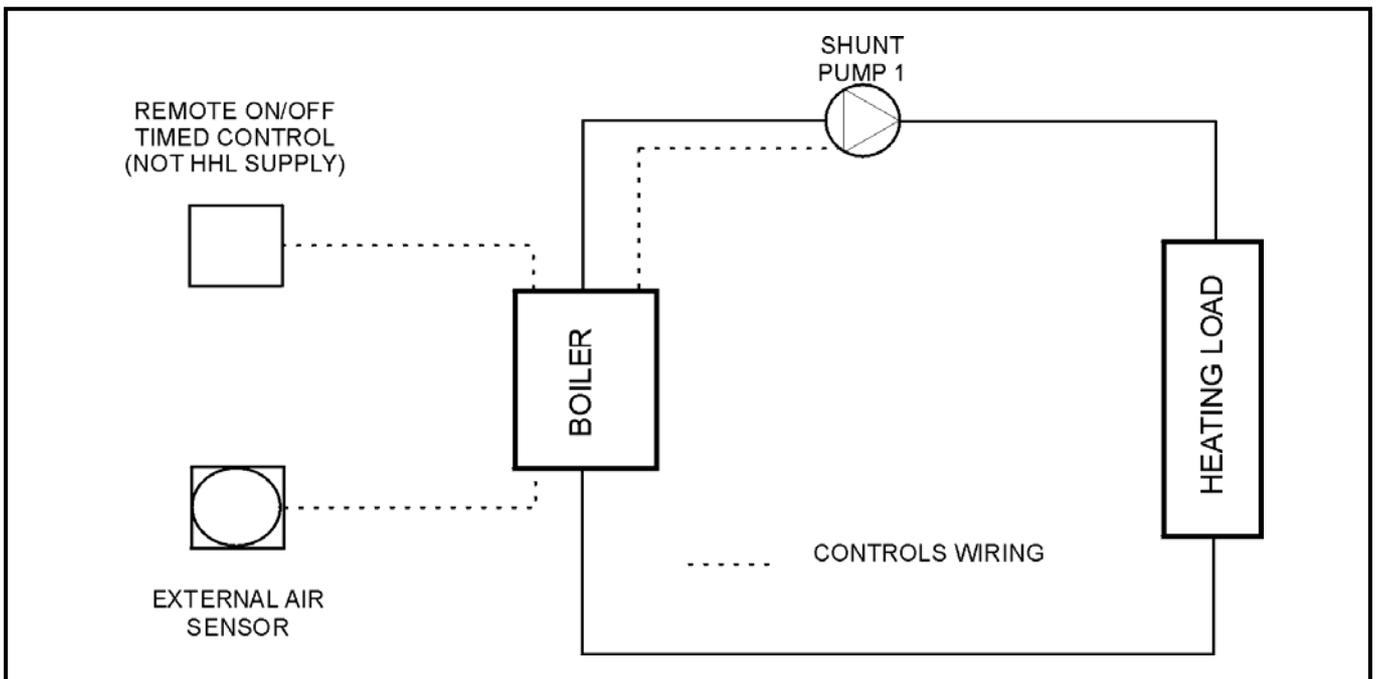
are required.

- 1) Static height of highest component in system (metres)
- 2) System volume. If this is not known, a general rule of thumb of 10litres/kW of installed boiler power can be used.
- 3) Maximum flow temperature (°C)
- 4) Maximum system hot working pressure, generally given in bar gauge.

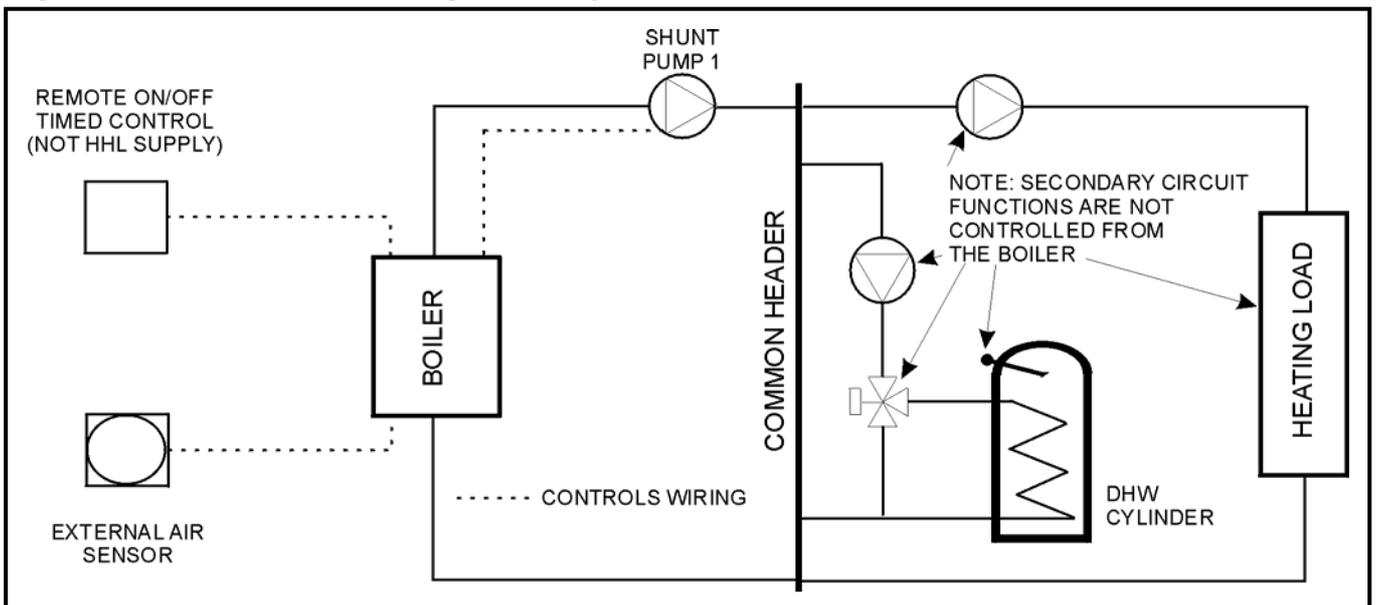
From the parameters given, Hamworthy Heating can size the pressurisation unit and also the expansion vessel required.

Care must be taken in sizing expansion vessels to ensure maximum acceptance factors are not exceeded. Normally manufacturers of vessels impose a limit of 0.5. This value must not be exceeded at any time during the operation of the boiler, this includes the over pressure condition should a safety valve lift.

Consideration should also be given to sizing of the safety valve(s) in the system. Refer to BS 6644: Part 1 for further information and to BS 6880: Part 1 for design considerations.



**Figure E 1.3.1 - Schematic for Single Boiler System**



**Figure E 1.3.2 - Schematic for Single Boiler, Primary Circuit System**

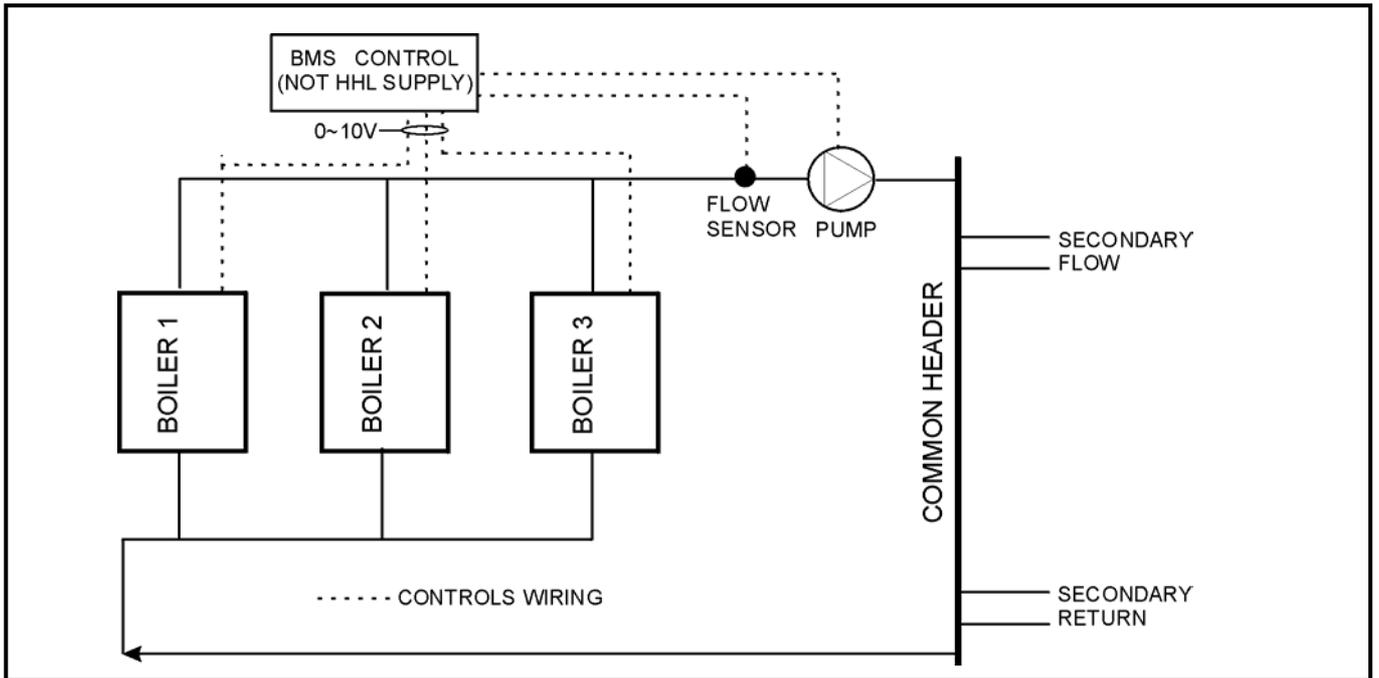


Figure E 1.3.3 - Schematic for Multiple Boiler (External 0~10V), Primary Circuit System

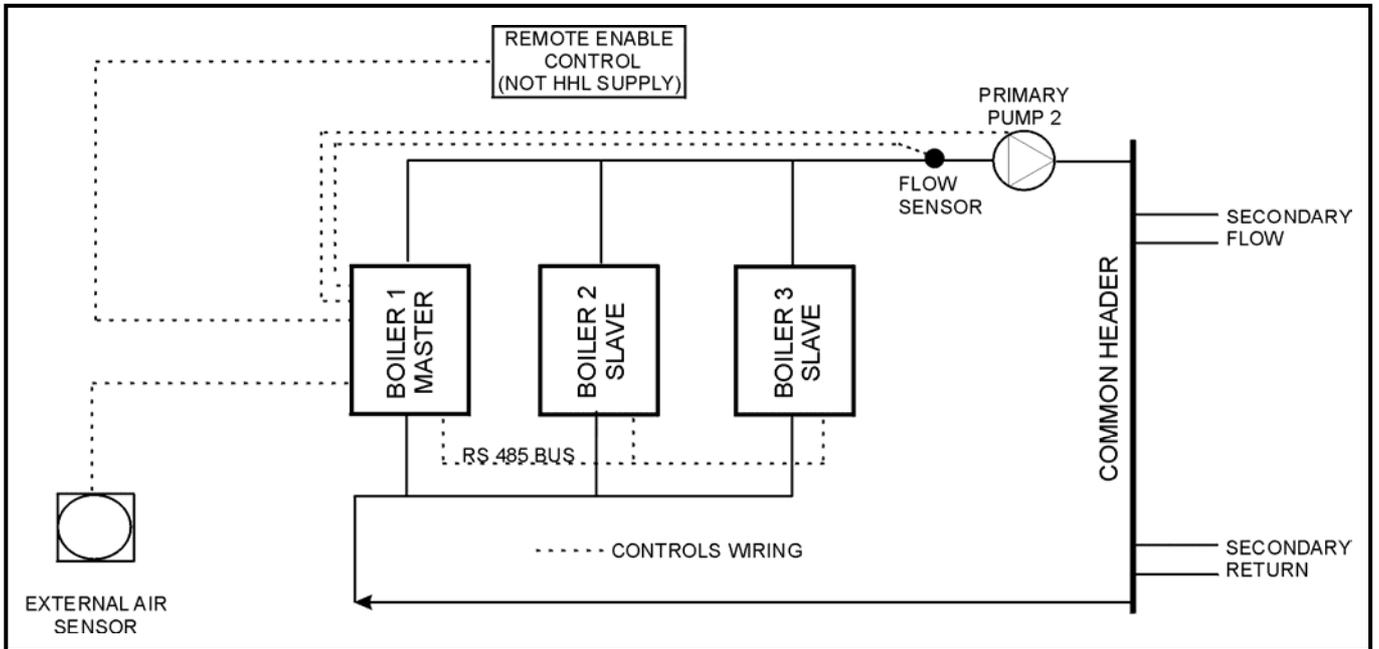


Figure E 1.3.4 - Schematic for Multiple Boiler (Internal Cascade), Primary Circuit System

**USEFUL USER INFORMATION**

<b>INSTALLER</b>	<b>SITE ADDRESS</b>

<b>BOILER TYPE</b>	<b>BOILER SIZE(S)</b>	<b>UNIT NO(S).</b>	<b>SERIAL NO(S).</b>	<b>FLUE</b>

**NOTES**

# Customer After Sales Services

Telephone: **0845 450 2866** E-mail: **aftersales@hamworthy-heating.com** Fax: **01202 662522**

## **Technical Enquiries**

To supplement the detailed technical brochures, technical advice on the application and use of products in the Hamworthy Heating range is available from our technical team in Poole and our accredited agents.

## **Site Assembly**

Hamworthy offer a service of site assembly for many of our products in instances where plant room area is restricted. Using our trained staff we offer a higher quality of build and assurance of a boiler built and tested by the manufacturer.

## **Commissioning**

Commissioning of equipment by our own engineers, accredited agents or specialist sub – contractors will ensure the equipment is operating safely and efficiently.

## **Maintenance Agreements**

Regular routine servicing of equipment by Hamworthy service engineers inspects the safety and integrity of the plant, reducing the risk of failure and improving performance and efficiency. Maintenance agreements enable our customers to plan and budget more efficiently.

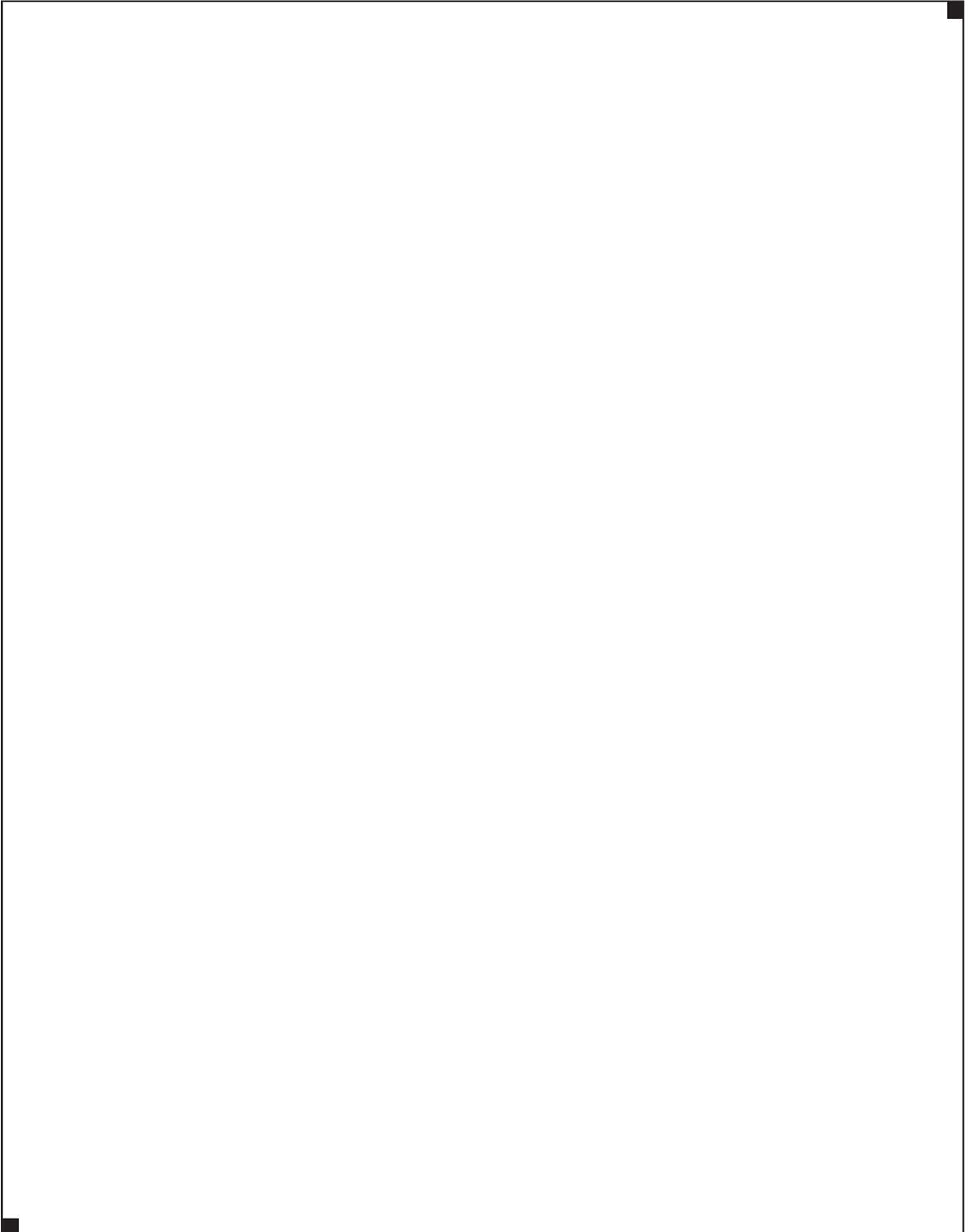
## **Breakdown service, repair, replacement**

Hamworthy provide a rapid response breakdown, repair or replacement service through head office at Poole and accredited agents throughout the UK.

## **Spare Parts**

A comprehensive spare parts service is operated from our factory in Poole, providing replacement parts for both current and discontinued products. Delivery of parts and components is normally from stock within seven days. However, a next day delivery service is available for breakdowns and emergencies.

# Notes



# Hamworthy Heating Accredited Agents

## **North West England**

Gillies Modular Services

210-218 New Chester Road, Birkenhead, Merseyside L41 9BG

tel: **0151 666 1030** fax: **0151 647 8101**

## **Southern Ireland**

HEVAC Limited

Naas Road, Dublin 12, Ireland

tel: **00 353 141 91919** fax: **00 353 145 84806**

## **Northern Ireland**

HVAC Supplies Limited

Unit A6, Dargan Court, Dargan Crescent, Belfast BT3 9JP

tel: **02890 777737** fax: **02890 771233**

## **Scotland**

McDowall Modular Services

14-46 Lomond Street, Glasgow, Scotland G22 6JD

tel: **0141 336 8795** fax: **0141 336 8954**

## **North East England**

Allison Heating Products

12 Sunnyside Lane, Cleadon Village, Sunderland SR6 7XB

tel: **0191 536 8833** fax: **0191 536 9933**



## **Customer Service Centre**

Hamworthy Heating Limited,

Fleets Corner, Poole,

Dorset BH17 0HH.

Telephone: **0845 450 2866**

Fax: **01202 662522**

Email: **[aftersales@hamworthy-heating.com](mailto:aftersales@hamworthy-heating.com)**

Website: **[www.hamworthy-heating.com](http://www.hamworthy-heating.com)**