POTTERTON
COMMERCIAL
PART OF BLUE CIRCLE

ERECTION INSTALLATION, COMMISSIONING & SERVICING INSTRUCTIONS FOR THE

MODULAR

GAS - FIRED BOILER

SECTION 1 - THE BOILER

Fig.1 General Dimensions (3 Module Boiler Illustrated)

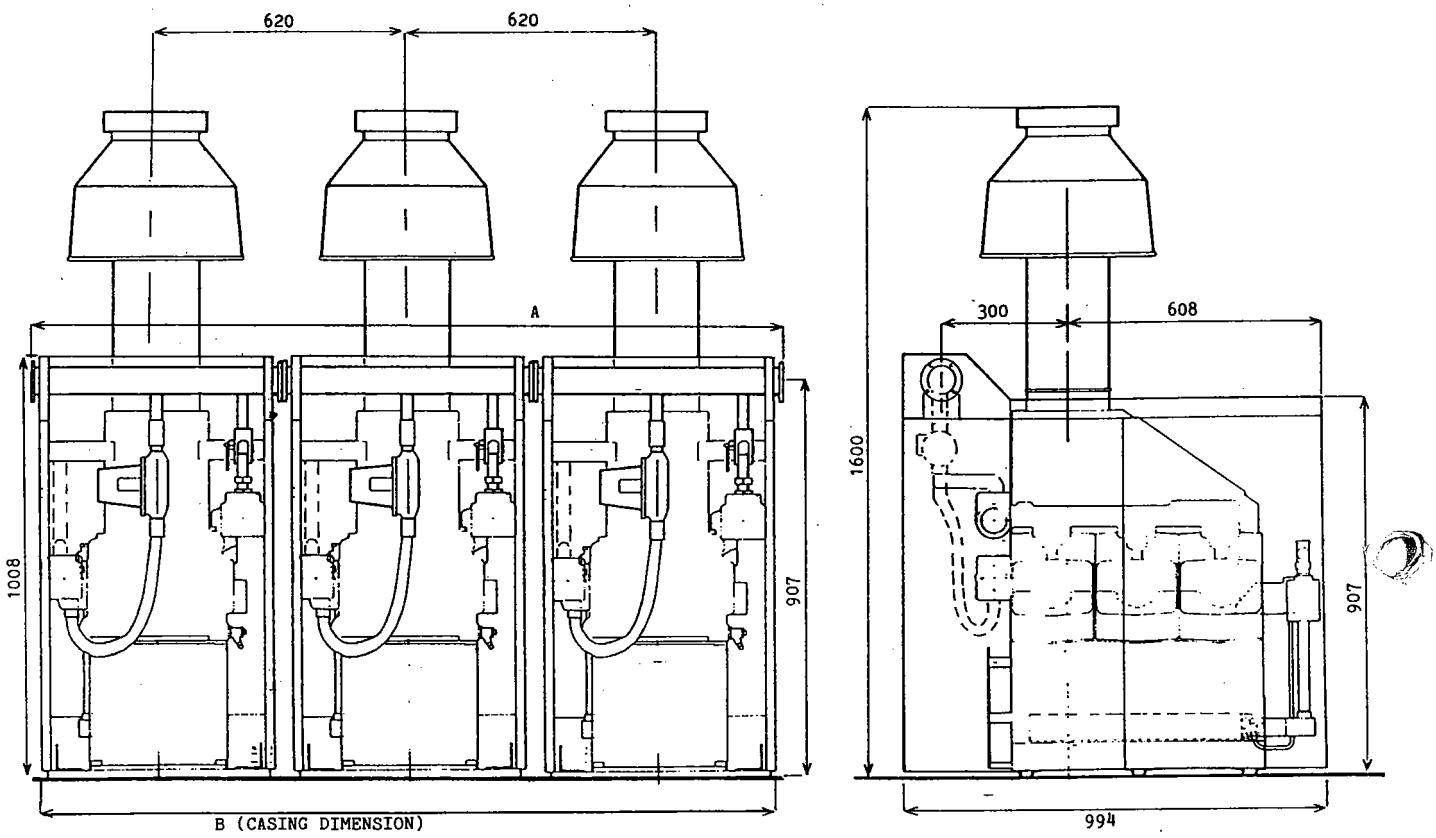


TABLE 1 Boiler Dimensions

MODEL	360	440	540	660	720	880	900	1080	1100	1320
SIZE Amm	1240	1240	1860	1860	2480	2480	3100	3720	3100	3720
SIZE Bmm	1160	1160	1780	1780	2400	2400	3020	2640	3020	3640

TABLE 2 Boiler Details

MODEL NUMBER		360	440	540	660	720	880	900	1080	1100	1320
DRY WEIGHT	kg	418	418	627	627	836	836	1045	1254	1045	1254
	lb	920	920	1380	1380	1840	1840	2300	2760	2300	2760
WET WEIGHT	kg	461.46	461.46	692.2	692.2	922.92	922.92	1154	1384	1154	1384
	lb	1017	1017	1526	1526	2035	2035	2544	3051	2544	3051
WATER CONTENT	litres	43.46	43.46	65.2	65.2	86.92	86.92	108.7	130	108.7	130
	gallons	9.57	9.57	14.4	14.4	19.14	19.14	23.92	28.8	23.92	28.8
WATER RESISTANCE	Δt 11°C Pa *	71.3	105	242	353	546	794	1054	1786	1556	2678
* 1 Pa = 0.09807 mm	Δt 20°C Pa *	21.5	31.8	73.2	106.8	165.2	240.2	318.9	540.3	470.7	810
WATER FLOW	Δt 11°C Lit/s	2.28	2.79	3.43	4.19	4.56	5.58	5.71	6.84	6.98	8.38
	Δt 20°C Lit/s	1.254	1.54	1.87	2.3	2.5	3.1	3.14	3.76	3.8	4.6
MINIMUM WATER FLOW @ Δt 25°C Lit/s		1	1.23	1.5	1.84	2	2.45	2.5	3	3.1	3.68
MAXIMUM FLOW TEMPERATURE °C		SEE PAGE 7 - SINGLE PIPE HEADER CONSIDERATIONS									

TABLE 3 Performance Details

MODEL NUMBER		360	440	540	660	720	880	900	1080	1100	1320
NUMBER OF MODULES		2	2	3	3	4	4	5	6	5	6
OUTPUT	kW	106	128	159	192	212	256	265	318	320	384
	Btu/hr x 1000	360	440	540	660	720	880	900	1080	1100	1320
GAS RATE (Based on 1000 Btu/ft³)	m³/hr	13.52	16.52	20.28	24.8	27.04	33	33.8	40.56	41.3	49.56
	ft³/hr	477	584	716	876	956	1167	1194	1432	1458	1750
FLUE GAS VOLUME (TOTAL)	m³/hr	332	407	499	610	664	814	831	996	1017	1220
	ft³/hr x 1000	11775	14390	17660	21590	23550	28780	29435	35173	35980	43180
MAIN BURNER PRESSURE	mbar	9.4	11.2	9.4	11.2	9.4	11.2	9.4	9.4	11.2	11.2
	in.w.g.	3.8	4.5	3.8	4.5	3.8	4.5	3.8	3.8	4.5	4.5
MAIN BURNER INJECTOR SIZE	mm	5.1	4.3	5.1	4.3	5.1	4.3	5.1	5.1	4.3	4.3
MINIMUM INLET GAS PRESSURE	mbar	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5	17.5
	in.w.g.	7	7	7	7	7	7	7	7	7	7
MAXIMUM INLET GAS PRESSURE	mbar	50	50	50	50	50	50	50	50	50	50
	in.w.g.	20	20	20	20	20	20	20	20	20	20

TABLE 4 Technical Data

MODEL NUMBER		360	440	540	660	720	880	900	1080	1100	1320
FLOW TAPPING	POSITION	LEFT HAND SIDE									
	SIZE	2½" BSP TABLE E (SCREWED COUNTER FLANGES PROVIDED)									
RETURN TAPPING	POSITION	RIGHT HAND SIDE									
	SIZE	2½" BSP TABLE E (SCREWED COUNTER FLANGES PROVIDED)									
MAXIMUM WORKING HEAD	BAR	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7
	P.S.I.	40	40	40	40	40	40	40	40	40	40
GAS INLET CONNECTION (PER MODULE)	BSP	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
ELECTRICITY SUPPLY *		240V 50Hz 1 PHASE + NEUTRAL SUPPLY									
POWER REQUIREMENTS	kW (Total)	0.33	0.33	0.5	0.5	0.66	0.66	0.83	1.0	0.83	1.0
NOMINAL FLUE ** HEADER SIZE	mm	300	300	350	350	400	400	450	450	450	500
	in	12	12	14	14	16	16	18	18	18	20
HIGH LEVEL NATURAL VENTILATION ("FREE" GRILLE AREA)	cm²	453	519	612	711	771	903	930	1089	1095	1287
	in²	70	80.5	95	110.2	119.5	140	144	169	170	200
LOW LEVEL NATURAL VENTILATION ("FREE" GRILLE AREA)	cm²	906	1038	1224	1422	1542	1806	1860	2178	2190	2574
	in²	140	161	190	220.4	239	280	288	338	340	400
MECHANICAL VENTILATION REQUIREMENT	m³/sec	0.154	0.188	0.23	0.28	0.31	0.377	0.386	0.46	0.472	0.566
	ft³/min	326	400	490	600	655	800	818	982	1000	1200

* Two power supplies are required to each module for module and pump control, the pump control should include pump overrun. Refer to page 16 for wiring schematic.

** Maximum flue header size shown in accordance with BS 6644: 1990, see page 9/10 for flue system configurations and possible size reductions. Each module has a 200mm (8") flue spigot.

GENERAL

Potterton Modular gas fired atmospheric boilers are available in ten sizes ranging from 106 kW (360,000 Btu/hr) to 384 kW (1,320,000 Btu/hr). They are suitable for use on open vented or sealed systems with a maximum operating pressure of 2.7 bar (90 ft). Refer to BS 6644 regarding the installation of gas fired appliances.

Potterton Modular boilers are delivered to site fully assembled excluding casing to provide a ready to operate system. All that is required is removal of the packaging, connection of the headers and fitting of the casing and services. The headers and individual boiler pumps are an integral part of the modules and require no additional on site support. The boiler module, pump and header are enclosed in an individual module case finished in white powder coat.

The boiler modules, including boiler pump and header, are shrink wrapped on a pallet for easy installation. The casings and aluminium draught diverters are packed on a separate pallet.

For sites with restricted access each module, including pump and header, will pass through a standard 762mm (30 in) doorway.

Each package is itemised against a reference number, eg. 1 of 4 Ref.12665, and only items of the same reference number should be used in the assembly of the Modular boiler

The individual modules incorporate full safety features which include thermoelectric flame detection, control thermostat, high temperature cut-out, gas isolation cock, water isolation and three-way vent valve. In addition each module has it's own boiler circulation pump incorporated within it's modular header.

The heat exchanger consists of a mono-block casting interconnected by flow and return headers. The flue hoods mounted on top of each heat exchanger incorporate access covers which allow cleaning of the flueway.

INSTALLATION

The installation should comply with relevant British Standard Specifications, Codes of Practice and current Building Regulations, together with any special regional requirements of the Local Authorities, Gas Undertaking and Insurance Company. All electrical wiring must comply with I.E.E. Regulations for the Electrical Equipment of Buildings.

The installation of the boiler must be in accordance with the relevant requirements of the:-

Gas Safety (Installation & Use) Regulations: 1984

Health & Safety at Work Act 1974

CP331:3 Low Pressure Installation Pipes

BS 6644: 1990 Installation of Gas Fired Boilers

CP341:300-307 Central Heating by Low Pressure Hot Water

CP342:2 Centralised Hot Water Supply

Also the following British Gas publications:-

IM/11 Flues for Commercial & Industrial Gas Fired Boilers and Air Heaters

IM/2 Purging Procedure for Non-Domestic Installations

IM/5 Soundness Testing for Non-Domestic Installations

In the event of a gas booster being necessary refer to IM/16 "Guidance Notes on the Installation of Gas Pipework, Boosters & Compressors in Customers Premises" and the Gas Act 1972, Schedule 4, Paragraph 18.

Manufacturers notes must not be taken, in any way, as overriding statutory obligations.

CLEARANCES

The minimum clearances required for access, erection and maintenance are:-

Front - 760mm to allow for burner removal

Rear - 300mm

Side - 500mm for access and service

Top - 1000mm for cleaning and draught diverter

ELECTRICAL SUPPLY

The electrical supply should be 240V 50 Hz single phase and must be connected to the boiler through a suitable two pole isolator.

All on site wiring shall conform to I.E.E. Regulations.

Electrical entry to the boiler and pump should be made via the rear of the boiler.

Power Requirements

Typically 0.17 KVA for each module including boiler pump.

BOILER SITING AND BASE

The boiler should be sited in accordance with BS 6644: 1986 with respect to protecting the boiler from damage, air for combustion and ventilation, access, discharge of products of combustion, clearance, temperatures, noise levels, the disposal of boiler water and the effects of flooding of the boiler house or seepage from a roof top boiler house. A level non-combustible floor capable of supporting the weight of the boilers filled with water together with any additional weight bearing down on the base from connections, etc, must be provided. This will typically be a 2" concrete plinth with an area equal to that of the plan of the boiler modules.

VENTILATION

Safe, efficient and trouble free operation of conventionally flued gas boilers is vitally dependent on the provision of an adequate supply of fresh air to the room in which the appliance is installed. Account must also be taken of any other fuel burning appliance existing or to be fitted when designing the ventilation and combustion air systems.

Air Supply by Natural Ventilation

Ventilation by grilles communicating directly with the outside air is required at both high and low levels.

A minimum free area of the grilles for a single boiler are given in Table 4 page 3 , and are based on:-

LOW LEVEL - 540 cm^2 plus 4.5 cm^2 per kilowatt in excess of 60 kW total rated input.

HIGH LEVEL - 270 cm^2 plus 2.25 cm^2 per kilowatt in excess of 60 kW total rated input.

Position ventilation grilles to avoid accidental obstruction by blockage or flooding.

Further guidance on ventilation is provided in BS 6644: 1990.

Air Supply by Mechanical Ventilation

The supply of air to a space housing the boiler by mechanical means should be by mechanical inlet with natural or mechanical extraction. Mechanical extract with natural inlet MUST NOT be used.

Where a mechanical inlet and a mechanical extract system is applied the design extraction rate should be 0.45 m^3/sec per 1000 kW heat input and the inlet rate should be 1.1 m^3/sec per 1000 kW heat input.

The requirements for air supply by mechanical ventilation are given in BS 6644: 1990.

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

IMPORTANT

The use of an extractor fan in the same room as the boilers (or in an adjacent room in communication) can, in certain conditions, adversely effect the safe operation of the boilers. Where such a fan is already fitted (or if it is intended to fit an extractor fan after installation of the appliance) the advice of the Gas Region should be obtained.

Tests for spillage of products from the draught diverter when the extractor fan is running and all doors and windows are shut should be carried out after installation. If spillage is detected, the area of permanent ventilation must be increased.

Contaminated Combustion Air

It is essential that fresh and uncontaminated air is introduced to the boiler for combustion.

Air contaminated with chlorine vapours and halocarbon gases must not be allowed to enter boiler combustion chambers or formation of chlorine gas and hydrochloric acid will create severe and rapid boiler corrosion. There is also a danger that toxic chlorine gas will be emitted from the boiler flue.

In areas where such products are used (and these include degreasants, dry cleaning fluids, refrigerants and aerosol propellants) steps must be taken to isolate the boiler modules from the area by situating in a separate area where fresh air can be introduced. Care should be taken in positioning extract ducts from contaminated areas in relation to boiler house grilles to ensure that cross contamination will not occur.

GAS SUPPLY

Where there is an existing primary gas meter, the appropriate gas supplier/undertaking must be consulted to ensure that the service/meter supply capacity is adequate for the proposed installation.

The gas supply entry to the boiler should be made via the rear of each module.

WATER CIRCULATION SYSTEMS

The Potterton Modular boiler is suitable for use on fully pumped water systems only.

The water circulation system should be indirect and installed in accordance with the relevant parts of British Standards Code of Practice CP342 and BS 6644: 1986. Refer to page 8 for typical hydraulic circuits.

The maximum and minimum temperature differential across the boiler should be 25°C and 10°C. The volume flow and pressure drop across the boilers at 11°C and 20°C are given in Table 2 page 2.

The maximum and minimum working head (not static head) are 2.7 bar (90 ft.w.g.) and 0.1 bar (3 ft.w.g.). Care is needed in siting the pump relative to the cold feed and open vent connections.

If the return water temperature is likely to fall below 55°C under normal operating conditions then back end protection should be provided.

The provision of pump overrun by a time delay system or a thermostat situated in the flow pipe close to the boiler is essential to remove residual heat from the boiler, see Fig.8, page 16.

It is essential that all systems are thoroughly flushed through to remove all debris and scale prior to fitting the boilers. Care should be taken when cleaning systems with descaling agents as, if incorrectly used, the scale and deposits may continue to break up after the system has been flushed and the boiler installed.

The fitting of strainers is strongly recommended, see page 6.

The system should be checked to ensure that there is no raw water make-up. The raw water hardness must not exceed 100 p.p.m. hardness nor must the TDS (salinity) be excessive. A specialist water treatment company should be consulted if in doubt.

If the integrity of the system is in doubt regarding raw water make-up then it is recommended that a water meter is installed in the cold feed to the system and evidence of make-up should then be rectified immediately.

The boilers and system should be protected by suitable frost thermostats and unions and isolating valves should be fitted to the flow and return manifolds so that the boiler can be isolated from the system if the need arises.

SAFETY VALVES

A common safety valve shall be sized to suit the total rated output of the boiler and shall be located between the boiler and the water isolating valve. The size of the valve will be based on the following table:-

SAFETY VALVE SIZES FROM BS 6644: 1990

Modular Boiler Size	Rated Output	Minimum Clear Valve Bore	
		Diameter	Area
	kW	mm	mm^2
360 - 880	45 - 264	19	284
900 - 1100	264 - 352	25	491
1320	352 - 440	32	802

The safety valve shall be fitted in the flow pipe work between the boiler and the next valve in line and the safety valve shall not be more than 1m from the boiler measured along the flow pipe.

The safety valve fitted shall have a maximum setting pressure not greater than 3.4 bar (49.3 p.s.i.).

Safety valves shall be of the direct spring loaded type or dead weight type and shall be set according to the following equation:-

VALVE SETTING = 0.7 + OPERATING PRESSURE
(IN BAR) (IN BAR)

NB: 1 bar = 33.5 ft head or 14.5 lb/in^2

Spring loaded valves are recommended where the static head exceeds 2.5 bar and/or where the boiler may be affected by external vibrations.

The size of the connecting pipe or fitting shall be not less than the nominal size of the valve inlet, or the cross sectional area shall not be less than the aggregate cross sectional area of the valves mounted on it.

The discharge pipe from the safety valve shall terminate in a visible position where discharge will not result in hazard to the user or plant. The size of the discharge pipe shall be not less than the nominal size of the valve outlet.

For further information on safety valves see BS 6644: 1990.

Open Vented Systems

A cold feed should be provided and taken directly from a feed and expansion cistern which shall not supply water for any other purpose.

It shall not be smaller than as specified below and shall be connected to the boiler or boiler side of any valve on the return pipe. The cold feed pipe shall be situated within the building and shall be insulated along those parts of its length where freezing conditions or condensation on the pipe may be expected to occur.

For the Modular boiler system the cold feed connection shall be to the common return pipe upstream of the individual boiler isolating valves. The cold feed to a Modular boiler installation shall be provided with a locakble isolating valve.

Cold Feed Pipe Sizes from BS 6644: 1990			
Modular Boiler Size	Rated Output	Minimum Bore	Nominal Bore
	kW	mm	in.
360 - 440	60 - 150	25	1
540 - 900	150 - 300	32	1¼
1080 - 1320	300 - 600	38	1½

For Modular boiler installations, each bank of boiler in a module shall be fitted with an open vent pipe on the common flow pipe. This vent pipe shall be sized to suit the total capacity of the bank (see table below) and shall be connected between the boiler bank and the safety valve. It shall rise continuously by the shortest practical route to the venting point.

The open vent pipe shall discharge into the feed and expansion cistern above the overflow level and the pipe shall not be fitted with valves (apart from a three-way type such that when it is closed to the common vent pipe the boiler is open to atmosphere through the third port and shall incorporate means of indicating the position of the open port and the nominal bore of the valve shall not be less than that of the open vent pipe pipe in which it is fitted) nor shall there be any obstruction which could prevent safe venting of the boiler.

The vent pipe shall be insulated along those parts of its length where freezing conditions may be expected and shall be situated as far as practicable inside buildings to reduce freezing problems.

Open Vent Pipe Sizes from BS 6644: 1990			
Modular Boiler Size	Rated Output	Minimum Bore	Nominal Bore
	kW	mm	in.
360 - 440	60 - 150	25	1
540 - 900	150 - 300	32	1¼
1080 - 1320	300 - 600	38	1½

For further details see BS 6644: 1990

Water Pressure Gauge (Head Gauge)

The Modular boilers shall be fitted with a gauge that indicates the pressure in metres or water or bars. The gauge shall be fitted on the flow pipe and sited so that it can be easily read and can be easily replaced without draining the boiler/system.

Strainers

When new boilers are connected to old systems the fitting of strainers is strongly recommended to protect the boiler from migrating system debris which could have a detrimental effect on the boiler. If the old system shows signs of excess scale/debris then it is strongly recommended that water treatment is considered.

System Filling

When filling the boiler system with water care should be taken that water does not backwash system debris into the boiler via the flow connection and by-passing any strainers that may have been fitted.

PRINCIPLES OF SINGLE PIPE HEADER SYSTEMS

The advantage of using a single pipe header system is that water flow is minimised through the off cycle boilers and reduces standing losses.

The following points must be observed to achieve a successful system:-

1. Each boiler on the line runs at differing temperatures controlled by the sequence controller sensor. It is therefore necessary to design the system so that the last boiler will not exceed the maximum recommended operating temperature.

   The boiler thermostats do not form part of the normal control and as such just act as a second safety control. It is usual to set the boiler control stats to a point above the sequence control range. This is to ensure that they do not operate under normal control as such operation will cause hunting between boiler stats and sequence control. In the example shown, boiler thermostats should be set to 90°C, ie. their maximum.

2. Main Primary Pump - should be sized to give the design boiler temperature rise (in this case 11°C). This is incorporated in a loop to achieve a constant flow rate.

   Where the heating system does NOT incoporate flow reduction devices such as mixing valves, two port motorised valves, TRVs, etc, a constant volume flow will be achieved by the main heating pump and this therefore can be regarded as the primary loop. This pump must be sized for the design Δt at full output. Where flow reduction devices are incorporated each circuit must be pumped separately from the primary loop as shown, Fig.3 page 8.

3. Boiler Pump Sizing - although the system shown has been sized for a temperature drop of 11°C, sizing the boiler pumps to give 11°C rise across the boilers would mean that the last boiler would need to run above the maximum temperature of 90°C. A temperature rise to give at least 1°C less than the highest boiler stat setting should be sought.

4. Boiler Control - it can be seen that with a decrease in heating load and associated increase in return temperature, the flow temperature will be maintained dependent on the number of boilers running, in the example below this would be:-

   1 BOILER ON - system design flow = 82°C
   return temperature = 80.16°C

   2 BOILERS ON - system design flow = 82°C
   return temperature = 78.33°C

   3 BOILERS ON - system design flow = 82°C
   return temperature = 76.49°C

   4 BOILERS ON - system design flow = 82°C
   return temperature = 74.66°C

   5 BOILERS ON - system design flow = 82°C
   return temperature = 72.83°C

   6 BOILERS ON - system design flow = 82°C
   return temperature = 71°C

It can be seen that the priority sequence does not matter, just the number of boilers that are running. For example, on the above six boiler system No.3 boiler only running would give a flow temperature of 82°C at a return water temperature of 80.16°C, No.4 with No.2 gives 82°C with a return water temperature of 78.33°C.

Therefore priority switching can be achieved without affecting the balance but of course all of the boiler stats must be set to maximum.

It is not recommended to situate the sequence controller sensor in the flow end of the header because the flow temperature can vary depending on the number of boilers operating. A sensor in the flow would need a wide differential, greater than the system temperature rise attributed to the operation of a single module, otherwise hunting will occur. In the case of a two boiler module on a system with an 11°C Δt design temperature, the differential would need to be greater than 11°C + 2 = 5.5°C.

With a constant flow rate primary loop, the sequence controller sensor can sense return temperature and because the system volume provides a buffer and thus an inherent time lag, a narrow proportional band of even 1°C can be achieved without hunting.

The sequence controller must incorporate a pump overrun device for each boiler pump to allow removal of residual heat from each boiler after sequence shut down. In addition, the primary pump should incorporate pump overrun following system shut down.

The high temperature achieved on boiler No.6 means that the boiler is approaching its maximum design conditions for both temperature and flow rate. Therefore six boilers should be regarded as an absolute maximum for single pipe headers.

A system can incorporate several banks of six boilers if required.

The maximum flow temperature is dependent on the number of modules and the temperature difference across each module and is calculated by the following formula.

$$\text{MAX FLOW TEMP } 89°C - [\text{MODULE } \Delta t] + \frac{\text{DESIGN FLOW TEMP - DESIGN RETURN TEMP}}{\text{NUMBER OF MODULES}}$$

$$\text{ie. } 89°C - [8.48] + \frac{82 - 71}{6} = 82.35°C$$

The temperature difference per module and corresponding maximum flow temperature is shown in Table 5.

Sequence control panels are available from Potterton Commercial Products Division at the address on the back page of this manual.

Fig.2 Temperature Distribution (Modular 1320 Illustrated) Boiler Pump Speed 5, Max. Flow Temperature 82.3°C

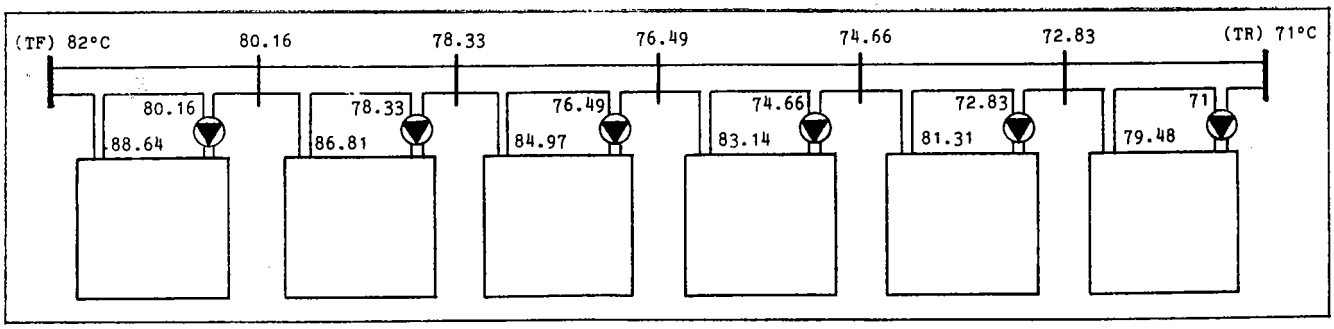
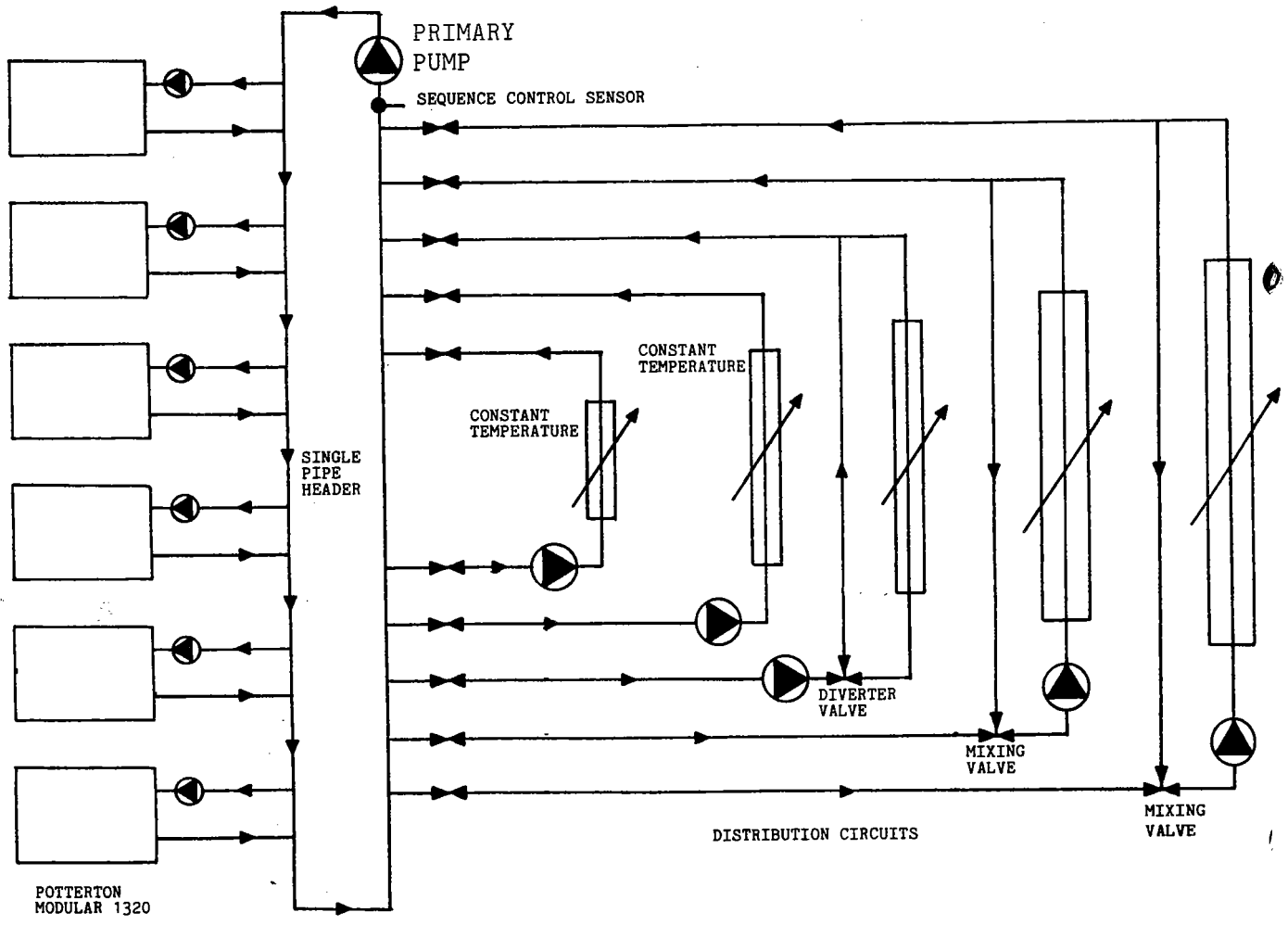


TABLE 5 Boiler Flow Temperatures

MODEL SIZE	MODULE PUMP SPEED							
	2		3		4		5	
	MODULE Δt °C	MAX FLOW TEMP °C	MODULE Δt °C	MAX FLOW TEMP °C	MODULE Δt °C	MAX FLOW TEMP °C	MODULE Δt °C	MAX FLOW TEMP °C
360	10	84.5	9	85.5	7.9	86.6	6.9	87.6
440	12.3	82.2	11	83.5	9.7	84.8	8.48	86
540	10	82.6	9	83.6	7.9	84.7	6.9	85.7
660	12.3	80.6	11	81.6	9.7	82.9	8.48	84.2
720	10	81.75	9	82.75	7.9	83.9	6.9	84.85
880	12.3	79.5	11	80.75	9.7	82.1	8.48	83.3
900	10	81.2	9	82.2	7.9	83.3	6.9	84.3
1080	10	80.8	9	81.8	7.9	83.5	6.9	83.9
1100	12.3	79.00	11	80.2	9.7	81.5	8.48	82.7
1320	12.3	78.5	11	79.8	9.7	81.1	8.48	82.3

NOTE: The maximum flow temperatures are based on a primary flow rate equating to an 11°C Δ t.

Fig.3 Typical Primary Loop System



FLUE SYSTEMS

To allow safe and satisfactory operation the chimney system, which may be common or individual, shall be capable of the complete evacuation of combustion products at all times. The effective height of the chimey terminal(s) above the boiler module flue outlets shall ensure sufficient buoyancy to overcome the resistance of the bends, tees and runs of the flue pipe involved and shall terminate in a down draught free zone.

The number of bends and lengths of horizontal flue pipe used should be kept to a minimum in order to comply with the recommendations made in BS 6644:1986, British Gas publication IM/11 "Flues for Commercial and Industrial Gas Fired Boilers & Air Heaters" and the third edition of the 1956 Clean Air Act Memorandum should be strictly observed where applicable.

For normal installation it is recommended that the number of boilers connected to a common horizontal header is kept to a minimum and examples of flue systems and flue sizes are given on page 9/10. Where it is required that more than three boilers are connected to a common horizontal flue header then the recommendations in British Gas publication IM/11 (as above) should be incorporated in the flue design.

A flue system should be no nearer than 50mm to combustible material except where it passes through it enclosed in a sleeve of non-combustible material with an annular (air) space of 25mm. The chimney design should avoid the formation of excessive quantities of condensate and for this reason it is recommended that all chimneys are insulated and lined. In the case of brick or simlar structures, a stainless steel rigid or flexible flue liner (Grade 304/316) may be used backed up with a 50mm minimum thick layer of vermiculite or perlite granules between the liner and the inner skin of the chimney body. Liners should be sealed at both top and bottom.

A terminal should be used for flues up to 200mm diameter, For other flues effective protection is necessary to prevent entry of rain, snow, leaves, birds, etc while having minimum resistance to the egress of flue products. The flue termination should be at least one metre above the roof surface and away from wind pressure areas where the flue products could re-enter the building, eg. near an openable window, mechanical air inlet, etc.

As the Modular boilers are each supplied with an individual draught diverter, no other draught diverter should be fitted in the system. The integral draught diverters are not load bearing and the flue should be supported by other means. Facilities should be included in the flue system(s) to disconnect the boilers from the flue should it ever be necessary for maintenance, repair or inspection of the flue system. A flue header which connects into the main flue or chimney should be independently supported and the connection soundly made.

Drainage points positioned at the bottom of all vertical chimney sections should be provided. Drain pipes should be no less than 25mm I.D. and should be manufactured from acid condensate resistant material such as stainless steel and positioned so that pipes runs and discharge points are not subject to the effects of frost. These runs should fall with a gradient of at least 3% and at no point must the drain pipe rise above the level of the drainage point connection.

The dimension of the nominal flue size and Modular boiler flue outlet socket are given in Table 4, page 3. A draught of 1 mm.w.g. (0.04 in.w.g.) should be provided at the flue sockets under full load running conditions. The flue should be designed to evacuate the products of combustion when all boiler modules are firing.

FLUE SIZES

Each module can be flued individually using a 200mm (8") flue, details of the module flue spigot are shown in Fig.4 below.

Where it is proposed to use a common flue system then it is recommended that a system as illustrated on page 9 is used. If a different system is required then refer to British Gas publication IM/11 "Flues for Commercial & Industrial Gas Fired Boilers & Air Heaters".

The flue sizes indicated in Table 6 are nominal flue sizes and are for guidance only. The flue should be installed in accordance with the notes of flue systems, in particular the minimum flue draught of 1 mm.w.g. (0.4 in.w.g.) should be provided at the module flue socket under full running conditions.

MODEL	FLUE SIZE	
	* D1 Ømm	** D2 Ømm
360	300	200
440	300	200
540	350	200
660	350	200
720	400	300
880	400	300
900	450	350
1080	450	350
1120	450	350
1320	500	400

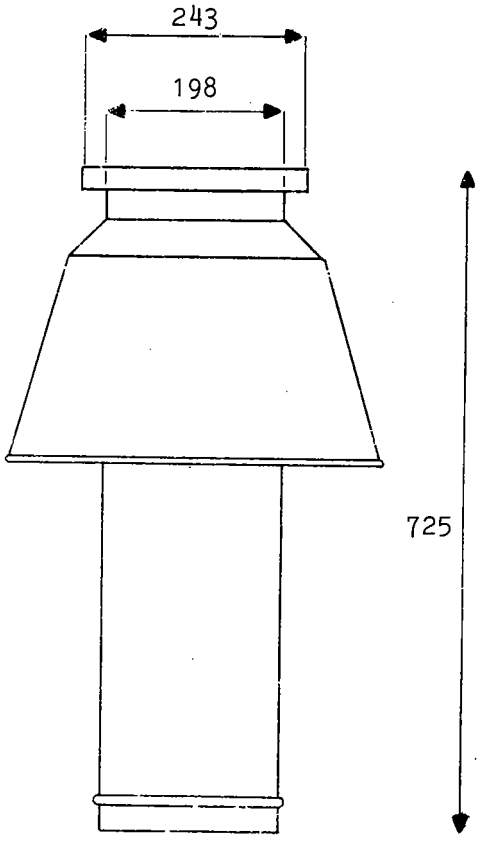
Table 6

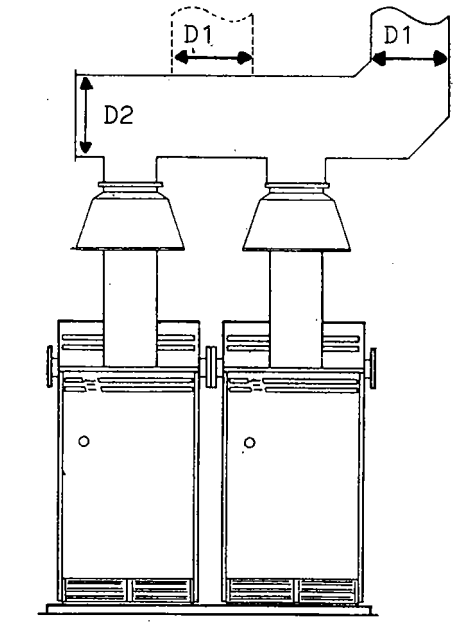
* Nominal flue size to BS 6644. Header may be dimension D1 throughout.

** D2 can only be used with centre flue off takes otherwise D1 must be maintained throughout.

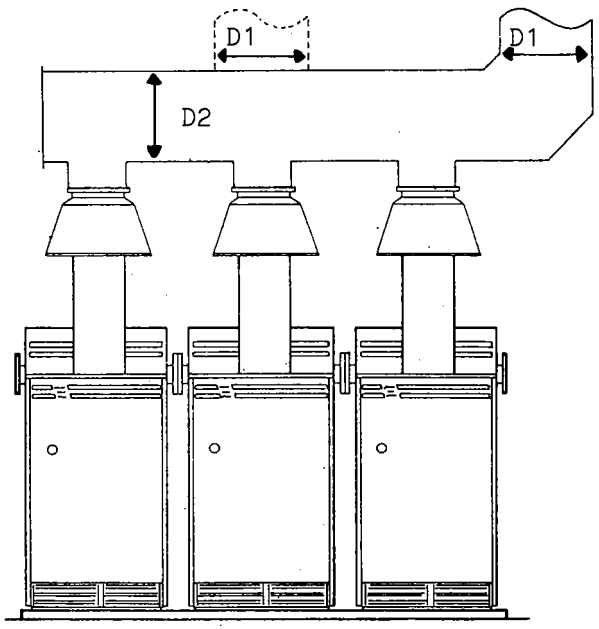
The centre off take can be offset to between boilers for ease of construction.

Fig.4 Draught Diverter Dimensions

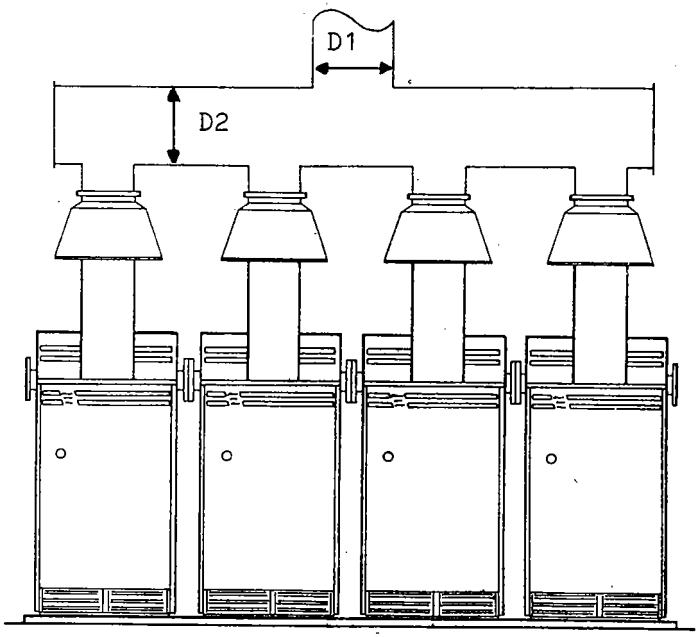




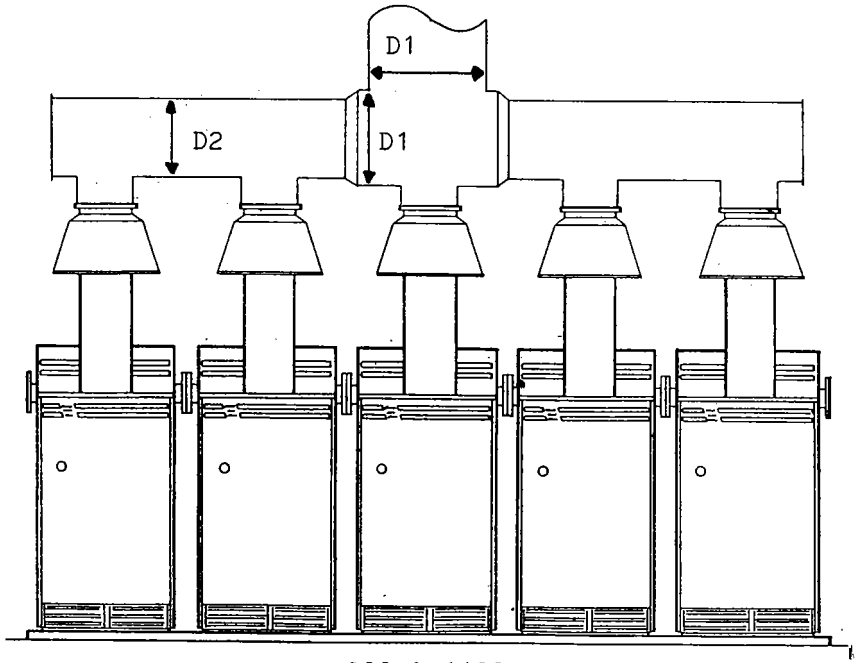
360 & 440



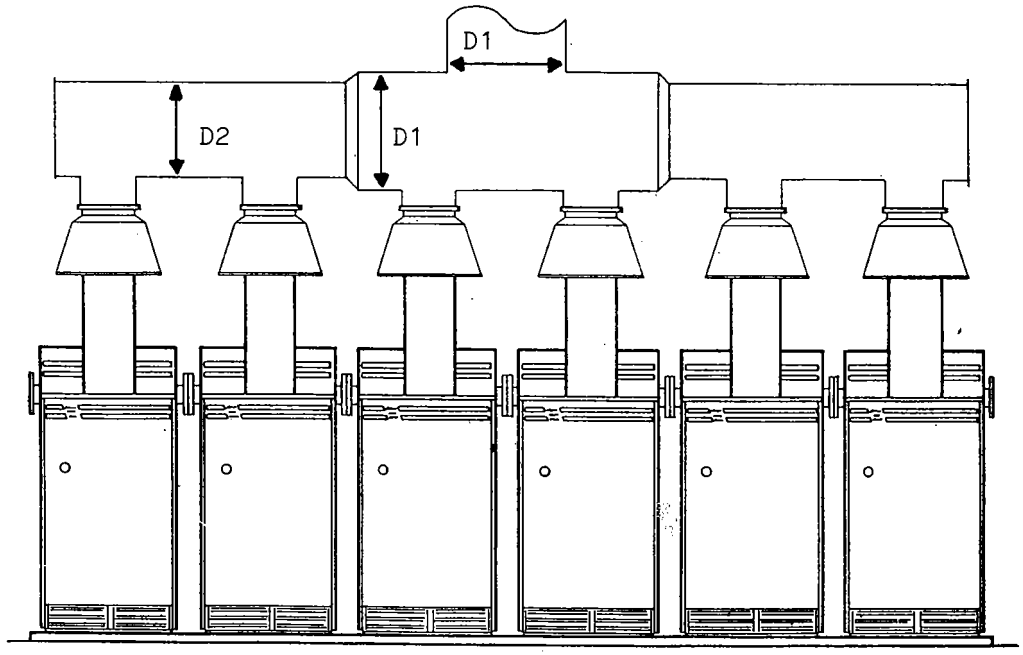
540 & 660



720 & 880



900 & 1100



1080 & 1320

Fig.5 Modular Flue Configurations

FAN DILUTION SYSTEMS

Modular boilers are suitable for fan dilution systems for low level discharge of products of combustion in accordance with BS 6644. See Fig.6 for typical system.

The fan dilution system should be designed to reduce the CO_2 concentration of the vented combustion products to 1% (volumetric) or less.

The discharge velocity from the fan dilution system should be a minimum of 7.5 m/sec and should be at least 2m above ground level for systems up to 1MW input.

The outlet grille should diffuse the products of combustion upwards and be located so that recirculation of combustion products is avoided, in particular the positioning of fan dilution systems in totally enclosed wells or courtyards should be avoided. The inlet and outlet grilles must be located on the same face of the building.

In accordance with BS 6644 the position of the outlet grille should comply with the following:-

1. The outlet grille shall not be less than 2 x 'U'm from any fan assisted intake, where 'U' is the uncorrected chimney height in metres, as defined in the Clean Air Act and is calculated from:-

$$'U' = 1.3\ Q^{0.6}$$

(where 'Q' is the heat input in MW)

2. The outlet shall not be within 2 x 'U' of an openable window or 6 x 'U' from an adjacent building.

3. The fan dilution system should be designed to provide a flue draught at each module of 1-2 mm.w.g.

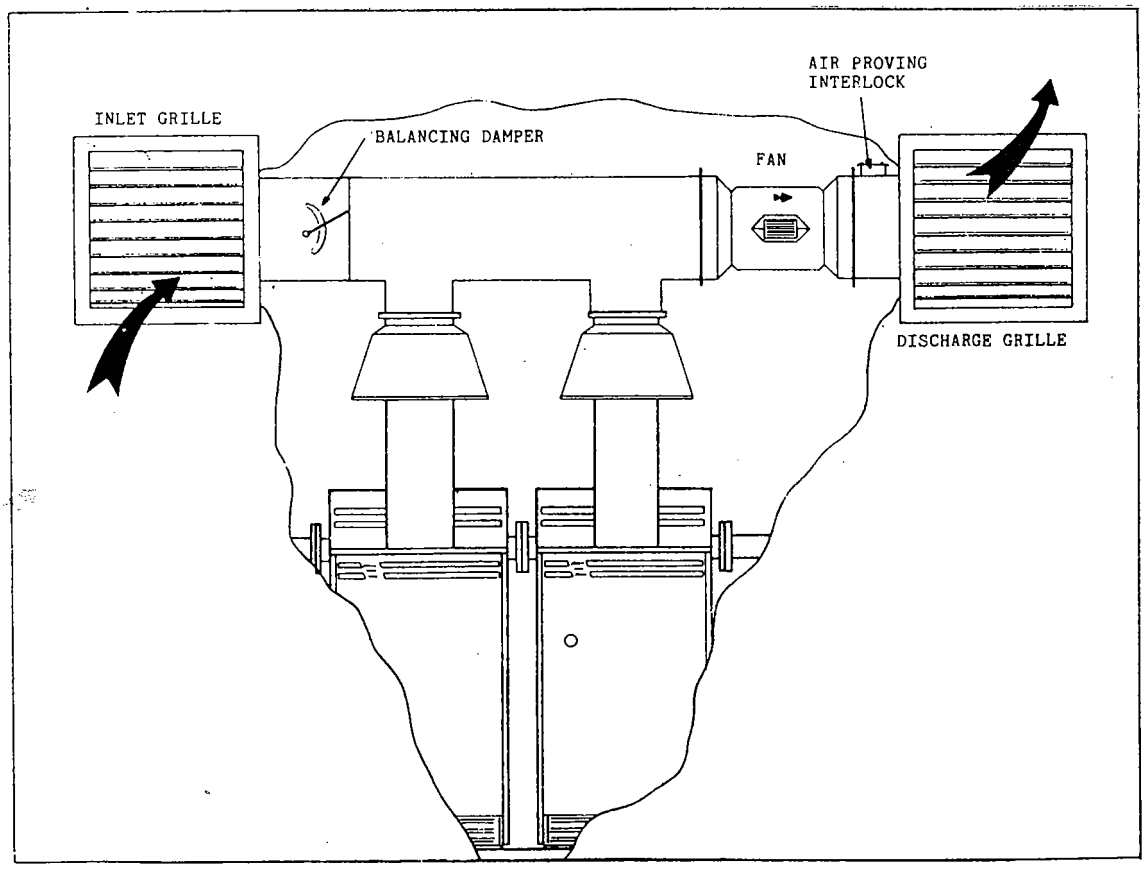
Typical duct sizes, fan volumes and values of 'U' can be found in Table 7 below.

Table 7

MODEL	FLUE VOLUME m^3/sec	DUCT SIZE mm	VELOCITY m/s	PRESSURE DROP mm/M *	'U' ** m
360	0.3757	250	7.6	0.27	0.4
440	0.4537	300	6.42	0.18	0.45
540	0.564	300	7.97	0.22	0.5
660	0.681	350	7.07	0.15	0.57
720	0.75	350	7.8	0.19	0.6
880	0.91	400	7.2	0.15	0.68
900	0.94	400	7.45	0.16	0.69
1080	1.13	450	7.1	0.12	0.77
1100	1.134	450	7.13	0.13	0.78
1320	1.36	500	6.93	0.1	0.863

* Pressure drop/meter at full volume flow in specified duct size.
** Uncorrected chimney height from "Clean Air Act".

Fig.6 Fan Dilution Systems



INSTALLING FULLY ASSEMBLED BOILERS

The fully assembled modules are delivered on one pallet (one module per pallet). The casing packs and draught diverters are packed in separate cardboard cartons on a separate pallet.

Each package is clearly labelled with the size of the boiler and serial number.

For all sizes of boiler remove the shrink wrap polythene and the cardboard protecting the boiler block. The boiler block is secured to the pallet by four screws.

When moving the Modular boiler into position do not use the header for lifting as damage may occur to the boiler and injury to personnel.

Position the boiler modules next to each other on the concrete base and connect the headers together using the M12 nuts, bolts and gaskets provided ensuring that the header remains level. Screwed 2½" BSP Table E counter flanges are provided for connection to the heating system.

Fitting the Casing

Unpack the boiler module casing pack and locate the fastener pack (which can be found wrapped together with the boiler grilles, flue brush and brackets).

Fit the tie bracket (Item 1, Fig.7) to the studs on the rear of the flue hood using M5 nuts and paint cutting washers. DO NOT fully tighten the nuts at this stage.

Fit the front tie bracket (Item 2, Fig,7) to the front of the return header using an M5 screw and paint cutting washer. DO NOT fully tighten the screw at this stage.

Remove the right hand side panel from the casing pack (Item 4, Fig.7) and fit two captive nuts to the bracket in the inside (Item 3, Fig.7).

Part assemble the side panels by joining an extension panel (Item 6, Fig.7) to a side panel (Items 4 and 5, Fig.7) using M5 screws, nuts and paint cutting washers. At this stage DO NOT tighten the upper fixing screw in the left hand side panel.

NOTE: The top return edge of the extension panels have elongated slots.

Position the panels on the boiler base channel supports, locating the holes in the bottom edge of each panel over the raised knibs on the supports.

Attach the additional extension panel to the rear of the assembled side panels ensuring that the front return edge of the side panel is fitted towards the front of the fitted tie bar (Item 1, Fig.7). Secure the rear panels together using M5 screws and nuts ensuring that the two screws are fitted through the tie bracket.

Secure the two rear tie brackets (Item 1, Fig.7) to the rear panels using M5 screws and paint cutting washers.

Secure the earth lead from the electrical junction box to the left hand side panel upper fixing screw previously left loose.

Secure the right hand side panel to the front tie bracket using two No.10 self tapping screws. Fully tighten all screws and nuts.

Use the cable clips to secure the incoming electrical cable beneath the top edge of the appropriate side panel.

Fit two captive nuts to the bottom of the front flange of each side panel (Item 14, Fig.7) then secure the grille (Item 8, Fig.7) hinge pin uppermost between the side panels using four No.8 self tapping screws.

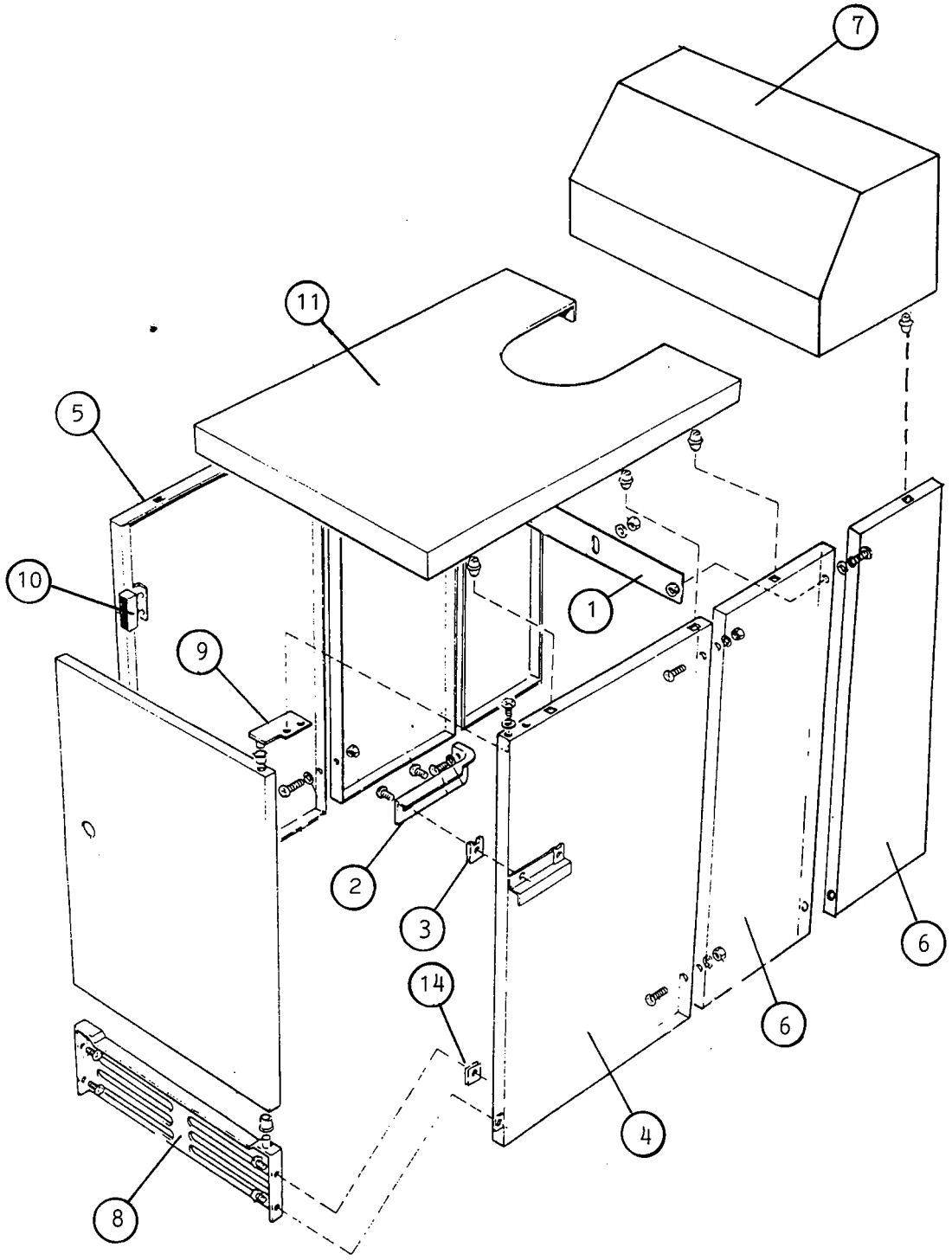
Fit a nylon bush to the upper and lower hinge holes in the door.

Assemble the hinge plate (Item 9, Fig.7) to the top of the door then fit the door to the bottom hinge pin on the plinth. Secure the hinge plate to the right hand side panel using two M5 screws and paint cutting washers locating the plate beneath the top flange of the panel.

Fit the two magnetic catches (Item 10, Fig.7) to the brackets on the left hand side panel.

Fit the nylon panel fasteners to the top panel (Item 11, Fig.7) and header cover (Item 7, Fig.7) then fit the top panel and header cover in position.

Fig.7 Casing Details



COMMISSIONING & OPERATION

Before commencing to commission the boiler check the following:-

1. Electricity supplies to the modules and sequence control panel (where fitted) are OFF, all electrical connections are sound and correctly made.

2. Electrical systems and modules are correctly earthed.

3. Gas supply is tested for soundness and purged of air.

4. Module gas cocks are all turned OFF.

5. Gas supply is turned ON at the meter.

6. Boiler and system are filled with water and vented of air.

7. Flow and return valves to each module are OPEN.

Pre-Lighting

1. Switch on the boiler control panel.

2. Switch on the primary pump and check its operation.

3. Switch on the module boiler pumps and check their operation.

Lighting

1. Ensure the electricity supplies to the modules are turned OFF.

2. Turn boiler thermostat to a high temperature.

3. Press in and release the red OFF button on the gas control valve. This ensures that the valve is in the OFF position.

4. Push aside the small plate in front of the pilot burner then press and hold in the white start button on the gas control valve whilst applying a light to the exposed pilot burner.

   Continue to hold in the start button and check that the pilot has lit, hold in the start button for a further 20 seconds then release it and the pilot should remain alight.

NOTE On first lighting establishment of the pilot flame may be slightly delayed due to the presence of air in the pipework. If the pilot fails to light or goes out at any time, immediately press the OFF button and then release it and wait for three minutes before repeating the lighting procedure. The Buttons on the control valve should not be touched during this period.

5. Switch on the electrical supply to the module and the burner should now light. Switch off the electrical supply.

6. Fit a pressure test gauge to the test point on the burner manifold. Switch on the electricity supply to the module. When all the burners are operating check the pressure. If the burner pressure is not correct to that given in Table 3 page 3 it should be adjusted.

   Also check the gas consumption at the meter if possible and adjust as necessary to obtain the correct gas rate per module to achieve the total gas rate given in Table 3 page 3.

During this period test for soundness between the last burner safety shut off valve and the burner injectors with a soap solution, or any other approved method, and seal any leakages.

Burner Adjustment

Pilot Burner

When correctly set the pilot flame must be sufficient to heat the thermocouple so that the pilot safety device is held in but must not cause the thermocouple to glow bright red. If the pilot needs adjustment, rotate the exposed adjusting screw clockwise to reduce, or anti-clockwise to increase the flame.

Main Burner

Remove the small cheese headed screw on top of the control valve, then turn the screw beneath anti-clockwise to decrease or clockwise to increase the pressure. Refit the screw when the pressure is correct.

Test for spillage of products of combustion at the draught diverter.

Switch off the module, remove the pressure test gauge and retighten the pressure test point.

Repeat the above procedure for each module and then check the gas rate and test for flue spillage with all modules operating.

For boiler houses with natural ventilation the area of the grilles should be checked against the notes given on Ventilation on page 4.

For boiler houses with mechanical ventilation the suitability of the ventilation and extract system should be checked against notes given under Mechanical Ventilation on page 5.

In addition the installer must check that it is not possible for the boiler to operate if either the ventilation or extract fans are not running.

OPERATION OF ANCILLARY CONTROLS

After lighting and commissioning of the boiler the operation of ancillary controls, eg. sequence control panel, time switch, should be checked in accordance with the manufacturers instructions. The operation of the module thermostats and pump overrun should also be checked.

TO SHUT DOWN BOILER

Temporarily

Switch off external control panel, switch off electrical supply to each module and module pump.

Long Periods

As above but in addition switch off the gas cock on each module.

WATER FLOW SWITCH

For boilers fitted with a water flow switch, the installer should check that it is not possible for the boiler to fire when there is no water flow. This may be done by checking that the boiler closes down when the pumps are switched off or the water flow is gated off. Always restore the water flow before completing commissioning.

SERVICE & MAINTENANCE

The frequency of service depends upon the usage and the application of the boiler. This is likely to be at least once a year.

At every service visit the boiler should be cleaned as detailed below. The boiler should be fully re-commissioned as described on page 14 with attention also paid to the following items:-

1. The effectiveness of natural and mechanical ventilation and in particular the safe operation of an air flow switch on a mechanical ventilation system.

2. That the chimney system is sound and adequately evacuating the products of combustion and that there is no spillage of flue products.

3. That the burner gas pressure is correct and that the boiler is still on rate.

4. That the low pressure switch on a booster system, if fitted, is operating correctly.

5. That the water flow switch, if fitted, is operating correctly.

To Clean The Boiler

1. Isolate gas and electrical supplies to the modules.

2. Open the boiler front door.

3. Disconnect the electrical supply to the gas valve using the plug and socket connection.

4. Disconnect the thermocouple interrupter from the gas valve.

5. Disconnect the union on the gas valve inlet, remove the burner fixing screws and remove the burner assembly as a complete unit.

6. Undo the four M10 nuts on the flue hood and remove the clean out cover.

7. Using the flue brush provided brush down through the heat exchanger until clean.

8. Remove the debris from the base of the boiler using a vacuum cleaner or other suitable means.

9. Reassemble the boiler as a reversal of the above, the flue hood clean out door seal should be inspected for soundness and replaced as necessary.

FAULT FINDING

The Modular boiler comprises several atmospheric thermoelectric modules. The modules are fitted with an overheat thermostat and thermocouple interrupter. Should the overheat thermostat operate, the pilot burner will require re-lighting.

If the pilot extinguishes intermittently, check for operation of the overheat stat and the gas rate of the pilot burner.

Ensure that the module pump is operational and incorporates pump overrun.

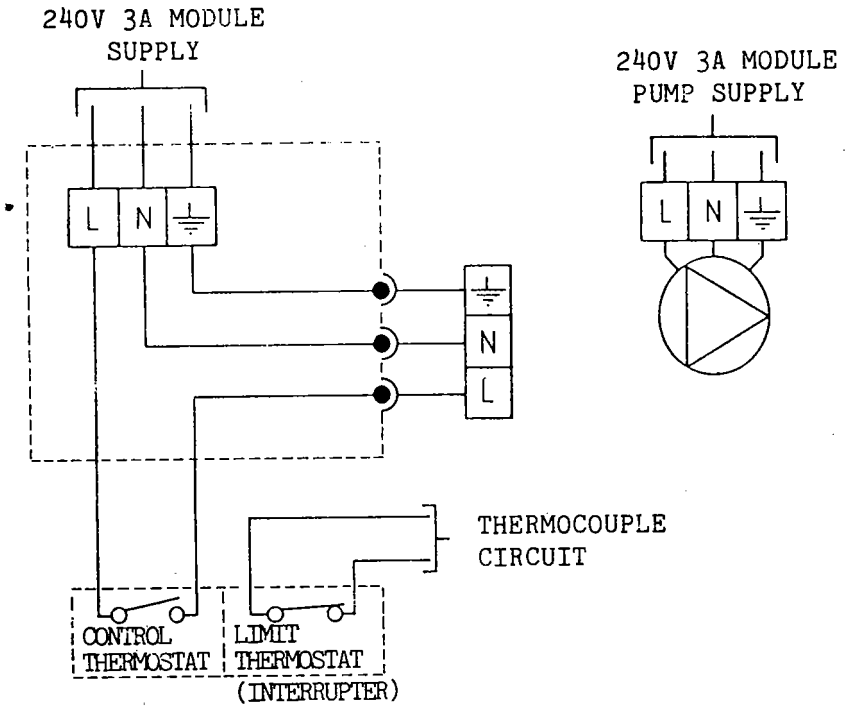
WIRING

Each module of the Modular boiler comprises a burner and module pump as shown in Fig.8.

The modules and pumps should be controlled by a suitable sequence controller that incorporates pump overrun for the module pump. A typical control logic for a three step sequence controller is shown in Fig. 10 . Sequence controllers are available from Potterton Commercial Products Division.

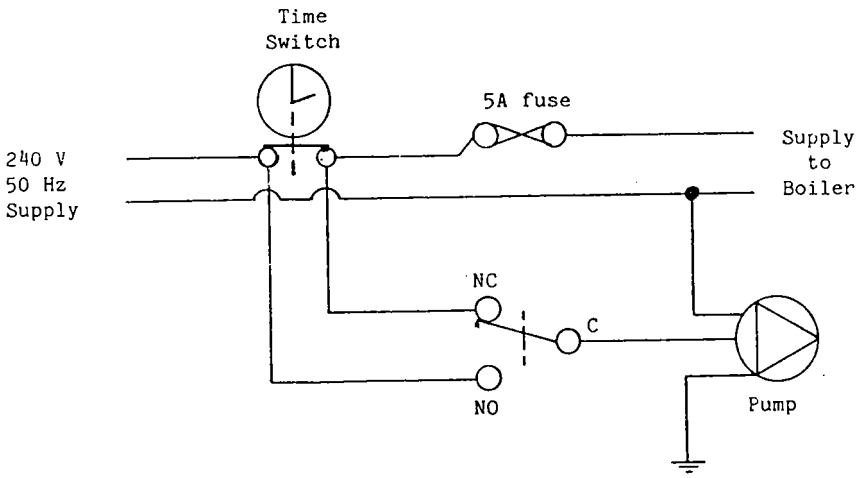
The heating system should include a primary pump incorporating pump overrun. The pump should be controlled from the control panel and the overrun period should either be by a time delay relay or a pipe thermostat. Details of pump overrun incorporating a pipe thermostat are shown in Fig.9.

Fig.8 Module Wiring



Power Requirements: Module - 0.02 Amp
Module Pump - 0.8 Amp

Fig.9 Pump Overrun Using Changeover Pipe Thermostat



NOTE: The electrical loading of the pump should not exceed the contact rating of the pipe thermostat.

Fig.10 Sequence Control Logic

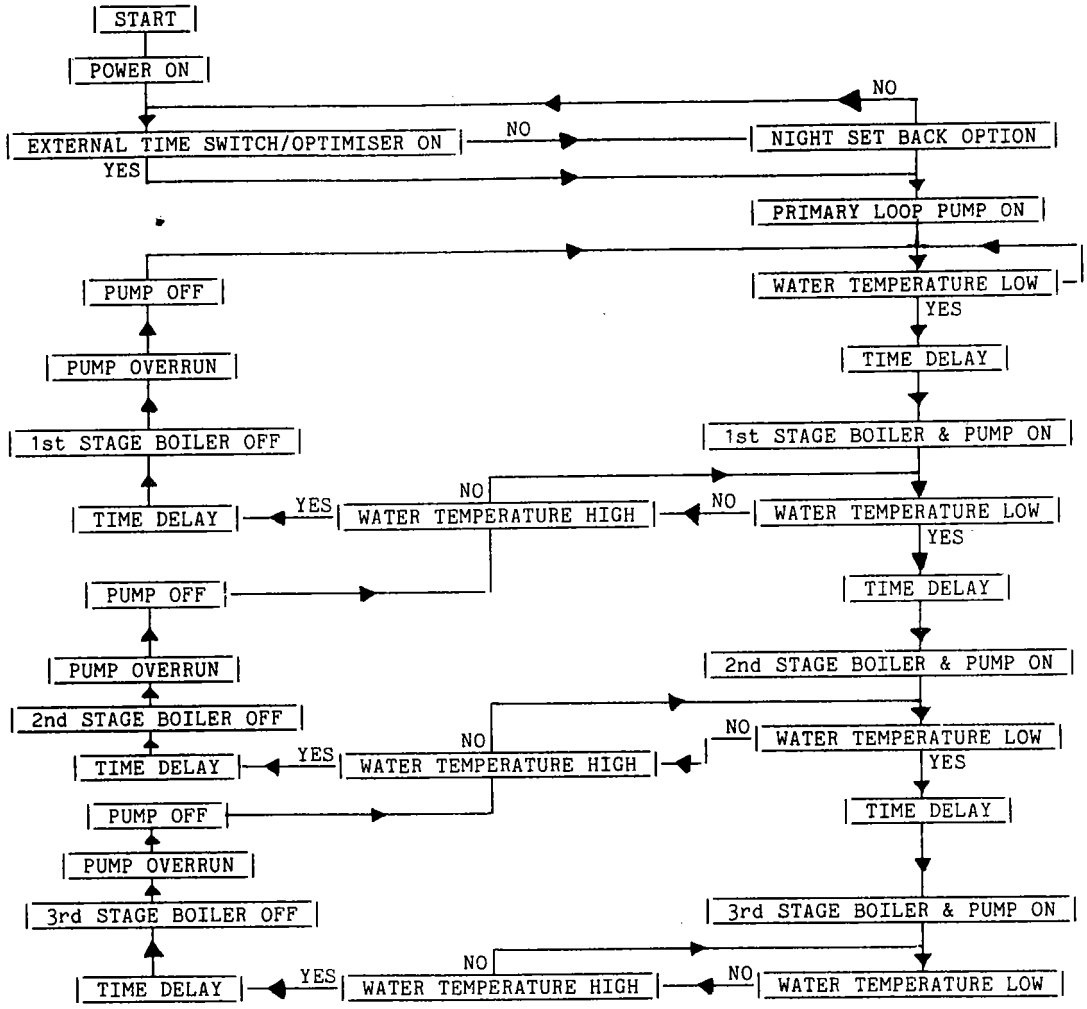
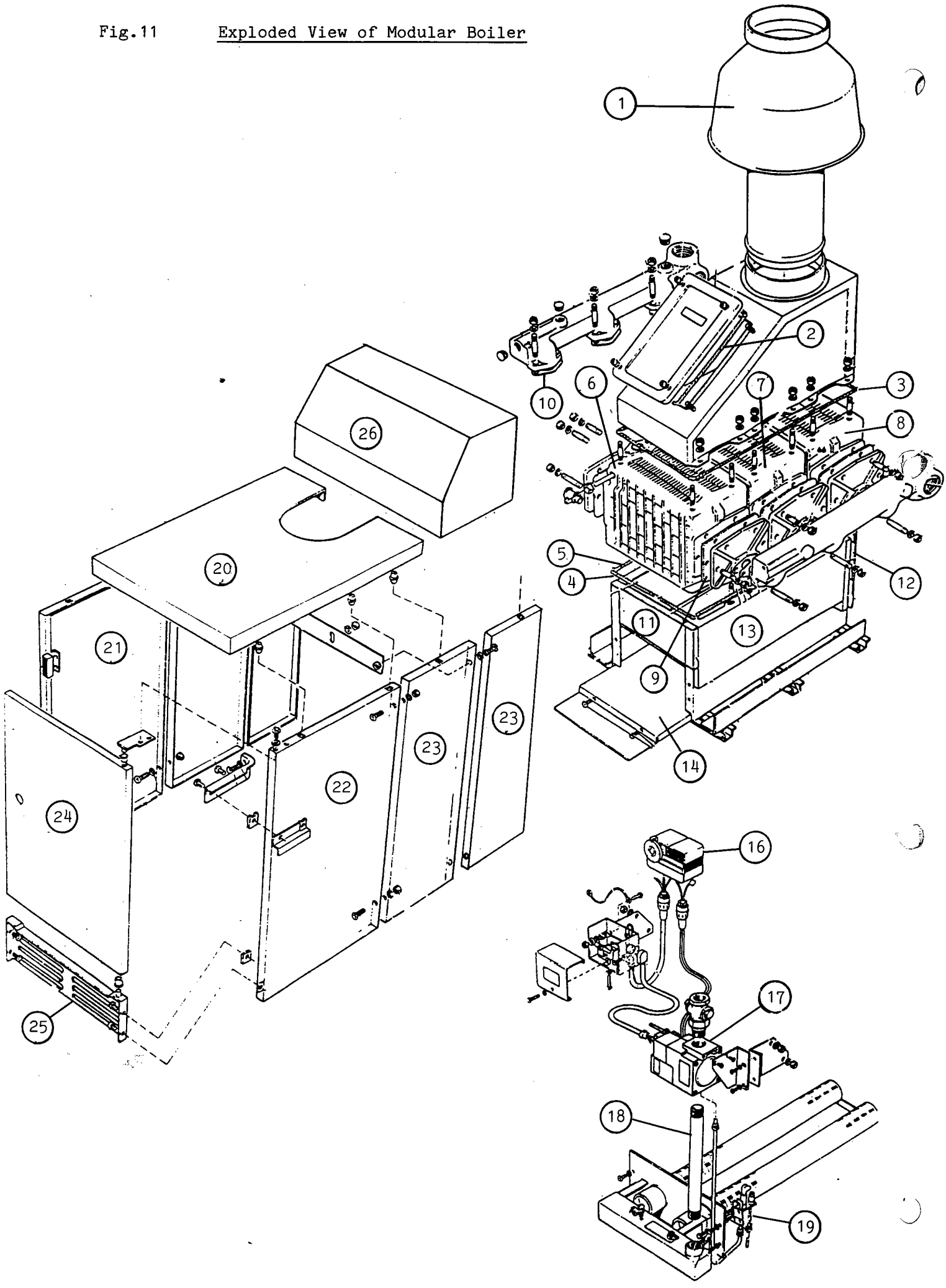


Fig.11 Exploded View of Modular Boiler



PARTS LIST

	Description		Potterton Part No
1	Draught Diverter - 180/220 Module		203413
2	Flue Cover Sealing Rope - ½" Ø x 880mm		650213
3	Flue Hood Sealing Rope - ½" Ø x 1720mm		650213
4	Combustion Chamber Sealing Rope - 5/8" Ø x 555mm		650277
5	Combustion Chamber Sealing Rope - 5/8" Ø x 320mm		650277
6	Heat Exchanger Front (Complete with Studs & Gaskets)		203144
7	Heat Exchanger Intermediate (Complete with Studs & Gaskets)		203145
8	Heat Exchanger Rear (Complete with Studs & Gaskets)		203146
9	Gasket (Cover Plate)		200337
10	Gasket (Header)		203220
11	Combustion Chamber Insulation - Front		203365
12	Combustion Chamber Insulation - Rear		203366
13	Combustion Chamber Insulation - Side		203367
14	Reflector Tray		203368
	Header Manifold	NOT ILLUSTRATED	354971
	Pump Isolating Valve		354972
	Pump - SMC 125 SE		354973
	1" Flexible Pipe Complete with Union		354974
	3-Way Vent Valve		354975
	Header Gasket - Table D 2½" BSP		354976
16	Combined Thermostat		402833
17	Gas Control Valve - ¾" BSP, V4400C 1211		402852
	Replacement Parts for this Valve are:-		
	Mains Solenoid Operator 904750		
	Pressure Regulator 904751		
	Power Unit 904752		
18	Main Burner - Module 180		414548
	Main Burner - Module 220		414549
19	Pilot Assembly		402821
	Main Injector (Module 180) - 5.1mm, Quantity 2		410460
	Main Injector (Module 220) - 4.3mm, Quantity 3		410459
20	Top Casing		203402
21	Side Casing - Left Hand		203407
22	Side Casing - Right Hand		203406
23	Side Casing - Extension		203401
24	Front Door Casing		203084
25	Door Grille		203282
26	Header Cover		
	Flue Brush (Not Illustrated)		200455

For further details on Potterton Commercial boiler products contact the following:-

COMMERCIAL SALES & TECHNICAL ENQUIRIES

Potterton Commercial Products Division
Portobello Works
Emscote Road
WARWICK
CV34 5QU

Tel: (01926) 493420
Fax: (01926) 410523

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Potterton Commercial Service Dept
Unit 5, Newtons Court,
Crossways Business Park,
DARTFORD
Kent DA2 6QL
Tel: (01322) 280388
Fax: (01322) 287575

Northern Region
Potterton Commercial Service Dept
Unit 102, Batley Enterprise Centre,
513 Bradford Road,
BATLEY
West Yorkshire WF17 8JY
Tel: (01924) 420035
Fax: (01924) 420276

Our service offices offer a wide range of specialised services including:-

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- Burner Commissioning for all Fuels
- Boiler Maintenance & Maintenance Contracts
- Breakdown & Repair Services
- Boiler Dismantling & Rejointing
- Burner & Boiler Replacement
- Oil/Gas Conversions
- System Conditioning
- Water Treatment & Descaling
- Packaged Units

SPARES

Potterton Commercial spares are available nationwide through the Potterton Myson Interpart Division at:-

Potterton Myson Parts & Distribution Centre
Queensway
Leamington Spa
Warwickshire
CV31 3RG

Tel: (01926) 880600
Fax: (01926) 880680

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