MILBORNE BOILERS

Wall Hung, Pre-Mix, Condensing, Modular Boilers

381 & 501 Series

Design Installation, Commissioning and Operating Instructions

NATURAL GAS I_{2H}
LPG - PROPANE I_{3p}

IMPORTANT NOTE

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

Hamworthy

Heating *at work.*

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.

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1.0 INTRODUCTION

1.1 This boiler must be installed by a competent person holding '**CORGI**' registration or equivalent. 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 This boiler is intended for use on Group H Natural Gas (2nd Family) and LPG - Propane (3rd Family). The firing information is to be found in Appendix 'A'. Boilers **MUST NOT** use gas other than that for which they are designed and adjusted.

1.3 The Milborne is a gas fired, fully modulating, pre-mix, condensing, room sealed central heating / hot water boiler, comprising of 1 or 2 - 37.5 or 50kW modules within a single casing.
Where the application requires more than 75 or 100kW, the boiler can be supplied in a modular format, with a maximum of six modules sharing a common flue and water pipework - optional HHL supply. See figures 2.3 - 2.6 for typical schematic layout.

1.3.1 Using the latest gas / air ratio control technology it is able to provide clean efficient operation across a large output range via a built in controls package ideally suited to installations that do not have a dedicated controls installation.
The integrated controls provide cascade management for multiple boilers and simultaneous management of three different circuits operating at different temperatures. (radiators, dhw & under-floor heating)

1.3.2 Each of the boiler models is designed for direct connection to a plastic flue system - HHL supply. The Technical Data for the various arrangements is given in section 5.2**.**
The flue outlets from more than one unit may be connected to a single chimney.
Individual modules can be room sealed using 50mm plastic flue pipe (HHL supply) up to a maximum length of 30 metres.
No draught diverter is fitted to the boiler nor is a fixed diverter required in the flue system.

1.3.3 The Milborne is intended for the heating of Commercial and Industrial premises, or large residential properties. It may also be used to supply hot water for these premises via an indirect cylinder.

1.3.4 The Milborne has a low water content and water flow rates **MUST** be maintained at or above the recommended levels shown in Appendix 'E'.
It is recommended by Hamworthy Heating, that the **primary pump MUST be controlled from the Master boiler** to ensure synchronised operation - refer to fig. 4.6.

1.4 The boiler is only suitable for connection to an un-vented (pressurised) heating system, care must be taken to ensure all extra safety requirements are satisfied and that the relevant interlocks will shut the boiler(s) off 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 Milborne boiler is not suitable for direct connection to domestic hot water supplies.

1.6 BOILER VARIATIONS
Milborne 381 - single 37.5kW c/w Master control
Milborne 382M - two 37.5kW modules c/w Master control
Milborne 382S - two 37.5kW modules c/w Slave control
Milborne 501 - single 50kW c/w Master control
Milborne 502M - two 50kW modules c/w Master control
Milborne 502S - two 50kW modules c/w Slave control

Note - when installing multiple boilers, one of the boilers must have Master control.

1.7 Each Milborne boiler is supplied with a vfc contact output for a General Fault and 0~10v analogue control input compatibility.

1.8 Options - refer to individual kit instructions for details

1.8.1 Optional frame set and water pipework kits are available for up to 4 boilers. These kits are free-standing allowing installation to the system prior to installing the boiler and incorporate all necessary valves, inter connecting pipework, and flow and return headers. Refer to individual kit instructions for details.

1.8.2 Optional Primary Circuit kit - In addition to the frame and pipework kit, the primary circuit kit includes a matched pump, low loss header and associated fittings to complete a packaged primary circuit.
It is recommended by Hamworthy Heating, that the **primary pump MUST be controlled from the Master boiler** to ensure synchronised operationoperation - refer to fig. 4.6.

1.8.3 Optional low temperature heating circuit sensor, used to provide temperature information to the Master control for modulation of a 3-port valve and pump (HHL supply part no. 573407126)

1.8.4 Optional Programmable room thermostat used to provide air temperature and timed control. (HHL supply part no. 573407127)

1.8.5 Optional DHW sensor used to control a DHW cylinder (HHL supply part no. 573407126)

2.0 SUPPLY AND DELIVERY

The 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.

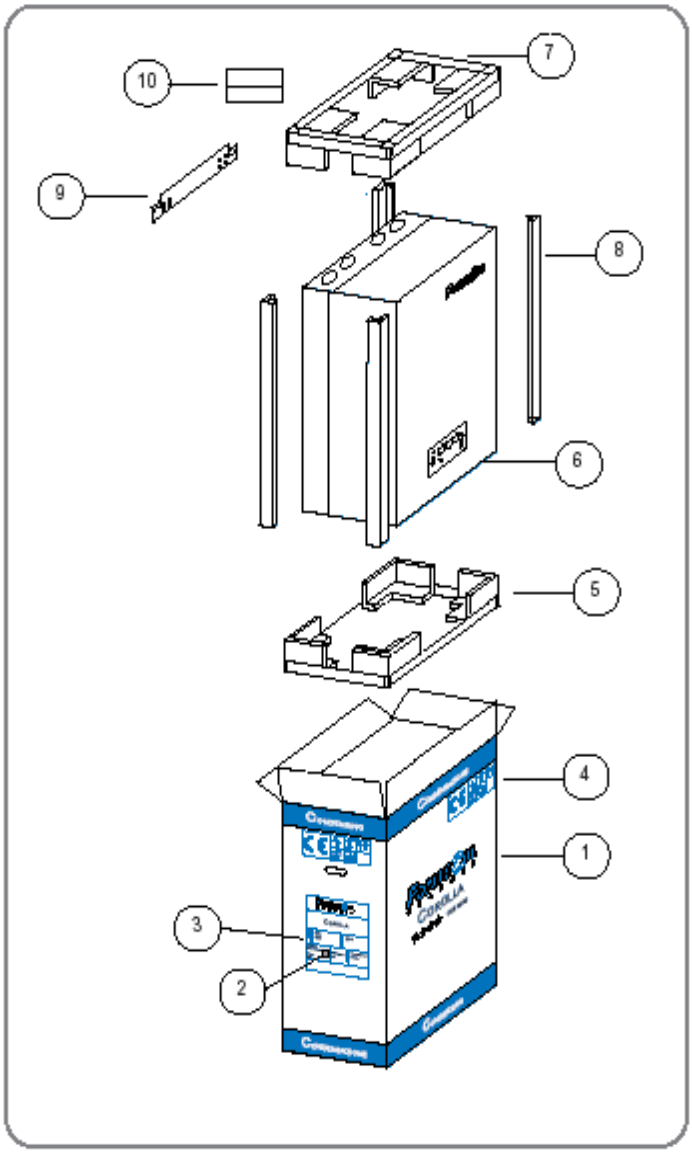


Figure 2.1 - Boiler Packaging

NOTE: The boiler is packaged within a cardboard carton. However, when handling and 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.

Warranty

Full warranty assistance will be covered when the appliance is commissioned by Hamworthy Heating Ltd, see Terms & Conditions for full details.

Hamworthy Heating Ltd will not accept any liability resulting from damage due to tampering, improper use, handling, installation errors, operation and maintenance. It is important to check for damage upon receipt of product, which if found must be notified to Hamworthy Heating Ltd immediately.

In the event of failure or breakdown, isolate the equipment and contact Hamworthy Technical Support
Tel - 0845 450 2866

Figure 2.2 - Boiler Packaged Dimensions

Model	H mm	W mm	D mm	Weight (kg)
381	1250	650	440	55
382M	1250	650	440	80
382S	1250	650	440	80
501	1250	650	440	60
502M	1250	650	440	90
502S	1250	650	440	90

Delivery Verification

When taking delivery please ensure that you have received the correct number of boilers and flue collector manifold 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.

Frame Set and Pipework Header Kits

Where pipework kits are supplied, these are packaged separately from the boilers. Additionally, ancillary items such as isolation valves and boiler make-up connectors are packaged in a cardboard box on the same pallet. The whole is shrink wrapped for security and basic protection.

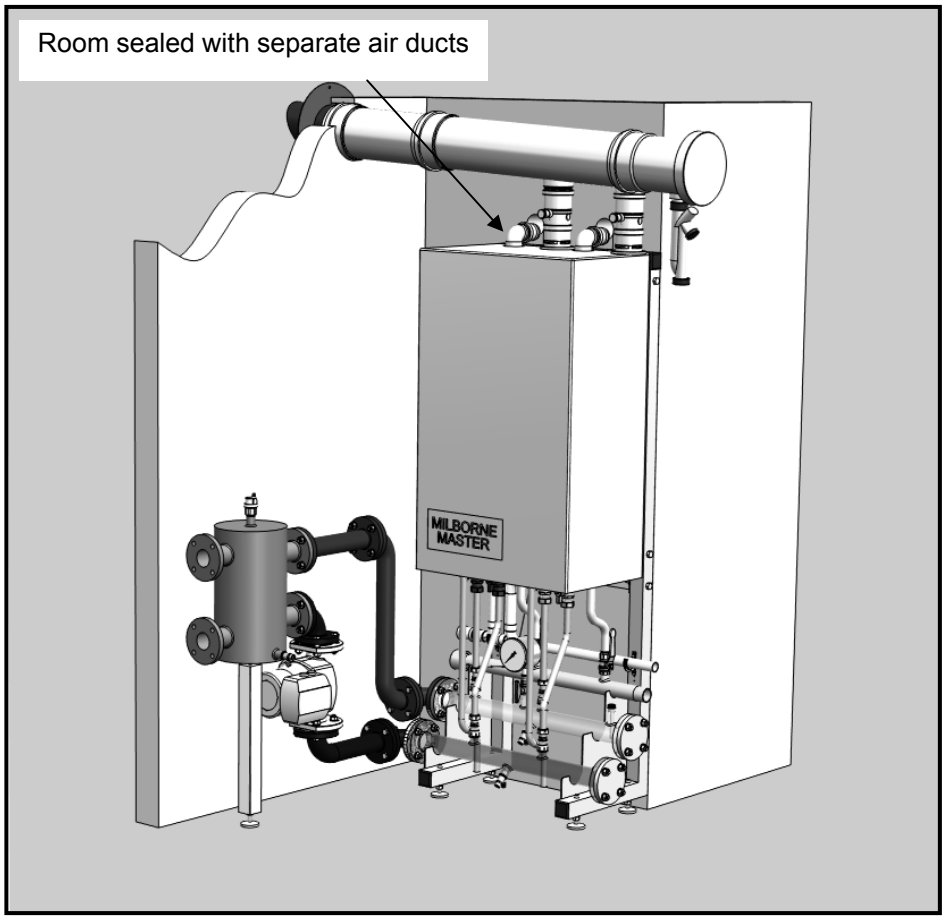


Figure 2.3 - Single boiler arrangement showing frame, flue header, water pipework and primary circuit pump kit

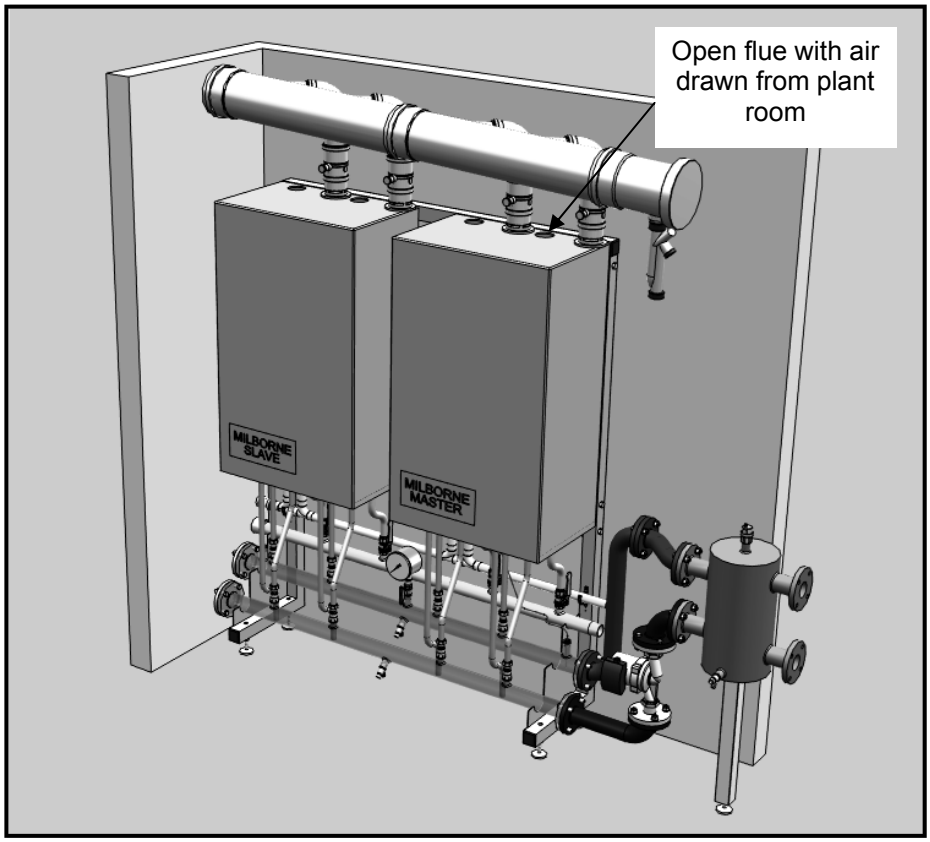


Figure 2.4 - Two boiler arrangement showing frame, flue header, water pipework and primary circuit pump kit

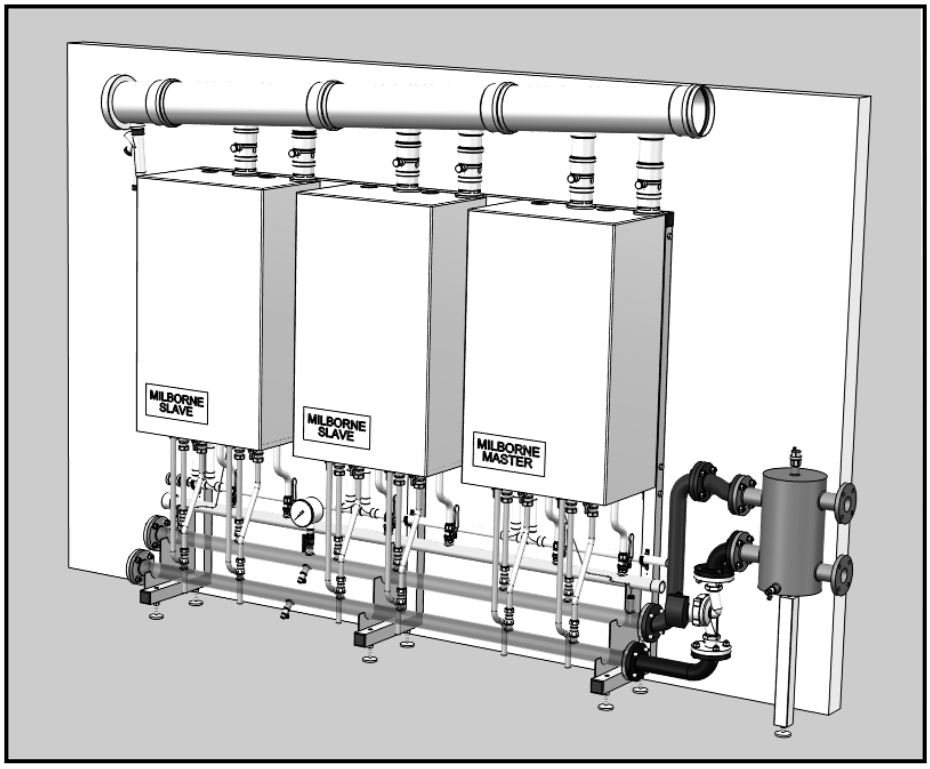


Figure 2.5 - Three boiler arrangement showing frame, flue header, water pipework and primary circuit pump kit

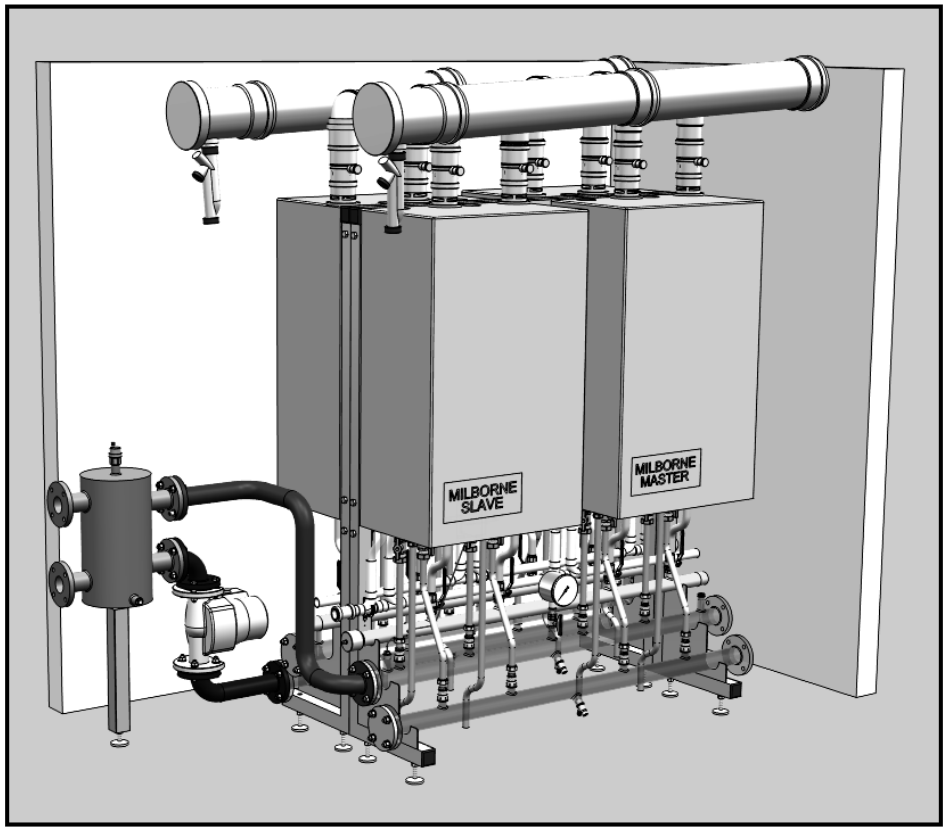


Figure 2.6 - Two boiler back to back arrangement showing frame, flue headers, water pipework and primary circuit pump kit

3.0 SIZE AND SPACE REQUIREMENTS

3.1 The Milborne boiler range has been designed to utilise minimum wall space, therefore it is important that the plantroom has sufficient ceiling height to allow for installation and connection to the flue system allowing for sufficient access at sides and below boiler for pipework connections. See Figure 3.1

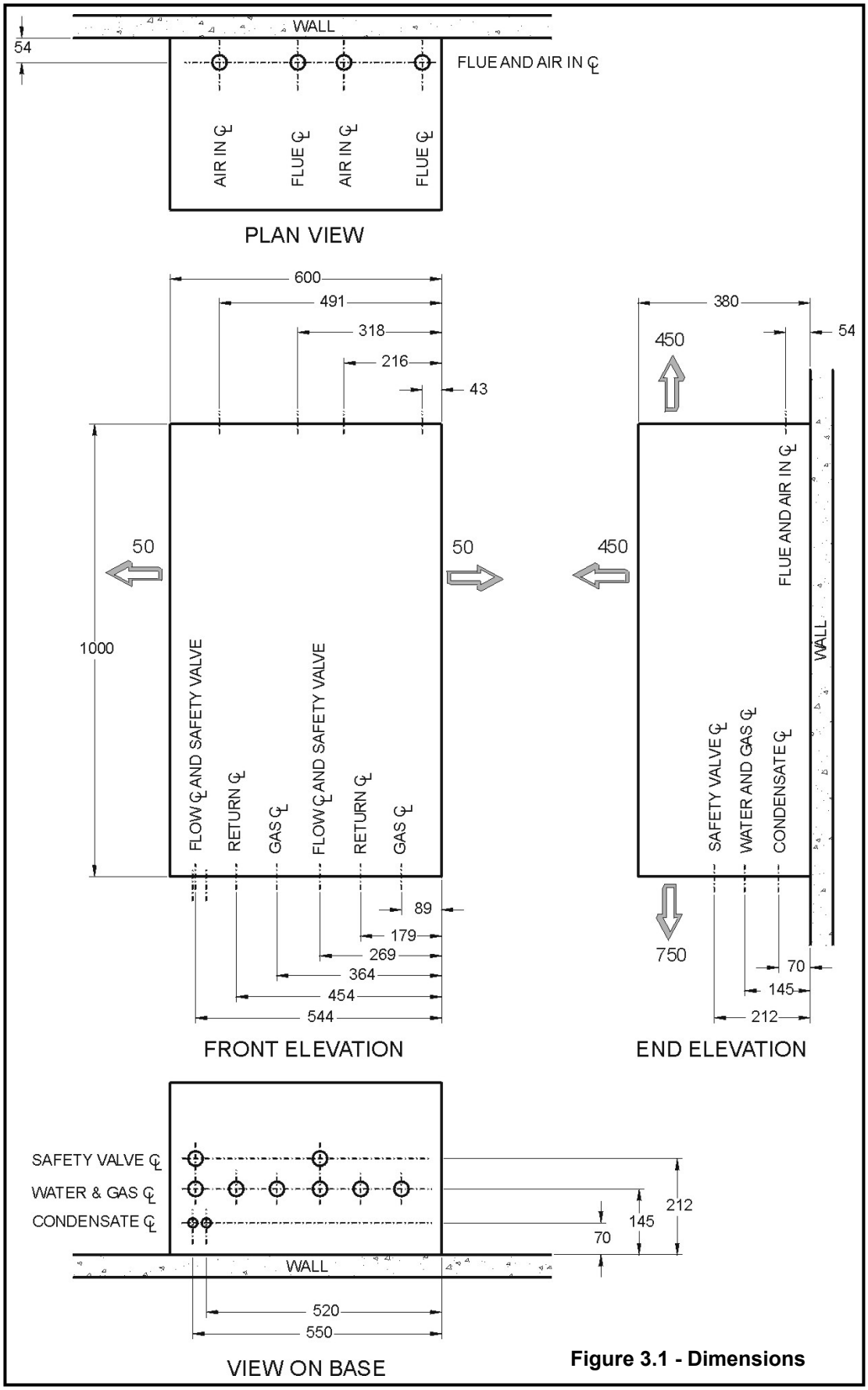


Figure 3.1 - Dimensions

3.2 The Hamworthy Heating Ltd frame set and pipework kit is designed to provide a compact solution for connecting the boilers to the gas supply and flow and return water connections.

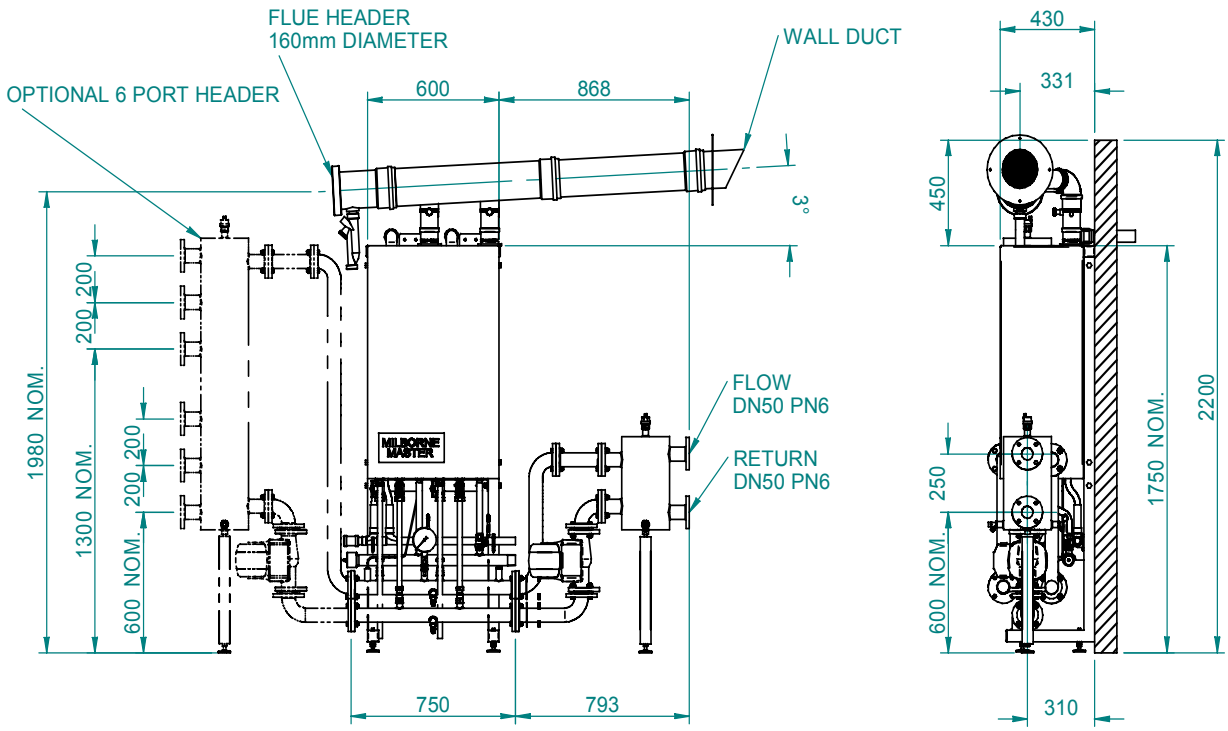


Figure 3.2.1 – Single boiler installation dimensions - room sealed

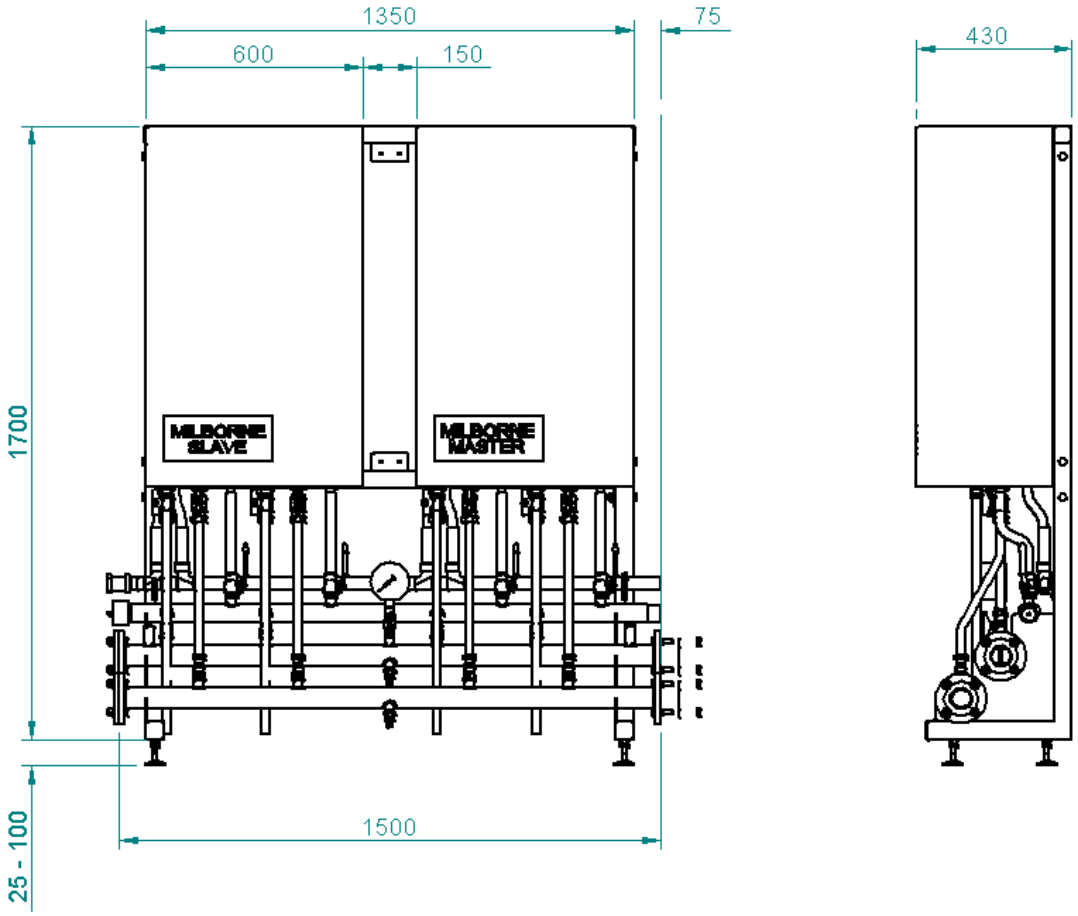


Figure 3.2.2 – Two boiler installation dimensions

4.0 SITE LOCATION AND PREPARATION

4.1 Site Location.

Wall mounting

- **The wall must be flat, solid and capable of supporting the weight of the boiler**
- **The boiler is heavy. Care must be taken when lifting the boiler**

Floorstanding

- **The floor or plinth for the boilers, frame and pipework 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 pipework 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, 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 connections to the boiler must not be smaller than the connection on the boiler - G 3/4 "**
- **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 measured at the gas valve, nominal 20mbar (minimum 17.5mbar) dynamic - refer to Appendix A**
- **Boiler house gas isolation valve must be clearly identified and installed close to the entrance / exit.**

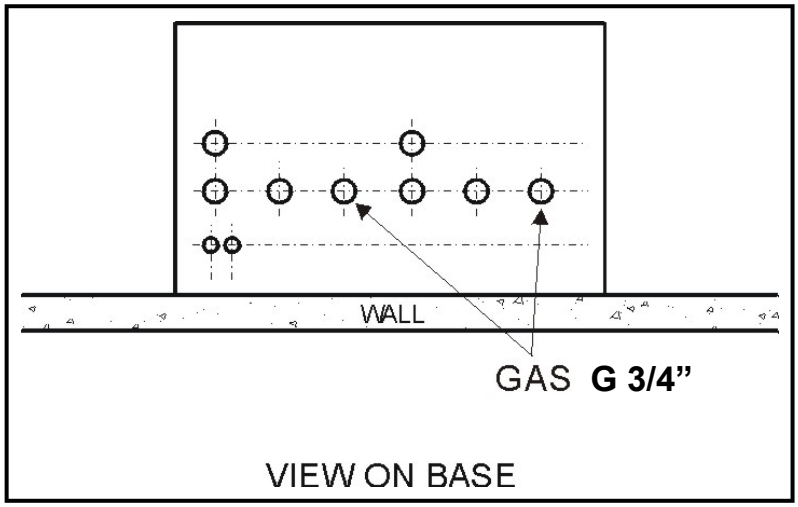


Figure 4.2 - Gas Connection Point

4.3 Flueing

- **The Milborne flue systems supplied by Hamworthy are non UV stabilised polypropylene and are therefore suitable for internal use only. For external flue runs and termination, either use the dedicated kits supplied by Hamworthy or refer to a chimney specialist .**

- **Flue termination, routing and construction must comply with the requirements of the Clean Air Act 1956, BS 6644, BS 5440 and IGE/UP/10 where applicable.**

- **Milborne boilers installed in modular format with a common flue, must use the header provided with the boiler prior to any connection to the flue system. Individual modules must be flued using the 50mm polypropylene flue ducts provided .**

- **Milborne boilers are suitable for open flue (type B_{23}) installation, drawing combustion air from the plantroom, or room sealed, twin duct (type C_{53}) installation - see section 5.2**

- **Due to the low flue gas temperature, (~50°C) condensation will occur in the flue, flue materials must be non-corrosive and utilise fully sealing joints.**

- **Adequate facilities must be provided for draining the flue condensation. Any horizontal runs of flue must provide condense drainage from the flue header/chimney. The flue system MUST NOT drain through the boiler - see section 5.2**

- **Horizontal flue runs must be kept as short as possible and be inclined at minimum 2° towards the terminal. Maximum equivalent length of flue - 30m.**

- **Any flue must be self-supporting and separable from the boiler for servicing requirements.**

- **Note: Due to high thermal efficiency of the Milborne boiler and the resultant low flue gas temperatures there will be visible pluming of the flue gases at the flue termination. This is likely even when the boiler is not operating at condensing temperatures.**

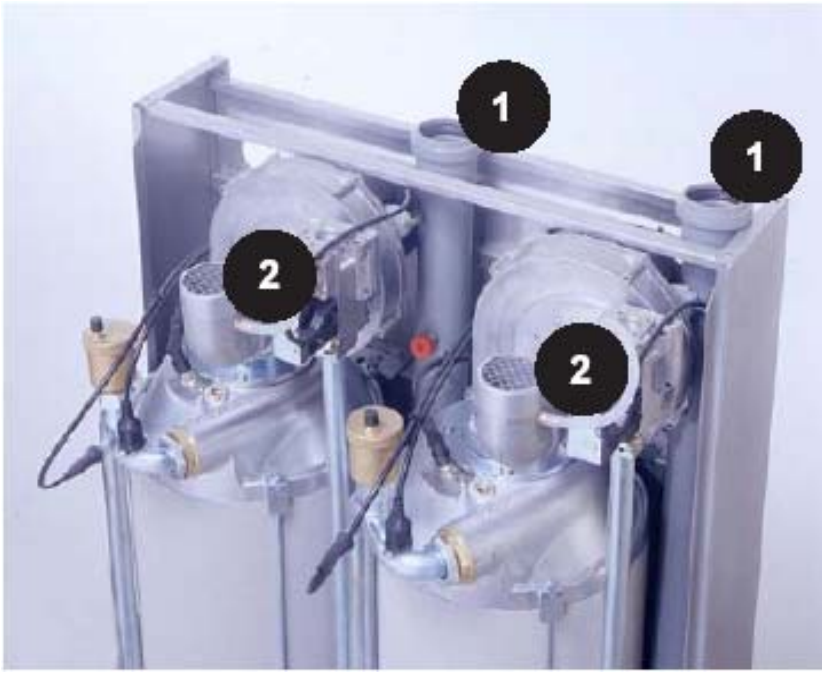
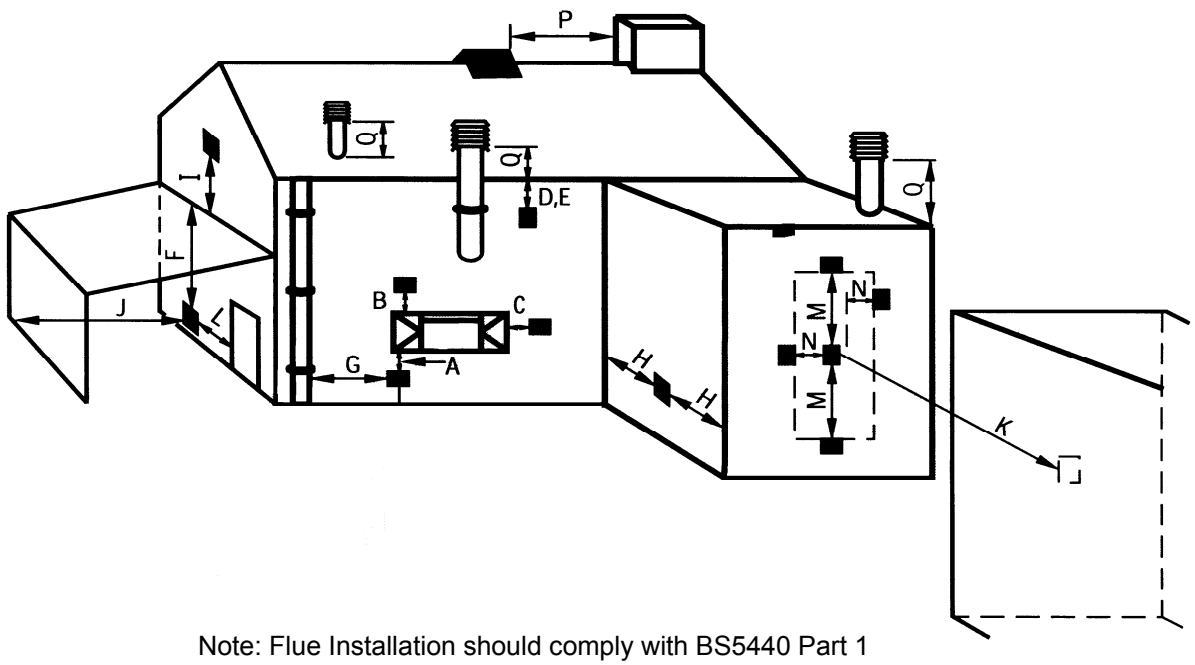


Figure 4.3.1 - Flue Connection - Open Flue - '1'- Flue connection, '2' - Air inlet

4.3 Flue Terminal Locations

The diagram below details the minimum spacing requirements for flue terminals from other building features when using horizontal flue terminals with C53 twin pipe flue systems.

It is recommended that air supply inlet terminals are positioned no closer than 300mm to any flue terminal when using C53 twin pipe flue systems. Air supply inlets should preferably be positioned lower than flue terminals.



Note: Flue Installation should comply with BS5440 Part 1

Figure 4.3.2

Dim	Terminal Position	Min Distance (mm)
A	Directly below an opening, air brick, opening window etc	300
B	Above an opening, air brick, opening window etc	300
C	Horizontally to an opening, air brick, opening window etc	300
D	Below gutters, soil pipes or drain pipes	75
E	Below eaves	200
F	Below balconies or car port roof	200
G	From a vertical drain pipe or soil pipe	150
H	From an internal or external corner	300
I	Above ground roof or balcony level	300
J	From a surface facing the terminal	600
K	From a terminal facing the terminal	1200
L	From an opening in the car port (e.g. door, window) into the dwelling	1200
M	Vertically from a terminal on the same wall	1500
N	Horizontally from a terminal on the same wall	300
O	From the wall on which the terminal is mounted	N/A
P	From a vertical structure on the roof	N/A
Q	Above intersection with roof	N/A

4.4 Water Supply

- **The Milborne boiler is only suitable for operating on sealed (pressurised) heating systems**

- **The Milborne boiler is fitted with an electrical isolating valve, which will shut off circulation through the heat exchanger 5 minutes after the boiler has ceased firing. This must be acknowledged in the system design.**
  It is recommended by Hamworthy Heating, that the primary pump MUST be controlled from the Master boiler to ensure synchronised operation - refer to fig. 4.6. Where twin head pumps are installed a changeover control (not HHL supply) external to the boiler is required.

- **Pressurised system to comply with BS 7074.**

- **Each module is supplied with a safety valve set at 6barg.**

- **It is strongly recommended that the system pipework is flushed at least twice before adding water treatment and before installing the boiler.**

- **In hard water areas (>180mg $CaCO_3$/litre) precautions such as water treatment are strongly recommended to prevent the build up of sludge and scale.**

- **Leaks in the system pipework should be fixed to prevent dilution of water treatment.**

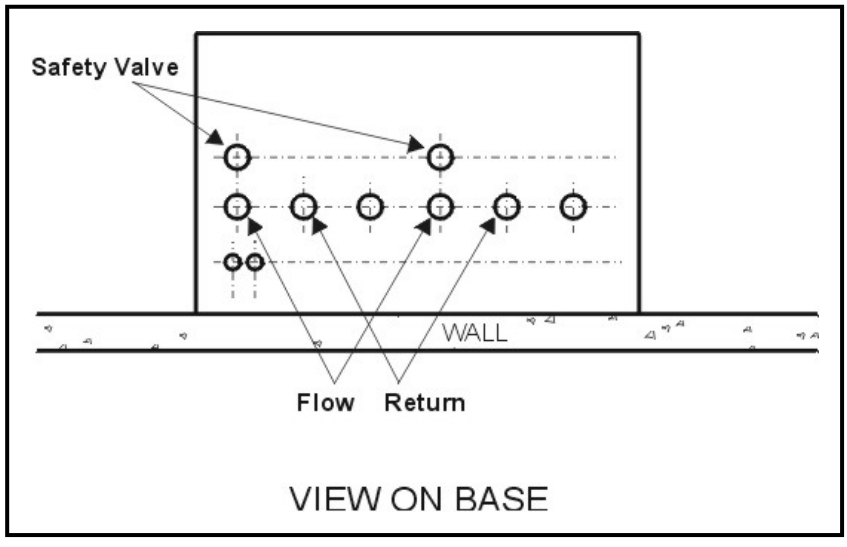


Figure 4.4 - Water Connection Point

4.5 Condensate Connections

- **Provision must be made for removal of condensate from the boiler and flue system.**
- **Condense is mildly acidic, typically pH3 - pH5.**
- **Condense pipework must be non-corrosive and not copper. Hamworthy recommend plastic waste pipe.**
- **Condense may be discharged to a standard drain subject to National or Local regulations.**
- **Location of condense pipework should prevent freezing within tundishes, traps and pipework.**
- **The connection to the boiler condense drain accepts a straight push-fit coupling for 18mm i.d. plastic waste pipe.**
- **Maximum condensate production - 5.1l/hr per 37.5kW & 7.2 l/hr per 50 kW module.**

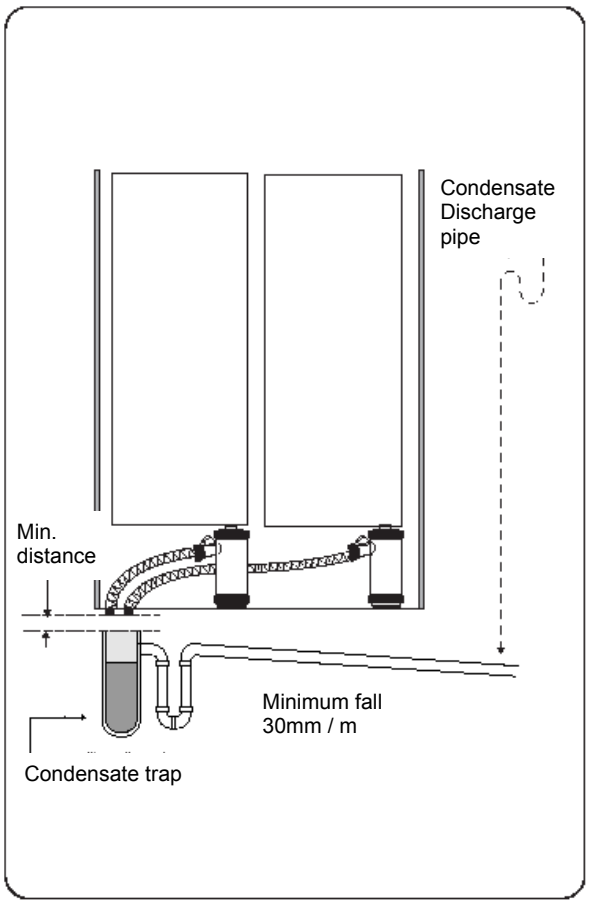


Figure 4.5.1 - Boiler Condensate Connection

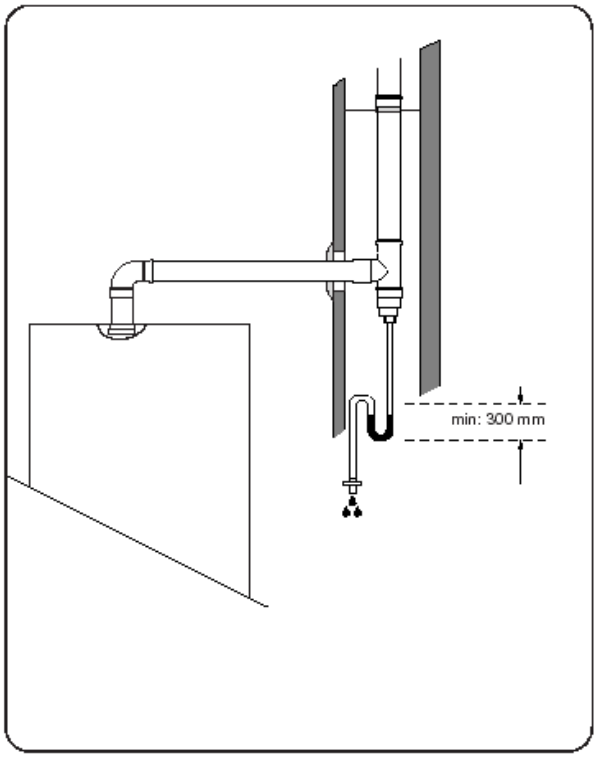


Figure 4.5.2 - Flue Condensate Connection

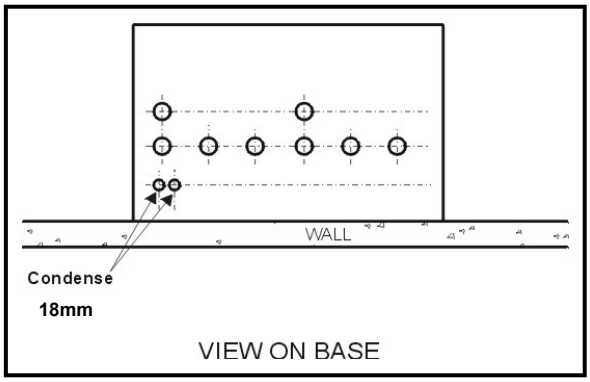


Figure 4.5.3 - Boiler Condensate Connection

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^2 csa.**
- **Each boiler MUST have individual means of isolation.**
- **Each boiler is supplied with a 500mm flying lead for connection to the electrical supply.**
- **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.**
- **Any pump controlled by the boiler must be installed using an adequate contactor.**
- **Where twin head pumps are installed a changeover control (not HHL supplied) external to the boiler is required.**
- **Where an external alarm is required, terminals are provided which are volt free and rated at 230v.**
- **Time clock control should be via the boiler modules stop/start circuit (24V DC).**
- **Any interlock circuit must be in series with the time control for each circuit. The interlock circuit must never be used to isolate the boiler electrical supply.**

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 TYPICAL SCHEMATIC DETAILS SEE FIGURE 4.6

FOR DETAILED WIRING INSTRUCTIONS SEE FIGURES 9.3.1 & 9.3.2 AND APPENDIX B

5.2.2.1 Flue Maximum Length.

Each 50 mm flue pipe maximum equivalent length is defined in Appendix C - figure C1.1.

5.2.2.2 Open Flue Installations type B_{23}

Figure 5.2.2.1 shows the configuration of a single Milborne 381 / 501 boiler installation using the B_{23} open flue arrangement.

Note: Consideration must be made for the prevention of condensate from freezing within the condensate trap in the flue. Locating the condensate discharge kit to the horizontal flue section within the building may provide a suitable solution.

Figure 5.2.2.2 shows the a single Milborne 382 / 502 boiler installation using the B_{23} open flue arrangement.

For B_{23} type open flue arrangements with air intake from boiler house the maximum equivalent flue length of 30 metres includes only the flue pipe.

Pictorial View	Description	Code	HHL Part No.
	Polypropylene 45° bend ø50 mm Polypropylene 90° bend ø50 mm	3 3	573407376 573407377
	Polypropylene pipe ø50 mm x 250mm Polypropylene pipe ø50 mm x 500mm Polypropylene pipe ø50 mm x 1000mm	1 1 1	573407379 573407380 573407381
	Terminal kit for flat room ø80 mm	7	573407387
	Terminal kit for pitched roof ø80 mm	8	573407386
	Stainless steel horizontal wall terminals ø50 mm	5	573407384
	Polypropylene condensate discharge kit. To remove condensate from vertical and horizontal flue sections.	7	573407385
	50mm Flue pipe wall bracket	2	573407249

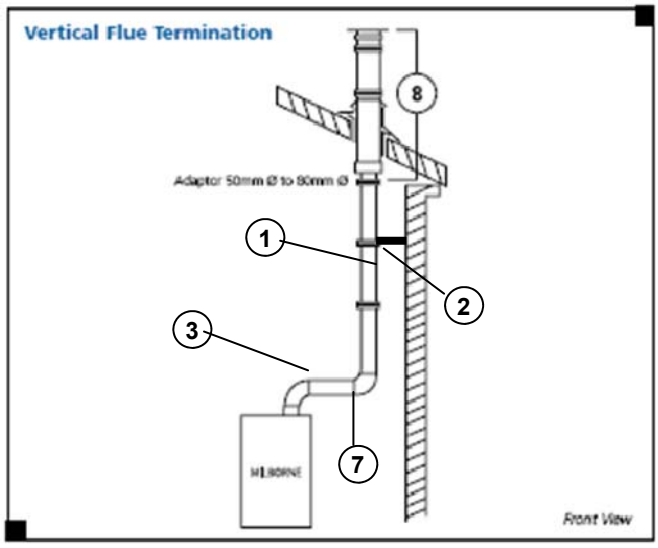


Figure 5.2.2.1 - Single Milborne Vertical Flue

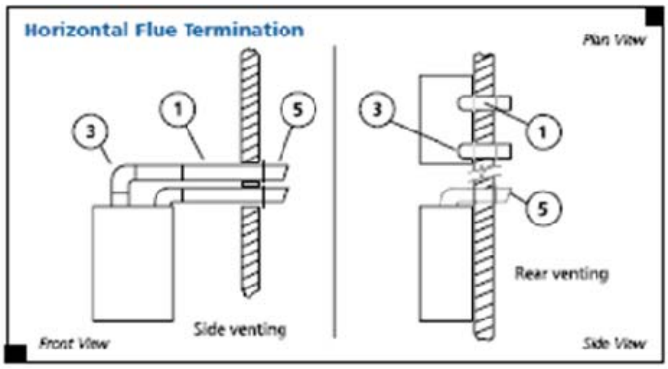


Figure 5.2.2.2 - Single Milborne Horizontal Flue

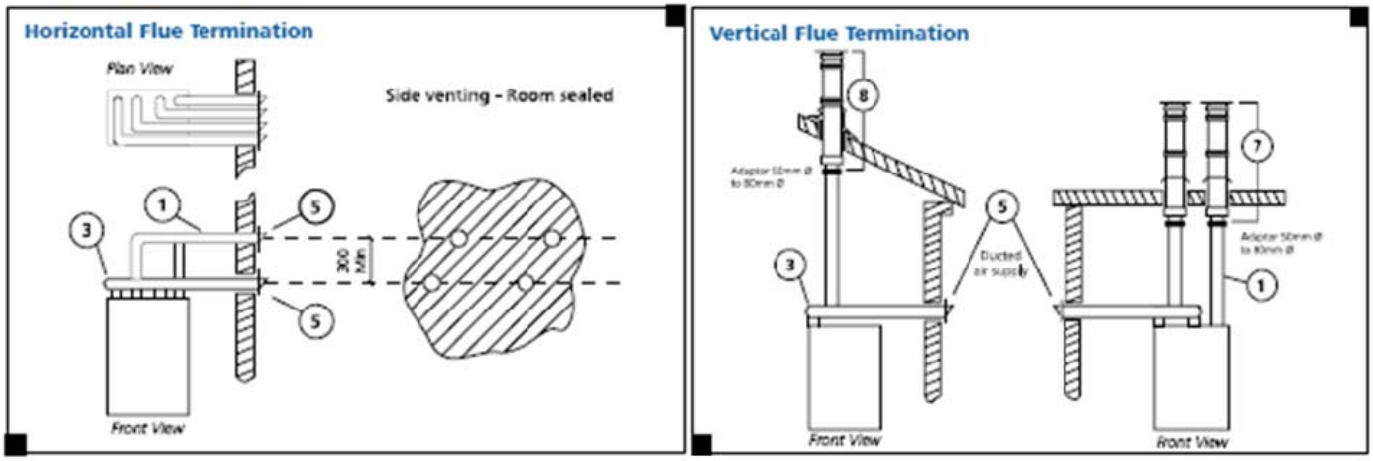


Figure 5.2.2.4 - Single Milborne - Room Sealed Flue Installation

5.2.3 Modular Boiler Installation Type C_{63}

Connection to a Flue Gas Header

The size of the flue system for the installation of several Milborne boilers is 125 or 160mm diameter, polypropylene flue gas headers with male / female connections. At the point at which the flue system penetrates the roof (flat or pitched), the stainless steel terminals are 130 & 180mm diameter.

A maximum of 3 Milborne 382 / 502 boilers (300kW) may be installed using the 125mm flue gas header.

Larger cascade boiler arrangements (upto 500kW) must use the 160mm flue gas header, refer to Appendix C figure C1.2 for equivalent lengths.

The header is designed to collect the flue gas discharge from the 50 mm flue pipes from the individual modules, through an 80mm non-return valve (specific to each module). The header can be located close to, or remote from, the boilers using the 80mm fittings available from Hamworthy, to connect the boiler modules to the header.
When using the flue gas header for boiler assemblies connected in cascade, the prescribed distance required between the assemblies is 150 mm - see figure 5.2.3.1

Note: the 80mm connecting pipes must be so arranged so as to provide the necessary 3° slope on the header to ensure the drainage of condensate to a suitable point.

Note: When using the 125 mm diameter flue header the maximum number of modules acceptable in a single flue system is six (6), or 3 x 382 / 502 models. Larger cascade capacities must use the 160mm diameter header.
For equivalent lengths for the 125 & 160mm systems refer to figure 5.2.3.2

Maximum pressure available at module flue connection is 0.7 kPa (7 mbar)

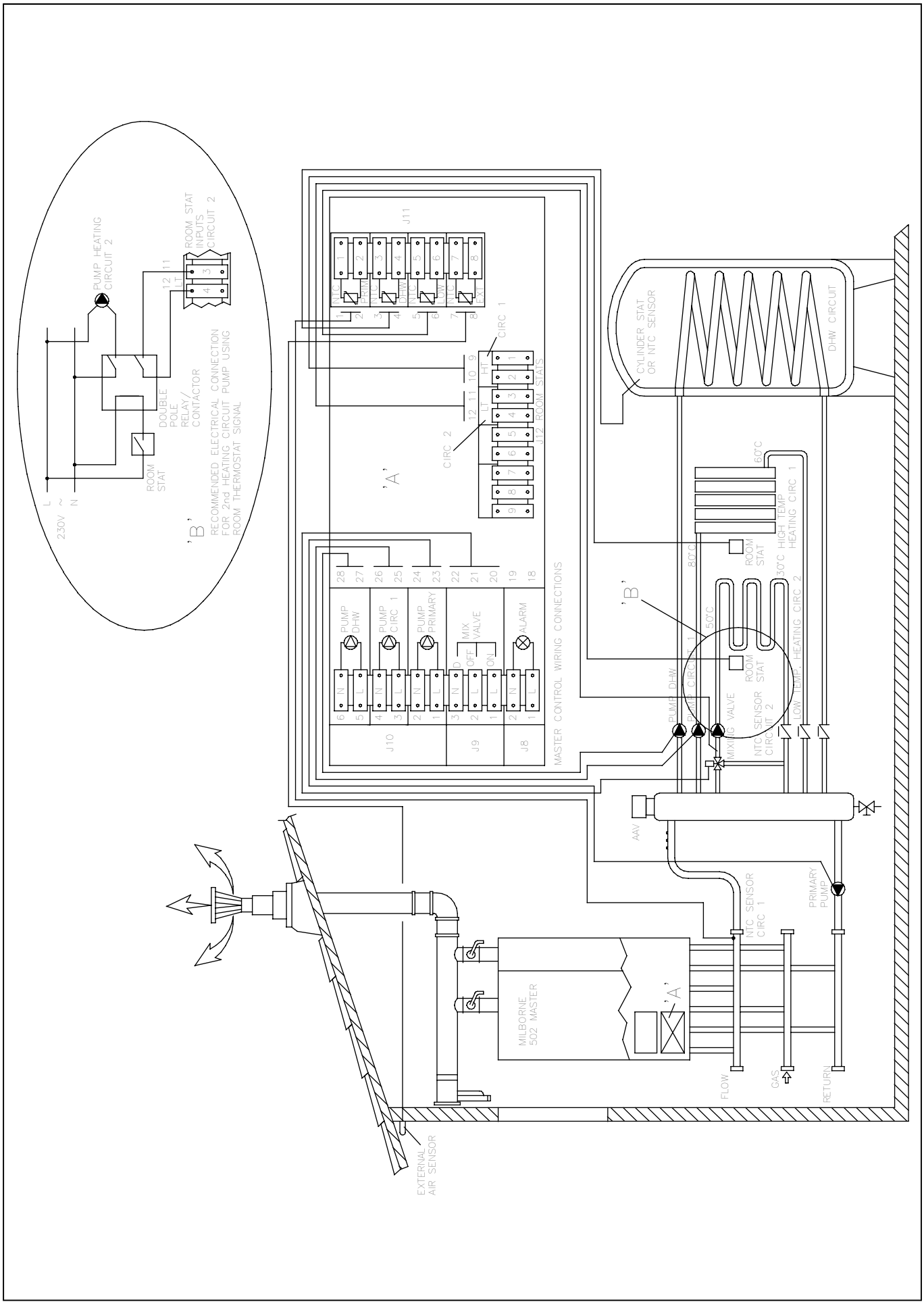
Note: For room sealed applications, the air supply ducts must not be connected together. Only individual air inlet ducts for each module are acceptable.

5.2.3 Components for Installations using Flue Headers - up to 3 x Milborne 382 / 502 Boilers

125/160 mm diameter flue components for use with Milborne 382 / 502 when using flue headers.

For use on applcations consisting of B_{23} type flue configurations, i.e. Drawing combustion air from the plantroom. Alternatively for use on applications consisting of C_{63} type (room sealed) flue configurations, i.e. Drawing combustion air directly from outside and ducted to individual modules.
In both instances, the flue should discharge in a riser terminating above roof level.

Figure 4.6 - Typical Schematic Details



5.0 BOILER ASSEMBLY

5.1 General

Boilers are despatched to site as fully assembled units. The flue header (where applicable) and frame / pipework 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.

Boiler positioning must allow the minimum clearances detailed in Section 3.0 to facilitate access for flue and pipework connections as well as maintenance. The boiler must be installed on a solid masonry wall using the mounting bracket supplied. To locate the boiler on the wall, a cardboard template is provided in the boiler packaging.

- Place the template supplied with the boiler on the wall, at a height of approximately 140 cm from the ground, using a spirit level to ensure that the mounting holes are horizontal.
- Secure the template on the wall temporarily and mark the boiler's mounting holes on the wall
- Drill the holes and install the screw anchors supplied with the boiler.
- Secure the wall mounting bracket and carefully lift the boiler onto the bracket.

Health and safety. Due to the weight of the boiler, care must be taken when lifting onto the mounting bracket.

Note: when installing multiple boilers, the Master boiler must be placed closest to the heating system to allow correct location of the mixed flow sensor.

5.2 FLUE SYSTEM

5.2.1 Room Sealed Flue Installations Type C_{63} - Twin Ducts

Figure 5.2.1 shows the twin pipe flue connection for a Milborne 502 boiler. This allows the air supply and the flue to be piped using separate ducts for room sealed applications.

It is important that horizontal flue terminals discharges are positioned in accordance with the requirements detailed in Figure 4.3.

Air supply inlets must be positioned at least 300 mm from flue terminals to prevent flue gas re-circulation.

Hamworthy Heating recommend that flue terminals discharges are positioned higher than air inlets.

For C_{63} twin type pipe installations the maximum equivalent length of 30 metres includes both the requirements for the air inlet pipe and flue pipe.

To comply with the requirements of the Clean Air Act 1956 a maximum of 150 kW may be terminated with horizontal flue discharges.

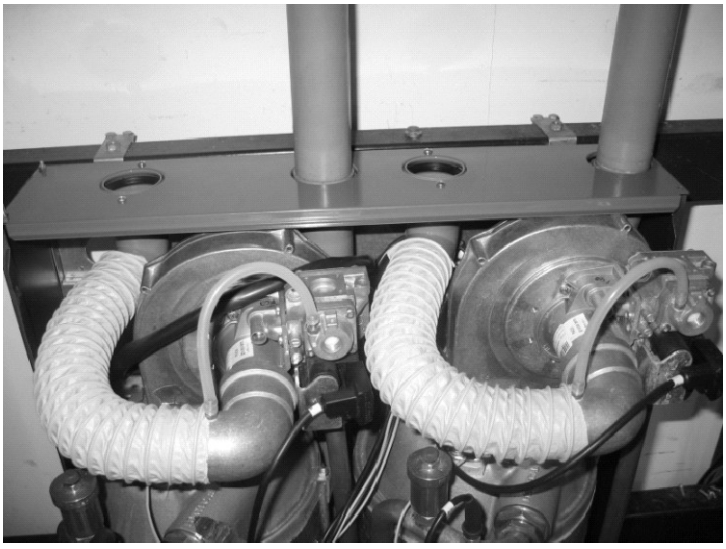


Figure 5.2.1 - Twin Duct connection

5.2.2 Components for Individual Flues per Boiler Module

50 mm diameter self extinguishing flue components for use with Milborne boilers.

For use on applcations consisting of B_{23} type flue configurations, where combustion air is taken from within the boiler house, and C_{63} room sealed twin duct systems where combustion air is taken directly from outside and ducted to the boiler.

Maximum equivalent length for this flue system is 30 metres from boiler to terminal for B_{23} applications, and from air inlet terminal to flue terminal for C_{63} applications.

Equivalent lengths for 90° bends is 4 metres with 3 metres equivalent length for a 45° bend.

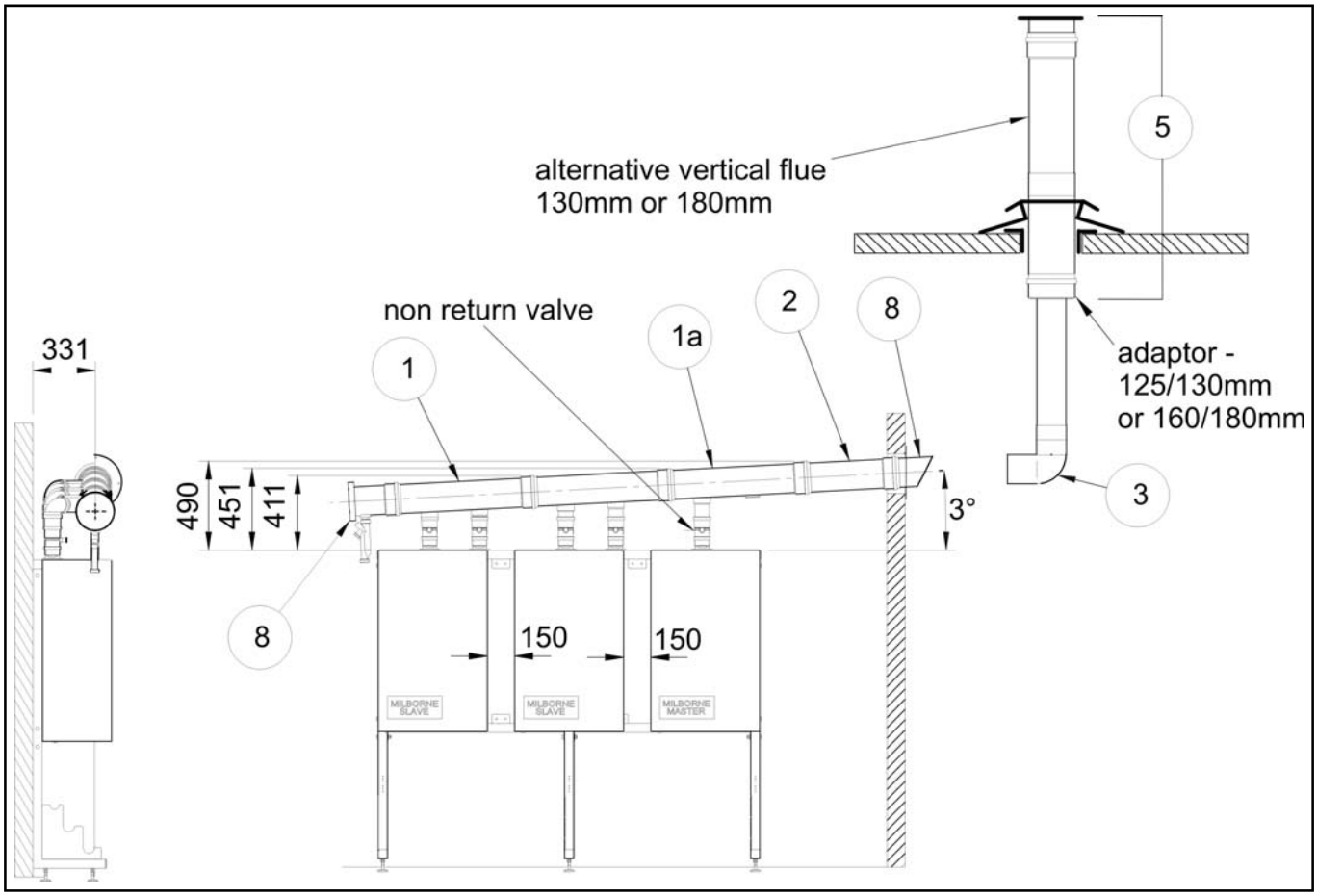
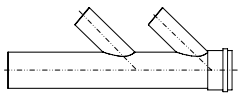


Figure 5.2.3.1 - Modular Milborne Flue Installation using Hamworthy kits

Pictorial View	Description	Code	HHL Part No.
	Polypropylene 45° bend ø125 mm	3	573407340
	Polypropylene 90° bend ø125 mm	3	573407341
	Polypropylene 45° bend ø160 mm	3	573407317
	Polypropylene 90° bend ø160 mm	3	573407316
	Polypropylene pipe ø125 mm x 500mm	2	573407337
	Polypropylene pipe ø125 mm x 1000mm	2	573407338
	Polypropylene pipe ø125 mm x 2000mm	2	573407339
	Polypropylene pipe ø160 mm x 500mm	2	573407313
	Polypropylene pipe ø160 mm x 1000mm	2	573407314
	Polypropylene pipe ø160 mm x 2000mm	2	573407315
	Polypropylene header kit for 502 boiler ø125 mm	1	573407292
	Polypropylene header kit for 501 boiler ø125 mm	1a	573407295
	Polypropylene header kit for 502 boiler ø160 mm	1	573407290
	Polypropylene header kit for 501 boiler ø160 mm	1a	573407294
	Condensate trap & tee piece kit ø125 mm	8	573407296
	Condensate trap & tee piece kit ø160 mm	8	573407297
	Flue pipe wall bracket ø125 mm		573407247
	Flue pipe hanger bracket ø125mm		573407355
	Flue pipe wall bracket ø160 mm		573407328
	Flue pipe hanger bracket ø160mm		573407329
	Horizontal Discharge Terminal ø125 mm	5	532511072
	Vertical Discharge Terminal kit pitch roof ø125 mm	5	573407388
	Vertical Discharge Terminal kit flat roof ø125 mm	5	573407389
	Horizontal Discharge Terminal ø160 mm	8	532511089
	Vertical Discharge Terminal kit pitch roof ø160 mm	5	573407390
	Vertical Discharge Terminal kit flat roof ø160 mm	5	573407391

5.3 Water Connections

The following connections are provided on each boiler module;

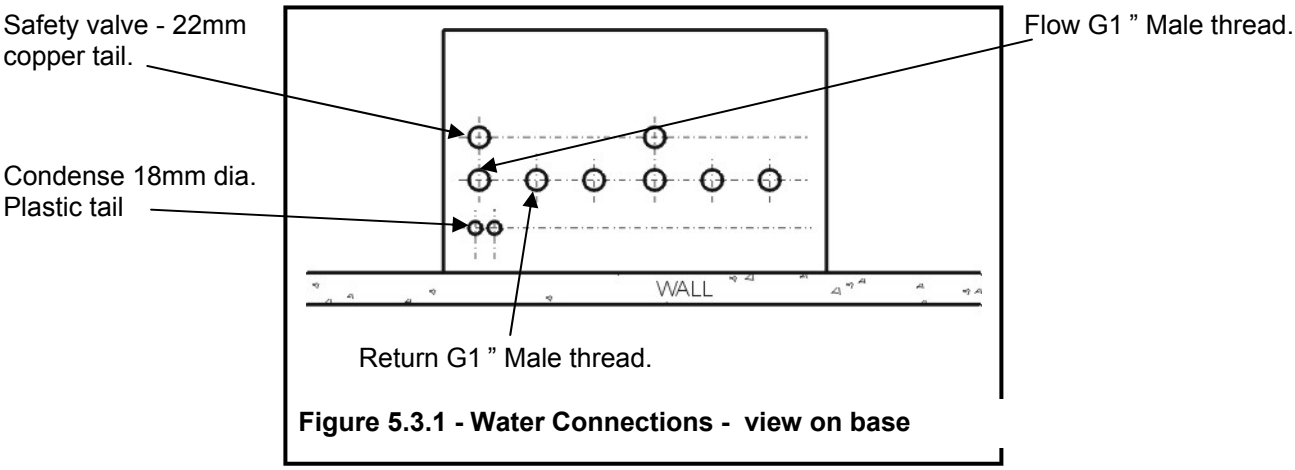


Figure 5.3.1 - Water Connections - view on base

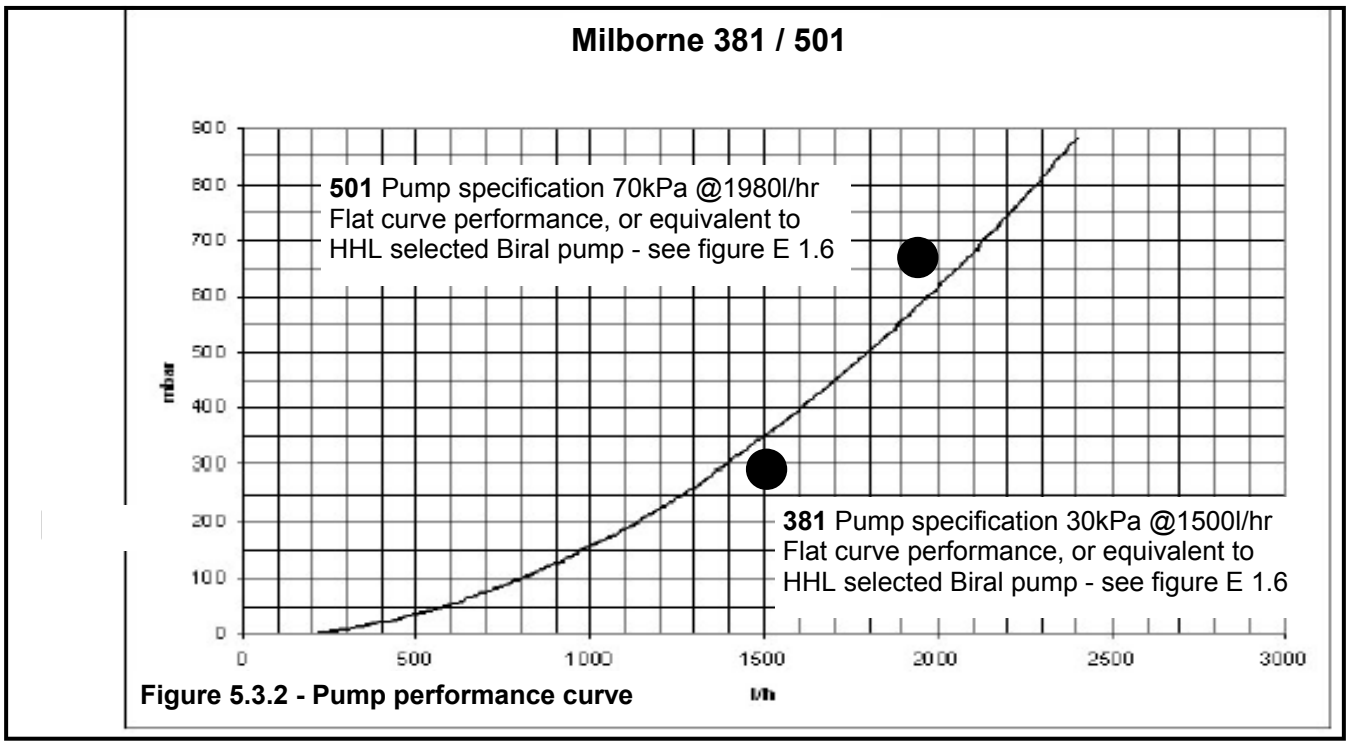


Figure 5.3.2 - Pump performance curve

Water Systems

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.

Each module is fitted with safety valve rated at 6bar. The valve discharge pipe is routed to the base of the boiler, where it must be piped to discharge via a tundish (not HHL supply) suitably located for ease of visibility.

It is strongly recommended that the boiler is fitted to a primary circuit configuration, whereby the primary pump ensures correct flow through all boilers at all times. The Milborne is designed to operate at 20°C ΔT across the flow and return. Should the flow rate drop, the boiler controls will modulate the burner to maintain 20°C ΔT. As a safety precaution, a differential pressure switch is fitted to the boiler heat exchanger to shut the system down in the event of sudden adverse flow conditions.

Where using Hamworthy Heating Ltd frame set and pipework kits, assembly of these is detailed in Operation and Maintenance manual 500001156 supplied with kit.

5.3 Electrical Connections:

The following electrical connections are provided on each module.

- Supply: Live, Neutral and Earth. See Section 4.5 for details.
- Boiler General Fault Alarm Signal Output
- 0-10v Analogue Control Signal Input
- Remote on/off Control Input
- Upto 3 Circuit Pump Outputs - 1 Primary & 2 Secondary
- Safety Interlock Circuit Input
- Programmable room thermostat Input
- Outside air temperature sensor Input
- LPB Bus connections for cascade management

6.0 PRE-COMMISSIONING

The following pre-commissioning check must be carried out before the boiler is commissioned.

6.1 Gas Supply.

Ensure that gas installation pipework and meter has 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.

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.
- 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.

6.5 Electrical

Ensure that;

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

WARNING: WHEN THE FRONT COVER IS REMOVED AND 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 ENSURE THAT THE PRE-COMMISSIONING CHECKS ON PAGE 20 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, fittings and gas valve assemblies etc.

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

NOTE: When testing 382 / 502 boilers, the test detailed below must be carried out on each module.

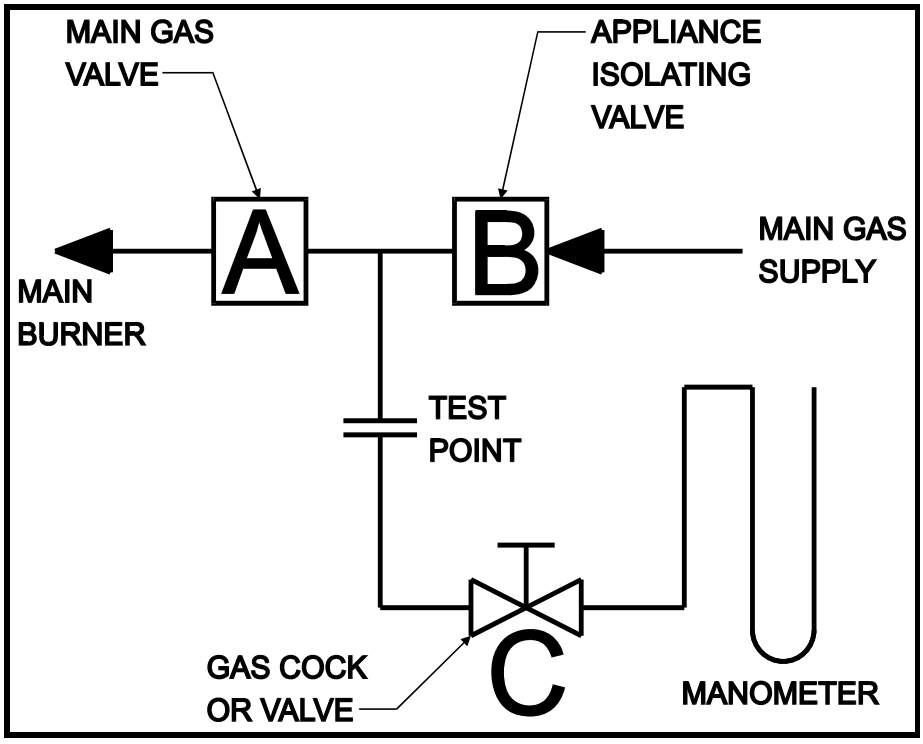


Figure 7.1 - Gas System Leak Check Diagram

Note:-
Main Gas Supply Pressures are as follows;
Natural Gas - 20mbar
LPG Propane - 37.5mbar

TO CHECK B

1) Turn off the electrical power and gas supply to the appliance.
2) Connect the manometer assembly to test point (Fitted on the inlet to the gas valve).
3) With A and B closed open C and monitor manometer over a 2 minute period, a rise indicates a leak on valve B.

TO CHECK A

1) Open C.
2) Open B to produce the mains gas supply pressure between A and B.
3) Close B.
4) 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, Gas Data Tables, for maximum inlet pressure for normal operation.

7.2.1 The Following checks must be made prior to lighting the boiler;

1. Remove the front cover to gain access to the boiler components. The cover is secured with 2 screw on the underside at the left and right hand sides. Once the screws have been removed the cover may be lifted to disengage the retaining clips at the top and removed. Store the front casing panel carefully to prevent damage.
Note: Before starting the boiler commissioning procedure verify the following;
2. Ensure that all external controls are not demanding that the boiler commences operation.
3. **Make certain that the boiler is configured for the appropriate gas being supplied.** Parameter 36 must be checked and set as necessary. When the boiler arrives on site parameter 36 is configured for Natural Gas supply with equivalent flue length less than 15 metres. If using the boiler with a LPG Gas supply or equivalent flue lengths greater than 15 metres, parameter 36 must first be modified in accordance with the table below. Instructions detailing the procedure for modifying parameters are given in Section 8.9 of this manual.

Parameter	36
Description	Type of Gas
Range	1-7
Default	1
Specification	1=Natural Gas with equivalent flue length <15m 2=Natural Gas with equivalent flue length >15m 3=LPG with equivalent flue length <15m 4=LPG with equivalent flue length >15m

9. Turn on the mains gas supply. Check that sufficient gas pressure is available at the boiler, 17.5mbar Natural Gas, 37.5mbar LPG.
10.Ensure that all electrical connections made to the boiler are correctly sized and installed. Refer to wiring diagrams in Section 9.3.
11 Check that the boiler controls wiring has not been modified. Any modification could lead to boiler failure.

7.2.2 Gas inlet pressure test

The gas pressure must be checked at the inlet to the boiler as shown in figure 7.2.2. This is to ensure that the gas pressure is both constant and sufficient to provide full burner output. To verify this the pressure has to be taken as a static and a dynamic reading. The dynamic reading cannot be taken until the boiler has been started - refer to 7.3.3

A maximum difference in gas pressure of 1 mbar must not be exceeded between static and dynamic conditions.

The gas pressure measured during these tests must be no less than 17.5 mbar for Natural Gas or 37.5 mbar for LPG.

4. Check that the heating system has been flushed and refilled and that air has been purged from all high points.
5. Ensure that the system isolating valves are in the open position and that the water pressure within the heating system is correct. Minimum pressure 0.5barg.
6. Ensure that circulating pumps have been installed correctly and that the pumps are available for operation.
7. Ensure that the flue ducts are correctly fitted and that they are free from obstruction. Check that the inlet and outlet terminal are located correctly and in accordance with regulations.
8. Ensure that the gas supply has been properly purged and verified for gas soundness. A purge and soundness certificate should be available from the gas pipework installation contractor.

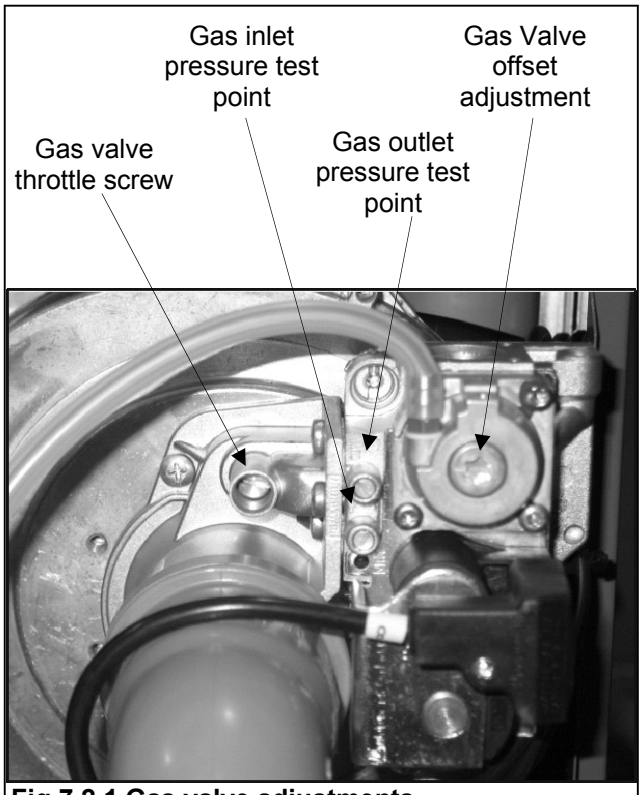


Fig 7.2.1 Gas valve adjustments

7.3 Commissioning the Boiler

Once the preliminary checks have been completed and the gas inlet pressure has been verified as correct, commissioning of the boiler modules may begin.

1. Insert the combustion analyser probe in the flue at the analysis point shown in figure 7.3.1
2. **LPG BOILERS ONLY.** Turn the throttle adjustment screw 2 full turns anti-clockwise as indicated in figure 7.3.2

Fig 7.3.1 - Flue gas analysis point

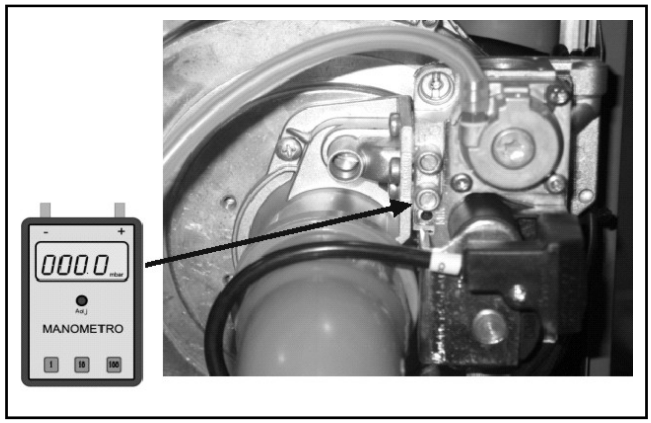


Fig 7.2.2 - Gas Inlet Pressure Test Point

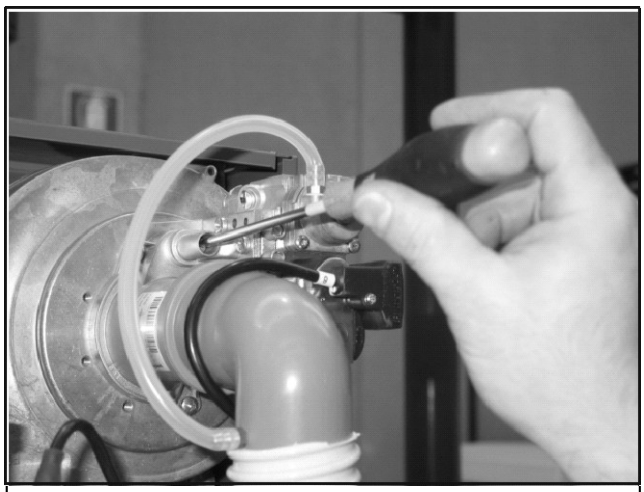


Fig 7.3.2 - Throttle Adjustment

7.4 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 boiler - refer to fig 7.3.1.
NOTE! Care should be exercised when the boiler is firing as the heat exchanger components can achieve temperatures, which could cause injury if touched.

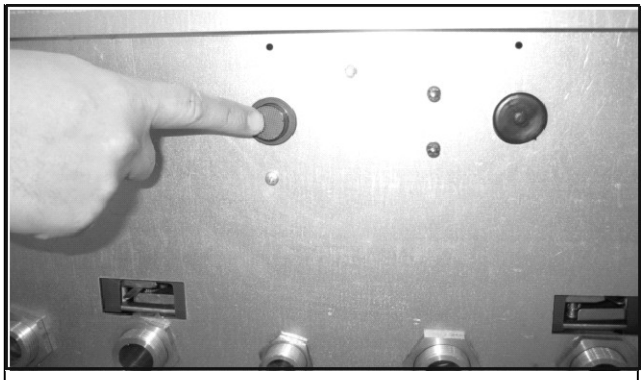


Fig 7.4.3 - Starting the Boiler

1. Ensure that all external controls are in demand and that the gas supply to the module is isolated.
2. Switch the main boiler on/off switch located on the underside of the boiler to the on position as indicated in figure 7.4.3.
3. Start the individual boiler module using the on/off switch located on the front of the control panel for the chosen module. Milborne 382 / 502 models have 2 switches on the front of the control panel. It is therefore important to select the switch corresponding to the boiler module being commissioned. See fig 7.4.4
4. Ensure that a number appears in the left indication window of the Master control panel. This number relates to one of the heating circuits.
5. As the gas is isolated, the boiler will make 5 ignition attempts and then go to ignition lockout displaying error code ‘A01’.
6. If the above procedure occurs correctly, open the gas isolation valve, press the reset button (S1) and the fault indication will extinguish. The boiler will commence the ignition sequence and the burner will light.
7. With the boiler firing, the flame signal displayed should be approximately 40µA but not less than 10µA.

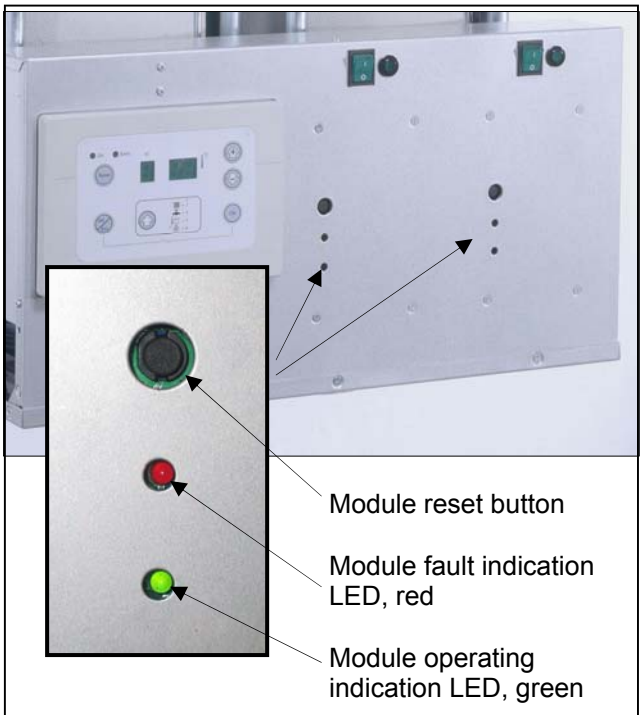


Fig 7.4.4 - Control Panel Modules

5 Ensure that a number appears in the left indication window of the Master control panel. This number relates to one of the heating circuits.

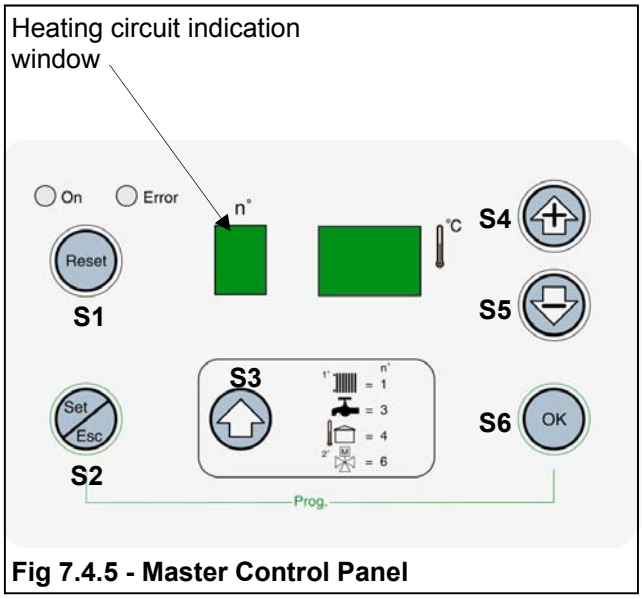


Fig 7.4.5 - Master Control Panel

The operating sequence for the display is as follows;

No Demand for heat;

Heat Demand for domestic hot water circuit or from heating circuits 1 and 2;

Demand from domestic hot water circuit or both in operation;

Demand from heating circuit 2;

6. Wait for the green indicator LED to illuminate, to indicate that the ignition phase of boiler start-up has commenced.

Slow flashing LED
= Standby

Fast Flashing LED
= Ignition phase

Steady LED
= Flame is present

Note: The ignition sequence is as follows;

1) 5 Seconds of pre-purge
2) 4 Seconds of post–purge

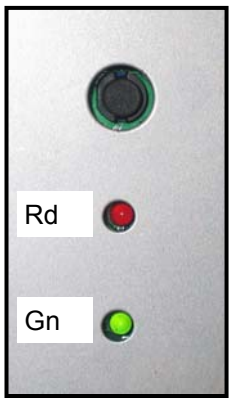


Fig 7.4.6

7. Run the burner to maximum power. To achieve this press and hold S2 and S4 for 5 seconds.

S2 S4

After 5 seconds the maximum fan speed can be selected with switch S4. All the fans in the boiler installation will operate now at the maximum speed as programmed at parameter 15; maximum fan speed CH.

The first digit of the display will indicate the fan speed. H = maximum speed.

The second two digits of the display indicate temperature, e.g. T1 = 80°C

8. The gas valve throttle setting can now be regulated.
This is a based on the flue gas combustion analysis rather than a fixed pressure. Check the CO_2 values in accordance with table 7.1. If the CO_2 values are incorrect then adjustment must be made by adjusting the gas valve throttle screw. Turning the throttle screw anticlockwise increases the CO_2 value. Turning the throttle clockwise decreases the CO_2 value. See fig 7.4.8.

Note: To increase the gas flow turn the throttle screw anti clockwise, to decrease the gas flow turn the throttle screw clockwise.

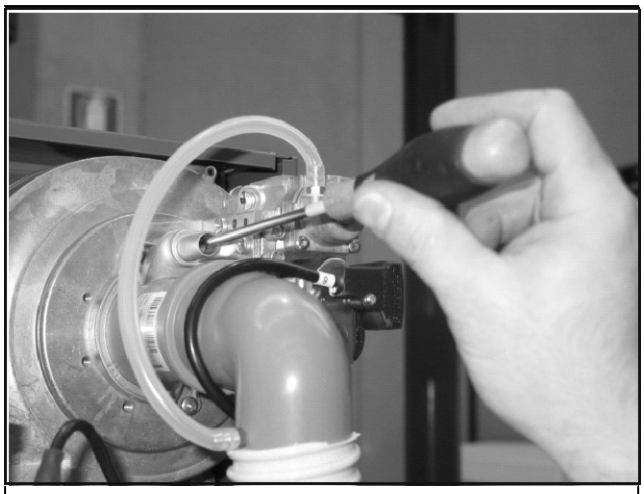


Fig 7.4.8 - Throttle Adjustment

9. Allow the boiler to stabilise at maximum power and if necessary readjust the gas flow rate.

10. Reduce the boiler power to minimum by pressing switch S5 on the control panel.

The first digit of the display will indicate the fan speed. L = minimum speed.

11. The minimum gas rate can now be set. This again is based on the flue gas analysis rather than a fixed pressure. Check the CO_2 values in accordance with table 7.1. If the CO_2 values are incorrect then adjustment must be made by adjusting the gas valve offset adjustment screw. See figure 7.4.11. Turning the offset screw anticlockwise decreases the gas flow and decreases the CO_2 value. Turning the offset clockwise increases the gas flow and increases the CO_2 value. See fig 7.4.11.

Note: To increase the gas flow turn the offset screw clockwise, to decrease the gas flow turn the offset screw anti-clockwise.

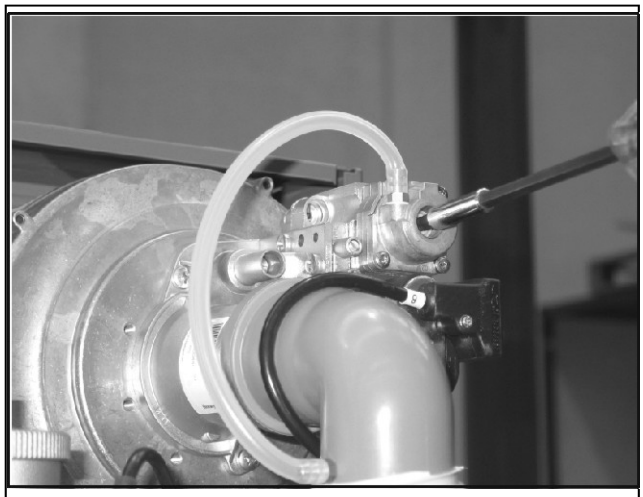


Fig 7.4.11 - Gas Valve Offset Adjustment

12. Ensure that the combustion settings are still correct at maximum output and if necessary repeat steps 7 to 12 until the settings are correct.

Table 7.1: Flue Gas Analysis CO_2 Readings

Gas	Maximum	Minimum
Natural Gas (model 381 & 501)	CO_2 9.2 - 9.4% CO - (80 - 100ppm)	CO_2 8.3 - 8.5%
L.P.G. (model 381)	CO_2 10.5 - 11.0% CO - (80 - 100ppm)	CO_2 9.0 - 9.5%
L.P.G. (model 501)	CO_2 10.2 - 10.4% CO - (80 - 100ppm)	CO_2 8.6 - 8.9%

13. The individual boiler module is now commissioned. If there are further modules to be commissioned then switch the commissioned module off using the external thermostatic controls or time clock to ensure correct shutdown. Further modules may now be commissioned individually by following procedure detailed and used for the first module.

14. Once all modules have been commissioned switch all modules to the 'on' position and take a dynamic gas inlet pressure test reading to ensure that the gas supply is sufficient for full operating load conditions. This should be taken at all boiler modules to ensure the supply is satisfactory at all boilers.

8.0 CONTROLS OPERATION

8.1 Overview

The Milborne control system is a self contained , micro -processor based package, controlling and monitoring all safety and functional aspects of the boiler performance and it's integration with external system controls.

The controls are split into a Master and Slave configuration, with the Master controlling up to 60 slaves. Every boiler module has a slave control and either a 381 / 501 or 382 / 502 boiler must have the Master control. All boiler performance information is accessible and visible through the Master control display.

The Master control will sequence modules with a lead boiler rotation based on hours run. Each Master is supplied with a mixed flow sensor for insertion into the common flow pipework. The sensor must be fitted closest to the heating system pipework, after the last boiler in the cascade. The sequencing can be set in Cascade mode, where individual boilers firing modulate to the maximum rate before switching on the next boiler in the sequence. Alternatively, the sequencing can be set in Unison mode, where individual boilers operate at minimum rate, and collectively modulate to satisfy the demand. Unison mode can realise higher operating efficiencies due to the superior part load performance at low firing rates.

The Master control will manage the operation of two heating circuits plus a dhw circuit. The heating circuits are designated as High temperature and Low temperature, the latter incorporates control outputs for both a pump and a mixing valve, whilst the former and the dhw only have outputs for pump control. An adjustable parameter is provided to enable pump overrun for all three pumps - see section 4.6

All three circuits can be set to operate at different temperatures. The low temperature and dhw circuits having additional optional sensors for control of water temperature. Any unused circuits can be disabled in the parameter settings.

Should there be a malfunction of the Master control, 'Emergency Mode' can be activated which will allow the system to operate at a default temperature—see section 8.3.

The Master control will provide summer shutdown, based on outside air temperature measured by the air sensor supplied with each Master. An adjustable parameter is available to select the desired temperature at which the heating circuits operate.

Two stage frost protection is provided by the Master via the outside air temperature. Stage 1 will start the primary pump and stage 2 will start the boilers based on water temperature within the heating circuit.

Weather compensation is available for the heating circuits based on outside air temperature and a common curve. Each circuit can be offset from this curve by setting the maximum and minimum water temperatures in the parameters.

A comprehensive self diagnostic fault identification system is incorporated within the Master control allowing visibility of all boilers in the installation.

8.2 System Design

Hamworthy Heating strongly recommend the use of a primary circuit configuration, with a suitably matched pump (refer to Hamworthy Heating Technical Department for help or assistance if in doubt). This ensures that the individual modules are flow rate protected with the Master controlling the primary circuit pump. Secondary circuits for high temperature constant volume heating, domestic hot water and low temperature variable flow heating, are also controlled from the Master control - refer to figure 8.2.

8.2.1 Primary Circuit

Whenever there is a demand for heat from any or all of the secondary circuits, the primary pump is initiated. A start signal from the Master control connected to the primary pump (P3), via a suitable contactor, will maintain the primary flow until all heat demands are satisfied and the overrun period is timed out. Where twin head pumps are installed a changeover control (not HHL supplied) external to the boiler is required. The temperature set-point of the primary circuit is equivalent to the highest secondary circuit requirement. The temperature sensor provided with the Master boiler must be located between the Master boiler and the low loss header - refer to figure 8.2.1

8.2.2 High Temperature Heating Circuit

Using constant volume flow, the high temperature heating pump (P1) is initiated when there is a demand from the associated room thermostat. The flow temperature to the circuit can be fixed, or directly compensated according to outside air temperature.

When there is a higher temperature demand for dhw, the high temperature pump (P1), is disabled for the duration of the dhw demand.

8.2.3 Low Temperature Heating Circuit

Using a mixing valve and optional flow temperature sensor, the low temperature heating circuit can operate at a lower temperature than the high temperature heating and dhw circuits. The flow temperature to the circuit can be fixed, or compensated using the mixing valve according to the outside air temperature. Regardless of demands on the high temperature or dhw circuits, the low temperature heating circuit operation remains uninterrupted. The low temperature pump (P4) must be started via a double pole relay in conjunction with the room thermostat for the low temperature zone - refer to figure 4.6

8.2.4 Domestic Hot Water Circuit

Using a traditional calorifier, the dhw demand is initiated by the cylinder thermostat (optional HHL sensor is available), starting pump (P2) and adjusting the primary circuit temperature to achieve the desired dhw set-point.

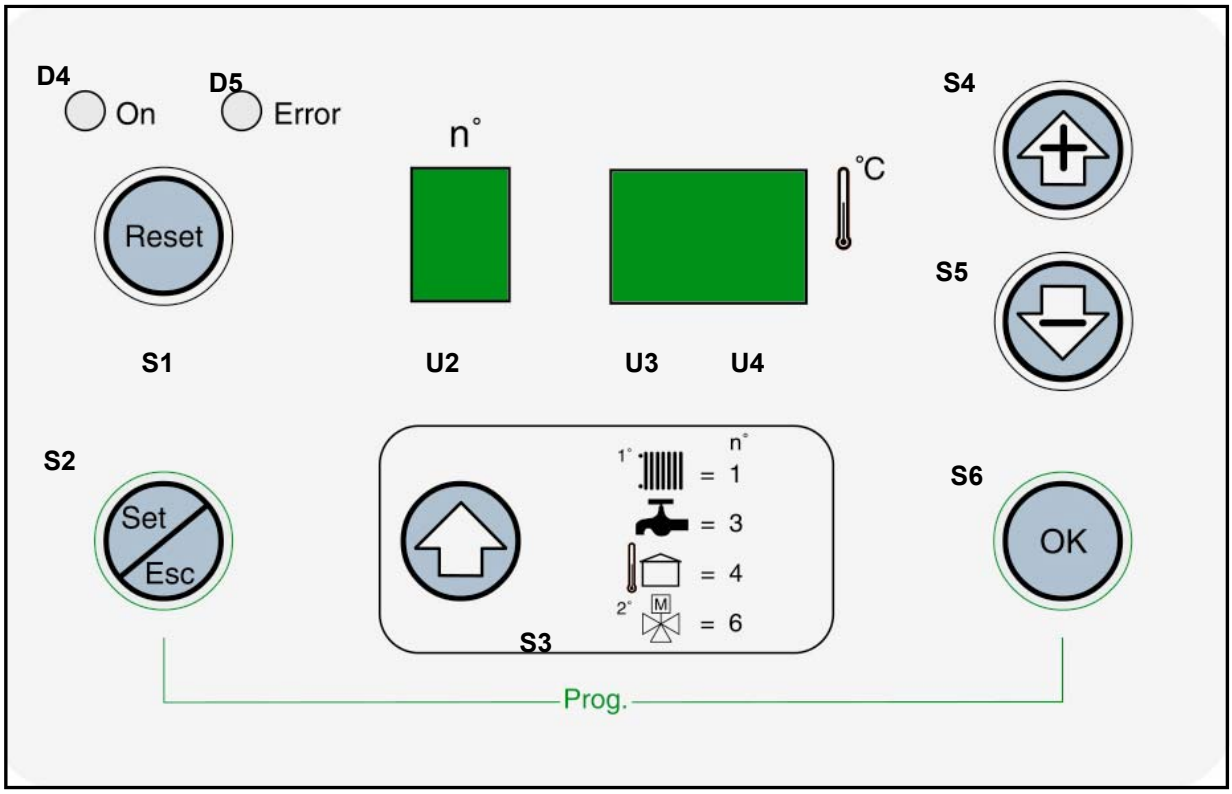


Figure 8.1.1 - Control Panel - (Master)

S1 - Reset
S2 - Set / Esc
S3 - Set Values
S4 - Increase
S5 - Decrease
S6 - Prog / Ok
U2 - LED Display
U3 - LED Display
U4 - LED Display
D4 - Power on green LED
D5 - Faults display red LED

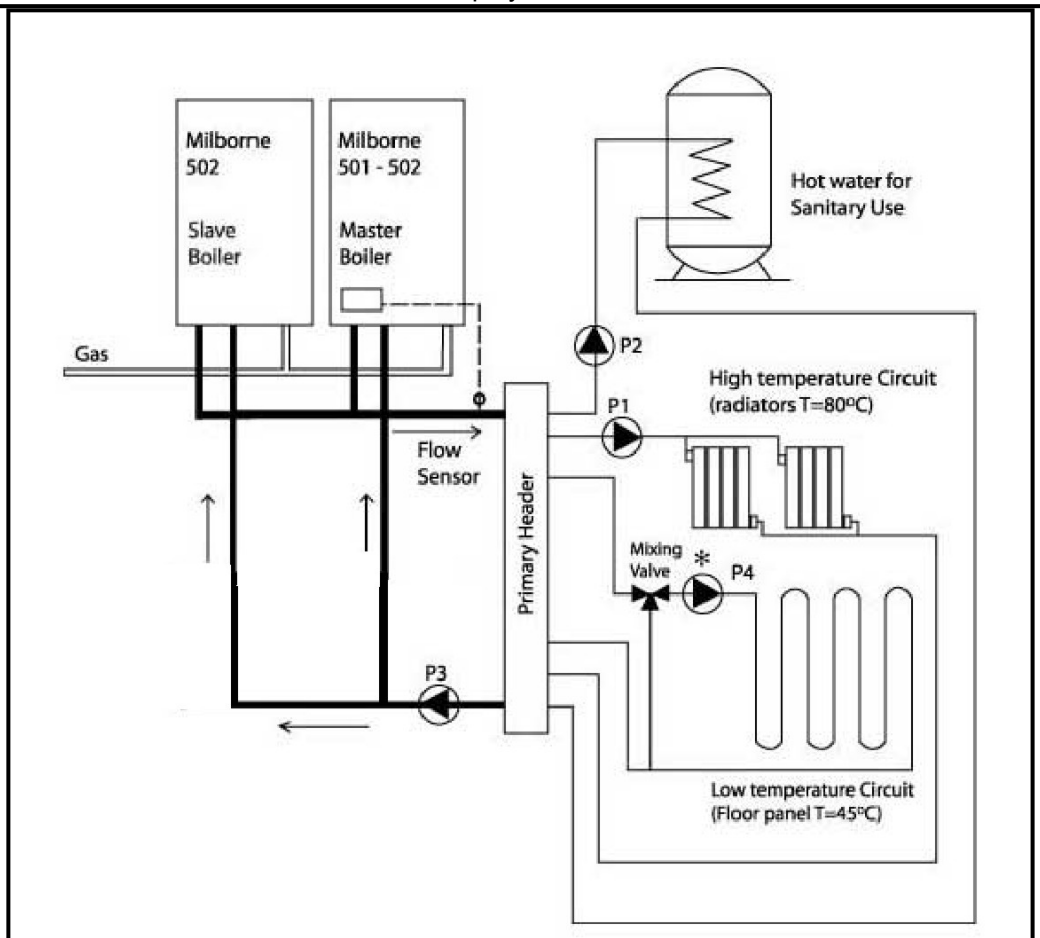


Figure 8.1.2 - System overview illustration

Should the high temperature heating circuit be operating at a lower temperature whilst there is a dhw demand, the high temperature pump (P1) will be disabled to prevent overheating in the heating zone.

8.2.5 Temperature Control

Whilst the maximum and minimum settings for the heating circuits are set during commissioning, the User can adjust the operating set-points within these limits via the Master control.

8.2.6 Building Management System Control

Where required, the Master control can be set to accept a 0-10v analog control signal. This can be configured for temperature or load control and will control the modulation of the boiler(s).

All safety interlocks MUST be wired across the 0-10v circuit using suitable low voltage contact ratings.

A 0-10v input signal, can be used to control one temperature circuit only. Either a High or Low Temperature circuit, or Primary circuit, can be controlled under the direction of the BMS signal. Any additional secondary circuits MUST be controlled by the BMS.

When using the Master control to manage temperature requirements, a separate time clock for each circuit is required. All external clocks must have volt free switching contacts.

When multiple Master boilers are used in the same heating system it is important to ensure a BMS is used to enable each Master Control using 0-10Volt analog signal. Each Master Control requires it's primary flow temperature sensor locating in a pocket installed in the flow pipework between the boilers and the primary circuit low loss header. When using Hamworthy Frame and Header Kits this pocket is provided.

Each Master Control can be configured to accept a 0-10Volt analog signal for either load control or temperature control.

The BMS should be configured to provide cascade control of all Master Controls fitted to the same heating system and facilitate load sharing via lead boiler rotation.

All ancillary plant (primary pump and secondary circuit pumps/valves) must be controlled via the BMS. The BMS must ensure operation of the primary pump using flow switches before initiating boiler operation. All plant interlocks (pumps, pressurisation units, fire alarms etc) must be configured to prevent boiler operation via the 0-10Volt analog signal.

8.2.6.1 Load Control

The Master control translates the analog input and sets the boiler output (%load) accordingly. Set parameter 14=2(for HT circuit) or 22=2(for LT circuit) - **see section 8.10.5.1**

A 2V input will switch the boiler(s) on at minimum load, 9V input will switch the boiler(s) to maximum load (parameter 15). The load between 2 & 9V is linearly calculated. A switching hysteresis of 0.2V calculates the switch off, hence when the input drops below 1.8V, the boiler(s) will switch off

To prevent boiler overheating, the control can be set to switch off at a pre-determined temperature, regardless of the input voltage (parameter 20 (HT) or 27 (LT)).

When using a 0-10v for a Primary circuit, in addition to setting parameter 22=2, set parameter 34=0 to designate pump 3 as the primary pump. This will operate the pump, whenever a demand is applied to the boiler.

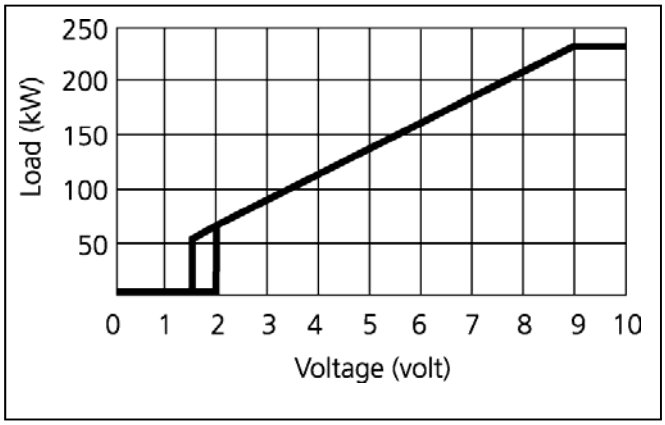


Figure 8.2.6.1 - Load Control

8.2.6.2 Temperature Control

The Master control translates the analog input and sets the boiler temperature accordingly. Set parameter 14=3(for HT circuit) or 22=3(for LT circuit) - **see section 8.10.6.1**

A 2V input will set the boiler(s) on at minimum temperature (parameter 18(HT) or 24 (LT)). A 9V input will set the boiler(s) to maximum temperature (parameter 1(HT) or 3 (LT)). The temperature between 2 & 9V is linearly calculated.

A switching hysteresis of 0.2V calculates the switch off, hence when the input drops below 1.8V, the boiler (s) will switch off.

When using a 0-10v for a Primary circuit, in addition to setting parameter 22=3, set parameter 34=0 to designate pump 3 as the primary pump. This will operate the pump, whenever a demand is applied to the boiler.

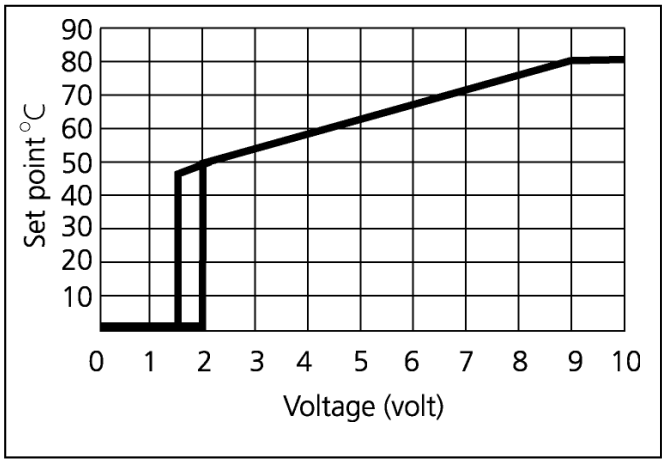


Figure 8.2.6.2—Temperature Control

8.2.7. Connection to temperature control devices

Milborne boilers are fitted with a versatile control and management system, which can manage up to three independent circuits operating at different temperatures.

Figure 4.6 shows the main devices (temperature sensors, circulators, valves, etc.) which form the three circuits which can be, directly controlled by the boiler controls.

Note: Temperature sensors for the secondary circuits are optional extras and must therefore be specified when requesting quotations and placing orders.

Programmable room thermostats for low and high temperature heating circuits are 24hr day programmable.

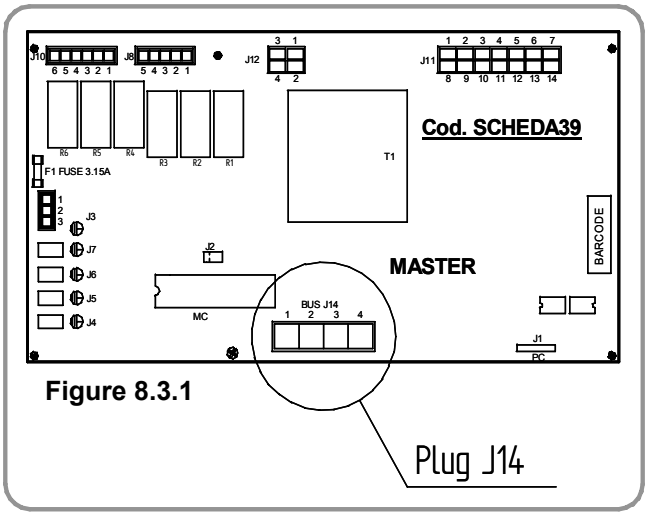


Figure 8.3.1

8.2.8 Outside Air Sensor Connection

If outside temperature compensation is to be used, the outside air sensor needs to be connected to terminals no. 7 and 8 (figure 4.6).

The outside air sensor shall be installed on an outside wall, North or North/East aspect, at a minimum height of 2.5 metres, away from windows, door, and ventilation grilles and flue discharges.

Never install the probe in a position exposed to the sun or other forms of radiated heat.

Note: the outside sensor is also required to facilitate 2 stage frost protection and Summer Shutdown control.

8.3 Emergency Mode

The Milborne boilers incorporate a function which can be activated in the case of a mal-function of the Master control - **Emergency Mode.**

Once enabled, this ensures that the system will operate at a default delivery temperature set by the Manufacturer.

8.3.1 Disconnect the 4 pole connector J14 from the Master pcb - see figure 8.3.1

8.3.2. Set all four J17 switches located on each Slave to the OFF position - see figure 8.3.2

8.3.3. Supply all system pumps with mains via the appropriate contactor hand auto switch

8.3.4. Terminal X1 or Terminal X2 which are part of the cabling of the J14 connector) must be connected to a 24V DC power supply (see figure 8.3.3)

WARNING! If several Milborne boilers are installed in series, one or both of the terminals (X1 or X2) may be connected to the adjacent boilers. If this is the case, supply the free terminal with 24V, for example terminal Xn - see figure 8.3.3.

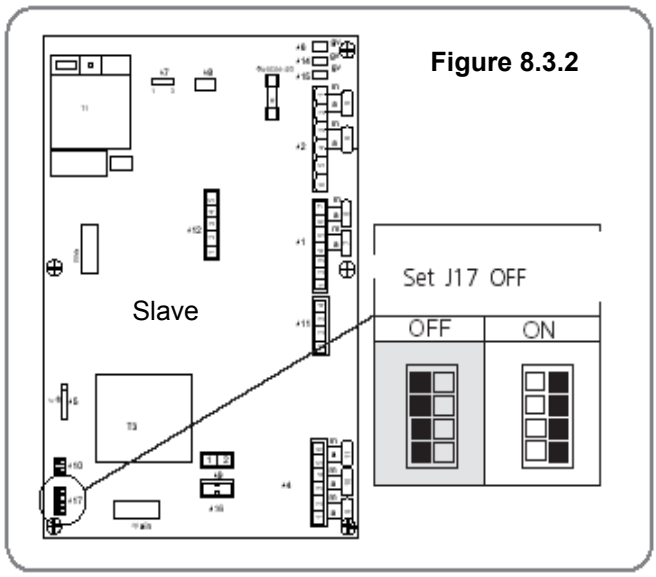


Figure 8.3.2

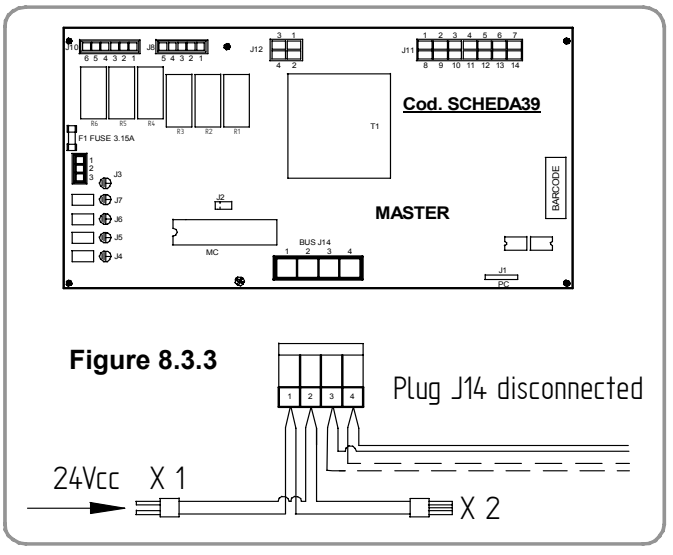


Figure 8.3.3

8.4 Set-up for multiple boiler installations

One of the many functions included in Milborne electronics allows for the installation of several modules in series, to create boiler assemblies having an overall power exceeding 75 kW.
This type of system requires one single Milborne equipped with a Master control unit, while all other boilers will be equipped with a Slave control unit.
The cabling and setting of components, is as follows:

8.4.1 Connect the cabling of the modules making up the series as shown in figure 8.4.1

8.4.2 Every slave control unit making up the system should be identifiable by the single Master control unit by means of an address which is assigned through specific settings on the two series of switches, J10 and J17, located on each Slave in the set.

Each slave (one for each burner) needs to be properly configured so that the Master controller can identify its position in the sequence.

First the Slave boards need to be divided into 15 blocks. The Master control system can manage a maximum of 15 blocks each made up of 4 Slaves.

Eg, If 5 Slave controllers are connected to one Master controller then 2 blocks are required. The first containing 4 Slave controllers and the second just 1.

To configure the addresses follow the next procedure.

1. Identify the block that each Slave is to be assigned, eg block 1… 2… 3… etc.
2. Identify the position that each Slave is to be assigned in its chosen block, e.g. position 1… 2… 3 etc.

Note: Master controllers are all pre-set as follows;
381/501 - 382/502 Master controllers are always despatched as position 1 and position 2 of block number 1.
382/502 Slave controllers always despatched as position 3 and position 4 of block number 1.

Therefore as part of the pre-commissioning checks the settings of all Slave controller block and position switches must be checked.

To assist the correct setting of the block and position switches, see figure 8.4.2.
Figure 8.4.1 indicates an installation with 1 block and with 1 boiler module. Both addresses are set to 1.

8.4.3 example of installation consisting of 7 boiler modules.

When installing 7 boiler modules, ie 7 slaves, two blocks are needed. The first consisting of four boiler modules and the second consisting of three boiler modules. The two blocks must be addressed separately 1 & 2, with block 1 having boiler module addresses 1, 2, 3 & 4 and block 3 having boiler module addresses 1, 2 & 3 - refer to figure 8.4.3

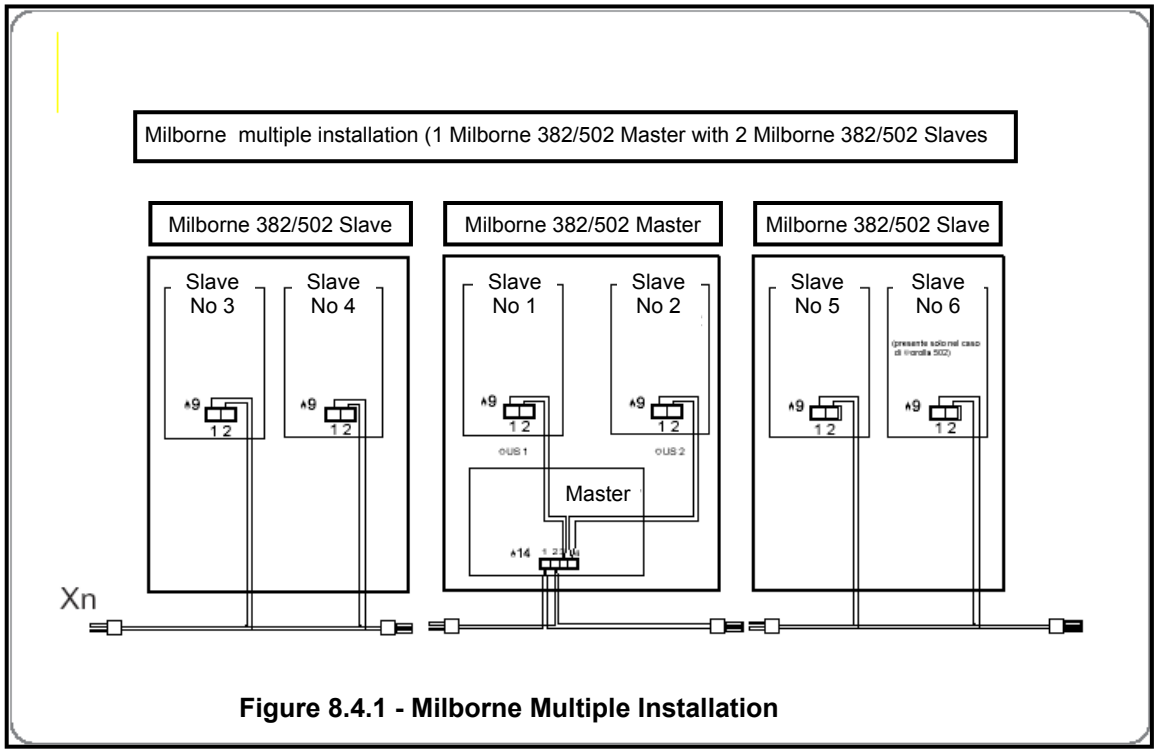
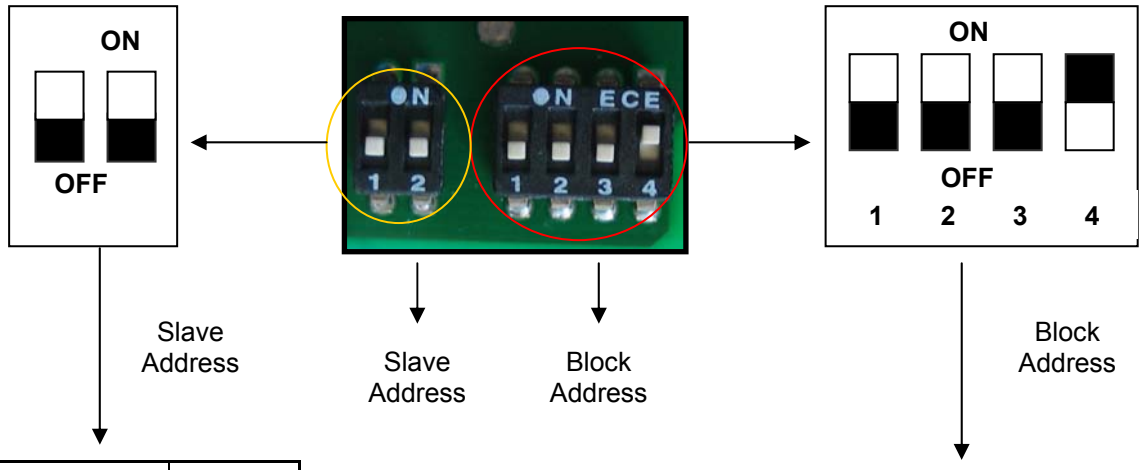


Figure 8.4.1 - Milborne Multiple Installation



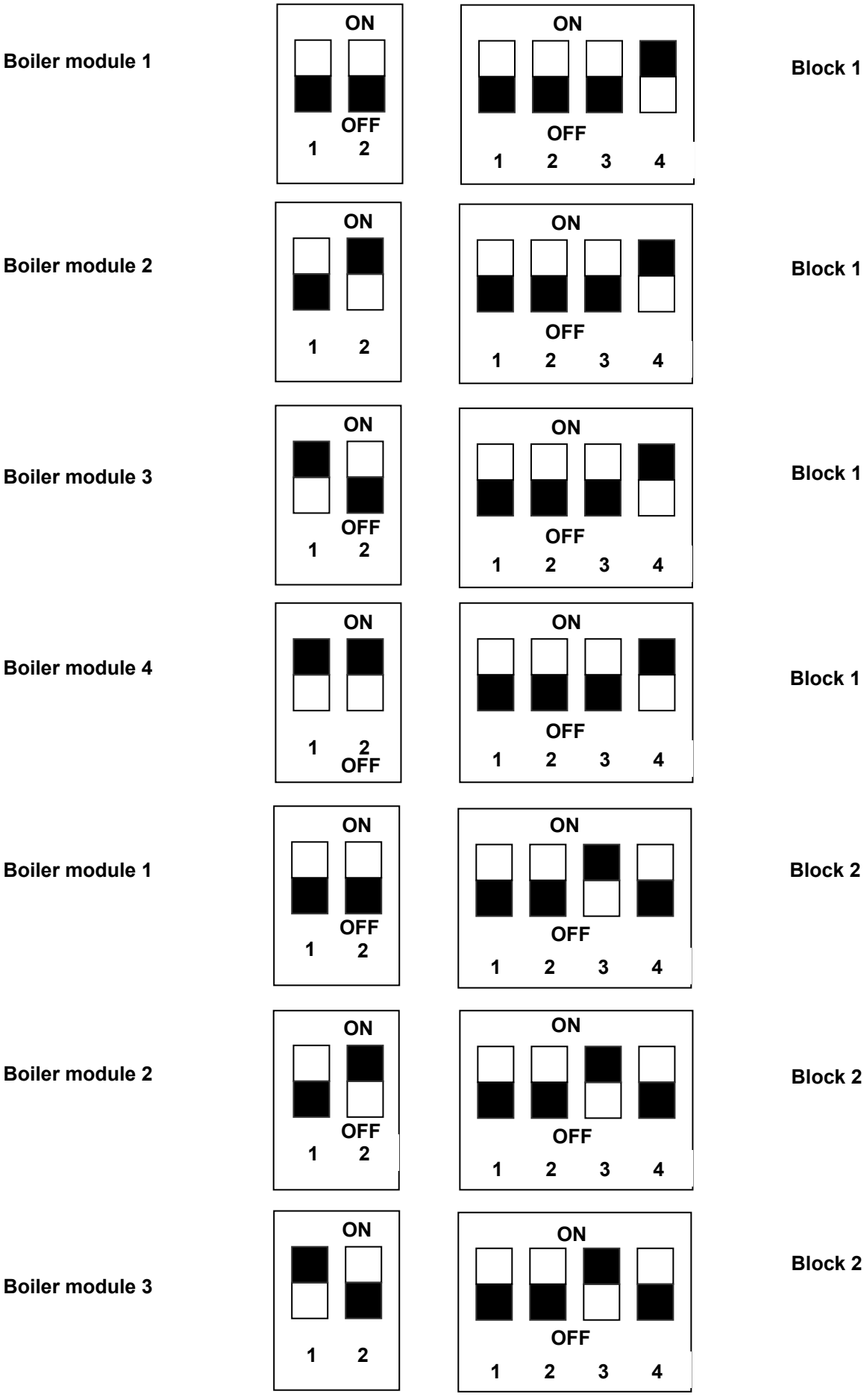
Jumpers		Boiler Module
1	2	
OFF	OFF	1
OFF	ON	2
ON	OFF	3
ON	ON	4

Jumpers				Block Settings
1	2	3	4	
OFF	OFF	OFF	OFF	Emergency Code
OFF	OFF	OFF	ON	Block 1
OFF	OFF	ON	OFF	Block 2
OFF	OFF	ON	ON	Block 3
OFF	ON	OFF	OFF	Block 4
OFF	ON	OFF	ON	Block 5
OFF	ON	ON	OFF	Block 6
OFF	ON	ON	ON	Block 7
ON	OFF	OFF	OFF	Block 8
ON	OFF	OFF	ON	Block 9
ON	OFF	ON	OFF	Block 10
OFF	OFF	ON	ON	Block 11
ON	ON	OFF	OFF	Block 12
ON	ON	OFF	ON	Block 13
ON	ON	ON	OFF	Block 14
ON	ON	ON	ON	Block 15

4 Boiler modules to each block

Figure 8.4.2

Figure 8.4.3 Example installation consisting of 7 boiler modules in same cascade sequence.



8.5 Programmable Room Thermostat

The high temperature and low temperature heating circuits may have an enhanced level of control by using the 7 day programmable room thermostat. Offering independent switching times for each week day the thermostat offers the flexibility required in buildings with sporadic heating requirements as well as the more traditional occupancy trends.
Note: One thermostat is required for each heating circuit.

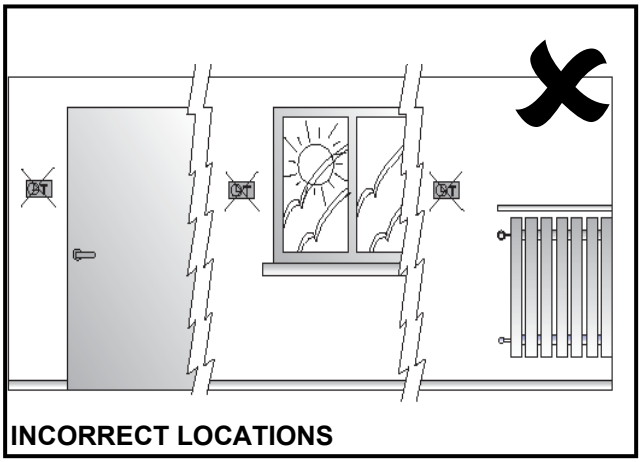
Technical data

Power supply = 2 x 1.5V battery
Normal temperature range T1 = 5 - 30°C
Night set-back range T2 =6°/14°/16°/18°C
Temperature updating = Once/minute
Room temperature switching hysteresis = 0.2° - 0.8°C
Contacts rating = Max 250V / 5A
Internal frost protection = 6°C
Minimum setting period = 1 Hour

8.5.1 Locating the thermostat

The thermostat should be positioned in the area of the building most critical for comfort. Within this area the thermostat must be positioned away from heat sources such as radiators, sun rays and kitchens. Additionally the thermostat must be located away from sources of draught such as doors, windows and ventilation grilles. All of these can lead to false readings at the thermostat.

Figure 8.5.1 - Thermostat Location



8.5.2 Mounting the thermostat

The thermostat is suitable for wall with rear cable entry. Alternatively the thermostat may also be mounted to a standard electrical back box or round conduit box.

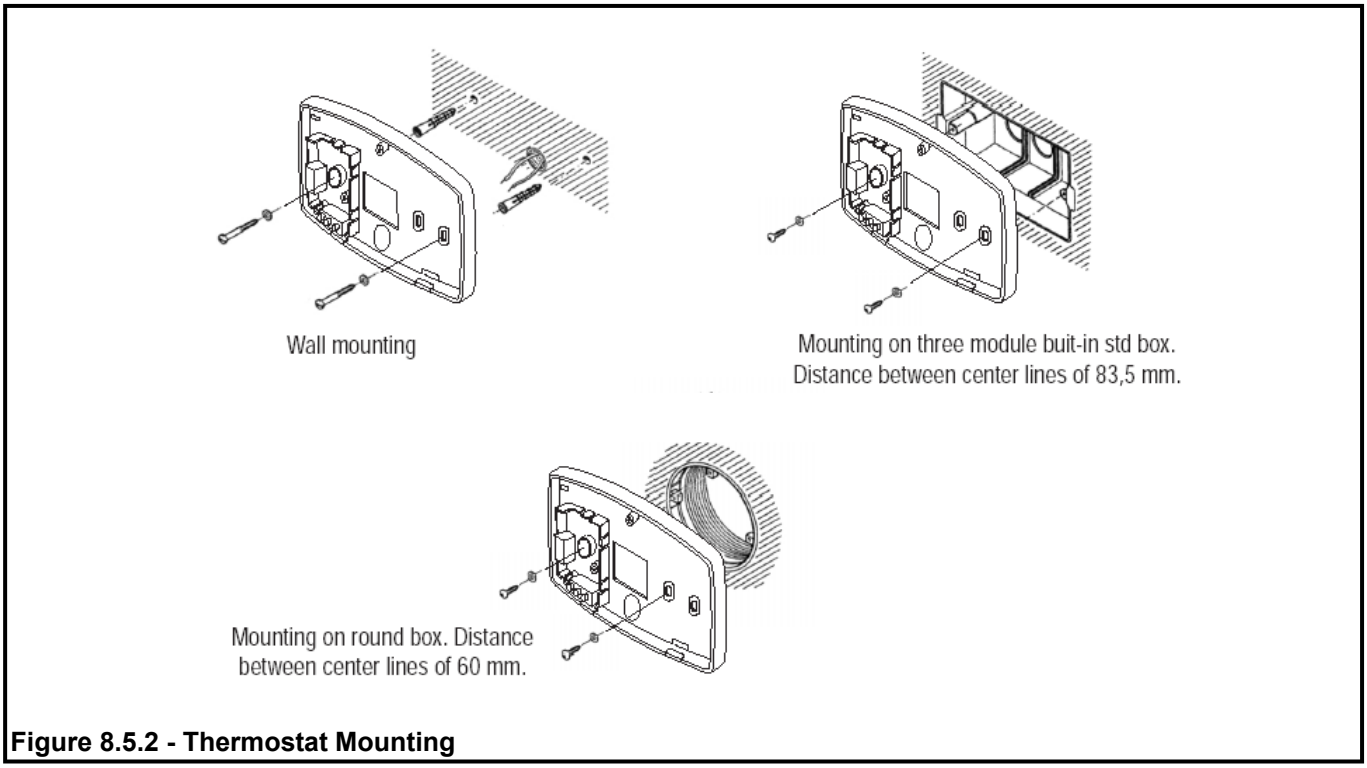


Figure 8.5.2 - Thermostat Mounting

Wiring connections

Connect the wires from the boiler Master controller to terminal 1 & 2 of the programmable room thermostat.

For high temperature heating circuit, terminal 9 at the Master control provides the live and should be wired to terminal 1 at the thermostat. Terminal 10 at the Master control receives the switch live return and should be wired to terminal 2 at the thermostat.

For low temperature heating circuit, terminal 11 at the Master control provides the live and should be wired to terminal 1 at the thermostat. Terminal 12 at the Master control receives the switch live return and should be wired to terminal 2 at the thermostat.

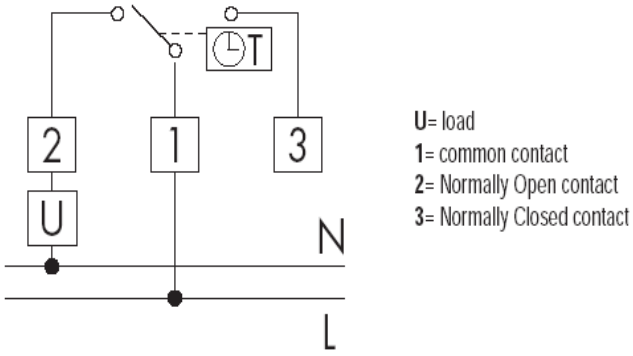


Figure 8.5.3 - Thermostat wiring

For programming details please refer to the instructions provided with the room thermostat. Alternatively contact Hamworthy Heating Ltd for a copy of instruction manual.

8.6 Master control panel error codes

The following tables display the Master control errors messages. These messages relate to faults that can occur within the Master control panel, or from the sensors and circuits connected to the Master control panel.

Errors can be divided into two groups: lock-out errors which can be automatically reset (E errors) and permanent errors (A errors) which must be reset just by pressing the reset button.

8.6.1 "Error" mode

The display starts flashing when a fault occurs.

Follow the procedures detailed in figure 8.6.1, to establish the fault code and its relevance.

8.6.2 Controls in permanent lock-out

In case of permanent lockout of the burners, it is necessary to press RESET (S1)

If you press RESET (S1) while you are in 'functioning display mode' all boiler modules will be reset.

If you press RESET (S1) while you are displaying the error which caused the permanent lock-out, only the boiler module involved will be reset.

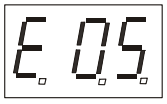
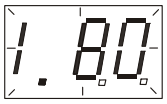
	Procedures	Button Required	Display
1.	The display starts flashing to signal one or more faults.		
2.	Press S4 (+): the display will alternate between the address of the first unit (boiler module) and the first error code. Press S4 again (+) to display all the errors for this unit (boiler module). The error of the successive unit (boiler module) will be visualized one after the other, press S4 (+). Press S5 (-) to display the errors in the opposite way, from the last to the first unit (boiler module) (e.g. unit [boiler module] 2 error code E 05. Fault can be either E codes or A codes. If errors derive from the Master, they will be displayed (before the other errors) as U 00 + error code. The Master controller always has addresses U 00.	   	  **See error list for codes and related faults**  
3.	Press S2 (SET/ ESC) to exit ‘errors’ and go back to display mode.		

Figure 8.6.1

Figure 8.6.3 Master control permanent lock-out errors (A) - manual reset

Display Nr	PC Nr	Fault	Action
A16	10	Internal E2PROM error	Reset, check and replace Master board
A18	12	Internal communication error	Reset, check and replace Master board

Figure 8.6.4 Master control blocking errors (E) - auto reset

Display Nr	PC Nr	Fault	Action
E02	51	Flow temperature sensor T1 - open circuit	Check and replace mixed flow sensor T1
E04	53	DHW temperature sensor T3 - open circuit	Check and replace DHW sensor T3
E18	67	Flow temperature sensor T1 - short circuit	Check and replace mixed flow sensor T1
E20	69	DHW temperature sensor T3 - short circuit	Check and replace DHW sensor T3
E23	28	Internal temperature calibration error	Check and replace Master board
E24	29	Internal temperature calibration error	Check and replace Master board
E25	0	Internal E2PROM error	Check and replace Master board
E25	30	Internal temperature calibration error	Check and replace Master board
E26	31	Internal temperature calibration error	Check and replace Master board
E32	33	No slaves connected	Check the position of the Bi-Polar switches. Check the slave addresses Check slave electrical connections Check and replace Master board Check and replace Slave board
E34	42	Supply frequency error	Main frequency is not 50Hz

Figure 8.6.5 Boiler module permanent lock-out errors (A) - manual reset

A01	1	5 failed attempts of starting up	Check the gas cock Check for spark and condition of ht. lead Check and replace Slave board
A02	2	Too many failed ignition attempts	Check and clean or replace the spark electrode. Check and clean or replace the ht lead.
A04	4	Intervention of limit stat > 90°C	Check and correct boiler flow rate Check and replace limit thermostat
A05	5	Failed gas valve Faulty connection on gas valve lead	Check and replace the gas valve Check and replace the gas valve cable
A06	6	Internal error	Check and replace Slave board
A07	7	Internal error	Check and replace Slave board
A08	8	Internal error	Check and replace Slave board
A09	9	Supply frequency error	Main frequency is not 50Hz
A10	10	Internal error	Check and replace Slave board
A11	11	Internal error	Reset, check and replace Slave board
A12	12	Internal error	Check and replace Slave board
A16	16	Intervention of limit stat > 90°C	Check and correct primary flow rate Check and replace limit thermostat
A19	19	Flue sensor error (fan will run at max. speed)	Check and clean heat exchanger Check and replace flue sensor
A20	20	Flame detected after closing the gas valve	Check and replace the gas valve
A22	22	Internal error	Check and replace Slave board
A24	24	Fan error - speed not achieved	Check the fan and electrical connections. Replace the fan

Figure 8.6.6 Boiler module blocking errors (E) - auto reset

Display Nr	PC Nr	Fault	Action
E33	33	Polarity reversed (L~N)	Check and correct
E34	34	Reset key error - pressed more than 7 times in 30 mins	If after 40 mins, the error has not cleared, check and replace the Slave board
E35	35	Differential water pressure switch error	Check the boiler flow rate and replace the switch if necessary
E36	36	Internal error	Check and replace Slave board
E37	37	Flame detection error	Check and replace or clean the electrodes
E38	38	Flue sensor - short circuit	Check and replace flue sensor
E39	39	Flue sensor - open circuit	Check and replace flue sensor
E40	40	Supply frequency error	Main frequency is not 50Hz, check supply
E41	41	Internal error	Check and replace Slave board
E42	42	Flow temperature sensor - short circuit	Check and replace flow sensor
E43	43	Flow temperature sensor - open circuit	Check and replace flow sensor
E44	44	Return temperature sensor - short circuit	Check and replace return sensor
E45	45	Return temperature sensor - open circuit	Check and replace return sensor
E46	46	Flow sensor error—limit temp. exceeded	Check the flow rate through the boiler
E47	47	Return sensor error - limit temp. exceeded	Check the flow rate through the boiler
E48	48	Flue sensor error - limit temp. exceeded. With this error the fan runs at maximum speed	Check the flow rate through the boiler, clean the heat exchanger, water and gas side
E49	49	Poor or no earth bond	Check installation and replace Slave board

8.6.7 Controls Information

Controls information can be accessed by pressing the buttons in a prescribed sequence see figure 8.1.1

S1 : Press it in order to unlock the unit when a fault has occurred.

S2: To enter into the parameters and monitor mode of each single unit.

S3: Displays the running state of the different master circuits

S4 & S5: To increase decrease a certain value.

S6: To store new values.

8.6.8 Mode Display.

The D5 red LED turns on in case a fault occurs causing the permanent lock-out of one boiler module (Reset either the Master or the relevant boiler module to restore normal operation).

The D4 green LED displays the presence of communication between the Master and individual boiler modules.

The 3 display LED's U2, U3 and U4 display the following information:

8.7 Users Parameter Adjustments

The three following User Parameters can be changed from the function 'mode display':

◊ High temperature heating circuit set-point
◊ Water circuit temperature set-point
◊ Low temperature heating circuit set-point

Press S3 to display the listed values:

◊ High temp. heating circuit flow _T (pos. 1)
◊ Domestic Hot Water_T (pos. 2)
◊ Low temp. heating circuit flow_T (pos 4)

The following procedure will modify one of the above values:
Press S2 to select the desired value,
the two right LED digits will flash.
Note: if the value does not need changing, press S2 to return to the mode display.

If the value needs to be modified,
press S4 and S5 until the desired value is displayed.

Press S6 to store the value. The chosen value will stop flashing and the display will be restored to the mode display.

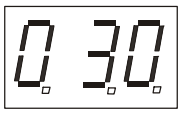
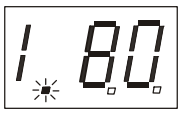
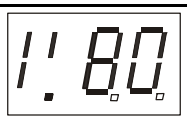
SYSTEM STATUS	DISPLAY
No demand of heat and water (the right digits display the flow temperature T1 e.g. T1=30°C)	
Request from circuit no. 1 or from the 1st and 2nd circuit at the same time. (the right digits display the flow Temperature T1 e.g. T1=80°C)	
Request from water circuit or simultaneous circuit requests. (the right digits display the Flow Temperature T1=80°C) The dot after the no. 1 left digit is flashing.	
Request from no.2 circuit. (the right digits display the Flow Temperature T1 e.g. T1=80°C)	
The external probe is not connected, the compensated function has been selected (parameters 14 & 22). In this configuration the pump will run continuously. Set parameters 14 & 22 to (0) - constant temperature.	

Figure 8.6.8

8.8 Changing Operating Temperature Set-Points.

Refer to figure 8.7.1. If no variations occur within 10secs after pressing S2 at step 3, (because the desired value corresponds with the set value) the display will be restored to the mode display.

If after pressing + and - , at step 4, no operation is carried out, after 1 minute the display shall be restored to the mode display. The new selected value shall not be restored.

8.9 Monitor Mode

Press S2, to enter into the Monitor mode and display the running status of each single boiler module (from address 1 to 60) - see figure 8.8.1.

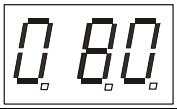
Step	Procedures	Button Required	Display
1.	Mode display, there is no demand from any circuit with the flow temperature at 80°C		
2.	Press S3 to enter into the setting display, press it again and set 6 on the first digit to display the current Low Temp. circuit set-point - 50°C.		
3.	Press S2 (set/esc) to select the chosen value. The two right LED digits will flash.		
4.	Press S5 (-) to change the setpoint to the desired value - 40°C. The two right LED digits will continue to flash.		
5.	Press S6 (Prog/OK) to store the new value. The two right LED digits will stop flashing. After 3 secs., the display will return to the mode display with the new set value.		

Figure 8.7.1 - procedure for adjusting Low Temperature Heating circuit

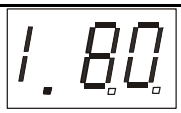
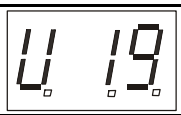
Step	Procedures	Button Required	Display
1.	Mode display is reading high temperature heating circuit flow at 80°C		
2.	Press S2 (SET/ESC), for 5 sec. The display shows that it is possible to read the values, or the functioning mode of boiler module 1.		
3.	Press S4 (+) or S5 (-) to scroll the desired boiler module (e.g. for boiler module 19)		
4.	Press S3 to display the 1st value for the selected boiler module. Press the same button, S3, to display the following values (e.g. 1st value, flow temperature reading)		
5.	Press S2 to exit from the monitor mode (SET/ESC). If no operations are carried out for 5 minutes, the display shall be restored to the mode display.		

Figure 8.8.1 - procedure for accessing the Monitor Mode

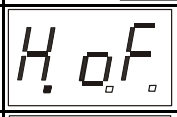
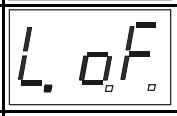
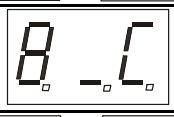
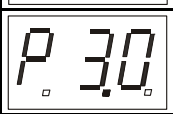
Pos.	Value	Display
1.	High temp. circuit flow temperature **T1 - 70°C**	
2.	Domestic hot water storage temperature **T3 - 50°C**	
3.	External temperature **T4 - 60°C**	
4.	2nd circuit or low temp circuit flow temperature **T6 - 50°C**	
5.	1st circuit or high temp circuit room thermostat Ta1 closed (**of**) or open (**on**)	 or 
6.	2nd circuit or low temp circuit room thermostat Ta2 closed (**of**) or open (**on**)	 or 
7.	Analogue input 0~10v - **5.5v or 10v**	 or 
8.	Mixing valve status - **closed**	
9.	1st circuit or high temp. circuit pump function status (**of**) or (**on**)	 or 
10.	Domestic hot water circuit pump function status (**of**) or (**on**)	 or 
11.	Main pump function status (**of**) or (**on**)	 

Figure 8.8.2 - display value sequence

8.9.1 Programming Mode

(restricted to Authorized Personnel and the Manufacturer only)

A Password is needed to modify these parameters. Only authorised personnel can enter the password and then modify the user and service parameters.

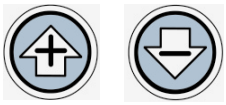
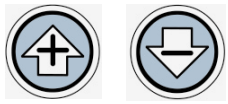
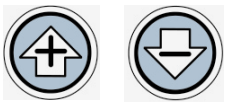
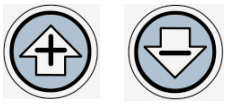
Step	Procedures	Button Required	Display
1.	Mode display is reading high temperature circuit at flow temperature at 80°C		
2.	Press S2 (SET/ESC) followed by S6 (Prog/OK). After 5 seconds the second and third digit will start flashing.		
3.	Use S4 (+) and S5 (-) to enter the second figure of the password on the right hand digit (e.g. password = x2)		
4.	Press S6 (Prog/OK) and store the second figure of the password.		
5.	Use S4 (+) and S5 (-) to enter the first figure of the password on the central digit. (e.g. password = 22)		
6.	Press S6 (Prog/OK) to store the password. If the password is wrong, the display will return to mode position		
7	Use S4 (+) and S5 (-) to scroll all password protected parameter addresses. Press S2 (Set/ Esc) to select the parameters for modification. Parameter address and its respective value will alternate on the display		**See parameter list for address and range se tings**
8.	Use S4 (+) and S5 (-) to change the value of the selected parameter. Every time one of these keys is pressed the alternating of the parameter address and the value is stopped for 5 seconds and only the value is shown.		
9.	Press S6 (Prog/OK) to accept and store the new value. The display will return to the display at step 6. To check and alter further parameters return to step 7 and follow through.		

Figure 8.9.1 - programming parameters

8.9.2 Combustion test parameters

Using the function ‘ Combustion Test’, it is possible to generate a request from the 1st circuit or high temperature heating circuit, to enable the combustion to be checked at maximum and minimum fan speeds and any adjustments made to the calibration of the gas valve.

The main pump and high temperature heating circuit are activated. All combustion fans will be activated. If a module or slave is electrically isolated by the ‘On/Off switch (see figure 7.4.3) all other fans will run.

To access the ‘combustion test’ display screen

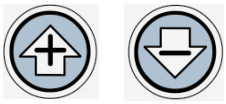
Step	Procedures	Button Required	Display
1.	Press S2 (SET/ESC) and S4 (+) for 5 seconds. All system fans will operate at the selected speed.		
2.	The maximum and minimum speeds can be selected by pressing S4 (+) for maximum (H) and S5 (-) for minimum (L).		
3.	The other two digits show the flow temperature at maximum or minimum firing rate. Press S6 (OK) to exit ‘test mode’ and return to the display.		

Figure 8.9.2 - combustion test parameters

8.10 Programming Procedure

8.10.1 Master control primary functions - must be set in all instances

Parameter	Description	Setting procedure
Heating engineer adjustable parameters – code protected		
P.33	Sequence control mode	Set to 0 – Cascade control mode. Minimum number of modules firing Set to 1 – Unison control mode. Maximum number of modules firing
P.34	Pump 3 priority	Ensure setting = '0' for primary pump control
P.35	Frost protection	Set to the external air temperature at which frost protection is started, -30°C to +15°C
P.36	Gas type	Set to 1 – Nat Gas with < 15m flue length Set to 2 – Nat Gas with > 15m flue length Set to 3 – L.P.G. with < 15m flue length Set to 4 – L.P.G. with > 15m flue length Set to 5 – Towns Gas (Channel Islands)
P.39	External air sensor calibration	Use to correct external air sensor reading, -30°C to +30°C. **Eg** If air temp = 25°C and sensor reading = 20°C set to +5°C
P.41	Parameter reset	Set to 1 to reset all parameter values to factory settings. Resets all parameters except P.36 for safety reasons. Set to 0 to make new parameter changes

8.10.2 Setting DHW functions

End user adjustable parameters		
P.2	Domestic hot water circuit set -point	Set to required operating temperature. Limited by setting at parameter 8.
Heating engineer adjustable parameters – code protected		
P.6	Domestic hot water circuit type	Set to 0 for DHW disabled Set to 1 for plate h/ex with NTC sensor Set to 2 for calorifier with NTC sensor Set to 5 for Plate h/ex with thermostat Set to 6 for calorifier with thermostat
P.8	Domestic hot water circuit upper limit	Limits the end users set-point adjustment available at parameter 2. Max 70°C
P.9	Domestic hot water circuit priority	Set to 0 or 1 for shared priority with heating circuits Set to 2 to prioritise domestic hot water
P.10	Domestic hot water primary set-point	Set the temperature difference between the required primary temperature and the domestic hot water set-point at parameter 2. Eg If P.2 = 60°C add 20°C, = 80°C
P.11	Domestic hot water circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 2. Eg. For 60°C set-point. Setting to 1 will stop the DHW pump at 61°C
P.12	Domestic hot water circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 2. Eg. For 60°C set-point. Setting to 2 will start the DHW pump at 58°C

Circuit priority Parameter P.9 - Prioritising the domestic hot water circuit allows the boiler management system to provide that circuit with maximum available power at all times there is a hot water demand.
The priority method may reduce the power available to other circuits if there is a high demand in the prioritised circuit and the boiler sizing is lean.
If all circuits are required to operate without interruption the priority should be set to shared, ie setting '0' or '1'.

8.10.3 Setting high temperature heating circuit functions for constant temperature

Parameter	Description	Setting procedure
End user adjustable parameters		
P.1	High temperature circuit set-point	Set to required operating temperature. Limited by setting at parameters 17 & 18.
Heating engineer adjustable parameters – code protected		
P.14	High temperature circuit type	Set to 0 for constant flow temperature
P.16	Heating circuit priority	Set to 0 for shared priority Set to 1 for high circuit priority Set to 2 for low circuit priority
P.17	High temperature circuit upper limit	Limits the end users set-point adjustment available at parameter 1. Max 80°C
P.18	High temperature circuit lower limit	Limits the end users set-point adjustment available at parameter 1. Min 10°C
P.19	High temperature circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 1. Eg. For 80°C set-point. Setting to 7 will start the burner at 73°C
P.20	High temperature circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 1. Eg. For 80°C set-point. Setting to 1 will stop the burner at 81°C

Circuit priority Parameter P.16 - Prioritising one heating circuit over the other, allows the boiler management system to provide that circuit with maximum available power at all times there is a heating demand.
The priority method may reduce the power available to other circuits if there is a high demand in the prioritised circuit and the boiler sizing is lean.
If all circuits are required to operate without interruption the priority should be set to shared, ie setting '0'.

8.10.4 Setting low temperature heating circuit functions for constant temperature

End user adjustable parameters		
P.3	Low temperature circuit set-point	Set to required operating temperature. Limited by setting at parameters 23 & 24
Heating engineer adjustable parameters – code protected		
P.22	Low temperature circuit type	Set to 0 for constant flow temperature
P.23	Low temperature circuit upper limit	Limits the end users set-point adjustment available at parameter 3. Max 70°C
P.24	Low temperature circuit lower limit	Limits the end users set-point adjustment available at parameter 3. Min 10°C
P.26	Low temperature circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 3. Eg. For 50°C set-point. Setting to 7 will re-start the burner at 43°C
P.27	High temperature circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 3. Eg. For 50°C set-point. Setting to 1 will stop the burner at 51°C
P.28	Mixing valve opening period	Set time taken for mixing valve to open from fully closed position. Eg 5 secs. Max 255 secs
P.29	Mixing valve closing period	Set time taken for mixing valve to close from fully open position. Eg 7 sec. Max 255 secs
P.30	Mixing valve static period	Set time mixing valve is to remain static after moving. Eg 5 secs. Max 255 secs

8.10.5 Setting high temperature heating circuit functions for compensated (variable) temperature

Parameter	Description	Setting procedure
End user adjustable parameters		
P.1	High temperature circuit set-point	Set to required operating temperature. Limited by setting at parameters 17 & 18.
Heating engineer adjustable parameters – code protected		
P.14	High temperature circuit type	Set to 1 for compensated flow temperature
P.16	Heating circuit priority	Set to 0 for shared priority Set to 1 for high circuit priority Set to 2 for low circuit priority
P.17	High temperature circuit upper limit	Limits the end users set-point adjustment available at parameter 1. Max 80°C Sets max flow temperature at the minimum external air temperature set at parameter 37
P.18	High temperature circuit lower limit	Limits the end users set-point adjustment available at parameter 1. Min 10°C Sets min flow temperature at the maximum external air temperature set at parameter 38
P.19	High temperature circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 1. Eg. @ 80°C set-point. Setting to 7 will re-start the burner at 73°C
P.20	High temperature circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 1. Eg. For 80°C set-point. Setting to 1 will stop the burner at 81°C
P.37	Compensation curve min external air temp setting	Set for external air temperature at which the maximum flow temperature set in parameter 17 is required. Eg -1°C Also sets external air temperature limits for low temperature heating circuit
P.38	Compensation curve max external air temp setting	Set for external air temperature at which the minimum flow temperature set in parameter 18 is required. Eg +18°C Also sets external air temperature limits for low temperature heating circuit

Circuit priority Parameter P.16 - Prioritising one heating circuit over the other, allows the boiler management system to provide that circuit with maximum available power at all times there is a heating demand.
The priority method may reduce the power available to other circuits if there is a high demand in the prioritised circuit and the boiler sizing is lean.
If all circuits are required to operate without interruption the priority should be set to shared, ie setting '0'.

8.10.5.1 Setting heating circuit functions for 0-10v analog input (LOAD)

P.14	High temperature circuit type	Set to 2 for BMS 0-10v load based High temperature circuit
P.15	Heating circuit maximum load	Sets the heating circuit maximum load (1-255) **Eg.** 230 equates to 90% load
P.19	High temperature circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 1. **Eg.** For 80°C set-point. Setting to 7 will re-start the burner at 73°C
P.20	High temperature circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 1. **Eg.** For 80°C set-point. Setting to 1 will stop the burner at 81°C
P.22	Low temperature circuit type	Set to 2 for BMS 0-10v load based Low temperature circuit
P.26	Low temperature circuit hysteresis on	As 19 above. **Eg.** For 40°C set-point. Setting to 7 will re-start the burner at 33°C
P.27	Low temperature circuit hysteresis off	As 20 above. **Eg.** For 40°C set-point. Setting to 1 will stop the burner at 41°C

8.10.6 Setting low temperature heating circuit functions for compensated (variable) temperature

Parameter	Description	Setting procedure
End user adjustable parameters		
P.3	Low temperature circuit set-point	Set to required operating temperature. Limited by settings at parameters 23 & 24.
Heating engineer adjustable parameters – code protected		
P.22	Low temperature circuit type	Set to 1 for compensated flow temperature
P.23	Low temperature circuit upper limit	Limits the end users set-point adjustment available at parameter 3. Max 70°C Sets max flow temperature at the minimum external air temperature set at parameter 37
P.24	Low temperature circuit lower limit	Limits the end users set-point adjustment available at parameter 3. Min 10°C Sets min flow temperature at the maximum external air temperature set at parameter 38
P.26	Low temperature circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 3. Eg. For 50°C set-point. Setting to 7 will re-start the burner at 43°C
P.27	High temperature circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 3. Eg. For 50°C set-point. Setting to 1 will stop the burner at 51°C
P.28	Mixing valve opening period	Set time taken for mixing valve to open from fully closed position. Eg 5 secs. Max 255 secs
P.29	Mixing valve closing period	Set time taken for mixing valve to close from fully open position. Eg 7 secs. Max 255 secs
P.30	Mixing valve static period	Set time mixing valve is to remain static after moving. Eg 5 secs. Max 255 secs
P.37	Compensation curve min external air temp setting	Set for external air temperature at which the maximum flow temperature set in parameter 23 is required. Eg -1°C Also sets external air temperature limits for high temperature heating circuit
P.38	Compensation curve max external air temp setting	Set for external air temperature at which the minimum flow temperature set in parameter 24 is required. Eg +18°C Also sets external air temperature limits for high temperature heating circuit

8.10.6.1 Setting heating circuit functions for 0-10v analog input (TEMPERATURE)

P.14	High temperature circuit type	Set to 3 for BMS 0-10v temperature based
P.18	High temperature circuit lower limit	Limits the end users set-point adjustment available at parameter 1. Min 10°C - Max 50°C
P.19	High temperature circuit hysteresis on	Sets the temperature at which the burner will re-start after reaching set-point at parameter 1. **Eg.** For 80°C set-point. Setting to 7 will re-start the burner at 73°C
P.20	High temperature circuit hysteresis off	Sets the temperature at which the burner will stop after reaching set-point at parameter 1. **Eg.** For 80°C set-point. Setting to 1 will stop the burner at 81°C
P.22	Low temperature circuit type	Set to 3 for BMS 0-10v temp. based Low temperature circuit
P.24	Low temperature circuit lower limit	Limits the end users set-point adjustment available at parameter 3. Min 10°C - Max 25°C
P.26	Low temperature circuit hysteresis on	As 19 above. **Eg.** For 40°C set-point. Setting to 7 will re-start the burner at 33°C
P.27	Low temperature circuit hysteresis off	As 20 above. **Eg.** For 40°C set-point. Setting to 1 will stop the burner at 41°C

9.0 FAULT FINDING

The Milborne boiler is equipped with full self-diagnostic fault indication, with faults allocated a code, which is displayed (flashes) on the screen - refer to section 8.6
The common fault codes are detailed in section 8.6. Fault codes not detailed in this manual should only be investigated by an Engineer.

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

9.1 Safety Features

9.1.1 Temperature Limit Thermostat The electronic control thermostat has several safety levels built in such that controlled shutdown should occur before the limit thermostat is activated requiring manual reset. Should these safety levels be overridden (say external pump overrun failure after shutdown, or operation of the module on/off switch during operation), the temperature limit thermostat will trip initiating a boiler lockout, preventing the boiler from firing. An error code will be indicated on the display (A17) which will require the control to be reset (S1), once the boiler has cooled sufficiently. An investigation should be carried out to ascertain the reason for the overheating. An obvious reason would be low or no flow through the heat exchanger.

9.1.2 Flame Sensing The flame is under constant supervision by the burner control. This is accomplished by measuring the flame's ability to rectify an AC current. If the flame diminishes for whatever reason, the rectified current drops until such that it is below the control threshold (2μA) and the boiler will shut down and will perform up to 5 ignition attempts. If the boiler has failed to light it will go to lockout an error code will be indicated on the display (A01) which will require the control to be reset (S1). If the boiler continues to lockout, an investigation must be made to ascertain the cause—refer to section 9.3

9.2 Fault Finding Procedures

General error codes are detailed in section 8.5 to assist with general fault finding. If the boiler still cannot operate satisfactorily after following the instructions, consult Hamworthy Heating for assistance.

9.3 Possilbe Causes of Boiler Lockout

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

10.0 SERVICING

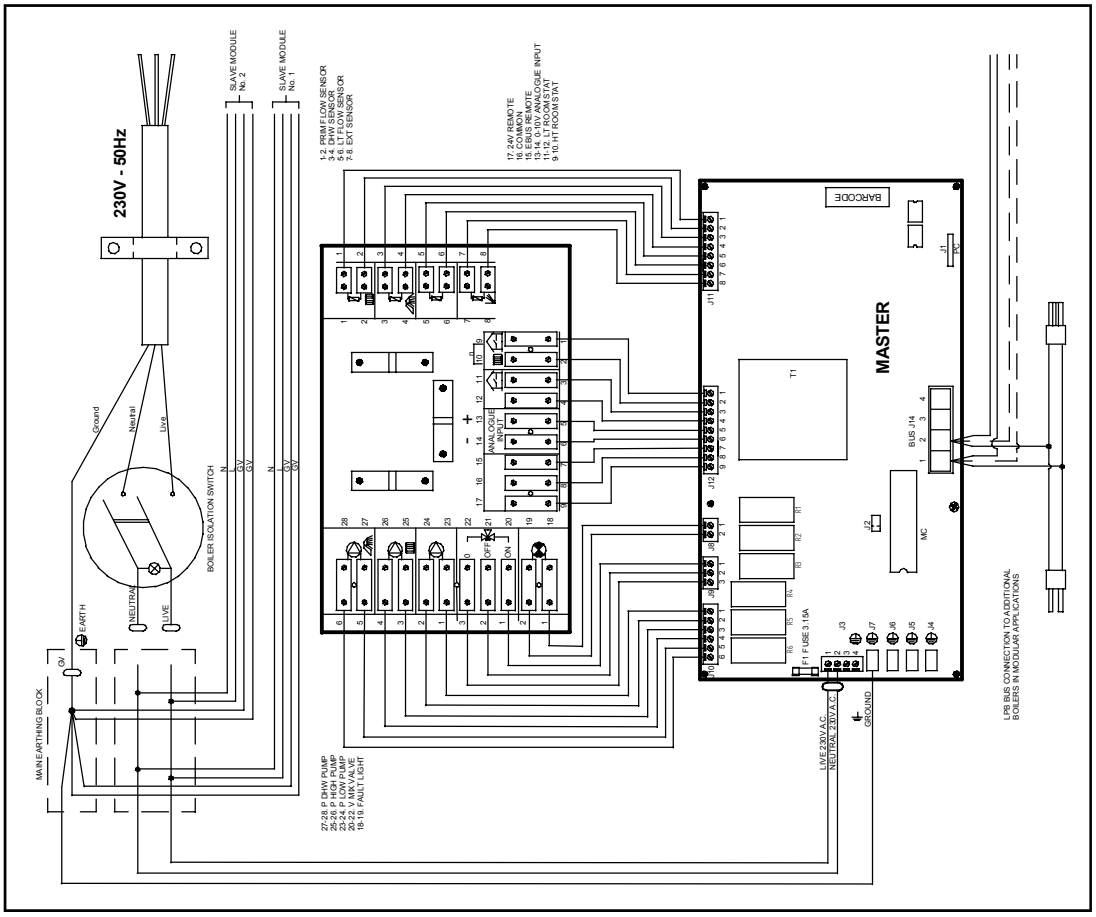
A competent person registered for working on non domestic gas appliances should check and ensure that the flue, its support and terminal, the ventilation to the boiler house, safety valve, condensate trap, drain, water filter if fitted, pressure gauge etc., are in a serviceable and working condition, 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 Milborne boiler, 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_2 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 module and must be carried out on all modules within a bank of boilers. Before servicing the boiler, the following procedure must be carried out: -

PREVIOUS WIRING SCHEMATIC



CURRENT WIRING SCHEMATIC

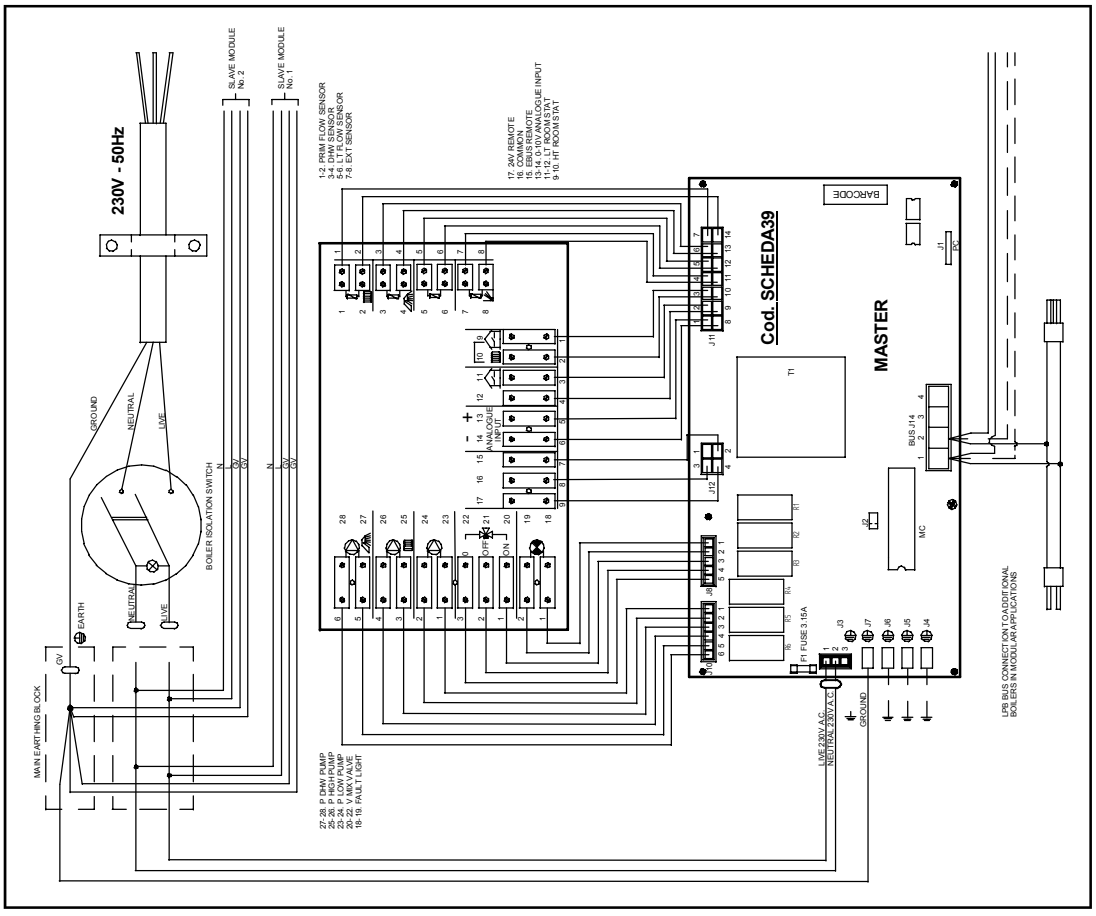


Figure 9.3.1 - Milborne 382 / 502 - Wiring Schematic

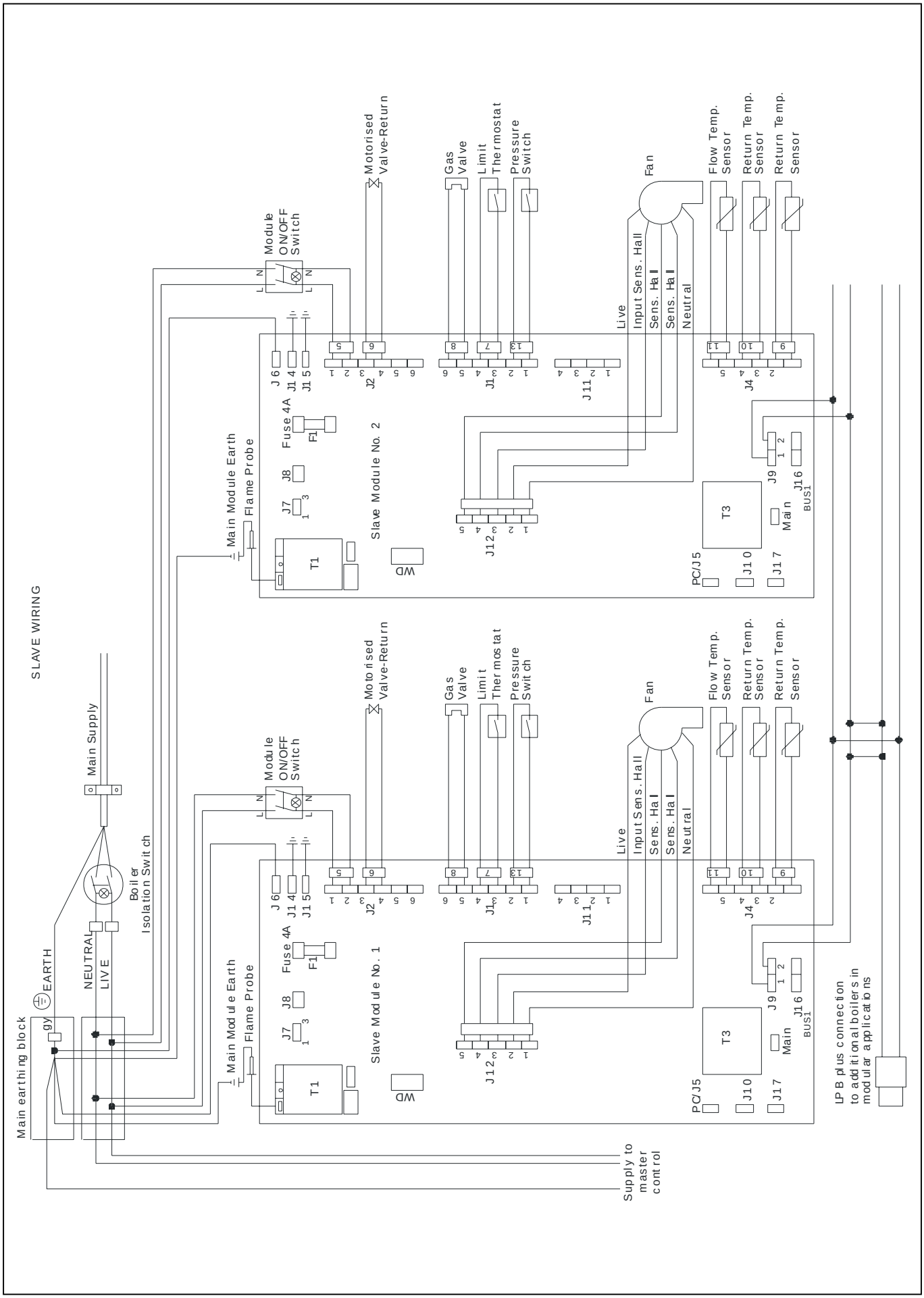


Figure 9.3.2 - Milborne 382 / 502 Slave - Wiring

WARNING: Isolate the electrical supply using the switch on the base of the control panel (see figure 7.4.3) and turn off the gas supply to the boiler module being serviced.

10.3 **Cleaning the burner**

In order to clean the burner, simply dust it with a bristle brush, wash it with water and blow compressed air through it from the inside outwards.

To carry-out this operation, remove it from the heat exchanger in the following manner:

Unscrew the upper panel and remove it as shown in figure 10.3.1

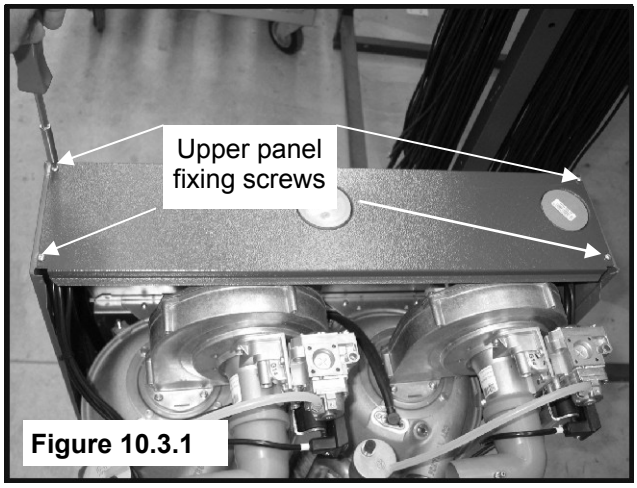


Figure 10.3.1

Disconnect the power supply connector of the fan as shown in figure 10.3.2

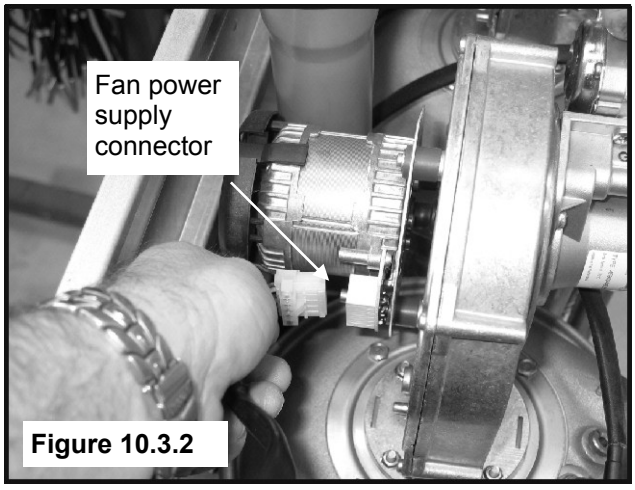


Figure 10.3.2

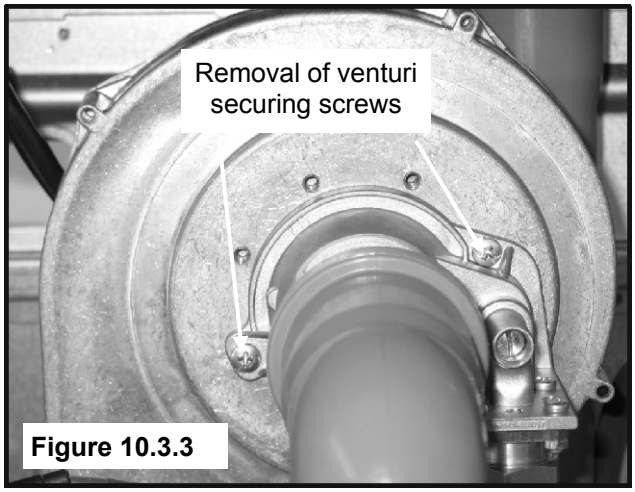


Figure 10.3.3

Unfasten the three screws on the Venturi pipe to disconnect it from the fan as shown in figure 10.3.3

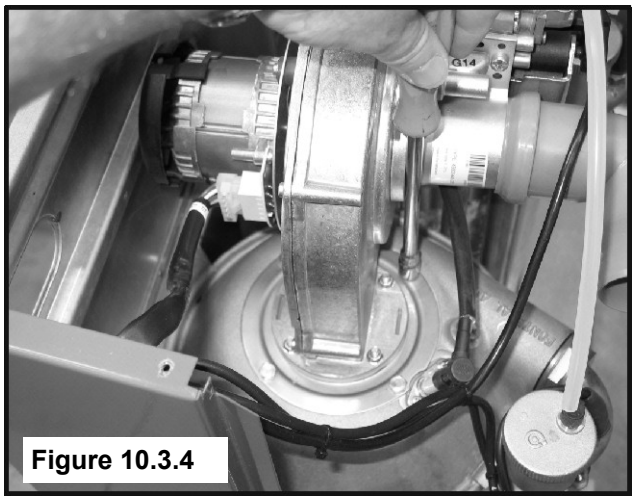


Figure 10.3.4

Unscrew the 4 nuts locking the flange onto the burner head and remove the fan as shown in figure 10.3.4

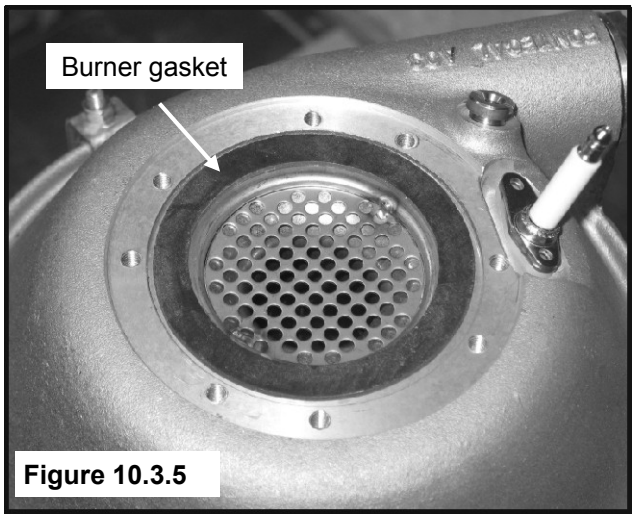


Figure 10.3.5

Remove the gasket and slide the burner upwards and out of the exchanger as shown in figure 10.3.5 and figure 10.3.6

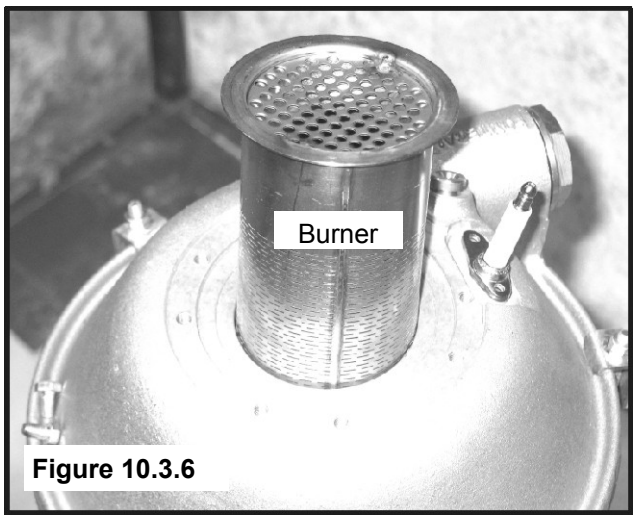


Figure 10.3.6

Caution! After cleaning the burner, new gaskets must be used for the burner and air-gas manifold flange.

10.4 **Cleaning the exchanger**
The heat exchanger is made of a corrugated bi-metallic hose with AISI 316 L stainless steel external surface and copper internal surface, and does not need any special maintenance.

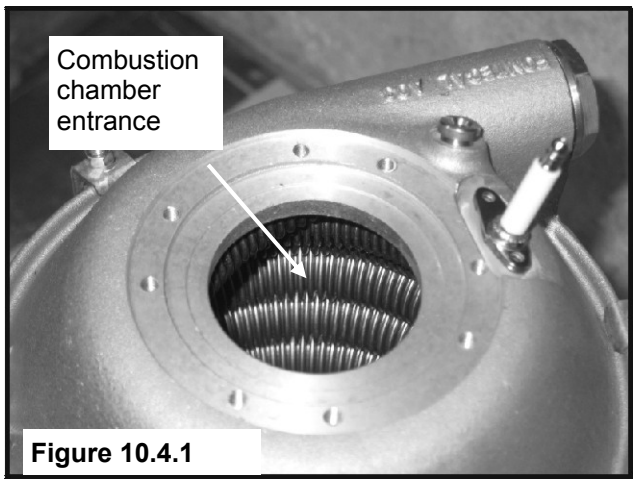


Figure 10.4.1

To clean the heat exchanger, remove the burner and gasket from its housing at the top of the heat-exchanger, as shown in figure 10.4.1.

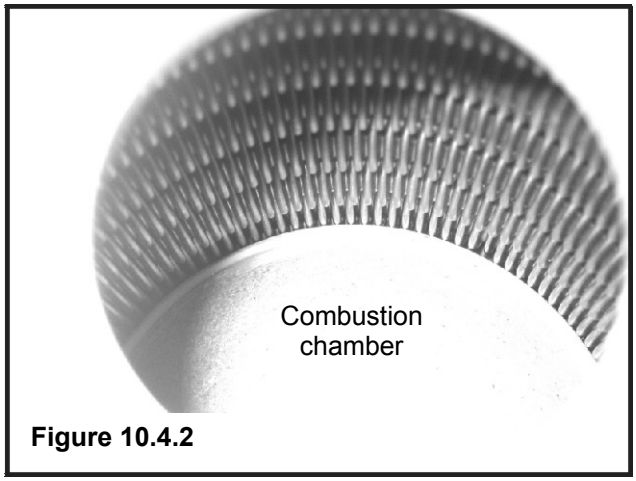


Figure 10.4.2

Clean the heat exchanger by accessing through the top hole of the combustion chamber and brush it clean - see figure 10.4.2.
Remove any debris from the combustion chamber with a vacuum cleaner. Finally, wash with water.
Caution! After cleaning the exchanger, new sealing gaskets **must be** used .

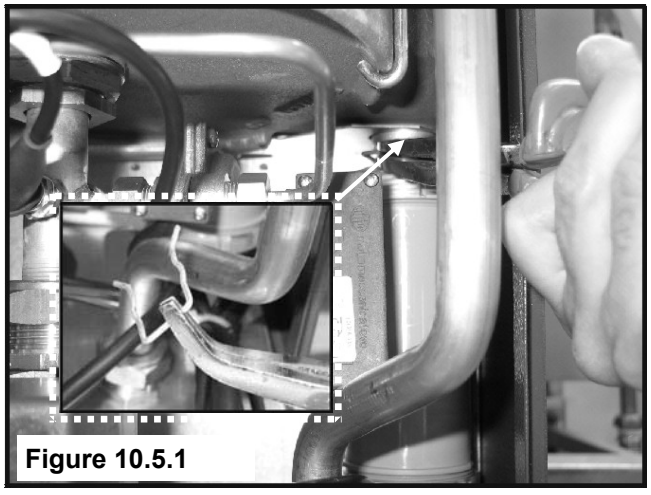


Figure 10.5.1

10.5 **Cleaning the condense drain**
The condense drain must be cleaned once per year as follows.
Disconnect the condensate drain device by removing the locking fork as shown in figure 10.5.1
Slide the device downwards through the hole below the boiler as shown in figure 10.5.2

Unscrew the plastic fitting on the condensate drain pipe as shown in figure 10.5.3
Disassemble the condensate drain trap as shown in figure 10.5.4

Wash away any deposited dirt with water.

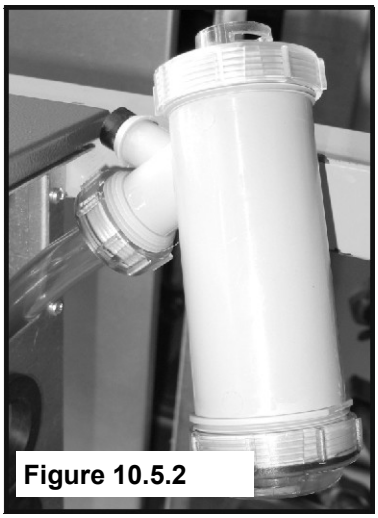


Figure 10.5.2

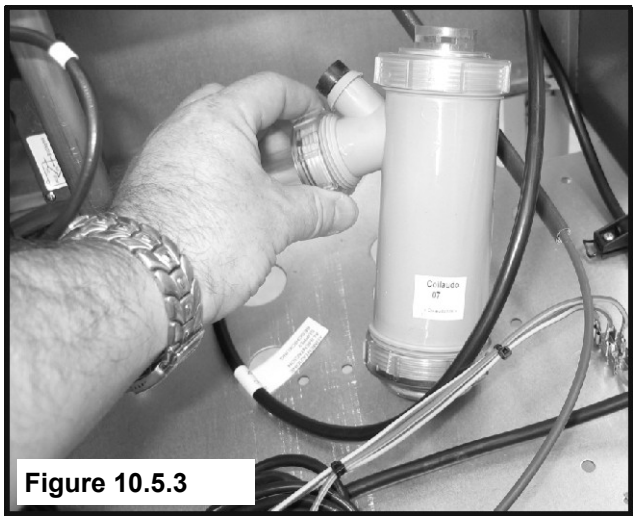


Figure 10.5.3

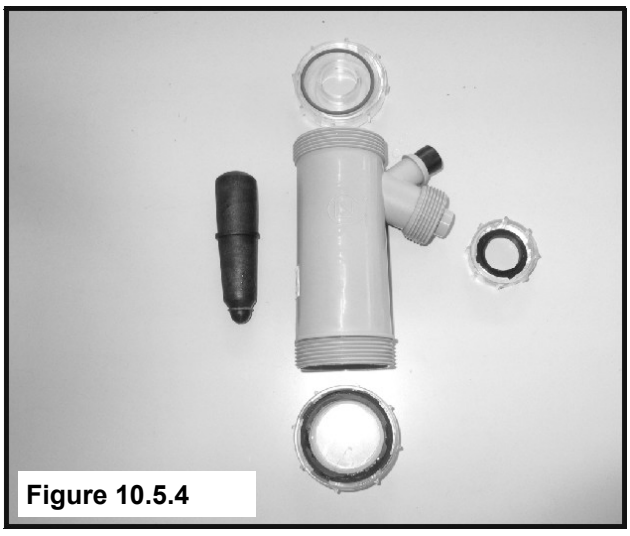


Figure 10.5.4

10.6 **Cleaning the ignition electrode**
The ignition electrode is used to create a high-voltage spark and also to sense the flame. This component requires annual maintenance to remove any layer of oxide which may have built-up on the wire. Check whether the electrode wire has any earth current leakage and make sure that the cap is not oxidized.
In case of oxidation, replace the spark plug and its cap with new ones - see figure 10.6.1

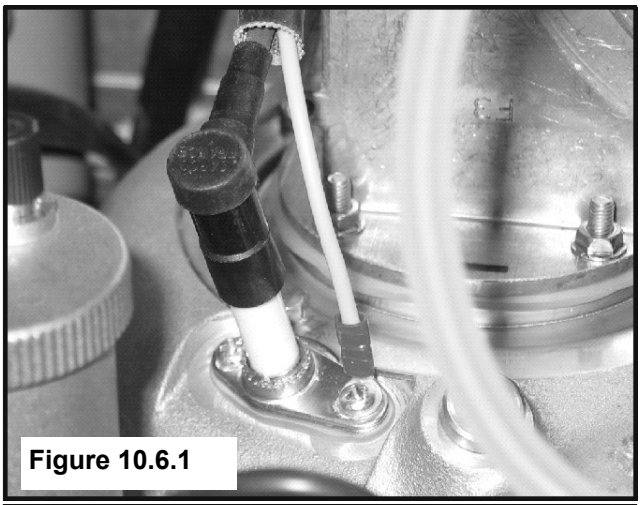


Figure 10.6.1

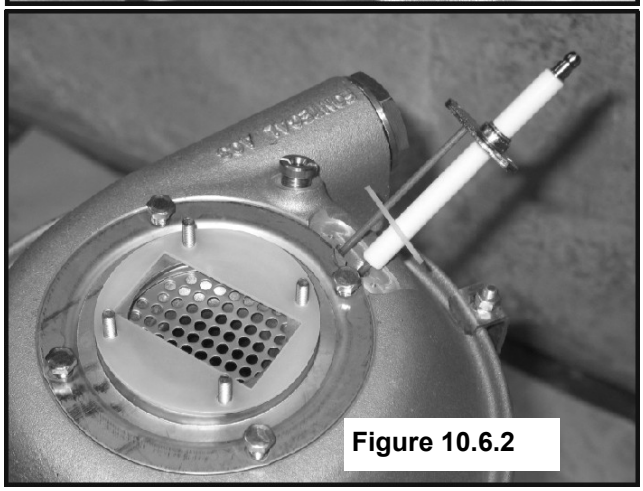


Figure 10.6.2

Loosen the fixing screws of the ignition electrode bracket - see figure 10.6.1.
Remove the electrode from the heat exchanger - see figure 10.6.2.
Check the condition of the electrode and remove any oxide present with abrasive paper, or replace the electrode.
If the electrode is replaced, a new gasket **MUST** be fitted.
Accurately check the distance between the electrode wires - see figure 10.6.3. & 10.6.4.

NOTE: Two types of electrode have been used and both are interchangeable.
The distance should be 3 - 5 mm;
10.7 **Reassembly** - having carried out the detailed servicing procedure, re-assemble all components, having fitted replacement gaskets where required. Check all gas connections are tightened securely before opening the gas service cock. Re-connect

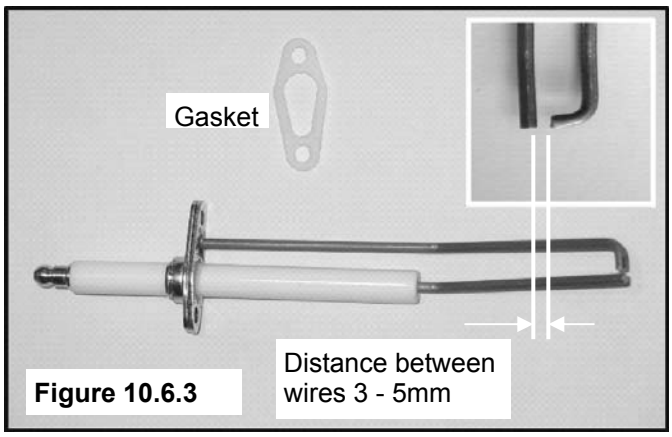


Figure 10.6.3

electrical connections. Switch on the electrical supply to the module - see figure 7.4.3, and re-light the boiler following the procedure detailed in section 7.4.
Take combustion readings and compare with those previously taken—see section 7.4 Ensure that no gas leaks are evident from gas connections. Check temperature settings and adjust if necessary

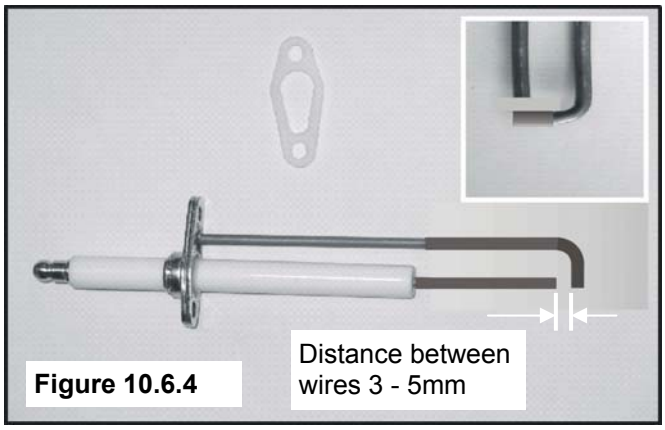


Figure 10.6.4

10.8 **Flue sample point sealing plug**

The plug is provided to allow set-up and adjustment, if necessary, of combustion during maintenance and commissioning of the boiler

THE PLUG MUST BE REPLACED FINGER TIGHT ONLY!

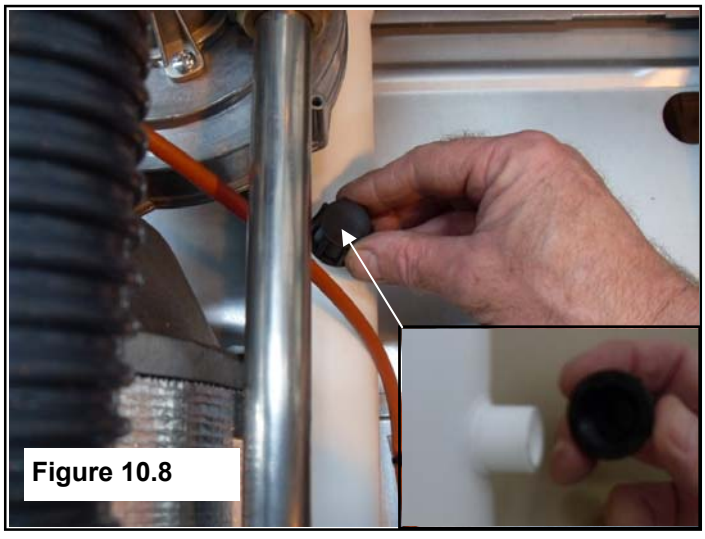


Figure 10.8

11.0 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 combustion chamber front panel. 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.

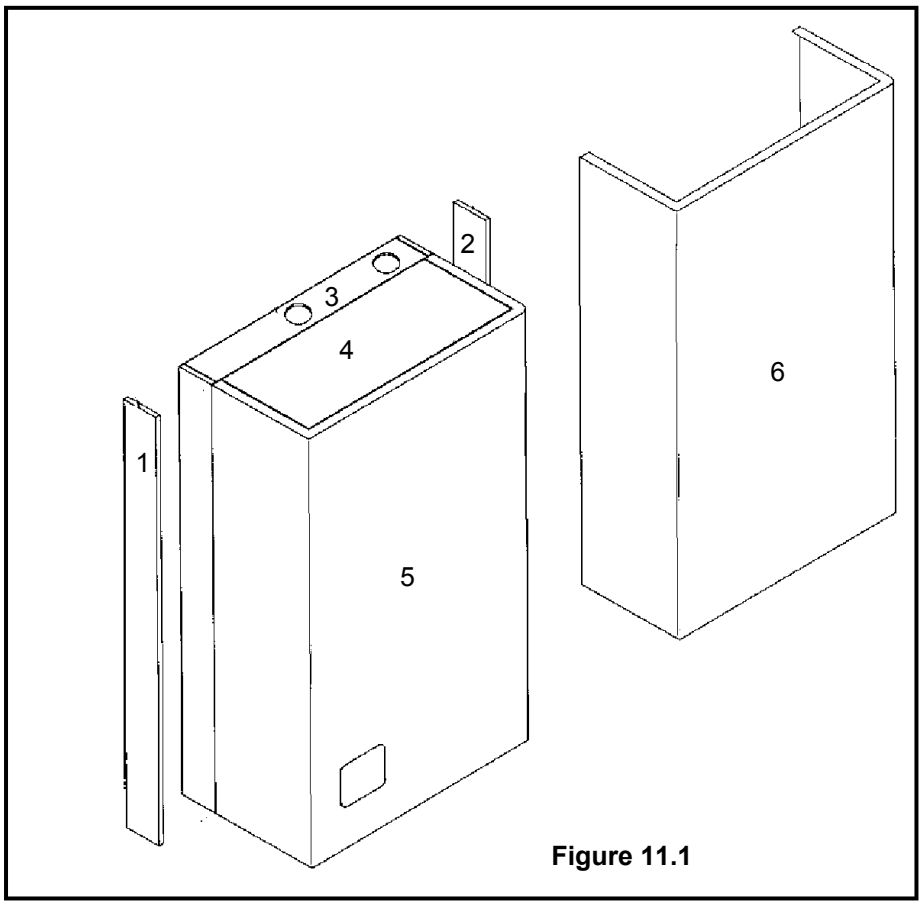


Figure 11.1

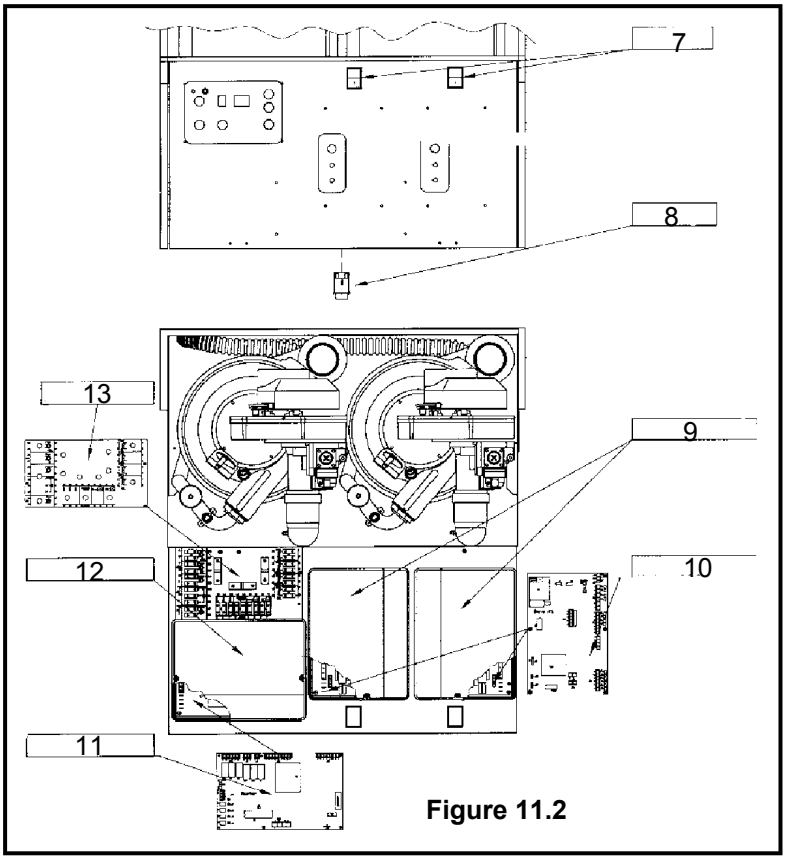


Figure 11.2

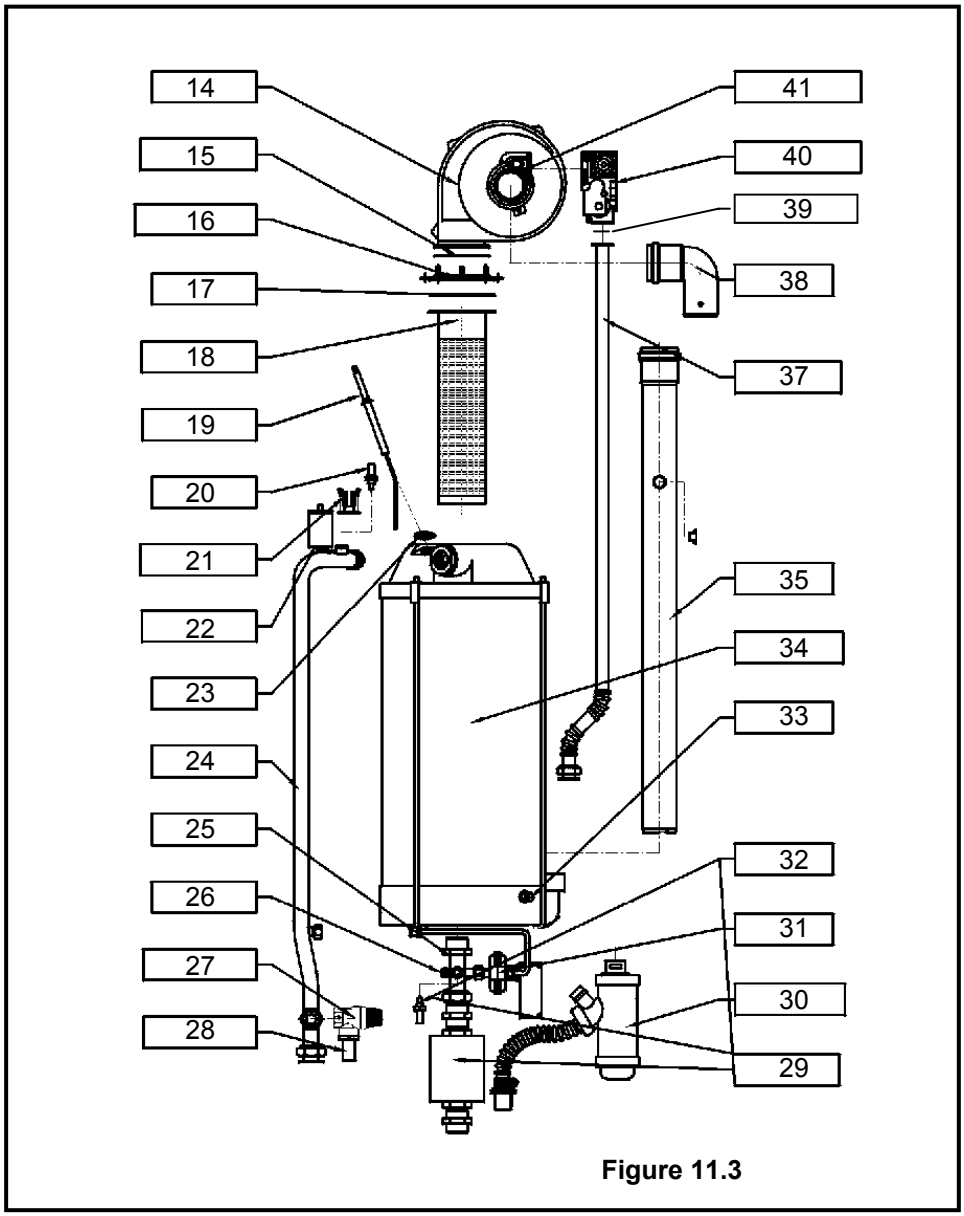


Figure 11.3

T (°C)	R (Ω)	T (°C)	R (Ω)	T (°C)	R (Ω)	T (°C)	R (Ω)
-20	67799	15	14694	50	4161	85	1451
-15	53452	20	12090	55	3538	90	1266
-10	42449	25	9999	60	3021	95	1108
-5	33925	30	8313	65	2589	100	973
0	27279	35	6944	70	2229	105	857
5	22069	40	5828	75	1925	110	757
10	17959	45	4913	80	1669		

Figure 11.4 - sensor resistance values

KEY	SPARES ITEM	PART No.
1	Left hand side casing panel	573407097
2	Right hand side casing panel	573407096
3	Upper rear casing panel	573407098
4	Upper front casing panel	573407099
5	Front casing panel - Master	573407095
6	Front casing panel - Slave	573407094
7	Slave module on/off switch	573407039
8	Main boiler on/off switch	573407071
9	Slave control box	573407073
10	Slave control pcb - no housing	573407083
11	Master control pcb 501/502 - no housing (**before** serial number 08020095)	573407082
11a	Master control pcb 501/502 - no housing (**after** serial number 08020095)	573407280
11b	Master control pcb 381/382 - no housing (**before** serial number 08020095)	573407256
11c	Master control pcb 381/382 - no housing (**after** serial number 08020095)	573407281
12	Master control box	573407072
13	Electrical connection label	573407062
14	Combustion fan - 501/502	573407092
14	Combustion fan - 381/382	573407257
15	Fan outlet gasket	573407016
16	Fan - heat exchanger flange - 501/502	573407093
16	Fan - heat exchanger flange - 381/382	573407258
17	Burner gasket	573407080
18	Burner - 501/502	573407396
18	Burner - 381/382	573407259
19	Ignition / flame electrode - 501/502	573407077
19	Ignition / flame electrode - 381/382	573407021
19a	Ignition cable	573407067
20	Flow temperature sensor	573407085
21	High limit thermostat	573407087
22	Automatic air vent	573407001
23	Electrode gasket	573407079
24	Flow pipe assembly	573407102
25	Return pipe assembly - 501/502 (**after** serial number 10090000)	573407395
25	Return pipe assembly - 381/382 (**after** serial number 10090000)	573407397
26	Boiler drain valve	573407075
27	Safety pressure relief valve	573407179
28	Safety valve discharge pipe	573407236
29	Motorised 2 - way valve	573407089
30	Condense trap assembly	573407078
31	Differential pressure switch (**after** serial number 10090000)	573407392
32	Return temperature sensor	573407085
33	Flue gas temperature sensor (**after** serial number 10090000)	573407393
34	Heat exchanger assembly - 501/502	573407081
34	Heat exchanger assembly - 381/382	573407261
35	Flue discharge pipe - 50mm - 501/502	573407088
35	Flue discharge pipe - 50mm - 381/382	573407262
37	Gas supply pipe assembly	573407100
38	Air inlet elbow - 50mm	573407068
39	Gas supply pipe gasket	573407250
40	Gas valve	573407090
41	Gas valve venturi	573407019

For service or spares please contact :-

Hamworthy Heating Ltd
Fleets Corner
Poole
Dorset BH17 0HH

Tel; **01202 662500**
Fax **01202 665511**
Service **01202 662555**
Spares **01202 662525**
Technical **01202 662566**

APPENDIX A - GAS DATA

Natural Gas - A1

GENERAL DATA Milborne - condensing			BOILER MODEL			
Model - Condensing			381	382	501	502
Boiler Input (maximum)	-	kW (Gross)	37.5	75	50	100
Boiler Input (maximum)	-	kW (Nett)	33.8	67.5	45	90
Boiler Output kW (maximum) condensing 50/30°C	-	kW	36.5	73	48.5	96.8
Boiler Output kW (maximum) non condensing 80/60°C	-	kW	32.5	65	44.2	88.3
Boiler Module Output (minimum)	-	kW	11		15	

GAS DATA			381	382	501	502
Gas Inlet Connection Pipe Thread Size			1 - G3/4"	2 - G 3/4"	1 - G3/4"	2 - G 3/4"
Nominal Gas Inlet Pressure	-	mbar	20			
Maximum Gas Inlet Pressure	-	mbar	25			
Gas Flow Rate (maximum)	-	m^3/h	3.55	7.1	4.74	9.48
Target CO_2 % at Low fire ±0.2%			8.3 - 8.5			
Target CO_2 % at High fire ±0.2%			9.2 - 9.4			

LPG Propane - A2

GENERAL DATA Milborne - condensing			BOILER MODEL			
Model - Condensing			381	382	501	502
Boiler Input (maximum)	-	kW (Gross)	37.5	75	50	100
Boiler Input (maximum)	-	kW (Nett)	34.6	69.1	45	90
Boiler Output kW (maximum) condensing 50/30°C	-	kW	36.4	72.6	48.5	96.8
Boiler Output kW (maximum) non condensing 80/60°C	-	kW	33.2	66.4	44.2	88.3
Boiler Module Output (minimum)	-	kW	11		15	

GAS DATA			381	382	501	502
Nominal Gas Inlet Pressure	-	mbar	37.5			
Maximum Gas Inlet Pressure	-	mbar	50			
LPG orifice diameter	-	mm	6.50			
Gas Flow Rate (maximum)	-	m^3/h	1.4	2.8	1.9	3.8
Target CO_2 % at Low fire ±0.2%			8.6 - 8.9			
Target CO_2 % at High fire ±0.2%			10.2 - 10.4			

A2.1 Conversion to LPG Propane

Note: It is strongly recommended that, on LPG installations, gas detection equipment is fitted. This equipment should be positioned near the boiler and at low level. It is important that the space housing the boiler is adequately ventilated at high and low level - refer to Appendix D.

For single module installations, ie 1 x Milborne 381 / 501, the boiler must not be installed in a room or compartment located below ground level. BS6798.
For multiple module installations, ie 1 x Milborne 382 / 502 or greater, the boiler must not be installed in a plant room located below ground level. BS6644.

A2.2 Installation

The design and operation of the Milborne boiler using LPG-propane (3rd family) I_{3P} is similar to that on Natural Gas (2nd family) I_{2H} and the design and installation details in the main body of this guide should be followed.

There are however differences in the construction and commissioning requirements of the propane boiler as follows.
The propane boiler is supplied with a gas orifice sized 6.50mm dia. fitted to the gas valve/venturi assembly before leaving the factory. Full commissioning details are provided in the operation and commissioning manual.

LPG kits can also be supplied separately if required to convert the boilers from Natural Gas to LPG on site. To order additional LPG conversion kits please contact Hamworthy Heating Ltd to order the required number of kits quoting part number 573407132. One kit will be required for each module, ie;

Milborne 381 / 501 **1 kits.**
Milborne 382 / 502 **2 kits.**

During commissioning the parameters must be set for propane firing to ensure correct fan speeds for ignition and operation are maintained. Hamworthy Heating Ltd strongly recommend that the Milborne boiler is commissioned by our engineers. This will ensure that the boiler is operating correctly and efficiently.

LPG Conversion Kit
(HHL Part No. 573407132)

The LPG kit is supplied with 2 sizes of orifice. The 6.50mm orifice is used for the majority of installations. However, the 6.75mm orifice is occasionally used in special circumstances, see Section A2.3 point 7.

A2.3 Procedure for Converting boiler from Natural Gas to LPG.

1 Ensure that the boiler is isolated from both the electrical supply and the gas supply. Remove the front cover to gain access to the internal boiler assemblies.

2 Figure A3 shows the gas valve and air inlet assemblies of the boiler. Where the boiler has two (2) modules then both modules will need to be modified for LPG gas supply.

3 The following operations can be performed on the installed boiler. For clarity purposes the illustrations show the assemblies removed from the boiler.

4 To separate the venturi from the gas valve remove the 3 screws as indicated in figure A4. When the parts are separated access to the gas valve air inlet passage is possible.

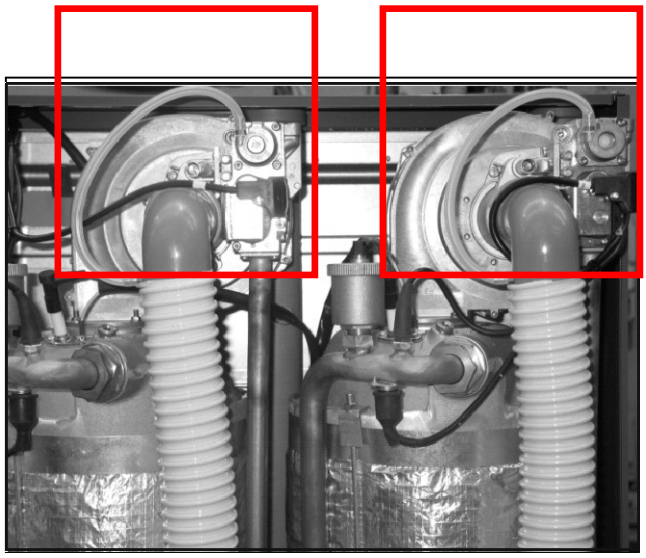


Figure A3

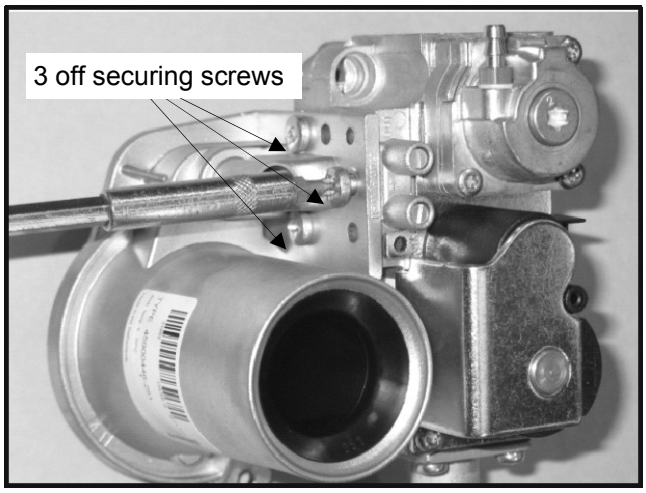


Figure A4

5. Following separation of the venturi from the gas valve the rubber seal will be clearly visible, see fig A5. All Milborne's are supplied Natural Gas as standard so there will be no orifice fitted to the gas valve air inlet passage.

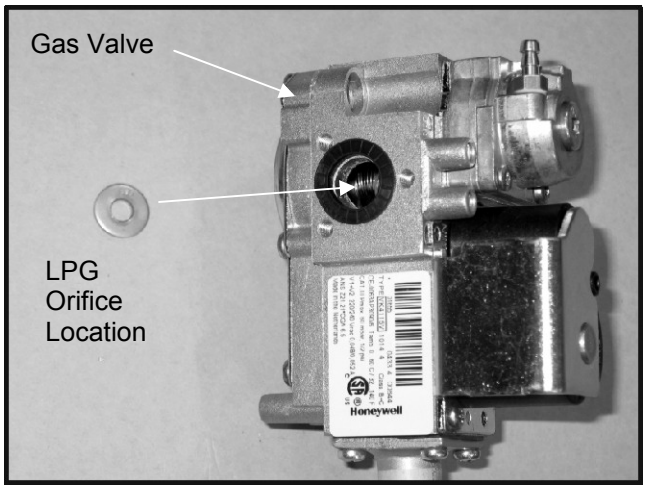


Figure A5

6. The LPG orifice consists of a precisely drilled washer of 6.5mm internal diameter. This orifice is to be fitted in the gas valve outlet port. There is no need to remove the rubber seal to complete this operation.

7. Figure A6 shows LPG gas orifice correctly located in the gas valve air inlet passage.

Figure A6

NOTE: In certain circumstances it is necessary to fit a larger LPG orifice to the gas valve air inlet port. If poor ignition is experienced after commissioning the boiler then the larger orifice may be fitted. It is important to commission the boiler first, as correctly setting the gas valve offset for clean combustion may overcome initial poor ignition.

The alternative LPG orifice is sized at 6.75mm internal diameter and is fitted in exactly the same way as the 6.5mm diameter orifice. If fitting the larger orifice then the 6.5mm diameter orifice must first be removed.

Figure A7

8. To replace the assembly, ensure that all the components that have been removed and modified are clean. Position the venturi to the gas valve and refit 3 screws that were previously removed in step 4. Ensure the 3 screws are securely tightened to prevent leaks at the venturi to gas valve joint.

9. Modifying the Boiler Parameter, Master Boiler Only

It is essential to modify the boiler parameter number 36 to identfy the type of gas being used. This must also take account of the flue length as indicated in the table below. To modify the parameter it is necessary to reinstate the gas and electrical supplies.

WARNING! As the boiler MUST NOT fire before the parameter is modified ensure that there is no demand for heat from any of the connected circuits and time clock controls.

Notes:
1. The procedure for modification and adjustment of the parameters at the Master Control Panel is detailed in Section 8.5 of this manual.
2. Once the boiler has been modified for LPG firing it is essential to complete the full commissioning procedure to all boiler modules as detailed in Section 7.0
3. If after commissioning, the larger orifice has to be installed then the full commissioning procedure as detailed in Section 7.0 must again be completed.

Parameter	Description	Range	Default	Specification
36	**Type of Gas**	**1-24**	**1**	501/502 boilers 1= Natural Gas with equivalent flue length < 15m 2= Natural Gas with equivalent flue length > 15m 3= LPG with equivalent flue length < 15m 4= LPG with equivalent flue length > 15m **381/382 boilers** 21= Natural Gas with equivalent flue length < 15m 22= Natural Gas with equivalent flue length > 15m 23= LPG with equivalent flue length < 15m 24= LPG with equivalent flue length > 15m

APPENDIX B - ELECTRICAL CONNECTIONS AND CONTROLS

ELECTRICAL DATA						
Model			**381**	**382**	**501**	**502**
Normal Supply Voltage			230V ~ 50Hz			
Power Consumption (maximum)	-	W	170	340	170	340
Start and Run Current (per module)	-	A	0.8 / 0.74			

B1.1 Electrical Supply

IMPORTANT: Individual boilers 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. 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 1.0mm² cross sectional area. Boilers are normally supplied for connection to a 230 volts, 50Hz mains supply. The boiler control is supplied with a replaceable fuse (T4A). External fuses should be 6A for all boilers.

2. 3-Phase Electrical Supplies. Individual modules of Milborne 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 / battery with a separation of at least 3mm in all poles.

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

4. Multiple modules. It is highly recommended that each boiler is connected via its own mains isolator to facilitate servicing and maintenance of the individual boiler whilst leaving the remaining boilers in operation.

5. Further details regarding connection to the electricity supply are given in BS EN 60335, Part 1 or BS 3456, Part 201.

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

CAUTION: DO NOT FEED MAINS VOLTAGE ONTO THE TIMER TERMINALS

6. The mains power supply must be maintained at all times. Each Milborne boiler module incorporates a remote stop/start loop, which can be used to operate the boiler(s) under a timed regime. The boiler controls provide a 24V 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.

7. Any pump controlled by the boiler must be installed using an adequate contactor.

NOTE: FOR BASIC TERMINATION DIAGRAM SEE FIGURE 4.6

Pump Connection

Milborne boiler regulation system includes the simultaneous management of up to three circulators.

Therefore, if a low temperature circuit supplied by its own circulator is present and a general pump is to be installed on the system, it will be necessary to choose which one of the two devices should be managed by the Boiler Master Control.

This operation is carried out by setting the relevant parameter during commissioning.

The pumps shall be installed using an adequate contactor, as shown in Figure B.1.2

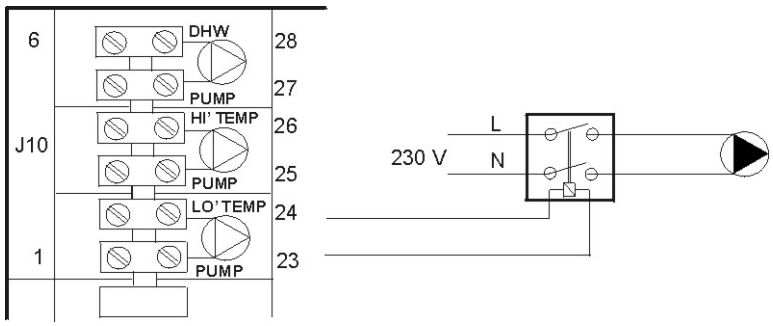


Figure B.1.2

BMS Connections

For 0 - 10v connection, the input signal must be connected to terminals 13 & 14 - see figure B.1.3
Note: any safety interlocks MUST be wired across the 0– 10v circuit using suitable low voltage contact ratings.

For connection of an external alarm device, use terminals 18 & 19, which are volt free and rated at 230v - see figure B.1.3

For an optional programmable room thermostat, use terminals 9 & 10 for the high temperature heating room sensor and terminals 11 & 12 for the low temperature heating room sensor - see figure B.1.3

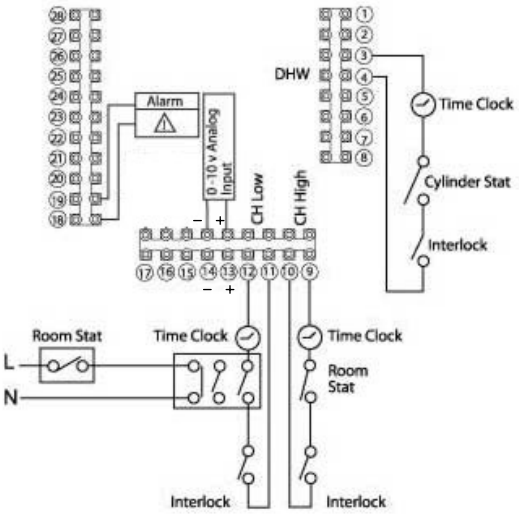


Figure B.1.3

APPENDIX C - FLUE DATA - Natural Gas & LPG

FLUE DATA					
Model - Condensing	381	382	501	502
Approx. Flue Gas Temperature @ 80/60°C - °C (Gross)	65			
Approx. Flue Gas Temperature @ 50/30°C - °C (Gross)	35			
Pressure at the boiler flue outlet - Pa/mbar	700 / 7.0			
Approx. Flue Gas Volume @ 9% CO_2 - m^3/h*	56	113	75	150

* **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 150kW output must comply with the third edition of the 1956 Clean Air Act Memorandum.

WARNING: THE FLUE DISCHARGE FROM A MILBORNE 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 Milborne boilers are designed to be used with natural draught or room sealed flues. Flue systems should be designed in accordance with regulations and with reference to BS 6644 and IGE/UP/10.

The following points should be noted:

a. Due to the high thermal efficiency of the boiler, condensation will occur in the flue. It is strongly recommended that the design of the flue system recognises this.

b. Care should be taken to ensure that the flue is installed such that any condensation is continuously drained. Any flue system with a horizontal section should have a maximum slope of 2° upwards in the direction of the exhaust gas flow. 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 - 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 the above tables.

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 should be designed to maintain atmospheric pressure or a slight suction at the boiler flue connection at all times acknowledging the positive pressure available from the combustion fan.

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. Milborne 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 each module suitable for connection to a 20mm 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 (pH3-5), 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.
In addition to the above, should the plastic flue system supplied discharge into a metallic chimney system, any condensate formed in the chimney MUST NOT drain back through the plastic components to the boiler. A separate drain for the chimney system must be provided.

Module kW	Equivalent lengths (m)			Flue pressure (Pa)
	Max length	45° Bend	90° Bend	
38	40	1.0	3.0	410
50	31	1.0	3.0	560
	125mm	1.3	5.3	
	160mm	1.7	7.6	
Note: flue pressure quoted at full output				

Figure C1.1 - 50mm Flue equivalent lengths

No. Of Modules	Nominal cascade output	Maximum length (m) of open flue system B_{23} incl. header	
	kW	125mm	160mm
2*38	76	428	n/a
3*38	112	176	n/a
4*38	150	103	n/a
5*38	187	65	n/a
6*38	225	45	n/a
2*50	100	300	n/a
3*50	150	134	n/a
4*50	200	75	n/a
5*50	250	47	150
6*50	300	33	105
7*50	350	n/a	78
8*50	400	n/a	60
9*50	450	n/a	46
10*50	500	n/a	38

Figure C1.2 - 125/160mm Maximum flue lengths

APPENDIX D - VENTILATION

D1.1 Air Supply

Detailed recommendations for air supply are given in BS 6644 and BS5440 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.
Note: For Open flue applications, combustion air for the boiler is drawn through the top of the boiler casing. The air inlets **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) - 4cm² per kW of total rated input (Net)
High level (output) - 2cm² 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) - 10cm² per kW of total rated input (Net)
High level (output) - 5cm² per kW of total rated input (Net)

D1.2.2 Air Supply by Natural Ventilation - Room Sealed Installations

Where the boiler(s) are to be installed in a boiler room or internal space, the room or internal space must have permanent air vents directly to the outside air, at high level and at low level with the general requirements detailed above on location and construction.

Boiler house ventilation

Low level (inlet) - 2cm² per kW of total rated input (Net)
High level (output) - 2cm² 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 may communicate to an adjoining room or outside, for cooling purposes.

Ventilation to a room or internal space - 10cm² per kW of total rated input (Net)
Ventilation direct to outside - 5cm² per kW of total rated input (Net)

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 does not exceed one third of the design inlet rate.
3) Mechanical extract ventilation with natural inlet ventilation **MUST NOT** be used.

For Mechanical ventilation systems an automatic control should be provided to cut off the gas supply to the boiler, in the event of failure of air flow in either inlet or extract fans.

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

	Flow rate per kW total rated heat input (Net)	
	Inlet air (Combustion ventilation)	Difference between Inlet & Extract air *
	m³/h.	m³/h.
Volume	2.6	1.35

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			381	382	501	502
Water Connections (Flow & Return)			G 1" male			
Maximum Water Pressure	-	bar g	6			
Minimum Water Pressure	-	bar g	0.5			
Water Content (not including headers)	-	litres	3.5	4.9	7.0	9.8
Design Flow Rate @ 20°C ΔT Rise	-	litre/s	0.42	0.55	0.84	1.1
Waterside Pressure Loss @ 20°C ΔT Rise	-	mbar	300		700	

E1.1 Water Circulation System

The Milborne 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 and CP 342.

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 G1" male flow and return connections. Boilers should be connected by flow and return headers. Hamworthy strongly recommend that boilers are connected in a primary circuit configuration utilising a low loss header arrangement to enable secondary circuits to be connected to the header. Figure E1.1.1 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 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 an integral safety valve terminating in a 22mm stub pipe on the base of the boiler. 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.

E1.3 Altitude Gauge (Water Pressure Gauge)

Every boiler or group of boilers should be provided with an altitude gauge complete with isolating valve. See Figure E1.1.1 for typical position.

E1.4 Thermometer

A thermometer complete with pocket should be fitted in the pipework to indicate water flow temperature. See Figure E1.1.1 for typical position.

E1.5 Drain Valves

Each boiler should have a 15mm NB drain valve (not Hamworthy Heating Ltd supply) fitted 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 E1.1.1 for typical position.

E1.6 Circulating Pump

It is recommended by Hamworthy Heating, that the **primary pump MUST be controlled from the Master boiler** to ensure synchronised operation - refer to fig. 4.6.

No. of Boilers	System Load kW	Pump Model	System Load kW	Pump Model
1	37.5	Biral MX13-1	50	Biral M15-1
1	75	Biral LX403	100	Biral HX501-1
2	112.5	Biral LX403	150	Biral HX501-1
2	150	Biral LX403	200	Biral HX501-1
3	187.5	Biral LX503	250	Biral HX501-1
3	225	Biral LX503	300	Biral HX501-1
4	262.5	Biral LX504	350	Biral HX502-1
4	300	Biral LX504	400	Biral HX502-1

Figure E1.6 - Pump selection

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 Milborne 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

E1.7 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.

E1.8 Waterside Pressure Drop

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

E1.9 Water Flow Controls

The Milborne boiler is fitted with an electrical isolating valve, which will shut off circulation through the heat exchanger 5 minutes after the boiler has ceased firing.
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. As a precaution, the Milborne boiler is fitted with a flow switch. The flow switch is designed to operate such that the boiler will shut down if insufficient flow occurs.

E1.10 Frost Protection

Consideration should be given to fitting an optional outside air sensor, to provide the necessary frost protection.

E1.11 Unvented Systems

Refer to Figure E1.1.1 on opposite page 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.

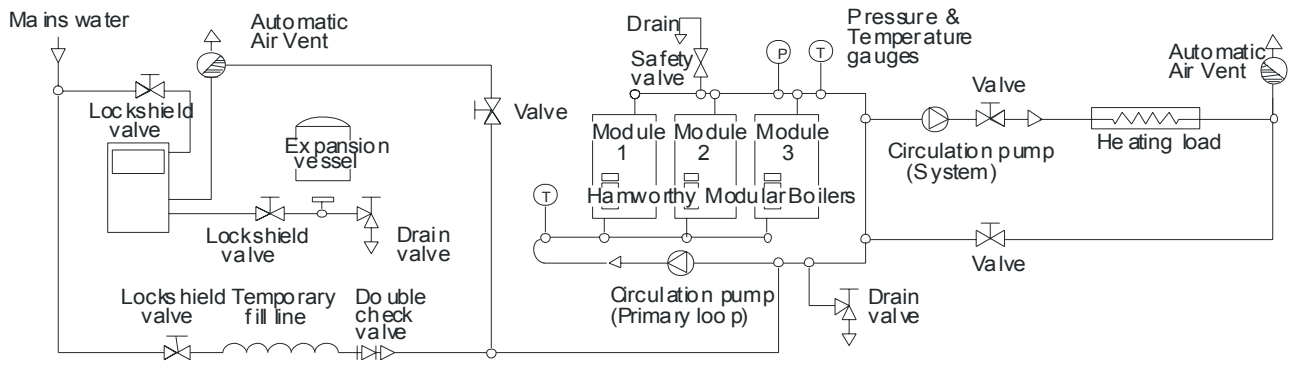
1) Static height of highest component in system (metres)
2) System volume. If this is not known, a general rule of thumb of 10litres/kW of installed boiler power can be used.
3) Maximum flow temperature (°C)
4) Maximum system hot working pressure, generally given in bar gauge.

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

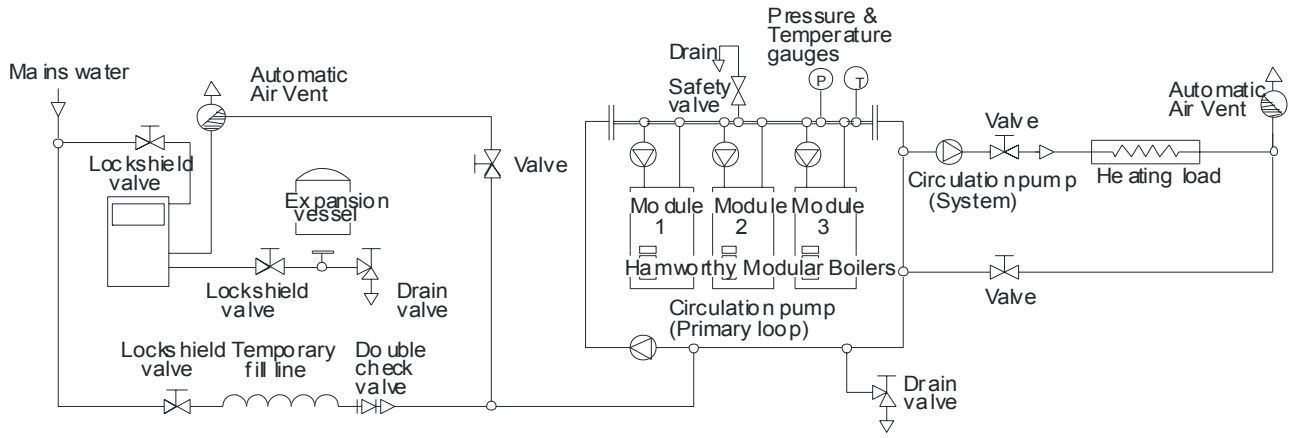
Care must be taken in sizing expansion vessels to ensure maximum acceptance factors are not exceeded. Normally manufacturers of vessels impose a limit of 0.5. This value must not be exceeded at any time during the operation of the boiler, this includes the over pressure condition should a safety valve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

Consideration should also be given to sizing of the safety valve(s) in the system. Refer to BS 6759: Part 1 for further information and to BS 6880: Part 1 for design considerations.

Figure E1.1.1 - Typical Piping Layouts



UNVENTED SYSTEM: Primary loop, Hamworthy recommended system.



UNVENTED SYSTEM: Single pipe header

NOTES:

USEFUL USER INFORMATION

INSTALLER	SITE ADDRESS

BOILER TYPE	BOILER SIZE(S)	UNIT NO(S).	SERIAL NO(S).	FLUE

Notes

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