POTTERTON
COMMERCIAL
PART OF BLUE CIRCLE

POTTERTON ULTIMATE CONDENSING DERWENT

Installation, Operation & Maintenance Manual

August 1995

Fig.1.1 - General Data & Dimensions

Figures in brackets are for the 20 and 22 section boilers.

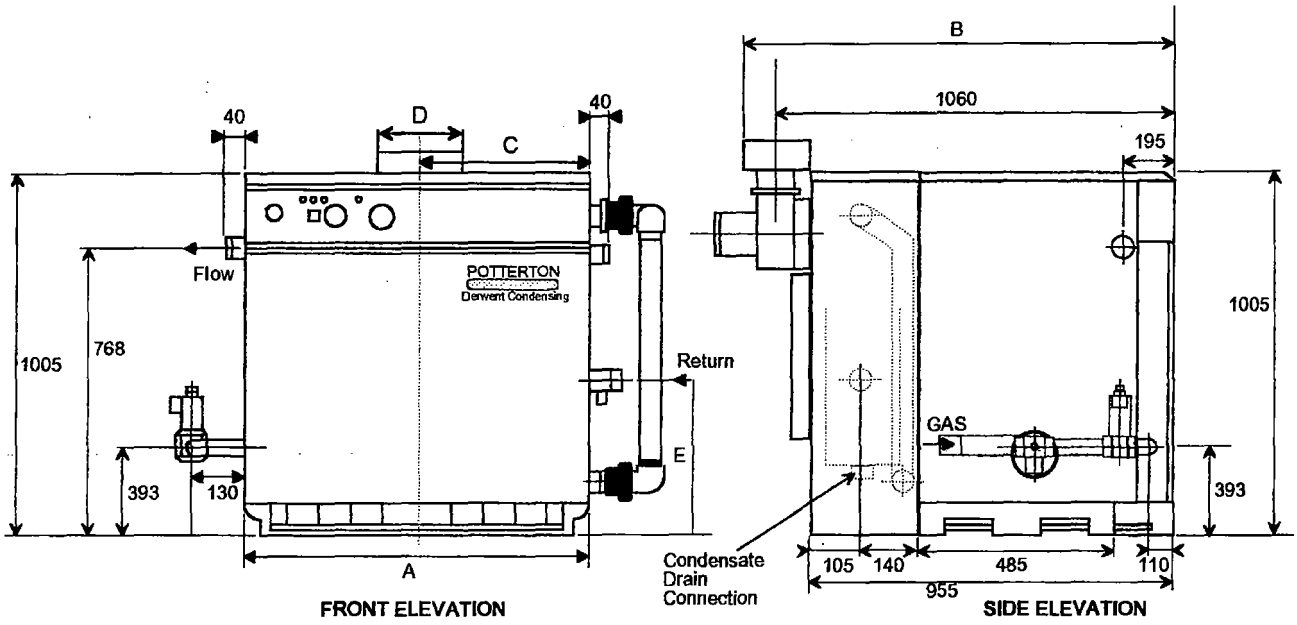

Table 1.1 - Boiler Dimensions

No of Sections		5	7	9	10	12	14	15	17	20	22
A	mm	467	629	791	872	1034	1196	1277	1439	1682	1844
B	mm	1150	1160		1185		1205	1230			
C	mm	162	243	396	436	517	598	639	720	841	922
D	mm	393	200		250			300			
E	mm	464				470				478	
F	mm	1075			1105		1240				

Connections

Water - Flow & Return: 5 to 10 section - 1 1/2" BSP
12 to 17 section - 2" BSP
20 and 22 section - Flanged, mating flange supplied and screwed 2 1/2" BSP.

Drain: 3/4" BSP - drain cock supplied.

Condensate Drain: 32 mm OD

Gas: 5 to 9 section - 1" BSP
10 to 15 section - 1 1/2" BSP
17 to 22 section - 2" BSP

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TABLE 1.2 - Technical Data

	No of Sections	5	7	9	10	12	14	15	17	20	22
	Output @ 60°C Return kw	69	104	138	156	190	225	242	277	315	348
	Output @ 40°C Return kw	74	111	148	167	203	241	259	297	337	373
	Input kw	80	120	160	180	221	261	281	321	365	403
1	Fuel Consumption m^3/hr	7.45	11.19	14.89	16.75	20.59	24.29	26.16	29.89	33.98	37.25
	Maximum Design Pressure	5 Bar									
2	Minimum Operating Pressure	0.1 Bar									
3	Nominal Flue Connection Size mm	180	200		250			300			
4	Flue Gas Volume m^3/hr	106	160	203	240	293	347	373	427	485	536
5	High Level Natural Ventilation to BS 6644 cm^2	315	405	495	540	632	722	767	857	956	1042
5	Low Level Natural Ventilation to BS 6644 cm^2	630	810	990	1080	1264	1444	1534	1714	1912	2084
6	Mechanical Inlet to BS 6644 m^3/sec	0.089	0.133	0.176	0.198	0.243	0.287	0.309	0.353	0.402	0.444
7	Water Connection Size BSP	1 1/2"				2"				2 1/2" Flanged	
8	Water Flow @ 11°C Δt lit/sec	1.5	2.26	3.0	3.39	4.13	4.89	5.26	6.02	6.84	7.56
8	Minimum Water Flow @ 25°C Δt lit/sec	0.65	0.99	1.31	1.48	1.80	2.14	2.30	2.63	3.0	3.3
8	Hydraulic Resistance @ 11°C Δt kPa	7.1	16.5	29.5	34.8	29.8	35.9	40.7	52.2	66.8	81.9
8	Hydraulic Resistance @ 20°C Δt kPa	2.15	4.99	8.92	10.53	9	10.87	12.3	15.8	20.2	24.8
9	Cold Feed Size to BS 6644 Minimum Bore mm	25			32					38	
9	Open Vent Size to BS 6644 Minimum Bore mm	32			38					50	
	Safety Valve Size to BS 6644 Minimum Bore mm	19							25		
2	Maximum Flow Temperature	90°C All Models									
10	Minimum Return Temperature	35°C All Models									
11	Dry Weight kg	327	432	537	589	696	805	857	961	1120	1226
	Water Content kg	41	54	67	73	86	99	106	119	144	158
	Power Requirements	240V 50Hz 1Ph - Isolator & 5A Fuse Required									

For metric to imperial conversions refer to page 1.5

1. FUEL CONSUMPTION

Gas fuel consumption is based on natural gas with a gross calorific value of 38.6 mj/m^3, refer to relevant burner data sheet for minimum and maximum fuel pressures. The gas rate should be corrected for the meter supply pressure particularly on high pressure supplies to prevent overfiring.

2. MINIMUM OPERATING PRESSURE

This is the minimum operating pressure of the boiler with pumps operating (NOT static pressure). The requirements of the Health & Safety Executive guidance note PM5 regarding maximum operating temperatures should be observed. See section 3 for further details.

3. BOILER FLUE CONNECTION

The boilers are provided with a flue adaptor to suit BS 835 flue pipe, see Table 1.2.

4. FLUE GAS VOLUME

Flue gas volumes are given at STP (standard temperature and pressure [15°C and 1013.25 mbar]). Typical flue gas temperatures for flue sizing are 100°C at 8.5% CO_2 , see section 3.

5. NATURAL VENTILATION

The sizes indicated are free grille areas and are based on a single boiler installation. See section 3 for further details on ventilation.

6. MECHANICAL VENTILATION

The volume given is for a single boiler installation. See section 3 for further details on mechanical ventilation.

7. WATER CONNECTION SIZES

The boiler water connections are screwed BS up to 18 section size and 20 and 22 section sizes are flanged 2 1/2" with screwed counter flanges provided. For further details on water connections see Fig.1.1.

NOTE: Only one flow connection and one return connection can be used on each boiler.

8. WATER FLOW RATES

Water flow rates are given for boiler flow and return temperature differences of 11°C. See section 3 for further details of maximum/minimum flow rates and hydraulic resistances at alternative flow rates.

9. COLD FEED/OPEN VENT/SAFETY VALVE SIZES

Sizes indicated are minimum sizes for single boiler installations. See section 3 for further details.

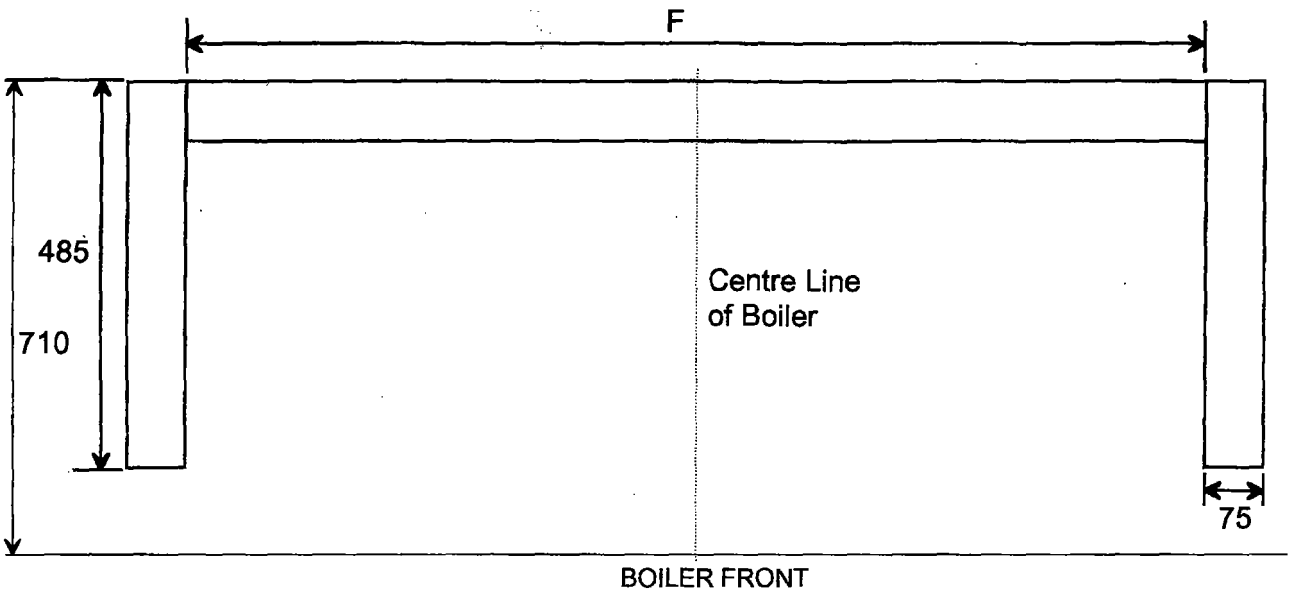
10. MINIMUM RETURN TEMPERATURE

This is the minimum operating return temperature to prevent condensation within the boiler system. See section 3 for further details on back end protection.

11. WEIGHT

The dry weight is inclusive of the gas train.

Fig.1.2 - Steel Base Strip Details (See Section 2 - Boiler Siting & Base)



No of Sections	5	7	9	10	12	14	15	17	20	22
F mm	243	405	567	648	810	972	1053	1215	1458	1620

CLEARANCES

The minimum boiler room clearances for access, erection and maintenance are as follows:-

REAR - 500 mm (20 in) from rear of flue connection.

SIDES - 500 mm (19.7 in) on gas train side, 250 mm on the other.

FRONT- 600mm to allow for burner removal.

TOP - 1000mm to allow for cleaning.

CONDENSATE

The boiler can produce condensate at an approximate rate of 0.1 lit/kwh. The condensate is slightly acidic with a pH of 3.5. Copper pipe should not be used for drainage purposes.

CONVERSION TABLE

IMPERIAL TO METRIC	METRIC TO IMPERIAL
HEAT **1 Therm = 100,000 Btu/hr**	
1 Btu/hr = 0.2931 W	1 kW = 3412 Btu/hr
1 Btu = 1055 J	1 J = 0.0009478 Btu
1 Btu/hr = 0.252 kcal/hr	1 kcal/hr = 3.968 Btu/hr
FUEL CONSUMPTION	**1 dm^3 = 1 LITRE** **1,000 dm^3 = 1m^3**
1 ft^3 = 28.317 dm^3 (litre)	
1 Imp. Gall = 4.546 litre	1 m^3 = 35.3147 ft^3
1 Imp. Gall = 1.2 U.S. Gallon	1 litre = 0.2199 Imp. Gallon
PRESSURE **1 PSI = 2.307 FT**	**1 kPa = 1000 Pa** **1 bar = 1000 mbar = 100 kPa**
1 lb/in^2 = 6895 Pa	1 bar = 33.45 ft.w.g.
1 lb/in^2 = 68.95 mbar	1 kPa = 0.3345 ft.w.g.
1 in.w.g. = 249.1 Pa	1 bar = 14.5 lb/in^2
1 in.w.g. = 2.491 mbar	1 Pa = 0.3858 in.w.g.
1 in.w.g = 25.4 mm.w.g.	1 mm.w.g. = 0.0394 in.w.g.
	1 mm.w.g. = 9.8 Pa
LENGTH	**1m = 1000mm**
1 inch = 25.4mm	1 mm = 0.03937 in
1 ft = 0.3048 m	1 m = 3.281 ft
1 yard = 0.9144 m	1 m = 1.094 yard
1 mile = 1.609 km	1 km = 0.6214 mile
VOLUME	
1 ft^3 = 0.02832 m^3	1 m^3 = 35.3147 ft^3
1 ft^3 = 28.32 litre	1 litre = 0.03531 ft^3
AREA	
1 in^2 = 645.2 mm^2	1 mm^2 = 0.00155 in^2
1 in^2 = 6.452 cm^2	1 cm^2 = 0.155 in^2
1 ft^2 = 929 cm^2	1 m^2 = 1550 in^2
1 ft^2 = 0.0929 m^2	1 m^2 = 10.76 ft^2
FLOW RATE **1 kg/sec = 1 lit/sec @**	**0°C reference temperature**
1 gall/min = 0.07577 lit/sec	1 lit/sec = 13.2 gall/min
1 ft^3/min = 0.4719 lit/sec	1 lit/sec = 2.119 ft^3/min
1 ft^3/min = 0.00047 m^3/sec	1 m^3/sec = 2119 ft^3/min
TEMPERATURE	
°F to °C = ("X"°F - 32) x 0.5556	°C to °F = ("X" °C x 1.8) + 32
TEMPERATURE DIFFERENCE	**1°C = 1°K**
"X"°F x 0.5556 = °C	"X" °C x 1.8 = °F
WEIGHT	
1 lb = 0.4536 kg	1 kg = 2.205 lb
1 cwt = 50.8 kg	1 tonne = 0.9842 ton
1 ton = 1016 kg	1 tonne = 2204.6 lb

GENERAL

The Potterton Ultimate Condensing Derwent boiler is available in ten sizes with outputs ranging from 69 to 348 kw (at 60°C return temperature). Tables 1.1 and 1.2 give kw outputs and technical data for each model.

The Ultimate Condensing Derwent boiler is a special version of the tried and tested Derwent range. This version has been specially developed to produce low NOx emissions coupled with very high efficiencies.

To obtain optimum benefits from this product there are specific requirements with regard to assembly, installation, commissioning, operation and maintenance. Therefore it is essential that assembly, commissioning and maintenance are carried out by Potterton Commercial Division personnel.

The following instructions for site requirements, installation and operation must be strictly observed.

The Ultimate Condensing Derwent boilers are suitable for use on open vented and sealed systems up to a maximum operating pressure of 5 bar (73.5 psig). Refer to the relevant British Standards and Codes of Practice for installing boilers on sealed systems.

For ease of installation the 5 to 15 section boilers are delivered fully assembled (less casing and control panel). The boilers are delivered with air, gas, water and flue connections sealed DO NOT REMOVE ANY PACKAGING UNTIL YOU HAVE READ THE WHOLE MANUAL. THE INSTRUCTIONS ATTACHED TO THE BOILER AND OBSERVED ALL CONDITIONS.

17 to 22 section boilers are delivered unassembled. The boilers must be assembled by Potterton Commercial Division personnel who will ensure that the boiler is air and water tight. Following erection the boiler connections will be sealed. DO NOT REMOVE ANY COVERS OR SEALS UNTIL YOU HAVE READ THE WHOLE MANUAL . THE INSTRUCTIONS ATTACHED TO THE BOILER AND OBSERVED ALL CONDITIONS.

Potterton Commercial cannot accept any responsibility for performance or component failure unless the above is strictly adhered to.

The boiler sections are cast iron with pips to extend the heat exchange area. The secondary heat exchanger is constructed of stainless steel plain tube.

The burners are of the full pre-mix type. All air for combustion is drawn into the burners from a manifold within the boiler casing. The combustion chamber is fully sealed and operates under negative pressure. Products of combustion are drawn through the primary and secondary heat exchangers via a fan assembly at the flue connection.

The fully automatic control system which incorporates full safety features includes combined low fire and control thermostat, limit thermostat, thermometer and on/off switch with lamp.

All models have automatic ignition with a sequential control box and ultra violet flame failure device coupled with an interrupted low energy pilot burner.

The boiler is insulated with glass fibre insulation ranging in thickness from 30 to 60 mm. The casing is finished in a powder coat paint as follows:-

Control Panel - Red - Code RAL 3020
Top and Front - Dark Grey - Code RAL 7011
Sides and Rear - Light Grey - Code RAL 7004

To achieve optimum performance and reliability the specially designed low NOx pre-mix burners must operate in a clean environment. Contamination through airborne debris and dust will not only impair performance but will severely shorten their operating life.

We cannot stress too strongly that the boilers and boiler house must be kept clean both during installation and throughout their operating life.

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:-

Health & Safety at Work Act 1974.

CP331:3 Low Pressure Installation Pipes.

BS 6644: 1991 Installation of Gas Fired Boilers.

BS 779: 1989 Cast Iron Boilers for Central Heating & Indirect Hot Water Supply (Rated Output 44 kw and above).

BS 7074: 1989 Part 2 Application, Selection & Installation of Expansion Vessels & Ancillary Equipment for Sealed Water Systems.

PM5 Health & Safety Executive Guidance Note for Automatically Controlled Steam & Hot Water Boilers.

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

CP342:2 Centralised Hot Water Supply.

Also for gas fired appliances the following British Gas publications:-

Gas Safety (Installation & Use) Regulations 1984.

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

IM/2 Purging Procedure for Non-Domestic Installations.

CIBSE AM3 Applications Manual for Condensing Boilers.

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 and 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.

BOILER SITING AND BASE

The boiler should be sited in accordance with BS 6644: 1991 with respect to protecting the boiler from damage, air for combustion and ventilation, discharge of products of combustion, clearances for service and access, 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. See section 1 for required boiler clearances for service and access.

A level non-combustible floor capable of supporting the weight of the boiler filled with water, see Table 1.2A and 1.2B, together with any additional weight bearing down on the base from connections, etc, must be provided. This will typically be a 50mm concrete plinth with an area equal to that of the plan of the boiler.

Steel strips should be provided (not supplied by Potterton Commercial) to support the left and right hand section feet and the back feet of the intermediate sections, see Fig.1.2, page 1.5 for details. These strips should typically be 3" wide and 1/8" thick.

It is not recommended to install commercial boilers in kitchens or living areas.

The boiler must only be installed in a clean dust free boiler house. Walls and floors should be sealed and painted and pipework insulation should be clad in a suitable easy clean material.

Particular attention should be given to the quality of the air supply which should be clean. See section 3.

ELECTRICAL SUPPLY

A 240V 50Hz AC single phase electrical supply is required. The incoming mains supply should be terminated via a double pole fused isolator to the boiler, see Section 6 for wiring details. A 5A fused supply is required for all sizes.

Power Requirements

The electrical supply is to feed control circuits and gas valves. Typical loading is:-

5 section - 300 W
7-12 section - 330 W
14-22 section - 525 W

The external supply must be fitted with a 5A fuse.

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

FUEL SUPPLY

NATURAL GAS

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 burner gas connection sizes are given in Section 1 and minimum and maximum inlet pressures are 17.5 mbar and 35 mbar respectively.

The gas supply pipe should be sized to allow the minimum operating pressure to be available at the burner inlet under full running conditions. The pipe should be sized to prevent excessive pressure drops under full running conditions.

Where gas boosters are required attention is drawn to the Gas Act 1986, Schedule 5, Part II, paragraph 8 (4). Guidance is given in IM/16 "Guidance Notes on the Installation of Gas Pipework, Boosters and Compressors in Customers Premises" published by British Gas Plc. The gas booster should be electrically interlocked to the burner.

VENTILATION

Safe, efficient and trouble free operation of conventionally flued 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.

The air supplied for boiler house ventilation shall be such that the maximum temperatures within the boiler house shall not exceed 25°C at floor level, 32°C at mid level (1.5m above floor level) and 40°C at ceiling level (or 100mm below ceiling level). Refer to BS 6644: 1991 for further details.

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 1.2. Where plant is likely to used at or near maximum capacity during the summer months, additional ventilation may be required to prevent excess temperatures.

For boiler houses with multiple boiler installations the minimum ventilation should be sized in accordance with BS 6644 as follows:-

Low Level (inlet) - 540 cm^2 plus 4.5 cm^2 per kW in excess of 60 kW total rated input.

High Level (outlet) - 270 cm^2 plus 2.25 cm^2 per kW in excess of 60 kW total rated input.

The above calculated areas are "free" grille areas. Grilles should be designed to minimise high velocity air streams within the boiler house. Typical free area of a standard louvre is approximately 50%.

For boilers installed in a basement boiler house or similar, it is recommended that the inlet air be ducted to low level in ducting not less than equal to the free grille area. Should the inlet duct length be excessive then mechanical ventilation should be used.

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

Further guidance on ventilation for gas appliances is provided by BS 6644: 1991.

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 ventilation with natural inlet must not be used, see Table 1.2 for mechanical inlet ventilation rates for single boiler applications

For multiple boiler installations the ventilation rate is based on a 1.1 m^3/sec flow rate per 1000 kW total rated input. The design extract rate should be based on 0.45 m^3/sec flow rate per 1000 kW total rated input.

For mechanical ventilation systems, an automatic control should be provided to cut off the supply of fuel to the boiler(s) 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 boiler (or in an adjacent room in communication) can, in certain conditions, adversely affect the safe operation of the boiler and therefore must be avoided.**

Tests for spillage of products from the flue system when the extractor fan is running and all doors and windows are shut should be carried out during commissioning. 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 CFC 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 from the area by situating it 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.

Dust contamination in the combustion air may cause blockage of the burner slots or localised overheating of the burner surface leading to premature failure. It is recommended that where there is a likelihood of a contaminated air supply a fanned filtered air supply should be used. A differential pressure switch fitted across the filter should shut down the boiler if the air supply is reduced owing to partial blockage of the filter.

FLUE SYSTEM

The flue gas temperature at the boiler flue outlet will be no greater than 10°C above the return water temperature under normal running conditions. Buoyancy in the stack will be relatively low and the boiler fan is therefore designed to overcome the flue resistance.

The flue gases will be at or near saturation point under all running conditions and droplets of condensate will precipitate onto the walls of the flue system.

The flue system must be corrosion resistant, water and gas tight and free draining. Typically a flue constructed in Grade 316 stainless steel with gasketed joints will be suitable.

Most flexible flue liners are unsuitable as they are not water and gas tight under positive pressure. Advice on flexible flue liners should be sought from a flue specialist.

The use of insulated or twin wall type flue systems should be avoided. The only necessity for insulation is for personnel protection. Exposed surfaces of the flue would reach a maximum temperature of 90°C.

The number of bends used should be kept to a minimum and any bends used should be of the slow radius type, 90° tees must not be used.

All flue runs should be run to allow free drainage and all low points must be drained. Materials used for drainage should be stainless steel or plastic. Avoid the use of copper.

Flue systems should meet the applicable sections of BS 6644: 1991, British Gas Publication IM11, CIBSE Application Manual AM3 on condensing boilers, the Third Edition of the 1956 Clean Air Act Memorandum and the Building Regulations should be strictly observed.

Care should be exercised with tall flue systems to ensure that excess buoyancy is not created. If this is unavoidable draught stabilisers should be considered plus a time delay device to prevent the boiler short cycling otherwise frequent nuisance lockouts may occur.

Flue Terminals

Flue sizes 200mm and above should not be fitted with a flue terminal below 200mm and should be fitted with a mesh ball with mesh spacings of 25mm.

In all cases the discharge must be vertically upwards to allow the plume to dissipate.

Table 3.1 shows maximum flue lengths for each boiler using up to four slow radius bends. Do not use more than four bends.

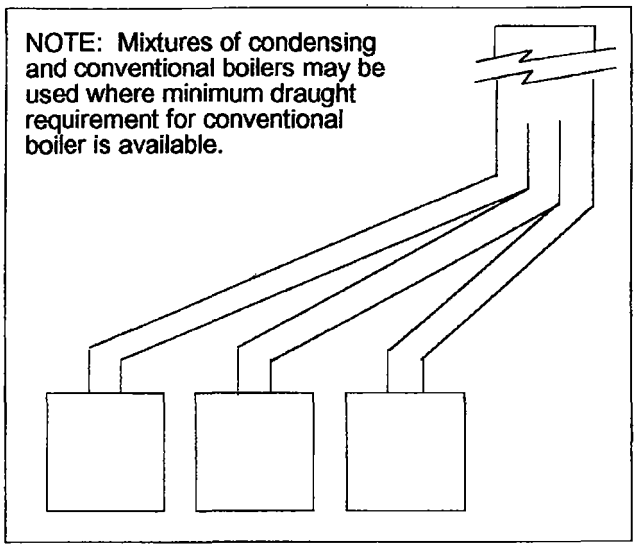
Table 3.1 - Maximum Flue Lengths

Boiler Size	Boiler Flue Connection Size mm	Flue Diameter mm	Maximum Flue Length (m)			
			No Bends	2 Bends	3 Bends	4 Bends
5	180	150	20	16	13	12
		180	58	52	48	44
7	200	150	6	2	-	-
		180	20	18	16	-
		200	40	35	32	30
9	200	150	1	-	-	-
		180	9	4.5	2	-
		200	20	14	11.5	9
		250	72	64	60	56
10	250	180	6	1	-	-
		200	14	9	6	3
		250	55	49	45	42
12	250	180	2.5	-	-	-
		200	8	3	-	-
		250	38	32	28	25
		300	84	78	74	70
14	250	200	3	-	-	-
		250	21	15	12	9
		300	60	58	54	50
15	300	250	17	11	7.5	4.5
		300	55	47	43	40
17	300	250	11	5	-	-
		300	40	32	28	24
20	300	250	7	1	-	-
		300	29	21	17	13.5
		350	72	63	60	57
22	300	250	5	-	-	-
		300	24	17	13	9
		350	63	54	50	46

MULTIPLE BOILER FLUES

It is best to run separate flues from individual boilers. However, if this is unavoidable extreme care must be exercised to prevent flue gases being forced through off cycle boilers. This can be achieved by using a flue dilution system as described in the following section or by running individual connections to discharge vertically into a common stack, see Fig.3.1. The common stack size should be the equivalent cross sectional area of the total boiler connections.

Fig.3.1 - Multiple Boilers Utilising Individual Flues into a Common Stack



FAN DILUTION SYSTEMS

Potterton Commercial gas fired boilers are suitable for fan dilution systems for low level discharge of products of combustion in accordance with BS 6644.

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.

Fan dilution systems must be interlocked to prevent operation of the boilers unless adequate air flow is proved.

In accordance with BS 6644: 1991 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 boiler of 1-2 mm.w.g.

Typical duct sizes, fan volumes and values of 'U' are given in Table 3.2.

It is important that adequate ventilation is provided into the boiler house especially as a proportion of the dilution air is drawn through the air dampers on condensing appliances. Ventilation requirements must take this into account and may require larger louvres.

It should be noted however that flue dilution systems on condensing boilers may run below dew point especially during the winter months. The dilution system should therefore be constructed in corrosion resistant material, eg. 316 grade stainless steel, and be water and gas tight. All low points including the fan housing should be fitted with adequate drain facilities. The fan should also be constructed from corrosion resistant material.

Care should be exercised when siting the discharge grille as condensate droplets may be discharged in cold weather.

Table 3.2 - Typical Duct Sizes & Fan Volumes

Boiler Size	Input kw	* Flue Volume @ 1% CO_2 m^3/sec	Duct Size (Diameter) mm	Velocity m^3/sec	** "U" m
5 / 222	80	0.216	200	6.86	0.286
7 / 331	120	0.323	250	6.59	0.364
9 / 440	160	0.431	300	6.1	0.433
10 / 495	180	0.485	300	6.86	0.465
12 / 607	221	0.595	350	6.19	0.526
14 / 717	261	0.703	350	7.31	0.581
15 / 771	281	0.757	350	7.87	0.607
17 / 880	321	0.865	400	6.88	0.657
20 / 1003	365	0.983	400	7.83	0.71
22 / 1109	403	1.0857	450	6.83	0.754

* Flue gas volume @ 1013.25 mbar and 15°C. Typical diluted flue gas temperature is 10°C above ambient.

** Uncorrected chimney height from "Clean Air Act".

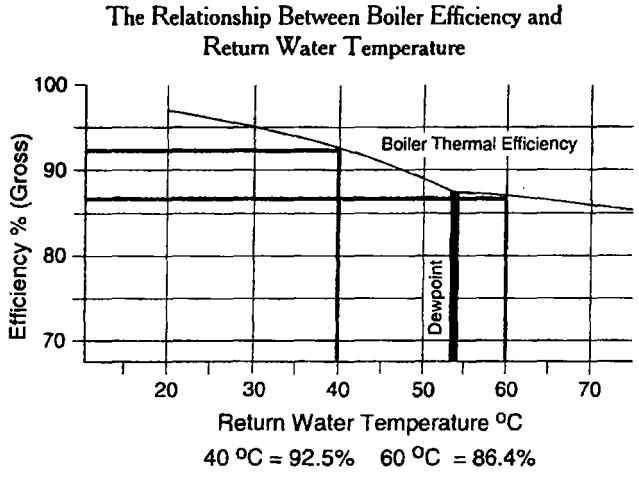
The efficiency of the Potterton Ultimate Condensing Derwent boiler varies with the temperature of the return water below 54°C, see Fig.3.2.

Typically the boiler will have a gross efficiency of 86.4% at 54°C return water temperature and above. The efficiency rises to 92.5% at a return temperature of 40°C.

Care should be exercised when designing a system incorporating condensing boilers to ensure that the boiler return temperature is as low as possible (but above 30°C under normal running conditions).

The boilers are ideally suited to the use of direct weather compensated control systems which reduce the required flow and return temperatures to suit the reducing load on rising outside temperatures. For further information see Potterton Technical Bulletin No.3, General Information on Systems with Condensing Boilers.

Fig.3.2 - Condensing Boiler Efficiency Curve



WATER CIRCULATION SYSTEMS

The water circulation systems should be indirect and installed in accordance with the relevant parts of British Standards Codes of Practice CP342 and BS 6644: 1991.

The maximum and minimum design temperature differential across the boiler should be 20°C and 10°C and the boiler should be prevented from operating with flow rates giving a temperature difference across the boiler greater than 25°C based on the full boiler output. Boilers operating under constant flow conditions can be more accurately controlled and are not subject to excessive temperature stresses.

On systems with variable flow rates due to flow reducing devices, ie. TRVs, zone valves, etc, or where the minimum heat demand, ie. summer domestic hot water load, does not achieve the minimum boiler flow rate then consideration shall be given to incorporating a primary loop system. For further information see Potterton Publication Technical Bulletin No.1 Issue 2.

The flow rate and hydraulic resistance for an 11°C boiler temperature rise are given in Table 1.4, alternatively, flow rates through boilers can be calculated from:-

$$\text{FLOW (lit/sec)} = \frac{\text{kW (Boiler Output)}}{4.2 \times \text{Boiler Temperature Rise °C}}$$

The minimum design flow rate relates to a 20°C boiler temperature rise and should not be misinterpreted as the system design temperature drop particularly where systems have been designed with stand-by capacity.

The hydraulic resistance of the boiler is proportional for flow rates equating to a boiler temperature of between 10°C and 20°C. The hydraulic resistance at 11°C is given in Table 1.4, hydraulic resistance at alternative flow rates can be calculated from:-

$$R_2 = R_1 \times \left(\frac{T_1}{T_2}\right)^2$$

where:- R_1 = Boiler Resistance at 11°C
R_2 = Boiler Resistance at T_2°C
T_1 = 11°C
T_2 = Alternative Boiler Temperature Rise

The maximum and minimum design pressures are 5 bar (170 ft.w.g.) and 0.3 bar (10 ft.w.g.). Care is needed in siting the pump relative to the cold feed and open vent connections. (NOTE: The above are not static pressures).

The boiler flow and return connection sizes are given in Table 1.2.

It is recommended that the system is designed to give a constant boiler flow rate. For further information on water circulation systems see Potterton Publication Technical Bulletin No.1 Issue 2.

Boiler Condensation

Care should be exercised to keep the boiler return temperature above 30°C. Prolonged operation at very low temperatures may cause the boiler to condense in the primary heat exchanger with the possibility that combustion conditions may be affected.

BOILER PROTECTION

The provision of pump overrun by a time delay relay or a thermostat situated in the flow pipe close to the boiler is essential to remove residual heat from the boiler, see Fig.6.2, Section 6.

The boiler and system should be protected by suitable frost thermostats.

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.

Strainers

Migrating sludge and debris will have a detrimental effect on the life and operation of the boiler and this must not occur. If all debris cannot be removed, strainers and/or other devices should be fitted. Consideration should be given to water treatment and inhibitors to maintain water quality. Migration of system debris or scaling of the waterways will impair the life expectancy of the boiler sections.

System Filling

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

It is essential that all systems are thoroughly flushed through with a flushing agent to remove all debris and scale prior to fitting the boilers. Cleaning systems with acidic descaling agents is not generally recommended as, if incorrectly used, the scale and deposits may continue to break up after the system has been flushed and the boiler installed.

Where the boiler is being installed as a replacement for an existing boiler it is recommended that where possible sections of the removed boiler are cut open and internally examined to determine the presence of scale or system debris to foresee and rectify any potential problems for the new boilers.

The fitting of strainers is strongly recommended.

The system should be checked to ensure that there is no raw water make-up. It is strongly recommended that a suitable water meter is fitted to the cold feed supply of the boiler system to monitor for unregulated water make-up.

The quality of the water in both the heating system and the water supply should be checked to ensure that the hardness (100 ppm) and salinity (TDS) are not excessive. In the case of systems containing aluminium components the pH should be monitored to prevent corrosion.

On systems where unregulated raw water make-up or system debris is known to exist but remedial action cannot be implemented then consideration should be given to installing a heat exchanger to isolate the boiler from the water system to protect the boiler otherwise premature failure may occur.

A specialist water treatment company should be consulted if in doubt.

Open Vented Systems

Maximum Operating Temperature

The maximum operating temperature of a system is dependent on the operating pressure. The minimum design operating pressure (not static) at any point of a system should be sufficient to prevent boiling within any part of the heating system and the boiler control thermostat should be set to provide a 17°C safety margin below the saturated steam absolute pressure given in Table 3.3 corresponding to the minimum design operating pressure.

COLD FEED SUPPLY

A cold feed pipe 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 in Table 1.4 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 it's length where freezing conditions or condensation may be expected to occur.

For multiple and modular boiler installations the cold feed connection shall be either to the common return pipe upstream of the individual boiler isolating valves or to each individual boiler return pipe downstream of the isolating valve.

The cold feed to a multiple or modular boiler installation shall be provided with a lockable isolating valve and sized in accordance with Table 3.5.

Table 3.3 - Saturated Steam Pressures

Temperature °C	110	120	130	140	160
Saturated Steam Absolute Pressure *	1.43 Bar	1.98 Bar	2.7 Bar	3.61 Bar	6.18 Bar

* NOTE: **These are absolute pressures not gauge. For gauge pressure 1 bar must be subtracted.**

EXAMPLE: A boiler system with a maximum operating temperature of 93°C and allowing for a safety margin of 17°C the temperature would be 93°C + 17°C = 110°C. From above the minimum gauge pressure within the system should be 1.43 bar - 1 bar = 0.43 bar.

CISTERN SIZING

The cistern should be sized to accommodate the water expansion in the system from 0°C to the maximum operating temperature. Where the volume of the system is not known then it can be estimated at 12 litres per kw of design load.

For systems with a maximum operating temperatures of up to 100°C the water can expand by 4% (for systems up to 140°C the expansion is 8%). Therefore assuming a system loading of 1000 kw, the approximate system volume is 1000 x 12 litres = 12000 litres and the expansion of water in a system with a maximum design temperature of 100°C is 4% x 12000 = 480 litres. In this instance the cistern should have an expansion capacity between the cold fill level and the overflow pipe of 480 litres (minimum), (overflow should be 80mm above the highest expansion level).

IMPORTANT: **The water level in the cistern or expansion tank should be minimal on cold charge to allow expansion without discharge from the overflow between cold and hot operating conditions.**

TABLE 3.4

Open Vent Pipe Sizes from BS 6644: 1991		
Rated Output	Minimum Bore	Nominal Size (DN[1])
kw	mm	mm
45 - 60	25	25
61 - 150	32	32
151 - 300	38	40
301 - 600	50	50
[1] Steel pipe sizes complying with medium or heavy quality of BS 1387		
For rated outputs above 600 kW the minimum cross sectional area of the venting pipe A (in mm^2) shall be determined as:- 3.5 x QR where QR is the rated output in kW		

Multiple or modular boiler installations shall have an open vent pipe or pipes of the size stated in Table 3.4 as appropriate. Individual open vent pipes shall be either routed independently to the venting point or be connected to a common open vent pipe of appropriate size for the total rated heat input of the installation (see Table 1.4 for individual boiler open vent sizes). The open vent pipe 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 for a single boiler installation the pipe shall not be fitted with valves (apart from a 3-way type such that when closed the boiler is open to atmosphere through the third port and shall incorporate means of indicating the position of the open port. The nominal bore of the valve shall be not less than that of the open vent 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 it's length where freezing may be expected and shall be situated as far as is practicable inside the building to reduce freezing problems.

TABLE 3.5

Cold Feed Pipe Sizes from BS 6644: 1991		
Rated Output	Minimum Bore	Nominal Size (DN[1])
kw	mm	mm
Below 60	19	20
60 - 150	25	25
150 - 300	32	32
300 - 600	38	40
Over 600	50	50
[1] Steel pipe sizes complying with medium or heavy quality of BS 1387		

For further details see BS 6644: 1991.

Boiler Safety Valves

Each boiler, whether in single or multiple installations, shall be fitted with an individual safety valve complying with BS 6759 Part 1.

In the case of modular boiler installations each bank of boilers shall be provided with a common safety valve sized in accordance Table 3.6 to suit the total rated output of the boiler bank. Any boiler in a modular installation that can be isolated from the water supply shall be fitted with an individual safety valve.

The 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. See Table 3.6 for safety valve sizes on open vented systems. Refer to notes on sealed systems for safety valve sizes on sealed systems.

TABLE 3.6

Safety Valve sizes to BS 6644 1991
(Open Vented Systems Only)

Rated Output	Nominal Size	Minimum Area (A)
kw	mm	mm^2
45 - 264	19	284
265 - 352	25	491
353 - 440	32	802
441 - 528	40	1135
529 - 732	50	2050
733 - 1142	65	3210
1142 - 1640	80	4540

Alternatively:-
'A' can be calculated from:- $A = \frac{R}{0.659 \times P1 \times Kdr}$

where R = Boiler Output in kW
P1 = 7.6
Kdr = The derated coefficient of discharge available from the safety valve manufacturer.
A = Flow Area in mm^2

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

Boiler safety valves shall be of the direct spring loaded type or dead weight type and the maximum setting shall not exceed the following equation:-

MAXIMUM VALVE SETTING (IN BAR) = 0.1 + MAX BOILER DESIGN PRESSURE (IN BAR)

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

On systems containing components with lower maximum operating pressures than the boiler, the rating of the safety valve should be reduced accordingly or additional safety valves provided to protect these items.

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 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 guidance on safety valve sizes see BS 6644: 1991.

SEALED SYSTEMS

General

Potterton Commercial boilers are suitable for use on sealed systems designed in accordance with BS 6644: 1991 and BS 6880 Part 2. In addition, reference should be made to the Health & Safety Executive guidance note PM5 "Automatically Controlled Steam & Hot Water Boilers".

Expansion Vessels

The sealed system should incorporate an expansion vessel complying with BS 4814 sized to accommodate the volumetric hydraulic expansion of the heating system between 0°C and the temperature setting of the overheat thermostat without exceeding the maximum design pressure of the boiler. The position of the expansion vessel(s) should be such that the manufacturers maximum operating temperature is not exceeded and the provision of an anti gravity tank may be required for systems operating above 100°C. In addition, the position of the expansion vessel(s) should prevent inadvertant isolation of the boiler system from the expansion vessel, where isolating devices, ie, valves, etc, are incorporated between the boiler(s) and the expansion vessel these should be capable of being locked in the open position during normal operation. See BS 6880 Part 2 for further details.

System Filling & Water Make-Up

The sealed system should incorporate suitable means for initial filling, ie. pressure boost pump, which shall comply with the local water authority bye laws and the cold feed supply to the system should incorporate a non-return valve and an isolating valve with the capability of being locked in the open position during normal operation. An automatic air vent should be provided between the isolating valve and the non-return valve and provision should be made within the sealed system to allow automatic replacement of water lost from the system. This may include a pressure boost pump and associated controls or an independent primary feed cistern. However, it is recommended that a suitable device such as a water meter is installed to detect unregulated raw water make-up. See BS 6644: 1991 for further details on provision for filling and make-up on sealed systems.

Maximum Operating Temperature

The maximum operating temperature of a sealed system is dependent on the operating pressure. The minimum design operating pressure (not static) at any point of a sealed system should be sufficient to prevent boiling within the any part of the heating system and the boiler control thermostat should be set to provide a 17°C safety margin below the absolute saturated steam pressure given in Table 3.3 corresponding to the minimum design operating pressure.

The boiler overheat thermostat should provide a safety margin of at least 6°C below the absolute saturated steam pressure.

Minimum Operating Pressure

The minimum operating pressure (not static) or cold fill pressure should be sufficient to maintain a positive pressure within the heating system to prevent boiling as detailed above. Care should be taken in positioning of the circulating pump(s) relative to the expansion vessel (zero or null point) particularly on systems where a high hydraulic resistance is present to ensure that operation of the pump does not cause a reduction in operating pressure at any point in the system below the minimum operating pressure.

A low water pressure cut off device shall be incorporated to prevent operation of the boiler plant on low water pressure. The pressure cut off device should be set at a pressure to prevent boiling in any part of the heating system while operating at the design working temperature.

Consideration should be given to the positioning of safety valves, low level cut off devices and automatic air vents relative to the minimum operating pressure to ensure that the influence of pump operation does not cause or prevent operation of these devices.

Maximum Operating Pressure

The boiler plant should be prevented from operating when the system pressure rises to within 0.35 bar of the safety valve setting.

Safety Valves

The safety valve on a sealed system should be sized in accordance with the following equation.

$$A = \frac{R}{2.5 \times Kdr}$$

where R = Boiler output in kW
Kdr = the derated coefficient of discharge available from the safety valve manufacturer.
A = flow area in mm

NOISE LEVEL

The Ultimate Condensing Derwent atmospheric boilers are regarded as being commercially quiet, ie. < NR65, under typical operating conditions. These boilers are only suitable for installing in dedicated boiler rooms.

BOILER INSTALLATION

Both boilers delivered fully assembled and boilers erected by Potterton Commercial on site will be fitted with seals and covers to protect the boiler from ingress of dust and dirt. Also, two copies of the following notice are attached to the boiler the contents of which should be read in conjunction with this manual and must be strictly observed.

ULTIMATE DERWENT LOW NOx CONDENSING BOILER
Site Instruction

The Ultimate Condensing Derwent boiler has been designed to operate with high efficiency and low emissions. To achieve optimum performance the following items should be noted and adhered to.

1. The boiler should be installed using good boiler house installation practice with at least the minimum specified boiler house ventilation. The boiler air intakes, gas connection, flue outlet and fan motor have been sealed at works to prevent ingress of dust during installation.

2. Do not remove the air intake covers of fan motor cover. This will be done by the Potterton Commercial engineer at the time of commissioning.

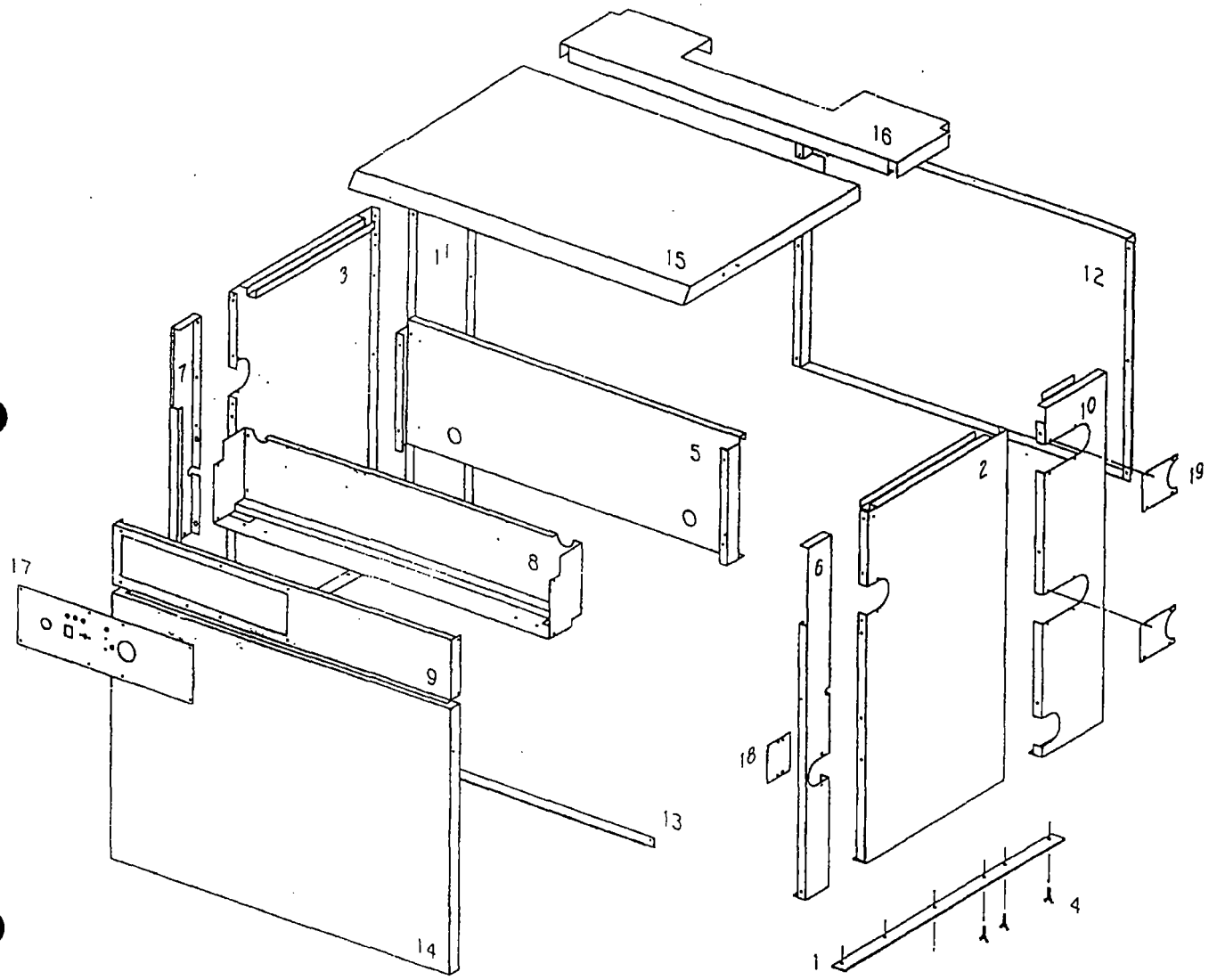
   The other seals should only be removed immediately prior to making the final connections.

3. To obtain optimum performance and reliability the boiler must be run in a boiler house free of air-bourne builders work dust and dirt especially insulation fibres.

   Ideally the boiler should only be commissioned when all other trades have completed their works. However, it is possible to commission prior to other trades finishing if the boiler house is cleaned, we will then commission and shut down the plant and re-seal the intakes to allow other trades to complete. The sealing caps must only be removed after all finishing trades have completed their works and the boiler house cleaned.

4. Care should be taken to ensure that ventilation air to the boiler house is clean and not severely contaminated. Ensure that the sealing caps are kept in a safe place to allow the boiler to be re-sealed in the event of future work being carried out in the boiler house which may create air-bourne dust.

Fig.4.1 - General Arrangement of Casing



1 Side Panel Fixing
2 Right Hand Side Panel
3 Left Hand Side Panel
4 Side Panel Fixing Fastener
5 Front Panel
6 Right Hand Side Panel - Front
7 Left Hand Side Panel - Front
8 Control Panel
9 Control Panel - Front
10 Right Hand Side Panel - Rear - 5 to 18 section
Right Hand Side Panel - Rear - 20 & 22 section
11 Left Hand Side Panel
12 Rear Panel
13 Door Hanger
14 Front Door
15 Top Panel - Front
16 Top Panel - Rear
17 Control Panel Fascia - 5 to 7 section
Control Panel Fascia - 8 to 22 section
18 Fillet Piece - Front
19 Fillet Piece - Rear - 5 to 18 section
Fillet Piece - Rear - 20 & 22 section

Assembly of Casing

See Fig.4.1 for number references.

1. Take one of the side panels (items 2 and 3) which have cut-outs in them to accommodate the flow manifold connections and fit the side casing support brackets (item 1). This should be fitted inside the panel between the lagging and the bottom edge. Make sure that the fixing holes between the support bracket and casing panel align and the support bracket (item 4) projects 78mm in front of the panel for securing the side panel extension pieces (item 6 and 7).

   Once the 78mm projection has been achieved the side extension panels (item 6 and 7) can be secured using the screws provided.

2. Secure the casing support bracket to the side casing panel with the wing nuts provided.

   AT THIS STAGE DO NOT FULLY TIGHTEN THE WING NUTS.

3. The side panel can now be positioned on the appropriate side of the boiler engaging the wing nuts into the lugs on the end section. Tighten the wing nuts and support the panel.

4. Repeat the above procedure for the other side panel.

5. The rear side extension panels (item 10 and 11) can now be fitted. This is done by fixing the bottom of the panel with wing nuts to the casing support bracket and with two self tapping screws to the side panel already fitted.

6. Take the aluminium front combustion chamber panel (item 5) complete with boiler data plate and secure it between and just behind the front of the two side panels using four self tapping screws provided in the casing pack.

7. Take the rear panel (item 12) and secure it between the two side panels using four self tapping screws provided.

8. Remove the control panel from it's box and remove the two securing screws from the ends so that the panel fascia hinges forward.

9. In order to fit the control panel casing the side extension panels have to be eased out to allow the gas train plug and cable to pass through the cut-out provided. The control panel can now be fitted.

10. Secure the control panel with four self tapping screws at top and bottom on both ends of the panel.

11. Fit the two pieces of insulation provided between the control panel and the flue hood (see Fig.4.3).

12. Place the top panel (item 15) and rear top panel (item 16) in position so that they locate securely on the side panels. Fasten with the self tapping screws provided.

13. At this stage the two thermostat phials, thermometer phials, dummy pieces and sealing strip should be positioned in the thermostat pocket. Ensure that the retaining clip is fitted to keep the phials in place. See Fig.4.2.

14. Fit the front door locating strip (item 13) with two self tapping screws into the front of the side casing extension panels.

15. Fit the front door panel into the locating strip.

16. After completion of casing fitting fit the fillet pieces (item 18 and 19) with the screws provided.

19. From the control panel fit the following connections:-

a) Pin connector to fan at rear of boiler.
b) Pin connector to gas train.
c) Ignition lead to plug on electrode on pilot assembly.
d) Earth spade connector to pilot assembly.
e) Earth post connector to the flow manifold stud provided with extra nut and washer.
f) Fit UV cell into bracket provided. Adjust cell point towards hole in burner front plate (see below) and then tighten bracket sufficiently to prevent movement.

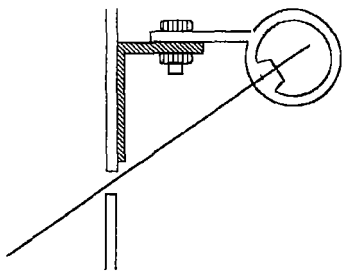


Fig.4.2 - Thermostat/Thermometer Phial Assembly

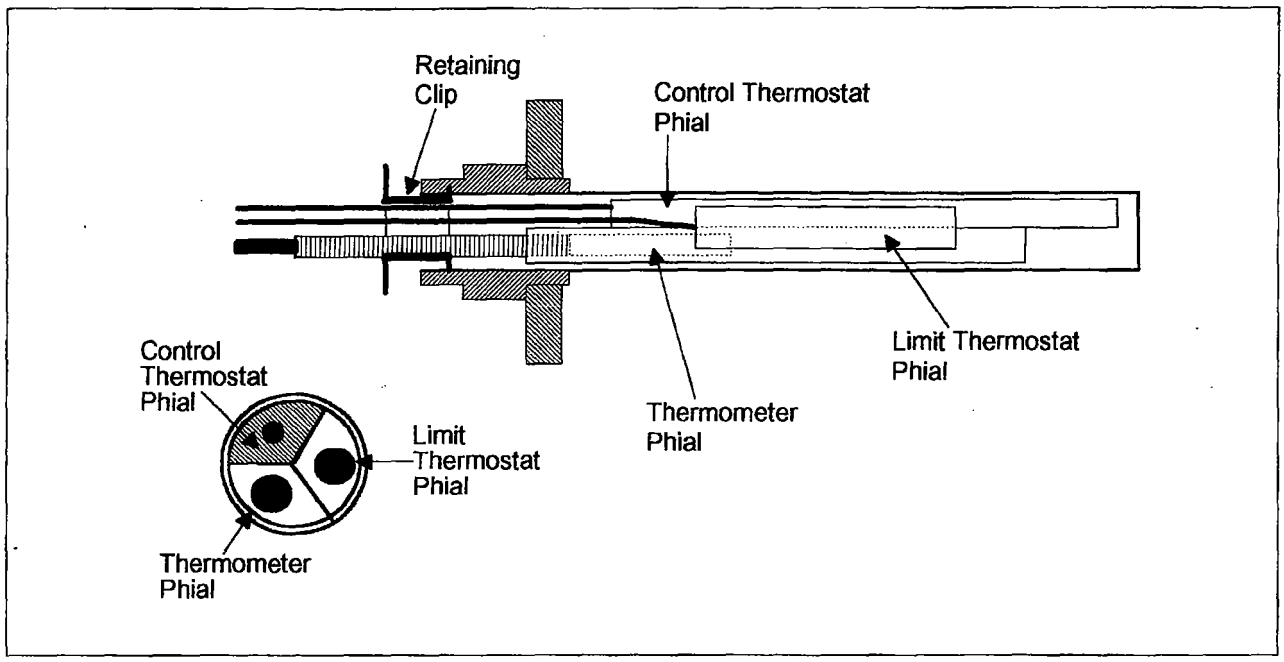
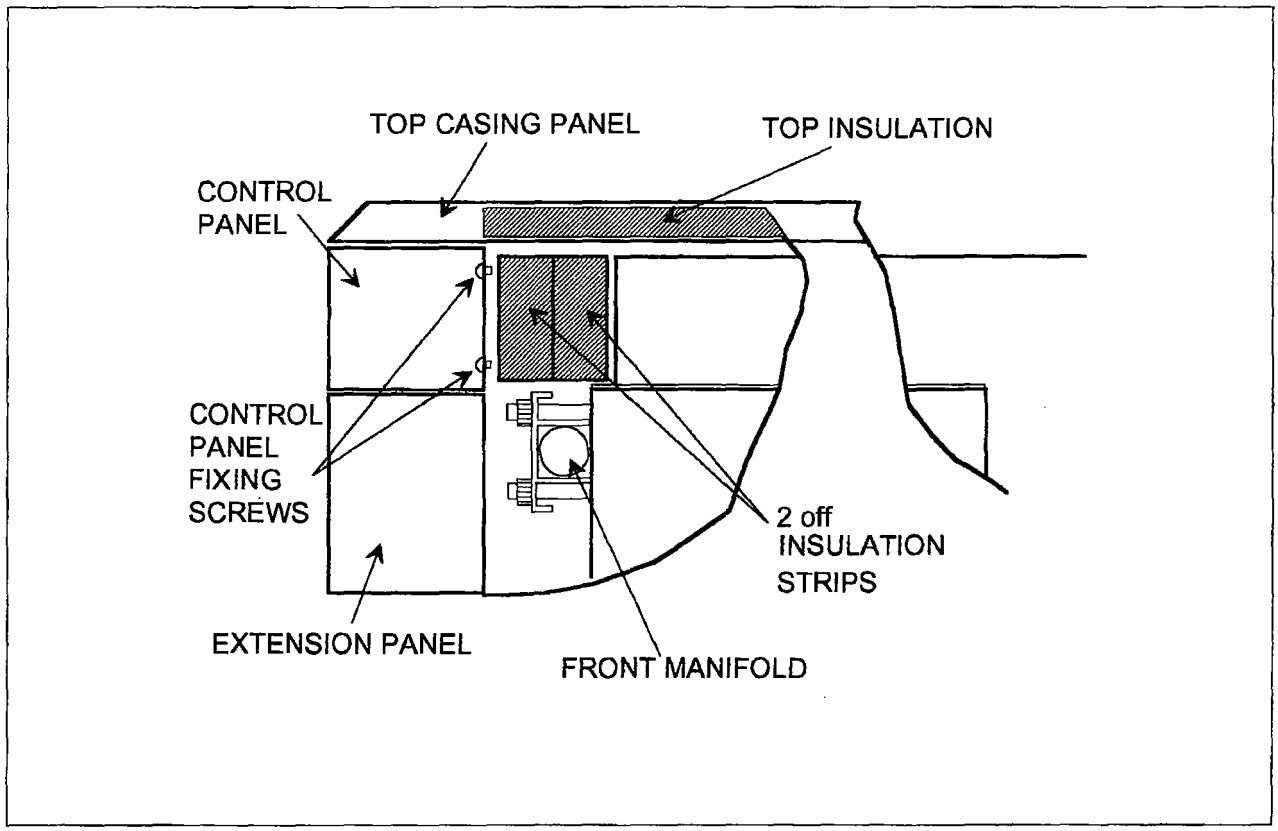


Fig.4.3 - Arrangement of Insulation



Connecting the Gas Supply

The connection should be made to the female connection (size given in Table 1.2). A union and isolating valve should be fitted close to the boiler to allow disconnection of the boiler controls for maintenance and repair.

The gas supply should be made through a suitable meter and the Local Gas Undertaking should be consulted to determine the suitability of the meter and gas supply to meet existing and additional demands for gas.

The installation should be made in accordance with the requirements of the Gas Safety (Installation & Use) regulations and all other Regulations and Codes of Practice given on page 2.1.

In particular a manual valve for isolation of the boiler house shall be fitted in an accessible position and readily identifiable.

The gas supply should be supported adequately.

For large single and multiple boiler installations consideration should be given to the installation of additional gas meters to assist in the monitoring of boiler performance.

Attention is drawn to the need for adequately sized pipework according to the maximum gas demand for multiple boiler installations and each boiler shall be provided with an isolating valve so that it is possible to isolate the boiler from a common gas supply for maintenance purposes.

Boosters will not be necessary if a minimum inlet pressure of 7 in.w.g. (17.5 mbar) can be provided at the inlet to each gas train and maintained during full load conditions. If a booster is required the Local Gas Undertaking must be consulted and the booster shall be fitted with a low pressure cut off switch upstream of the booster in the event of reduced pressure and to prevent automatic restart on pressure restoration. The cut off pressure shall be decided by the Local Gas Undertaking.

Connecting the Water System

The flow and return connections should be made to the flow manifold and return connection to the secondary heat exchanger.

For 20 and 22 section boilers the connections should be made to the female BSP connections on flanges provided fitted to the manifold and secondary heat exchanger.

The water system should be in accordance with the notes given on page 3.6.

NOTE: There is a tapping fitted to the primary/secondary link pipe. This must be plugged off and not used for any ancillary fittings or pipework.

CONNECTING THE ELECTRICAL SUPPLY

The electrical supply should be 240V 1Ph 50Hz. A suitable multi-pole isolator should be used to isolate all connections (except earth) to the boiler including alarm and control interlocks.

All on site wiring must conform with IEE Regulations.

All wiring should be brought into the boiler from the rear using the cable tray provided. Live and neutral connections to be connected to the live and neutral connections on the step down transformer mounted in the control panel (except 5 section where this is mounted on the rear of the boiler). Control interlocks and remote alarms should be taken to the main terminal strip, see Fig.6.1 for main wiring diagram.

For multiple boiler installations each boiler shall have an isolator and fuse as detailed above to protect the boiler and allow for maintenance.

Boiler Controls

The operation of the boiler is under the control of it's own control box, combined boiler control and high/low thermostat and high limit thermostat.

In addition, the boiler should be controlled by a time switch, frost thermostat, pump overrun facility and, fo multiple boiler installations, a boiler sequence controller. The boiler can be controlled by removing links 4 - 5 or 7 - 8 and providing volt free contacts across these terminals to switch the boiler.

High limit thermostat trip signal and control box lock out signals can be picked up from terminals 6 and 7 respectively. These are 220V AC single phase signals which can be used to illuminate a lamp or other low current device with a suitable neutral.

Connecting the Flue System

The flue system should be made in accordance with the notes given on page 3.3. The flue pipe should be supported so that no weight is transferred to the boiler. Facilities for disconnecting the flue system from the boiler should be provided.

Connecting the Condensate Drain

The boiler is capable of producing condensate at a rate of up to 0.1 lit/kwh at a temperature of up to 70°C.

The condensate is mildly acidic with a pH of 3.5. The use of copper in the condensate system is not permissible.

The boiler is supplied with a condensate trap that must be fitted to the secondary heat exchanger. The condensate drain should be run away from the boiler with a minimum fall of 2.5% (1 in 20). The drainage system must include a tundish to prevent water backing up into the boiler.

The condensate should be run to a suitable drain point or soak-away. The condensing boiler will cause condensate to be formed in the flue system which should therefore incorporate drainage points.

BOILER MAINTENANCE

At every service visit the boiler should be cleaned as detailed below and the soundness of the gas control assembly must be checked.

WARNING: ISOLATE THE ELECTRICAL AND FUEL SUPPLIES BEFORE ATTEMPTING ANY MAINTENANCE WORK

To clean the boiler it will be necessary to remove the boiler flue hood cover and burner assembly as detailed below.

1. Remove the boiler door by lifting forward and upwards. Disconnect the two link chains from the boiler door.

2. Disconnect the burner manifold from the gas train union.

3. Disconnect the ignition lead and earth wire from the pilot burner.

4. Withdraw the UV cell from its bracket by slackening the fixing screw. Make sure that the UV cell is put in a position where it cannot be damaged.

5. Release the door locating strip by releasing the two screws holding it in place.

6. Release the eight M8 nuts securing the burner assembly to the boiler and remove. The burner assembly should be kept in storage so that no air borne debris can settle on the burner bars.

7. Remove the top front and rear panels by releasing the securing screws.

8. Remove the air pressure switch pipe connected to the boiler flue hood cover.

9. Remove the screws securing the flue hood clean our cover and remove cover.

10. With the flue brush provided clean the flueways of the cast iron heat exchanger.

11. Following completion of the above remove any debris from the bottom of the boiler.

12. To clean the secondary heat exchanger use water by means of a hose connected to the water mains. Care should be taken to prevent water from contaminating the fan motor assemblies and any other electrical connections. The condensate drain will drain away the cleaning water.

IMPORTANT: Do not use brushes or chemicals on the secondary heat exchanger.

13. Clean the burner bars and ensure that they are in good condition. If there is any break up of the top mesh (ie. cracking) then the burner bars should be replaced, new bars can be obtained from Potterton Commercial Division. If necessary blow the mesh and internals clear with compressed air or a vacuum cleaner. On no account should the burners be wire brushed.

14. Following completion of the above the boiler should be re-assembled. The integrity of the gaskets and sealing strips and insulation should be checked and replaced if necessary during re-assembly.

IT IS IMPERATIVE THAT THE FLUE HOOD COVER AND BURNER BAR ASSEMBLY HAVE AN AIR TIGHT SEAL. ALL SEALING MATERIALS CAN BE OBTAINED THROUGH POTTERTON COMMERCIAL DIVISION.

15. After re-assembly test for gas soundness and check the burner manifold union and pilot burner union for gas leaks.

16. It is essential that the boiler is recommissioned following maintenance. This must be carried out by Potterton Commercial Division engineers or engineers trained to carry out this work.

Potterton Commercial can offer a training service for competent engineers to carry out this work and, if required, please contact one of our service offices listed on the back page of this manual.

COMMISSIONING

The boiler must be commissioned following completion and installation.

Do not attempt to fire the boiler prior to commissioning as damage to components may occur.

Commissioning of the Ultimate Condensing Derwent boiler requires a high degree of skill to obtain optimum reliability and performance. Commissioning must therefore be carried out by Potterton Commercial Division engineers or engineers trained to carry out this work. Please contact your nearest service office, addresses can be found on the back page of this manual.

Unauthorised operation or commissioning is liable to invalidate the boiler warranty.

Prior to requesting commissioning the installer should check the following.

1. Electrical supply is present but switched off. All electrical connections are sound and correctly made.
2. Electrical system and the boiler are correctly earthed.
3. Gas supply is tested for soundness and purged of air.
4. Boiler and system are filled with water.
5. Ventilation is adequate and, in the case of mechanical ventilation systems, operation of the boiler is inhibited unless the ventilation fan is proved.
6. On mechanically assisted flue systems the operation of the boiler plant should be inhibited unless the mechanical flue system is operational and flow proved.
7. The safety valve should be checked to ensure that it is of the correct size and pressure. See Section 3 for further details.
8. The cold feed and open vent sizes should be checked. See Section 3 for further details.
9. Check that the condensate trap has been fitted to the boiler.
10. **The boiler house has been completed and is totally free from dust and debris. Commissioning cannot be undertaken unless the above has been strictly adhered to.**

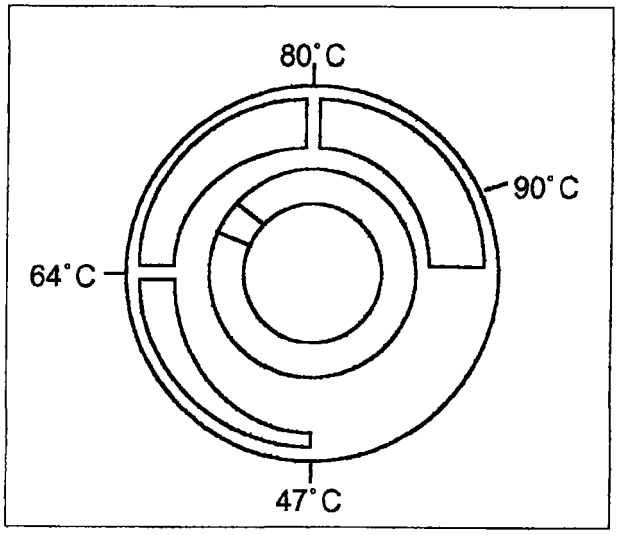
BOILER OPERATION

The boiler must not be operated unless commissioning has been completed.

All boiler controls and indicators are mounted on the boiler control panel fascia, see Fig.5.2.

1. Switch on the boiler at (1). The orange neon will illuminate.
2. Turn the boiler thermostat (2) to the required setting against the expanding scale. The approximate temperatures which correspond to the positions on the scale are given in Fig.5.1.

Fig.5.1 - Control Thermostat Expanding Scale



3. Lamp (10) will light followed by lamp (9) and then lamp (8) and the boiler will run.

The boiler is fitted with a fixed differential two stage thermostat. The boiler will therefore raise the water temperature to the thermostat setting then drop down to low fire [NOTE: The low fire condition is approximately 70% of rated output].

If the temperature starts to drop the boiler will return to high fire. If the temperature continues to rise when running on low fire the boiler will shut down.

If it is required to shut the boiler down do not switch the boiler switch off whilst the boiler is firing. Turn the control thermostat down and wait for the control box to cycle through post purge (approximately 10 seconds) then switch off the boiler at switch (1).

FAULT FINDING

Set out below are general guidance notes on system fault finding.

After following this guide and checking that boiler failure is not due to external control or system fault, should it be suspected that there is a fault in a boiler component then call the Potterton Commercial service office to arrange for an engineer to attend the boiler. It is not recommended that component replacement be carried out by anyone other than Potterton Commercial service personnel.

Overheat Operation

Operation of the boiler overheat thermostat is associated with a reduction in boiler water flow. Where overheat operation is reported the following should be checked.

a) The boiler/system pump has not tripped.

b) Pump overrun is operational to dissipate residual heat from the boiler on system shut down.

c) System valves are open.

d) The boiler is operating at the correct rate and is not overfired.

To reset the overheat thermostat allow the boiler to cool down, remove the overheat thermostat knob and press the reset button.

The use of a primary loop system is highly recommended to provide a constant boiler flow rate under all operating conditions. For further information refer to Potterton Publication Technical Bulletin No.1 Issue 2.

Burner Lockout

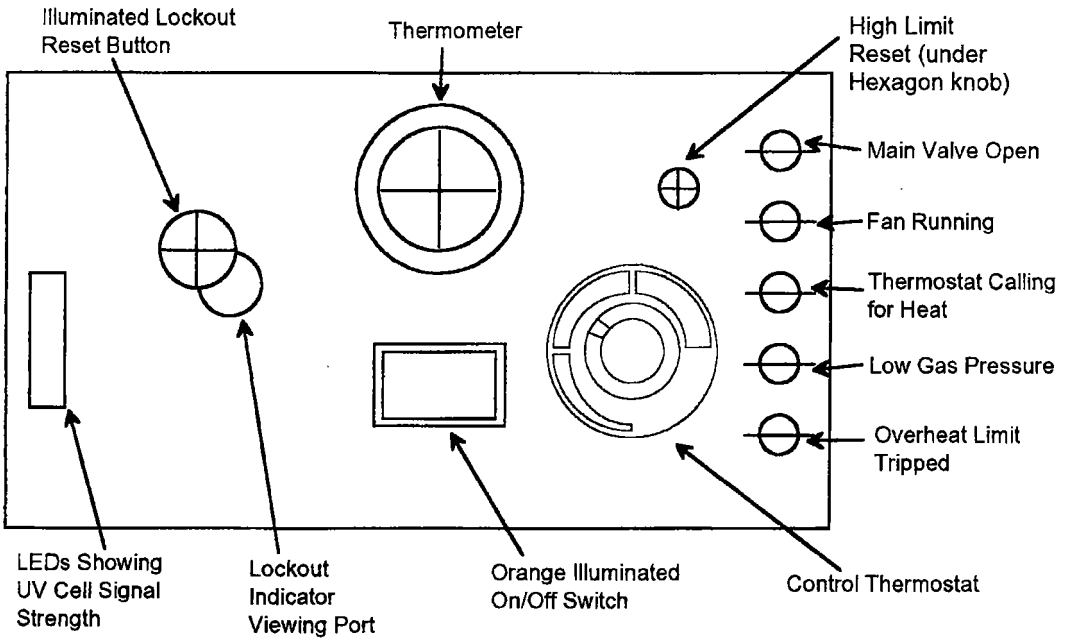
The boilers have an integral safety system to allow the safe and reliable operation of the burner. Failure of the burner to operate correctly will cause the burner control box to "lockout" and the lockout button on the burner will illiuminate to indicate this. See page ** for control sequence/fault finding details.

OPERATING & FAULT FINDING GUIDE FOR ULTIMATE CONDENSING BOILER CONTROL SEQUENCE

The Ultimate Condensing boiler is under the control of a Satronic TMG 740-3/32-32 control box. On the front of the control box is an LED bar chart indicating the signal strength of the measured flame and an indicator dial showing the current stage in the control sequence. Should the boiler go to lock out the indicator will show at which stage in the cycle the fault occurred.

IMPORTANT: WHEN THE CONTROL BOX LOCKS OUT MAKE A NOTE OF THE INDICATOR POSITION BEFORE RESETTING THE CONTROL BOX.

Fig.5.2 - Control Panel Fascia



The Ultimate Condensing boiler incorporates a burner system that pre-mixes the gas and combustion air to produce a flame with low nitrous oxide (NOx) emissions. To allow crosslighting of the burner bars on initial light up it is necessary to light the main burners with the high fire gas rate but only supplying the low fire air. The Satronic control box does not incorporate this facility and this is achieved by using the additional circuit board No.904537. The circuit board incorporates five relays. Relays H1 and H2 incorporate delay off times set at 10 seconds.

A simplified chart for the start up sequence is shown in Table 5.1. This details the Satronic control box indicator position and the PCB relay operation.

Fault Finding

Fault finding and Component replacement requires specialist knowledge to ensure optimum performance and safety. This service should be obtained from the Potterton Commercial Service offices, address as detailed on back page.

UNAUTHORISED SERVICE & REPAIR OF THE ULTIMATE CONDENSING BOILER COULD CAUSE DAMAGE TO THE EQUIPMENT.

Table 5.1 - Start up Sequence

Prepurge (30 seconds)	Satronic control box energises relay H4 from terminal 13 causing resistor to be switched in series with fan motor. Power from terminal 19 of control box - this causes fan to run at high speed for 30 seconds. Air flow must be proved by high fire air pressure switch before black line in blue sector (10 seconds) or control box will lock out. NOTE: At this stage no power is available from control box terminal 21 therefore relay 5 is de-energised preventing power on to relay H2. Satronic control box de-energises H4 by removing power from terminal 13. This causes the capacitor to be switched in series with fan motor power from terminal 19 of control box this causes fan speed to reduce from high to low speed.
Pilot Ignition Control Box Indicator: Orange to Yellow Sector	Satronic control box energises the pilot solenoid valve (terminal 2) and the ignition transformer (terminal 3) which in turn energises relay H1 on the PCB. H1 causes the fan motor to switch to low speed and also H1 energises H2 and H3. The ignition circuit is only energised for a short period (< 3 seconds), however, H1 has a 10 second delay on after removal of power from the ignition circuit. H2 switches the high fire pressure switch out of circuit as the fan is on low speed. H3 allows the high fire gas valve to be energised providing the Satronic control box is energised on terminal 6. The control box lights the pilot burner on low fire air. The Satronic control box must detect a flame signal before the end of the yellow sector or the control box will go to lockout.
Burner Ignition Control Box Indicator: Red to Green Sector	After successfully lighting the pilot burner the Satronic control box energises the two main gas valves from terminal 6. This causes the burner to light on main gas as H3 is energised but the fan is on low fire air due to H1. The Satronic controlbox switches off the pilot burner and monitors the flame signal from the main burner. At the end of the green sector the Satronic control box energises terminal 21 which switches in the high low thermostat. Relay H1 now de-energises due to the 10 second delay from pilot ignition having elapsed, this causes either the fan to increase speed to increase to high fire due to the high/low thermostat energising PCB terminal 4 which energises H4 (fan high) and H3 (gas high), or, the fan speed to reduce to low fire due to the high/low thermostat energising PCB terminal 5 which switches out the high fire air pressure switch.
Boiler High/Low Operation - Low fire to High fire	When changing from low fire to high fire voltage is removed from PCB terminal 5 and applied to terminal 4. Removal of power from terminal 5 switches the high fire air pressure switch into circuit (H2) and energises terminal 4 to switch the fan to high speed (H4) and the gas valve to high fire (H3). Due to the delay between the fan being switched from low fire and the high fire air flow rate being achieved, relay H2 has a 10 second delay on when PCB terminal 5 is de-energised.
- High fire to Low fire	When changing from high fire the low fire voltage is removed from PCB terminal 4 and applied to terminal 5. Removal of power from terminal 4 switches the fan from high speed (H4) and the gas valve to low fire (H3), energising terminal 5 switches the high fire pressure switch out of circuit (H2). There is a delay between switching the fan to low fire and the actual air flow reducing to low fire rate, however, the gas valve is fast acting and therefore to prevent the burner firing with high fire air and low fire gas on changeover, relay H3 is delayed on for 1.5 seconds when PCB terminal 4 is de-energised.

Fig.6.1 - Control Panel Wiring (See Legend and Notes on page 6.3)

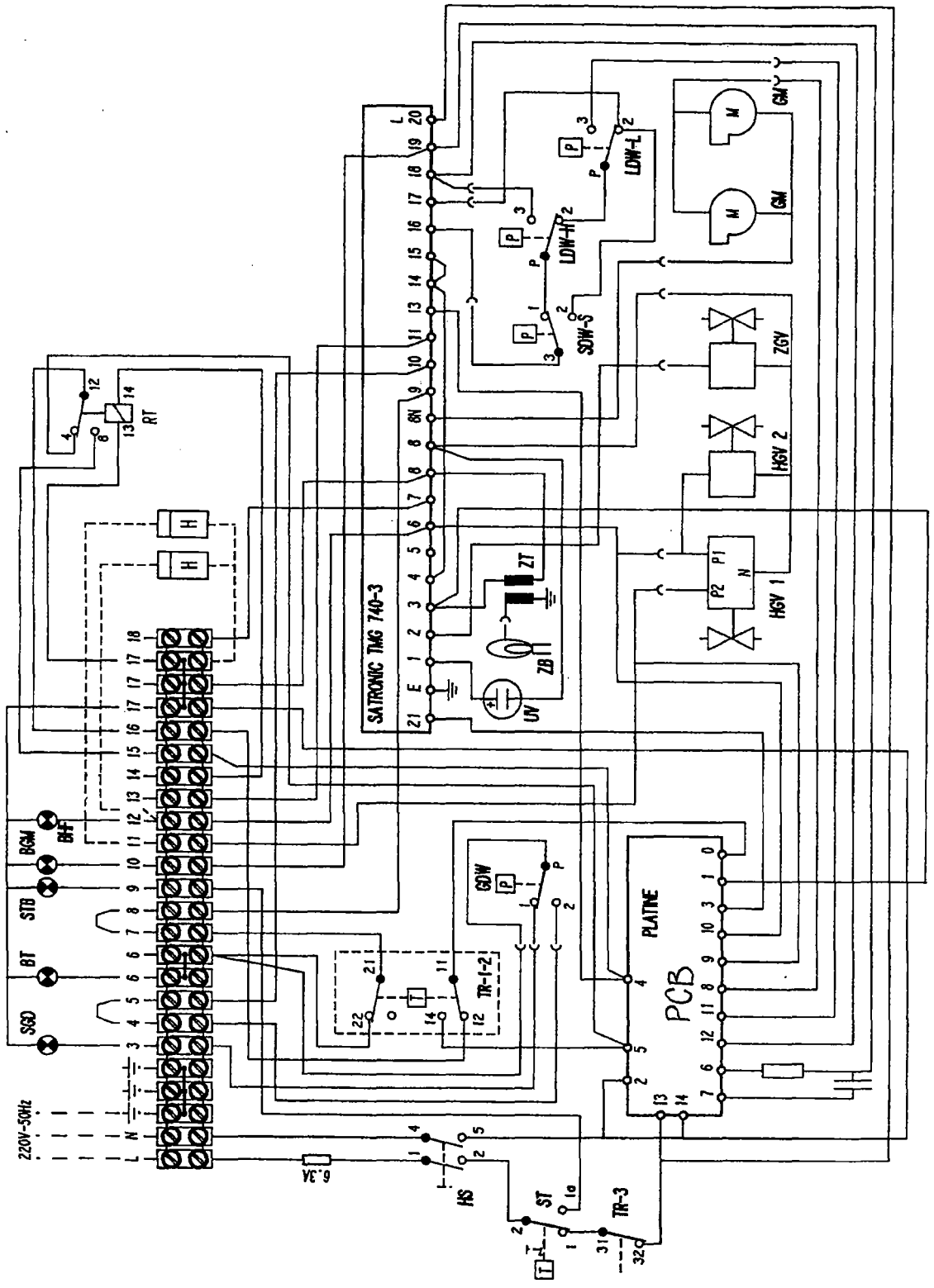
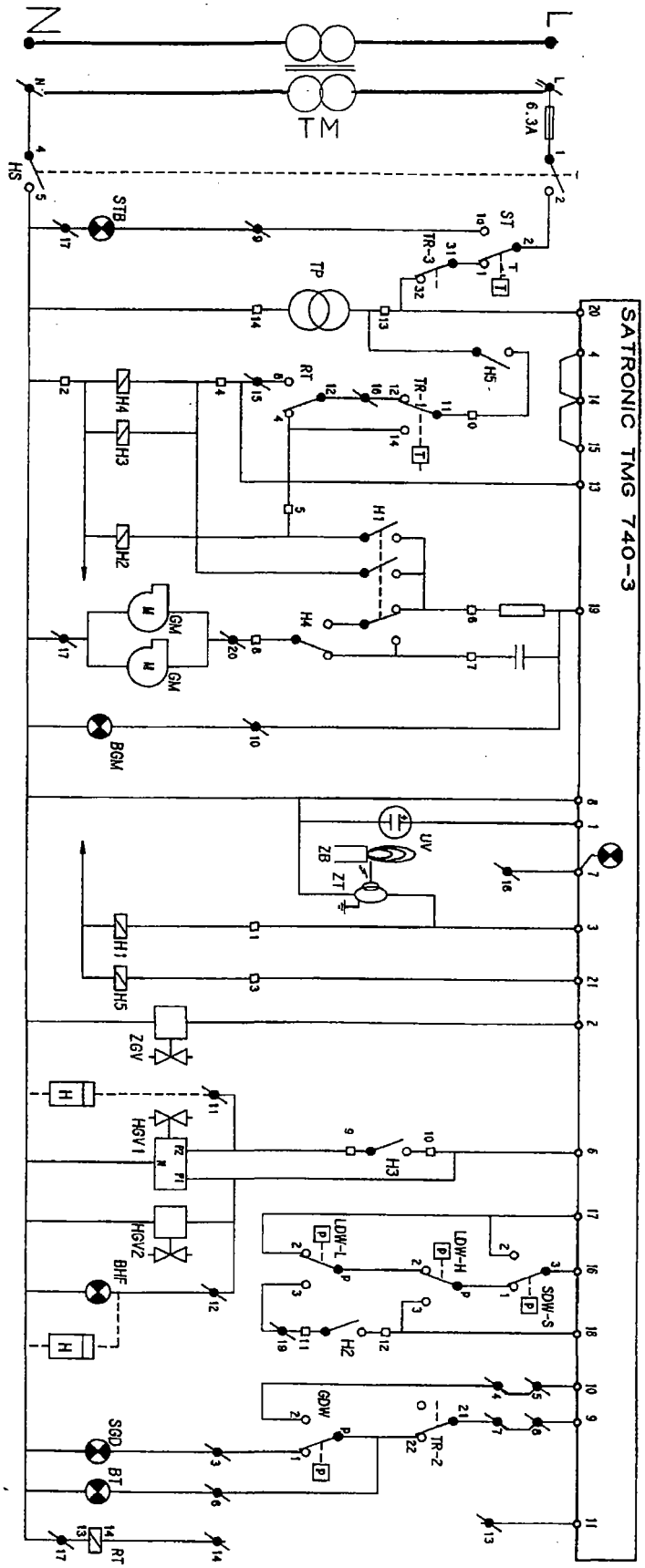


Fig.6.2 - Schematic Wiring Diagram (See Legend and Notes on page 6.3)



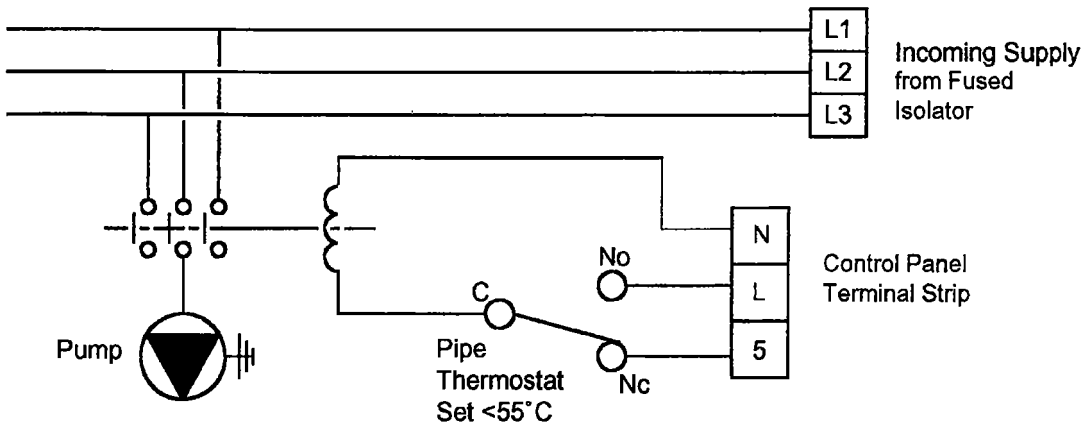
LEGEND for WIRING DIAGRAMS 6.1 and 6.2

TM	-	240-220V Transformer	
BGM	-	Fan Running Indicator	
BHF	-	Main Flame Indicator	
BT	-	Thermostat Calling Indicator	
GDW	-	Gas Pressure Switch	
GM	-	Fan Motor	
H	-	Hours Run Meter (not supplied)	
HGV1	-	Main Gas Valve 1	
HGV2	-	Main Gas Valve 2 (high fire)	
HS	-	On/Off Switch	
LDW-L	-	Low Fire Air Pressure Switch	
LDW-H	-	High Fire Air Pressure Switch	
RT	-	Low Fire Relay	
SDW-S	-	Safety Air Pressure Switch	
SGD	-	Low Gas Pressure Indicator	
ST	-	High Temperature Thermostat	
STB	-	High Temperature Indicator	
TP	-	PCB Transformer	
TR-1	-	High/Low Thermostat	)
TR-2	-	Control Thermostat - On/Off	) Combined Thermostat
TR-3	-	Control Thermostat	)
UV	-	UV Sensor	
ZB	-	Pilot Burner	
ZGV	-	Pilot Burner Valve	
ZT	-	Ignition Transformer	

NOTE: The incoming external supply must be taken to the LNE terminals on the step down transformer. This is fitted in the control panel on all sizes except the 5 section where it is mounted at the rear of the boiler. All other wiring to be taken to the terminal strip as below.

External on/off control and safety interlocks - terminal 4-5 and 7-8
External high/low control interlocks - terminal 6-14
Remote high temperature indication - terminal 9
Remote burner lockout indication - terminal 18
Remote burner run indication - terminal 12

Fig.6.3 - Pump Overrun Using Changeover Pipe Thermostat



NOTE: Pump contactor and pipe thermostat are not Potterton supply