

Oil Fired

Installation Guide, Operation and Service Manual

Oil Fired Storage Water Heaters

MODELS OFS25, OFS29, OFS63, OFS90, OFS108, OFS163



Working towards
a cleaner future





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Andrews Storage Water Heaters have been designed and manufactured to comply with current International standards of safety. In the interests of the health and safety of personnel and the continued safe, reliable operation of the equipment, safe working practices must be employed at all times. The attention of U.K. users is drawn to their responsibilities under the Health and Safety Regulations 1993.

All installation and service on the Andrews Water Heater must be carried out by properly qualified personnel, and therefore no liability can be accepted for any damage or malfunction caused as a result of intervention by unauthorised personnel.

The Andrews Water Heaters policy is one of continuous product improvement, and therefore the information in this manual, whilst completely up to date at the time of publication, may be subject to revision without prior notice.

Further information and assistance can be obtained from:

Andrews Water Heaters

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www.andrewswaterheaters.co.uk

**THE ANDREWS WATER HEATERS COVERED IN THIS MANUAL
ARE FOR USE WITH KEROSENE CLASS C2 (BS2869) OR GAS OIL CLASS D (BS2869)**

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**GENERAL
INFORMATION**

The Andrews Water Heater has been designed and manufactured to give an efficient, reliable and long service life.

To ensure the continued, trouble-free operation of your heater at maximum efficiency, it is essential that correct installation, commissioning, operation and service procedures are carried out strictly in accordance with the instructions given in this manual. By law, installation and commissioning of the heater must be carried out by properly qualified personnel.

The heater(s) must be installed in accordance with the following requirements;
The current BUILDING REGULATIONS
The Water Supply (WATER FITTINGS) REGULATIONS 1999

Additionally, installation should be performed in accordance with all relevant requirements of the Local Authority and recommendations of the British Standards and Codes of Practice detailed below.

**BRITISH
STANDARDS
AND CODES OF
PRACTICE**

BS 5410:Part 1	Installations up to 44kW output capacity for space heating and hot water supply purposes.
BS 5410:Part 2	Installations of 44kW and above output capacity for space heating and hot water supply purposes.

It is the duty of manufacturers and suppliers of products for use at work to ensure, so far as is practicable, that such products are safe and without risk to health when properly used and to make available to users, adequate information about their safe and proper operation.

Andrews Water Heaters should only be used in the manner and purpose for which they were intended and in accordance with the instructions in this manual. Although the heaters have been manufactured with paramount consideration to safety, certain basic precautions specified in this manual must be taken by the user.

It is imperative that all users of the heater must be provided with all the information and instruction necessary to ensure correct and safe operation.

Water systems in buildings have been associated with outbreaks of Legionnaires' Disease, particularly in health care facilities where occupants are significantly more susceptible to infection.

In recognition of the risks in hospitals, a Code of Practice for the Control of Legionellae in Health Care premises has been issued by the Department of Health (1991). Codes of Practice applicable to other premises have been published by other organisations, principally the Health and Safety Executive (HS)(G70) and the Chartered Institute of Building Services Engineers (CIBSE, TM13).

All Codes of Practice draw attention to the design and operation of water systems with reference to avoidance of factors that favour colonisation by Legionellae bacteria. These factors include stagnation, lukewarm conditions (20°C to 45°C) and the accumulation of debris, scale and corrosion in the base of tanks and calorifiers.

Andrews Water Heaters has commissioned an independent evaluation of their products to investigate their resistance to build-up of legionellae bacteria.

Experiments were conducted to determine whether, following a substantial challenge by legionellae pneumophila, after overnight and stagnation conditions, the system was rendered free from viable recoverable legionellae. It was found that at 61°C, following a challenge of approximately 107 organisms per litre, within one hour, more than 99.999% of organisms had been killed. After a subsequent stagnation period, sampling did not reveal any residual contamination. The design of the base of the water heater precludes legionellae colonisation, even after build-up of debris. The burner positioning ensures that the water at the bottom of the heater reaches the same, or higher temperature as in the rest of the heater.

Based on data obtained through experiment, the Andrews Water Heater can be described as legionellae resistant as it is considered unlikely that, at the temperature tested, the organism would colonise the water heater and present a possible health risk.

HEALTH AND SAFETY REGULATIONS 1993

EFFECTIVENESS IN COMBATING LEGIONELLAE

ANDREWS MODEL NO.		OFS25	OFS29	OFS63	OFS90	OFS108	OFS163
Storage Cap	Ltrs	192	265	146	146	378	306
Storage Cap	Galls	42	58	32	32	83	67
Rec Thro 44c	L/H	491	577	1227	1759	2110	3166
Rec Thro 44c	GPH	108	127	269	386	463	694
Rec Thro 56c	L/H	390	443	975	1398	1677	2516
Rec Thro 56c	GPH	86	97	214	307	368	552
Heat Input	kW	30.8	34.9	71.8	102.6	123.1	184.6
Heat Output	kW	25.2	28.6	63	90.3	108.3	162.5
Heat Input	Btu/Hr	105,000	119,000	245,000	350,000	420,000	630,000
Heat Output	Btu/Hr	86,000	97,580	215,600	308,000	369,600	554,400
Efficiency	%	82	82	88	88	88	88
Fuel	BS2869 Kerosene Class C2						
Fuel	BS2869 Gas Oil Class D						
Burner Type	EOGB	BTL4	BTL4	BTL6	BTL10	BTL10	BTL20
Elec. Data	V	220/240	220/240	220/240	220/240	220/240	220/240
Frequency	Hz	50	50	50	50	50	50
Power Cons.	Watt	110	110	110	110	110	185
Start Current	Amp	2.2	2.2	2.2	2.2	2.2	2.0
Run Current	Amp	0.87	0.87	0.87	0.87	0.87	1.28
Fuse	Amp	5	5	5	5	5	5
Nozzle fitted	Kero	0.75x80s	0.85x80s	1.65x80s	2.50x80s	3.00x80s	4.50x80s
Pressure	PSI	113	110	127	113	113	113
Pressure	Bar	7.8	7.6	8.6	7.8	7.8	7.8
Nozzle Supplied	Gas Oil	0.55x80s	0.60x80s	1.25x80s	1.75x80s	2.25x80s	3.50x80s
Pressure	PSI	195	211	206	214	187	174
Pressure	Bar	13.5	14.5	14.2	14.8	12.9	12
Smoke	No.	0	0	0	0	0	0
Flue Gas Temp	°C	380	380	260	260	260	260
CO ₂	%	11.5	11.5	11.5	11.5	11.5	11.5
O ₂	%	5.5	5.5	5.5	5.5	5.5	5.5
Flue Size	mm	150	150	200	200	200	200
(Secondary)	Ins	6	6	8	8	8	8

ANDREWS MODEL NO.		OFS25	OFS29	OFS63	OFS90	OFS108	OFS163
Flexible Hose Connection Size	G	0.25	0.25	0.25	0.25	0.25	0.25
Fuel Cons. Kero	L/H	3.2	3.7	7.5	10.8	12.9	19.4
Fuel Cons. Kero	GPH	0.70	0.81	1.65	2.4	2.8	4.3
Fuel Cons. Gas Oil	L/H	3.1	3.5	7.2	10.3	12.4	18.6
Fuel Cons. Gas Oil	GPH	0.68	0.77	1.60	2.3	2.7	4.1
Cold Inlet Top	BSP	0.75	1			1.5	
Cold Inlet Front	BSP			1.5	1.5	1.5	1.5
Cold Inlet Rear	BSP			1.5	1.5	2	2
Hot Outlet Top	BSP	0.75	1			1.5	
Hot Outlet Front	BSP			1.5	1.5	1.5	1.5
Hot Outlet Rear	BSP			1.5	1.5	2	2
Drain Port	BSP	0.75	0.75	0.75	0.75	0.75	0.75
Max Work Press	PSI	150	150	150	150	150	150
Max Work Press	Bar	10.3	10.3	10.3	10.3	10.3	10.3
Max Test Press	PSI	300	300	300	300	300	300
Max Test Press	Bar	20.6	20.6	20.6	20.6	20.6	20.6
Weight Empty inc Burner	Kg	118.5	143.5	195	195	345	395
Weight Empty inc Burner	Lbs	260	315	429	429	761	871
Weight Full inc Burner	Kg	309	406	340	340	722	699
Weight Full inc Burner	Lbs	680	895	749	749	1591	1541
Shipping Height	mm	1645	1740	1530	1530	2434	2134
Shipping Width	mm	686	737	991	991	965	965
Shipping Depth	mm	737	775	883	888	1073	1073

INTRODUCTION**THE LAW REQUIRES THAT INSTALLATION IS CARRIED OUT BY A PROPERLY QUALIFIED PERSON**

Installations must be carried out in accordance with current Building Regulations, The Water Supply (Water Fittings) Regulations 1999 and any requirements of the Local Authority, Water and Fire Authorities and the current British Standards and Codes of Practice listed in Section 1.

LOCATION

The location selected for installation of the heater must allow the provision of a satisfactory flue, adequate air supply, drain facilities and must be well illuminated.

A purpose built boiler room or compartment is strongly recommended. If a purpose built boiler room is not available, measures should be taken to protect the heater from damage and prevent any extraneous matter from being stored on or around the heater. There must be easy access to the boiler room and heater at all times.

The heater must not be installed in a room which contains a bath or shower and must not be installed in a bedroom or bedsitting room.

We recommend that adequate clearance is left around the heater for fitting and servicing purposes with no obstruction at the front of the heater to allow easy access to the burner. Service clearance above all the heaters except heater models OFS25 should be 1270mm for removal of the flue baffle. Heater model OFS25 flue baffle is hinged for low ceiling removal. It is very important that heater models OFS108 & OFS163 have at least 600mm clearance at the rear for the installation and removal of the T/P valve if fitted. We will supply magnesium articulated anodes part No.C333 as a service replacement for all heater models this will be beneficial where lack of head room is a problem.

The floor on which the heater is installed must be non combustible, level and of sufficient strength to withstand the heater weight when filled with water. Any combustible material adjacent to the heater must be placed or shielded as to ensure that its temperature does not exceed 65°C (150°F).

BURNER ASSEMBLY

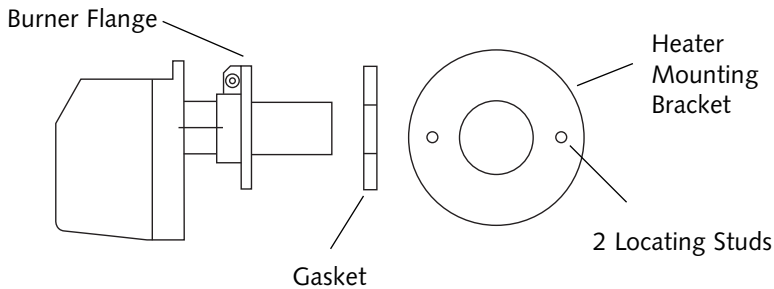
Every Andrews oil fired water heater is supplied with a purpose matched burner assembly. The burner is supplied complete with nozzle factory fitted for use with kerosene-class C₂ only. If the appliance is to be used with gas oil-class D₁ the nozzle must be changed before the burner is fitted to the water heater. The correct nozzle specified for use with gas oil is supplied in the nozzle burner box. It is the responsibility of the installer to ensure that the correct nozzle is fitted to suit the fuel to be used with this appliance.

BURNER ASSEMBLY

The burners are supplied complete with pre-wired control thermostat loom to a harness plug with connects to the harness socket on the burner. The burners are supplied with the flange fitted to the burner blast tube in the correct position. A gasket is also supplied loose in the burner carton. See below for correct burner fitting to the heater.

Heater Models: OFS256, OFS63, OFS90 & OFS108

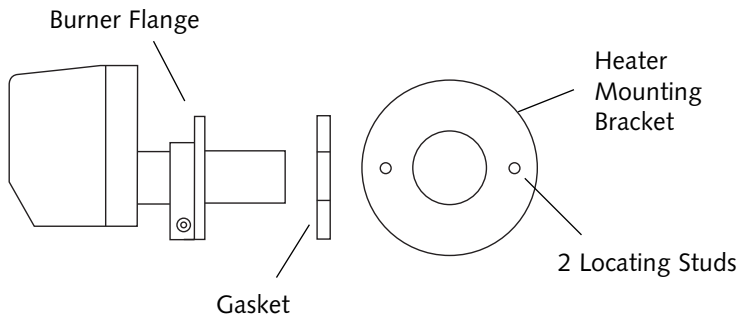
Locate the burner gasket on the two fixing studs fitted on the heater mounting flange. Push the burner into the heater combustion chamber and locate the burner flange on the two fixing studs fitted on the heater mounting flange and tighten the two fixing bolts supplied with the heater.



Heater Model: OFS29

Because of the reduced height of the combustion chamber entry position it is necessary to locate the burner onto the heater as the diagram below shows. The pump has been rotated thro 180° so that the solenoid is positioned above the vertical to ensure correct operation.

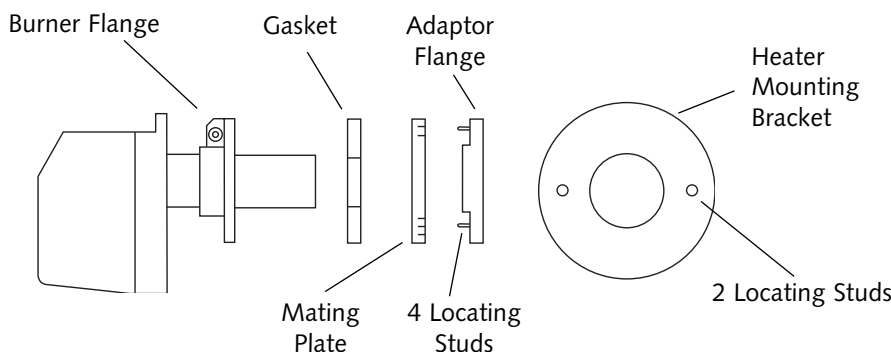
The burner is fitted to the heater in the same way as heater models shown above.



Heater Model: OFS163

The burner used on this heater is considerably bigger and heavier therefore a different fixing method is required. (See below).

Locate the burner adaptor flange on the two fixing studs fitted on the heater mounting flange and tighten the two fixing bolts supplied with the heater. Next locate both the mating plate and the gasket onto the burner adaptor flange using the four locating studs. Finally push the burner into the heater combustion chamber and located the burner flange onto four locating studs and tighten the four fixing bolts supplied.



FLUE SYSTEMS

Detailed recommendations for flue installation are given in BS5410 PT 1 and BS5410 PT 2

The Building Regulations allow the use of stainless steel under the term "Deemed to Satisfy" but the minimum thickness must be 0.71mm (22swg).

We recommend that Selkirk SMW Flue System is used to the following specification: Twin Wall, Insulated, Stainless Steel.

INSTALLATION OF FLUE

The flue route should be as vertical as possible avoiding sharp bends and horizontal runs. It is recommended that each heater should be fitted with its own individual flue.

It is essential that separate flues are used for equipment using oil and equipment using solid fuel.

A draught stabiliser is fitted to ensure burner flame stability.

If a common flue header is to be used see page 10.

- Notes:
1. Draught stabiliser to be fitted to appliance (see page 9).
 2. Male flue spigots to point downwards inside building to keep flue clean.
 3. Use changeover section going through roof so that male spigots point upwards outside the building to assist weatherproofing.
 4. The flue should be kept a safe distance from any combustible material especially when going through the roof (joists etc).

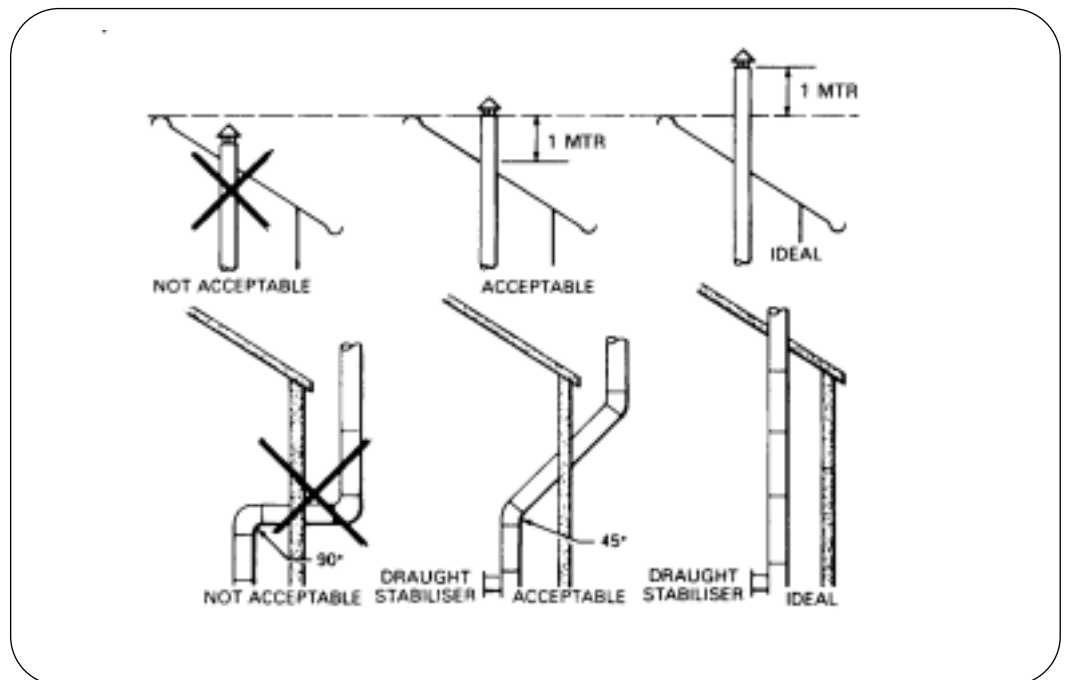


Fig. 1

TERMINAL LOCATION

This must be at a height at least level with the highest point of the building roof and not subject to down draught. Ideally the flue should terminate 1m higher than the highest point of the roof, or at least 1m higher than the section of roof through which it projects.

FLUE SYSTEMS

Assembly of Draught Stabiliser Approx Height

Flue kit 6"
E013
OFS25 = 1949mm
OFS29 = 2000mm

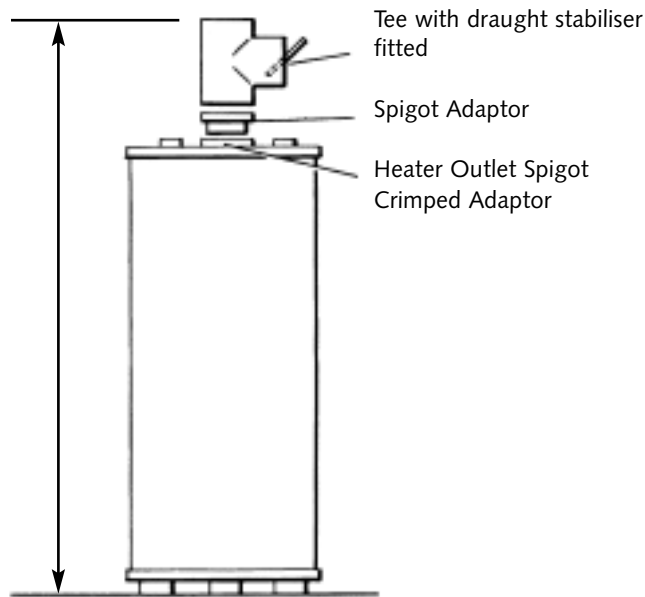


Fig. 2

The flue should provide a negative pressure at the base of the flue between -1.1mm (0.03" w.g.) and -2.00mm (0.06" w.g.). The flue route should be as vertical as possible.

A draught stabiliser is supplied with the heater (see Figs. 2 & 3).

Assembly of Draught Stabiliser Approx Height

Flue kit 8"
C916
OFS63 = 1739mm
OFS90 = 1739mm
OFS108 = 2307mm
OFS163 = 2307mm

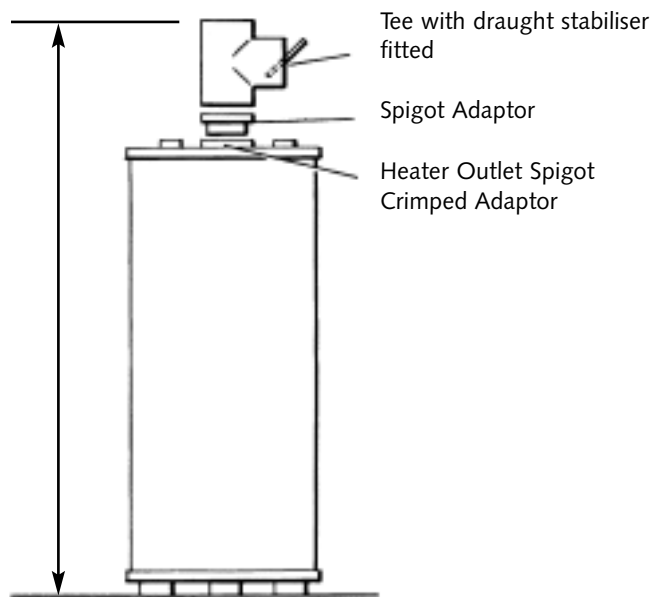
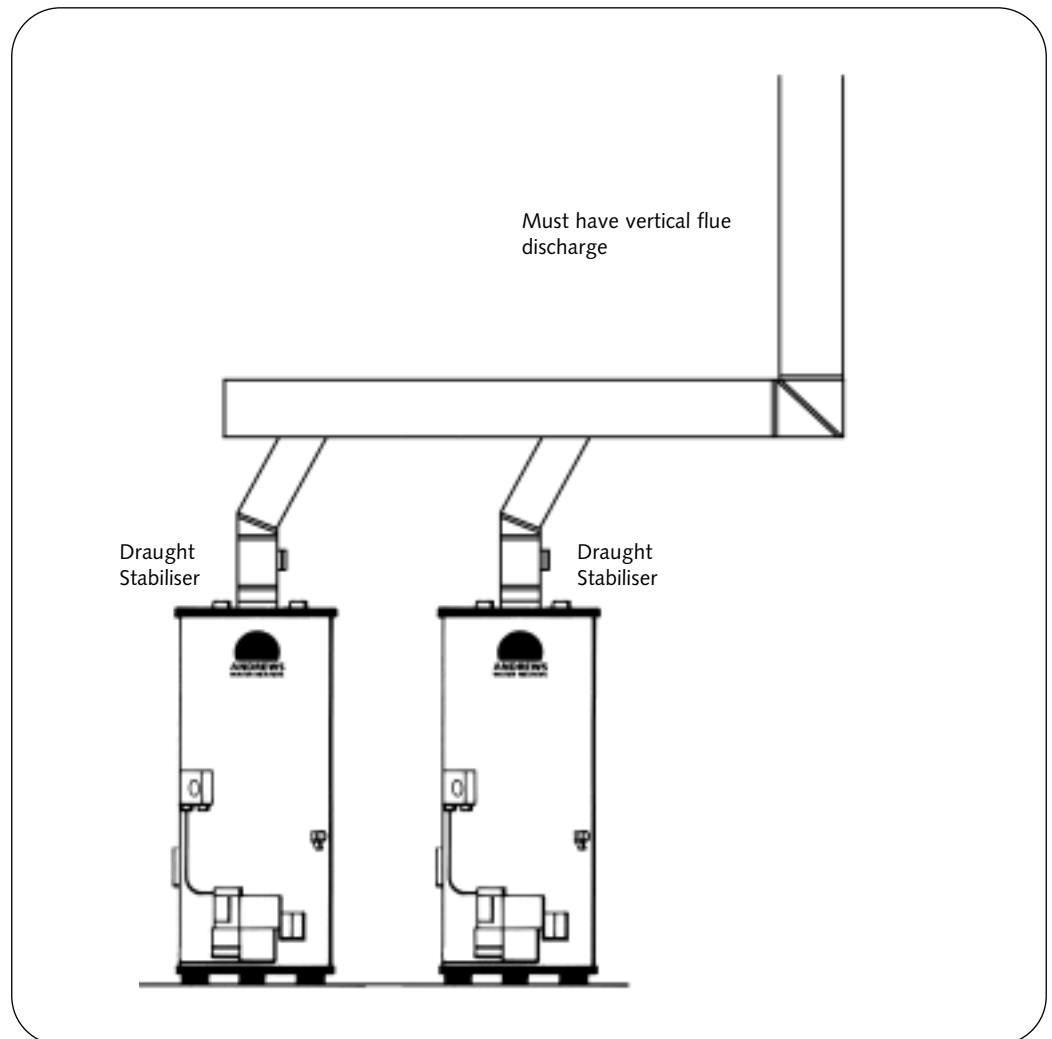


Fig. 3

Fit the flue tee c/w draught stabiliser to the outlet spigot of the water heater (see Figs. 2 & 3).

**COMMON FLUE
HEADER****Fig. 4**

It is recommended that individual flues are used for each heater. However if a common flue header is to be used the following guidelines must be used.

1. The cross - sectional area of the common flue header must be adequate for the combined output of both heaters. Contact the flue manufacturer or flue expert for further information.
2. Each heater shall be fitted with draught stabiliser and shall have its own flue pipe to the flue header.
3. The entry into the flue header shall be inclined towards the direction of the flue gases. (See fig. 4).
4. The common flue header must have a vertical discharge. Its is preferable to run the flue inside the building to avoid unnecessary heat losses and minimize the risk of condensation within the flue.

**AIR SUPPLY
AND
VENTILATION**

The following notes are intended to give general guidance:

Where the heater is to be installed in a room or internal space the heater requires the room or internal space containing it to have a permanent air vent. The vent must be either direct to outside air or to an adjacent room or internal space which must itself have a permanent vent of at least the same size direct to outside air. The minimum effective area of the permanent air vent(s) required is as follows:

Air supply requirements for appliances up to 44kW

Where the appliance is to be installed in a room.

High level 550mm² per kW of appliance rating over 5kW.

Where the appliance is to be installed in a compartment. Air supply direct to outside.

High level 550mm² per kW of appliance rating over 5kW.

Low level 1100mm² per kW of appliance rating over 5kW.

Where the appliance is to be installed in a compartment. Air supply into a room.

High level 1100mm² per kW of appliance rating over 5kW.

Low level 1650mm² per kW of appliance rating over 5kW.

The room itself must have permanent ventilation direct to outside.

High level 550mm² per kW of appliance rating over 5kW.

Draught Stabilisers

When an appliance with draught stabiliser is fitted in a room, add 550mm² per kW to the free air of the combustion air inlet. When an appliance with a draught stabiliser is fitted in a compartment which is vented as above, no additional allowance is required.

Air supply requirements for appliances of 44kW and above.

High level 0.1m² per 300kW of appliance rating.

Low level 0.2m² per 300kW of appliance rating.

Typical example for heater model OFS63

Heat input 71.8kW/300kW = 0.24kW

High level 0.24kW x 0.1m² = 0.024m²

Low level 0.24kW x 0.2m² = 0.048m²

Some halogen containing compounds can cause rapid corrosion of the Burner and Storage Vessel if drawn into the combustion air.

Therefore, if heaters are to be installed in any of the following locations or in any applications where the above compounds are present they should be sealed off from atmospheres which may contain these compounds, and all ventilation air must be taken completely from outside.

- i) Hairdressing salons and adjoining rooms or basement.
- ii) Establishments where dry-cleaning solutions are used.
- iii) Industrial use near chemical de-greasing processes or where solvents are used or stored.
- iv) Installations where refrigerant gases are used or stored.
- v) Environments with dust laden atmosphere.

WATER QUALITY AND TREATMENT

Where extreme conditions of water hardness exist, scale can form in any water heating equipment, especially when the heater is working under conditions of constant heavy demand and at high temperatures.

Each water heater is fitted with one or more magnesium anode(s) which protect the tank from corrosion caused by electrolytic action. Magnesium anodes are sacrificial in that they erode as they protect. When the anode has eroded to less than 50% of its original diameter, it may not offer protection. The anodes should be inspected annually and replaced as necessary. Frequency of anode replacement will vary dependent on water quality.

Andrews Water Heaters offer Correx™ UP powered anodes as an alternative to the standard magnesium anodes. These anodes do not need maintenance or replacement. The potentiostat which regulates the current to the Correx™ anode, features an indicator light which shows green to indicate correct function and red to indicate malfunction. An additional Correx™ BEMS version is available, which provides a remote warning signal.

These anodes are available as an optional extra on all Andrews Water Heaters.

In hard water areas, scale formation can occur in hot water systems and hot water heaters and the higher the temperature and volume of water used, the more problematic the scale build-up can be. Water treatment is normally recommended when the hardness reaches 100 - 150ppm (7 - 10 degrees Clark) and above. This problem can be minimised by reducing the water temperature in the heater and by fitting suitable water pre-treatment equipment.

When installing Andrews Water Heaters in hard water areas we would recommend that a water treatment specialist is consulted.

The following companies have supplied water treatment equipment in the UK for a number of years to various establishments including those where Andrews water heaters have been installed.

WATER TECHNOLOGY LTD

Powke Lane Ind. Estate
Blackheath
Birmingham
B65 0AH

Contact

Gareth Morris
Tel: 0121 561 3144
Fax: 0121 561 4184

WATERMATIC

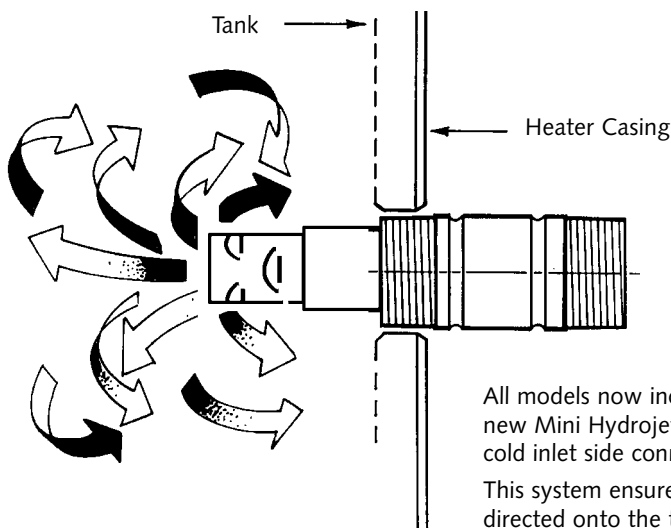
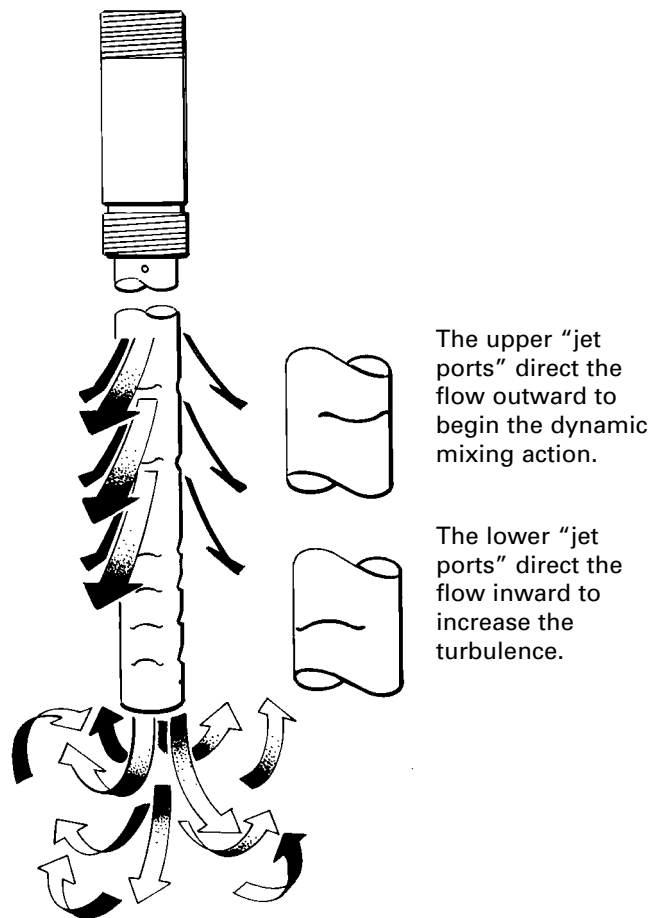
Reddicap Trading Estate
Sutton Coldfield
West Midlands
B75 7BY

Contact

Mike Potter
Tel: 08000 838496
Fax: 0121 311 1427

WATER CONNECTIONS

**Hydrojet System
Top Cold Inlet
Connection**



All models now incorporate the new Mini Hydrojet system on cold inlet side connections.

This system ensures water is directed onto the tank base which minimises sediment build up from day one of installation.

**Mini
Hydrojet Inlet Nipple
(Side Cold Inlet
Connection)**

The heater is fitted with the Hydrojet Total Performance System incorporated in the cold inlet dip tube. The tube is designed to increase turbulence and reduce sediment build up, reduce thermal stacking and increase delivery.

**WATER
CONNECTIONS
VENTED SYSTEMS**

The water heater must be supplied from a cold water feed cistern and the hot water supply pipe must be fitted with an open vent pipe in accordance with BS 5546 and BS 6644.

The Water Supply (Water Fittings) Regulations 1999 must be observed when installing the system.

The cold water feed cistern must have an actual capacity greater than the hourly recovery rate of the heater or heaters to which it is fitted, the minimum actual capacity allowed for a feed cistern being 227 litres (50 gallons).

The actual cistern capacity is the capacity to the normal water line of the cistern.

All cisterns should be manufactured to the relevant British Standard.

The distance from the normal water line to the top of the cistern should comply with that specified by the Water Authorities.

The cold water inlet and hot water outlet connection nipples are identified in Fig. 5.

Connect the cold water feed and hot water outlet to these nipples with union adaptors for ease of servicing.

CAUTION!

DO NOT APPLY HEAT TO THESE NIPPLES IF MAKING CAPILLARY SOLDERED JOINTS AS THEY ARE FITTED WITH PLASTIC INSERTS. MAKE THE CAPILLARY JOINTS TO THE PIPES BEFORE CONNECTING TO THE HEATER. A DRAIN COCK IS SUPPLIED WITH THE HEATER AND THIS SHOULD BE FITTED TO THE APPROPRIATE BOSS AS SHOWN IN FIG. 5.

After installation of the water system, open the main water supply valve, flush the system and fill the heater.

Open the hot taps to allow air to escape from the system.

When the water is free of air, close the taps and check for leaks at the gas control thermostat, drain cock and the pipe connections at the top of the heater.

Typical water service layout for single heater vented system is shown in Fig. 6.

WATER CONNECTIONS

All connection sizes are shown on page 5

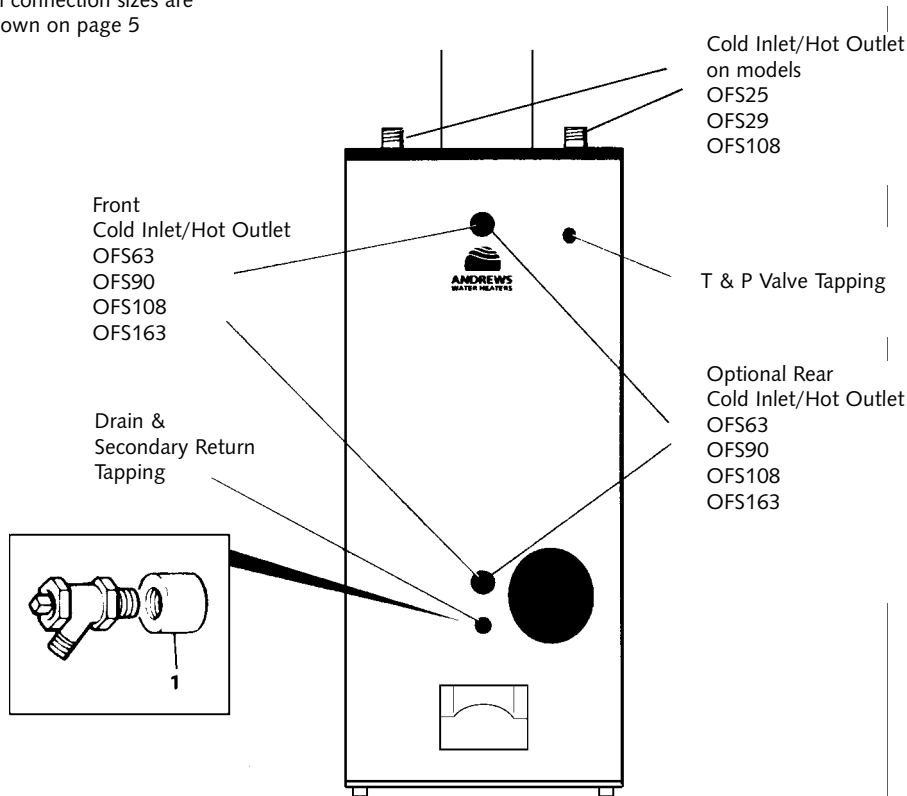


Fig. 5

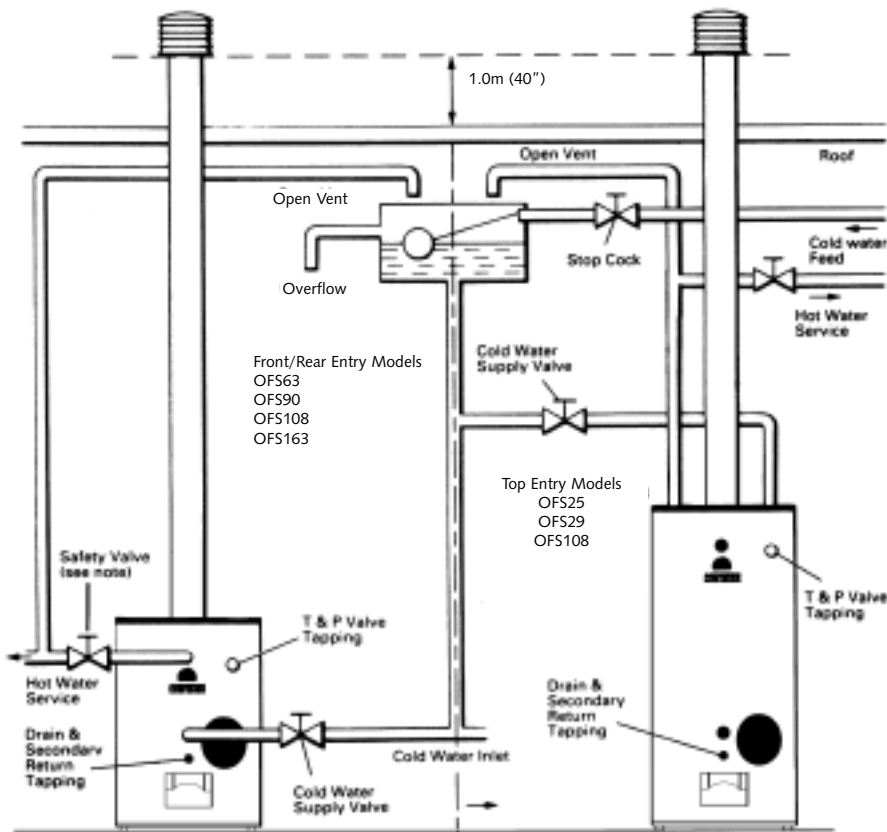


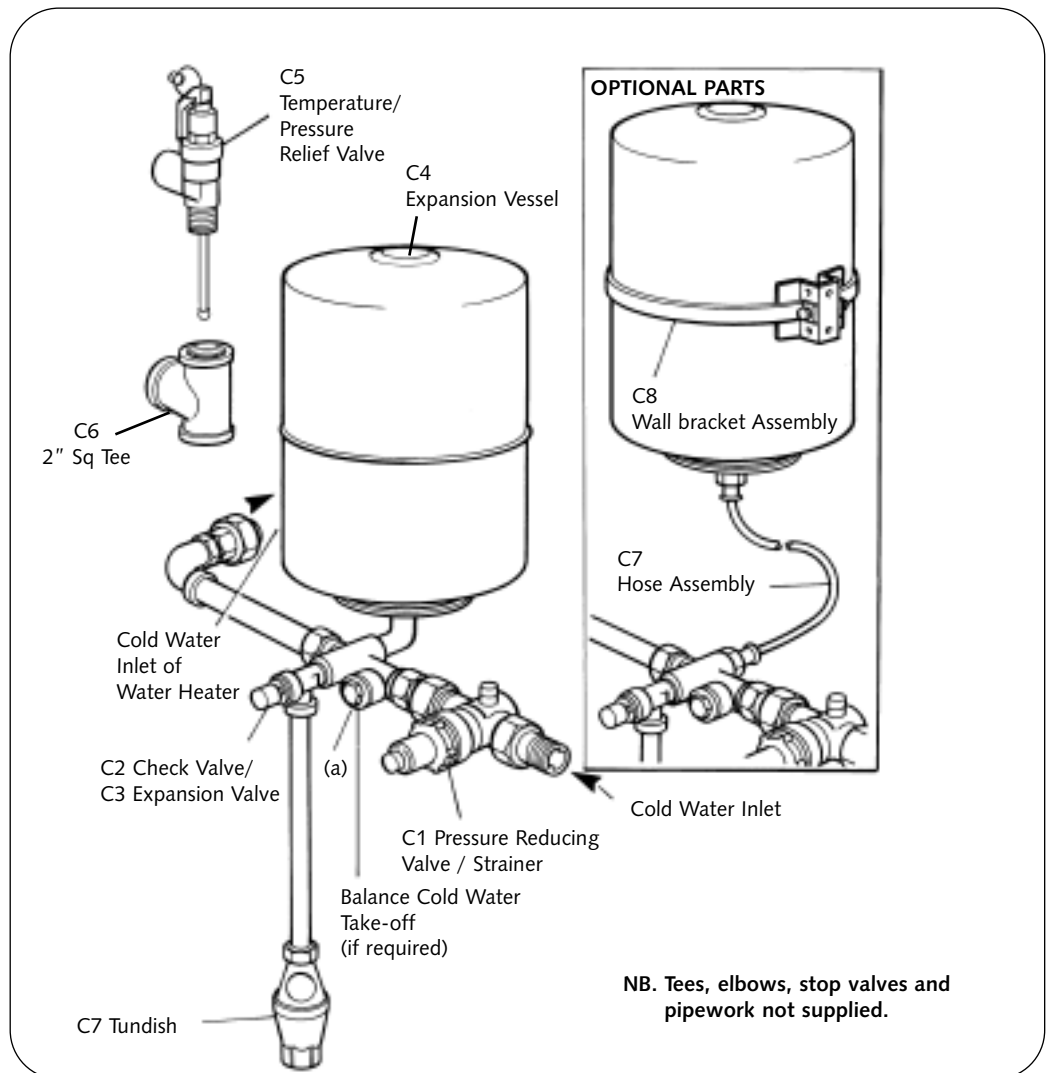
Fig. 6

WATER CONNECTIONS UNVENTED SYSTEMS

Unvented Systems should be fitted by an Approved Installer

When used in an unvented system, the Andrews water Heater will supply hot water at a pressure of 3.5bar (51lbf/in²), provided that this pressure is available at the mains feed. During conditions of no-flow, system pressure may rise to a maximum of 6bar (87lbf/in²) whilst the burner is operating. When testing the system, it is recommended that a maximum test pressure of 8.6bar (125 lbf/in²) is employed.

The heater can be used on unvented hot water storage systems, with the addition of an Unvented Systems Kit, these are available from Andrews Water Heaters. See Parts List Pages 40 - 42. The Wall mounting assembly is available as an optional extra.



Item C5 must be fitted into C6 and fitted on the hot water outlet nipple located at the rear of heater models OFS108 & OFS163.

When assembling items C1 and C2, ensure that the flow arrows marked on the components are pointing in the direction of flow, i.e. towards the water heater.

The cold water for services may be drawn from the 22mm compression port on item C1(a). The water pressure at this point will be similar to that available at the hot water outlet of the water heater. If port (a) is not used, it should be sealed with the blanking plug supplied.

WATER CONNECTIONS

If higher flow rates are required for the cold water services, a suitable tee fitting should be fitted to the pipework, upstream of item C1.

The pipework fitted to the tundish outlet should be one size larger than the outlet pipe of the safety device and should be terminated at a suitable drain (see Building Regulations 1991 Approved Document G3).

All fittings and materials must be suitable for use with drinking water and listed in the current Water Research Centre "Materials and Fittings Directory".

Installation of unvented hot storage water systems must comply with Part G of Schedule 1 of the Building Regulations 1991.

Typical water service layout for single heater unvented system is shown in Fig. 7.

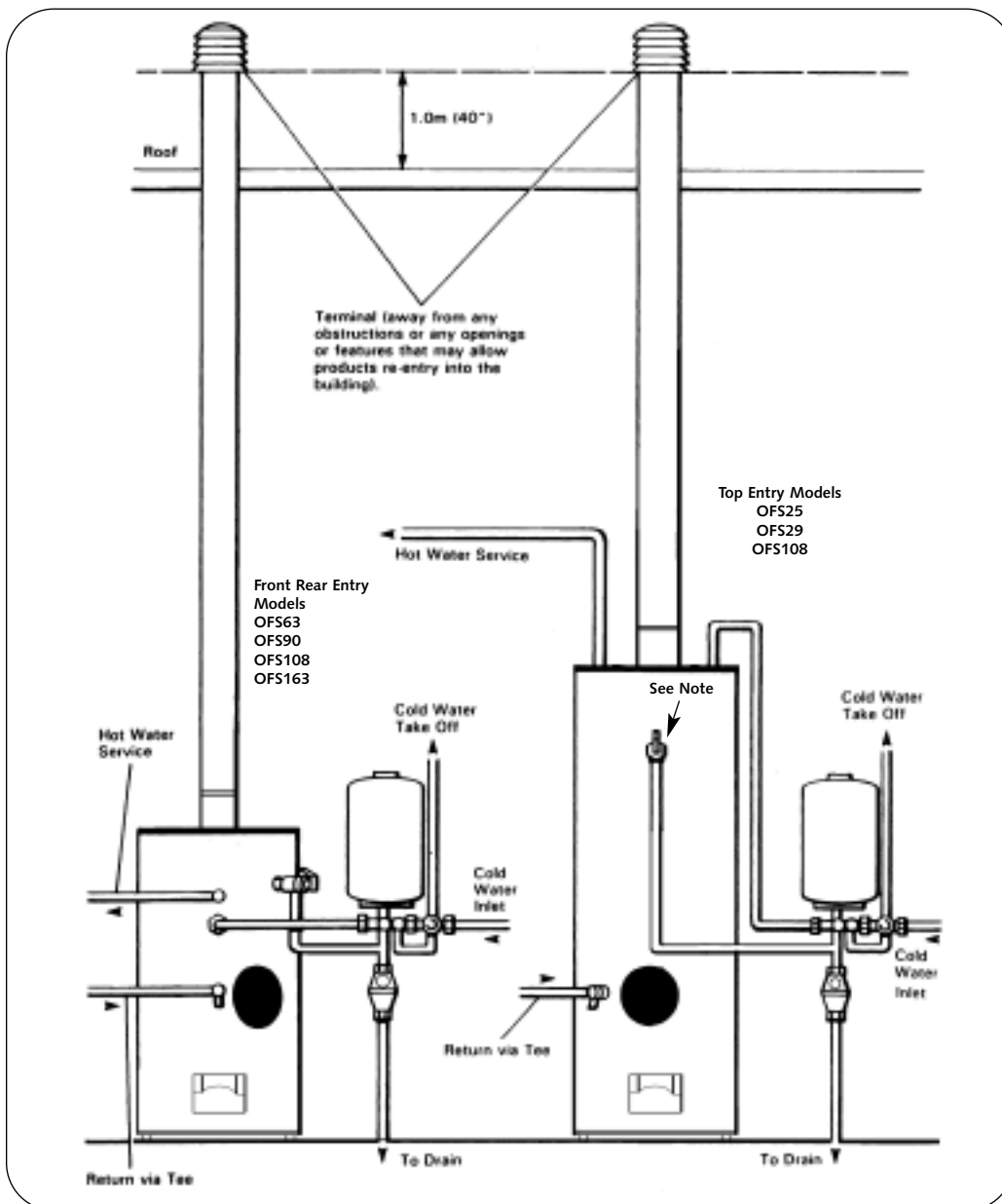


Fig. 7.

Note: On heater models OFS108 & OFS163 the 2" T/P is located at the rear via a 2" Sq Tee.

ELECTRICAL SUPPLY

Wiring external to the water heater must be installed in accordance with the I.E.E. Regulations for the wiring of buildings and to any local regulations that may apply.

The heaters are designed to run off 220/240V 1 Ph 50 Hz supply and the fuse rating is 5 Amp See pages 4 & 5.

The method of connection to the mains electricity supply should facilitate complete electrical isolation of the appliance preferably by use of an unswitched shuttered socket outlet in conjunction with a fused three pin plug both complying with the requirements of BS 1363/A.

Alternatively, a fused double pole switch of fused spur box serving only the heater may be used.

The point of connection to the mains should be readily accessible and adjacent to the appliance.

Connect electrical supply to the harness plug/socket (see Fig. 8 Wiring Diagram) Mains input cable should be connected to the mains supply as detailed above.

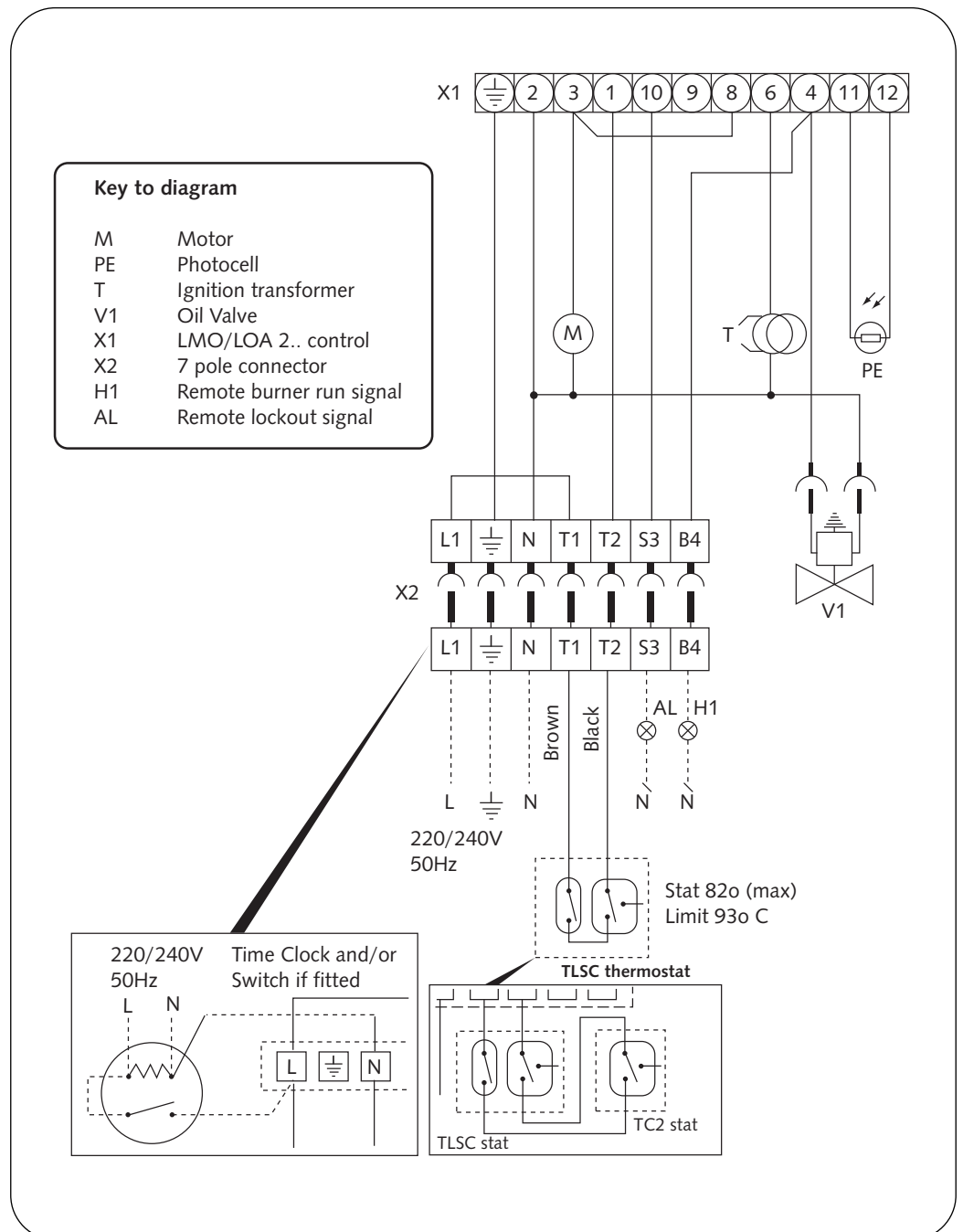


Fig. 8.

A fire valve and filter must be fitted in the fuel supply to the burner. (Not Supplied).

Current standards state that the "BIO-FUEL" has a blend of between 7% and 10%.

If a higher blend is being used then the burner manufacturer **MUST** be contacted for additional guidance.

Use either Kerosene Class C2 (BS2869) or Gas Oil Class D (BS2869). **NO OTHER FUEL SHOULD BE USED.**

Schematic representations of the fuel supply are shown below. It is suggested where possible a gravity feed is used.

Should a negative head system be employed, see typical example below.

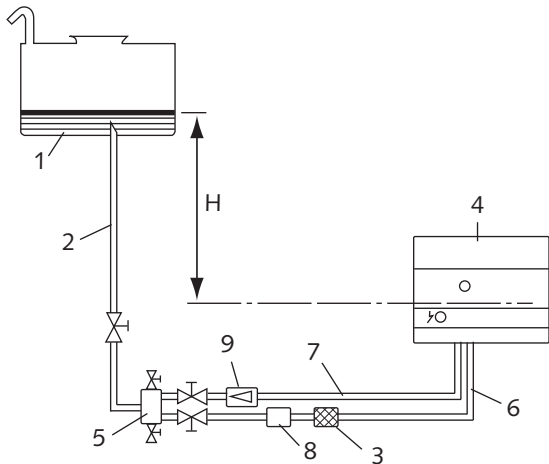
FUEL SUPPLY

MATERIALS AND JOINTING

All materials including the fuel storage tank, fuel supply pipe and jointing materials must comply fully with the requirements in BS5410.

SITING OF FUEL STORAGE TANK

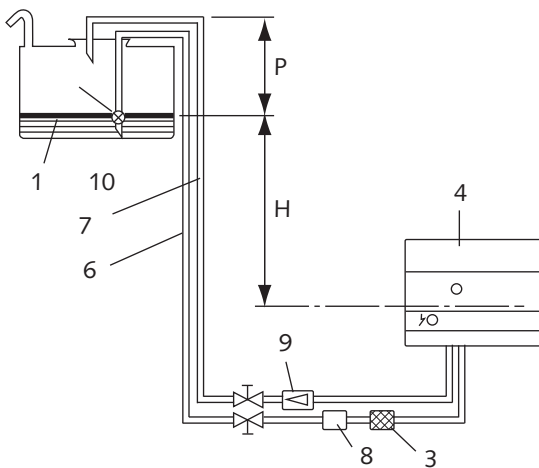
The siting of the fuel storage tank must fully comply with the requirements in BS5410.



TYPICAL GRAVITY FROM THE BOTTOM OF OIL TANK

- 1 Oil tank
- 2 Feed line
- 3 Filter
- 4 Burner
- 5 Degasifier
- 6 Suction line
- 7 Return line
- 8 Fire valve
- 9 Non return valve

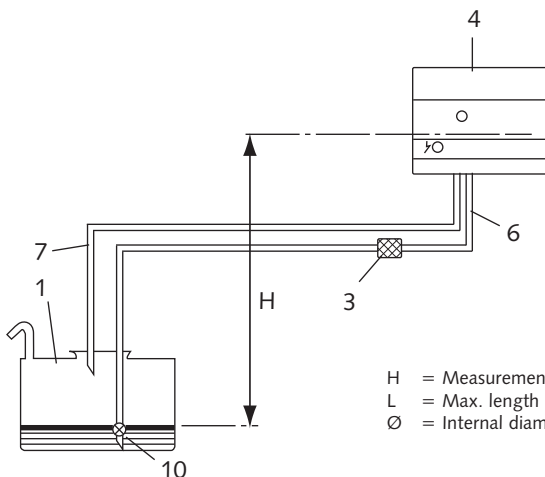
H meters	Total meters Ø i. 10mm
1	30
2	35
3	40
4	45



TYPICAL GRAVITY FEED OVER THE TOP OF OIL TANK

- 1 Oil tank
- 3 Filter
- 4 Burner
- 6 Suction line
- 7 Return line
- 8 Fire valve
- 9 Non return valve
- 10 Foot valve

H meters	Total meters Ø i. 10mm
1	30
2	35
3	40
4	45



TYPICAL SUCTION FEED

- 1 Oil tank
- 3 Filter
- 4 Burner
- 6 Suction line
- 7 Return line
- 10 Foot valve

H meters	Total meters	
	Ø i. 10mm	Ø i. 12mm
0,5	26	54
1	24	47
1,5	18	38
2	14	30
2,5	10	23
3	6	15
3,5	-	7

H = Measurement between minimum oil level and pump axis
 L = Max. length of suction line, including vertical lifts. For each bend of valve deduct 0,25m.
 Ø = Internal diameter of pipe

IMPORTANT:

These oil fired water heaters must be commissioned by a competent engineer.

CAUTION / IMPORTANT: PRESSURE WITHIN COMBUSTION CHAMBER SHOULD READ BETWEEN -0.2 MBAR AND -0.5 MBAR, ADJUST THE DRAUGHT STABILIZER TO ENSURE A READING OF -0.1" TO -0.4" IS ACHIEVED TO ENSURE SAFE AND CORRECT OPERATION.

CAUTION: DO NOT OPERATE THE WATER HEATER UNTIL THE STORAGE VESSEL IS COMPLETELY FILLED WITH WATER. WITH WATER RUNNING FROM ALL HOT TAPS.

CAUTION: ENSURE THE CORRECT NOZZLE IS FITTED TO SUIT THE FUEL TYPE BEING USED. SEE TECHNICAL DATA SECTION 2 OR PAGE 21.

A. To light the burner

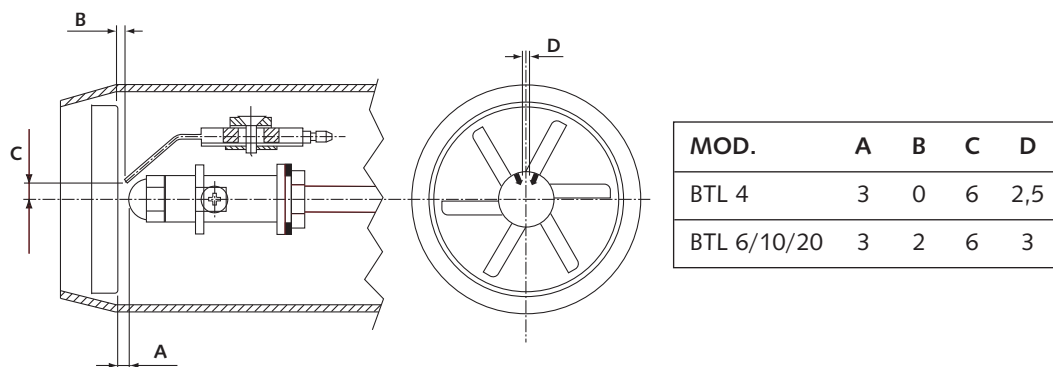
- 1) Turn on the fuel supply to heater.
- 2) Switch on power supply to burner.
- 3) Rotate the thermostat adjustment knob to the desired water temperature at which the burner will begin its prepurge. At about 15 secs. the burner will light. The thermostat should be set at a temperature to suit the system it controls.
- 4) The two control thermostats should be set to the same temperatures . (OFS108 & OFS 163 only)

B. To shut off the burner

- 1) Rotate the thermostat adjustment knob to the off position.
- 2) For long periods only, eg. holidays or periods of 7 days switch the burner power supply 'OFF', and turn off the fuel service cock. For shorter periods eg. less than 7 days, leave the heater under control of the thermostat.

C. Burner Adjustment

The burner comes factory pre-set. The correct burner head settings are shown below. Refer to the table if the nozzle or electrodes are replaced.

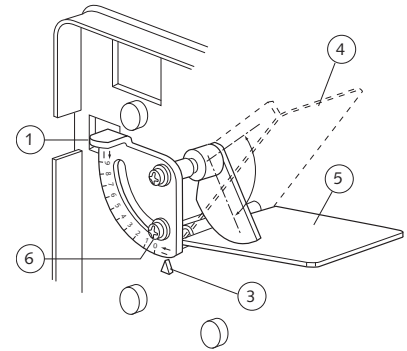
**COMBUSTION ADJUSTMENT**

The burner is factory pre-set to an average value that must then be adjusted to the water heater in question. To adjust the combustion device, start by increasing the air volume.

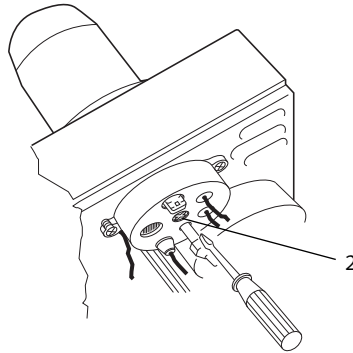
When the burner starts it is burning with excess air and smoke number 0. Reduce the air volume until soot occurs and increase again to reach a combustion free of soot. By this procedure an optimum adjustment is obtained. See Below.

Loosen the fixing screw '6' and bring the air damper into the position thought to be necessary as a midway point for fuel to be burnt. Turn the main switch to ON to power the burner and ignite it. Correct, if necessary, combustion air delivery by adjusting the intake damper and the position of the deflector disk (adjustable via screw 2). The burner is, in fact, fitted with a special screw to adjust the position of the deflector disk; this device allows for optimisation of combustion by reducing or increasing the air flow between deflector disk and head. It is normally necessary to reduce (undo screw 2) the air flow between deflector disk and head when there is reduced fuel delivery: this passage must be proportionately more open (screw in screw 2) when the burner is working with a higher fuel delivery rate. After modifying the position of the deflector disk, it is, usually, necessary to correct the air damper positions and afterwards check for proper ignition. See diagrams on page 21.

1. Air register opening adjustment
-Reference index in position "0" register closed
-Reference index in position "9" register open
2. Flame disc position
3. Air register opening adjuster reference index
4. Air damper in open position (9)
5. Air damper in closed position (0)
6. Air Damper Fixing Screw



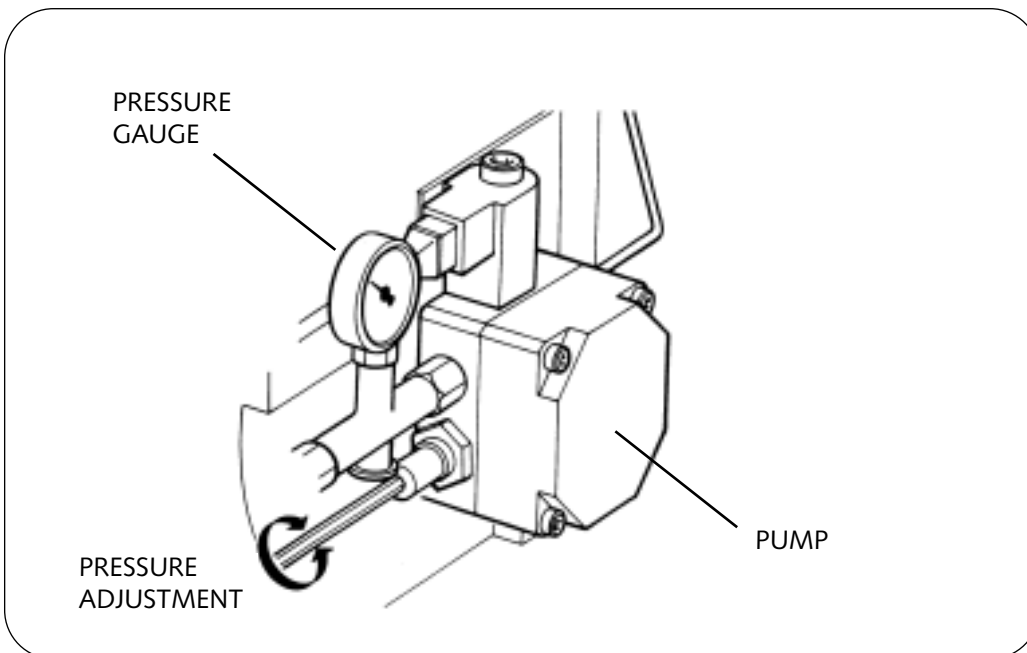
AIR ADJUSTMENT



When the combustion adjustment is complete the following combustion analysis readings will be achieved.

Andrews Model No		OFS25	OFS29	OFS63	OFS90	OFS108	OFS163
Smoke	No	0	0	0	0	0	0
Flue Gas Temp	°C	380	380	260	260	260	260
CO ₂	%	11.5	11.5	11.5	11.5	11.5	11.5
O ₂	%	5.5	5.5	5.5	5.5	5.5	5.5

PUMP ADJUSTMENT



The pump pressure must be adjusted and set correctly to suit the fuel type being used
See table below

Andrews Model No		OFS25	OFS29	OFS63	OFS90	OFS108	OFS163
Nozzle fitted	Kero	0.75x80s	0.85x80s	1.65x80s	2.50x80s	3.00x80s	4.50x80s
Pressure	PSI	113	110	127	113	113	113
Pressure	Bar	7.8	7.6	8.6	7.8	7.8	7.8
Nozzle Supplied	Gas Oil	0.55x80s	0.60x80s	1.25x80s	1.75x80s	2.25x80s	3.50x80s
Pressure	PSI	195	211	206	214	187	174
Pressure	Bar	13.5	14.5	14.2	14.8	12.9	12

**INSTRUCTING
THE USERS**

When satisfactory commissioning and testing has been achieved, hand this manual to the user or purchaser and explain the method of economic and efficient operation.

Explain that:

1. Other than for long shutdown periods, the heater must be left operating normally.
2. It is important that the control thermostat is set at the lowest temperature consistent with the user's needs.

Ensure that the user or purchaser is fully conversant with the lighting, shutdown and general operating procedures.

Advise that any air vents must be kept clear and items must not be placed or stored in the vicinity of the heater.

Advise of precautions necessary to prevent damage to the heater and systems in the event of the system remaining inoperative during frost conditions.

Advise the user or purchaser that for continued efficient and safe operation of the heater, it is important that magnesium anodes are inspected annually and that adequate servicing is carried out at regular intervals by the installer.

For your safety read before lighting the appliance

**USERS
SAFETY
GUIDE****WARNING**

1. Always follow manufacturers instructions when lighting the appliance. Failure to do so may result in damage to property, personal injury or loss of life.

WARNING

Hotter water increases the risk of scalding. Before changing the temperature refer to instruction manual or data label. Hot water can produce third-degree burns in:
6 seconds at 140°F (60°C)
30 seconds at 130°F (54°C)

When properly installed and adjusted, the heater will require minimal attention. Should it become necessary to completely drain the heater, close the cold water inlet valve and open a hot water tap to allow air to enter the system. Fit a suitable hose to the drain cock and open.

Whenever the heater is filled with cold water, condensation may form on the storage vessel surfaces when the burner is lit. This is normal and will disappear when the heater warms up.

The thermostats fitted to heater models OFS25, OFS29, OFS63 & OFS90 have a built in high limit thermostats. In the case of dangerous water temperatures the fuel supply will be automatically shut off. The reason for such high temperature must be corrected before the heater is relit.

The two control thermostats where applicable (OFS108 & OFS163) should both be set to the same operating temperatures. This will ensure stacking does not occur and will avoid high water temperatures when small amounts of water are drawn off during peak times of use.

INTRODUCTION

Servicing must be carried out by a properly qualified person.

Whilst giving these instructions for the care of the Heater, it is recommended that checks are carried out by the installer at least every 6 months. Ensure good ventilation by keeping the heater free of extraneous materials and clear of dust and lint. Keep pipework, flue and tops of heaters clear of any combustible materials. A water softener or lime inhibitor should be employed in hard water areas. The heater should be inspected every few months via the hand hole cleanout and lime and silt deposits removed failure to do so will shorten heater life and may invalidate the warranty.

Note! The cleanout hole gasket must be renewed whenever the cover is removed. (See parts lists pages 32,34,36 & 38).

PRE-SERVICE OPERATIONS

Before servicing, carry out the following operations.

1. Turn off the fuel supply to the heater.
2. Turn off the electrical supply to the heater.
3. Turn off the cold water supply to the heater.
4. Turn on the hot water draw-off taps served by the water heater, or, for multiple installations, turn off the hot water outlet connection valve and secondary return valve.
5. Drain down using the drain valve on the heater.

BURNER ASSEMBLY

The burner should be checked every 6 months and if necessary cleaned as follows:

1. Inspect fuel tank and drain any water contamination
2. Clean fuel filters (replace if necessary)
3. Remove the burner from combustion chamber
4. Remove all carbon from burner parts. Pay particular attention to electrode and nozzle (replace if necessary). Remove all dust/dirt from burner fan
5. Clean HT leads and check condition
6. Clean photo-cell
7. Check condition of control box terminals, check security and condition of wiring
8. Clean pump filter. Check condition of fuel pump drive dog, ensure pump is fitted correctly when assembling burner. Ensure burner settings are correct
9. Check combustion chamber condition, every 6 months

FLUEWAY

The flueway should be checked every 6 months and if necessary cleaned as follows:

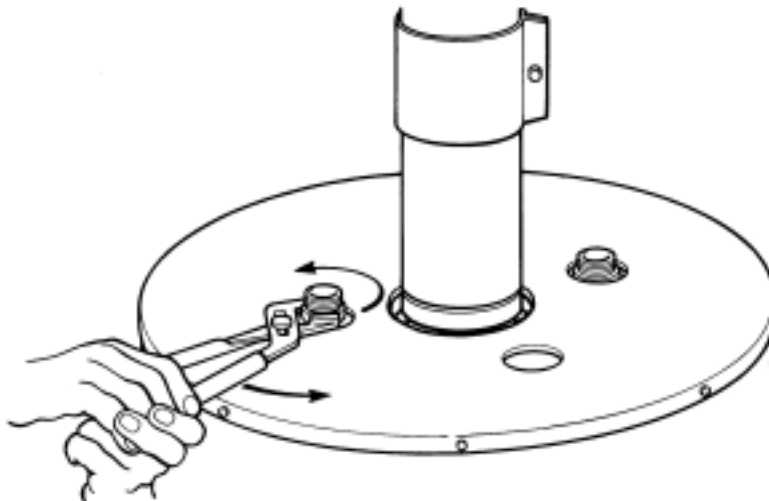
1. Remove burner assembly complete
2. Disconnect the flue/flue stabiliser from heater
3. Inspect and clean the secondary flue installation as necessary
4. Lift out the baffle/baffles from inside the central flueway
5. Clean the flueway with a brush and clean any deposit from the underside of the storage vessel bottom and from the flue baffle
6. Re-assemble in the reverse order
7. Re-light and carry out commissioning check

Magnesium sacrificial anode(s) is (are) fitted to the top of the storage vessel. The anode(s) will prevent corrosion of the storage vessel. Anode condition should be checked annually and replaced if excessive wear is present. We recommend that the anode(s) are replaced annually.

MAGNESIUM ANODE(S)

1. Withdraw each anode using 1 1/16in AF socket spanner. A new anode measures 21 mm diameter.
2. An anode should be replaced, if, at any point it's length, the diameter is reduced to half, or less of original. Particular attention should be paid to the ends.
3. If the anode is encrusted with limescale, it should be either wire brushed to reveal bright metal or replaced.
4. For models OFS25 & OFS29 withdraw the hot water outlet nipple/anode and replace (See Fig. 9) - Refer to parts list pages 32 & 32.
5. Replace all anodes with service anode (articulated) part no. C333.

OFS25 & OFS29



Disconnect pipe fittings and turn nipple anti-clockwise to remove.

Fig. 9

Where Correx™ anodes are fitted, no maintenance is necessary.

CLEANING THE STORAGE VESSEL

ALL MODELS

The storage vessel should be checked and cleaned annually

Scale formation in the base of the vessel may occur, particularly in hard water areas and is normally associated with high usage and high water temperatures. It is characterised by a rumbling noise when the main burner is lit. Scale formation in the base of the vessel will affect the efficiency of the water heater and reduce the life of the storage vessel.

It should be noted that the failure of the storage vessel due to scale formation on the base will not be covered by the terms of the warranty.

Any scale formation which cannot be removed by normal means of cleaning should be removed by chemical descaling. See below.

DESCALING INFORMATION

When descaling the water storage heater your attention is drawn to the following guidelines.

SAFETY FIRST

DUE TO THE CORROSIVE NATURE OF THE DESCALING FLUID ITS ESSENTIAL THAT SUITABLE PROTECTIVE CLOTHING EQUIPMENT IS USED AND ADEQUATE VENTILATION IS AVAILABLE WHEN DESCALING. IT IS IMPORTANT TO FOLLOW DESCALING MANUFACTURERS INSTRUCTION BEFORE AND DURING USE.

1. Isolate the electrical power supply to burner.
2. Close water inlet valve and drain heater tank.
3. Remove magnesium sacrificial anode.
Note: It is recommended that a new anode is fitted.
4. Add suitable hydrochloric based descale acid, the requirement is normally 5 litres for OFS25 & OFS29 and 10 for OFS63, OFS90, OFS108 & OFS163.
5. After a minimum of one hour relight the burner for 2 minutes (Maximum).
6. Turn the burner off and drain off descale fluid through drain port.
7. Open cold water feed valve and fill heater tank.
8. Drain and flush out heater for minimum of 30 minutes.
9. Replace hot outlet nipple/anode (OFS25 & OFS29).
10. Replace anodes using service anode (articulated) part no. C333.
11. Relight the burner and allow the heater to come to its working temperature.

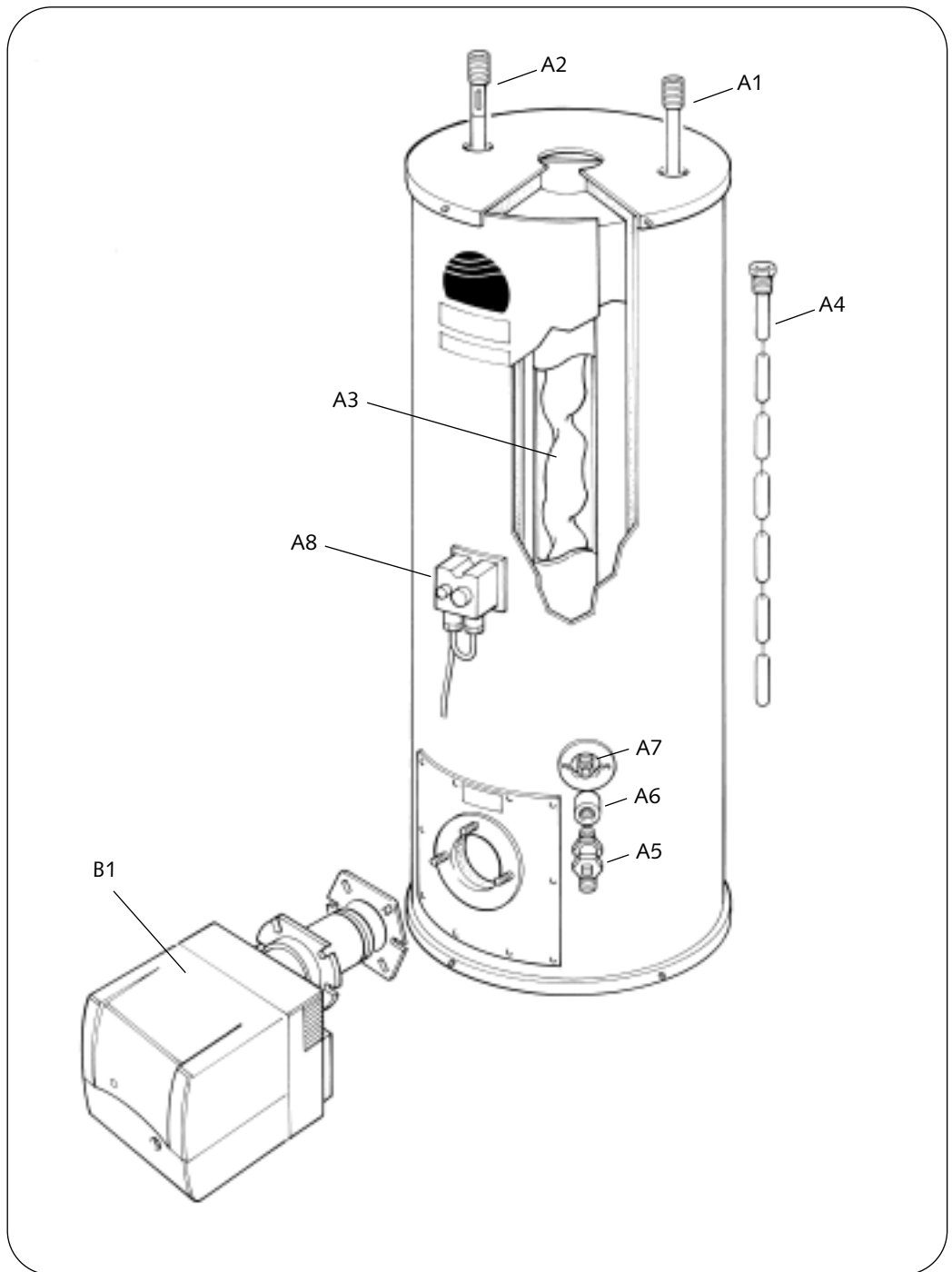
IMPORTANT!

Remove Correx anode(s) if fitted. Re-fit the Correx anode(s) when descaling operation is complete.

ALL MODELS

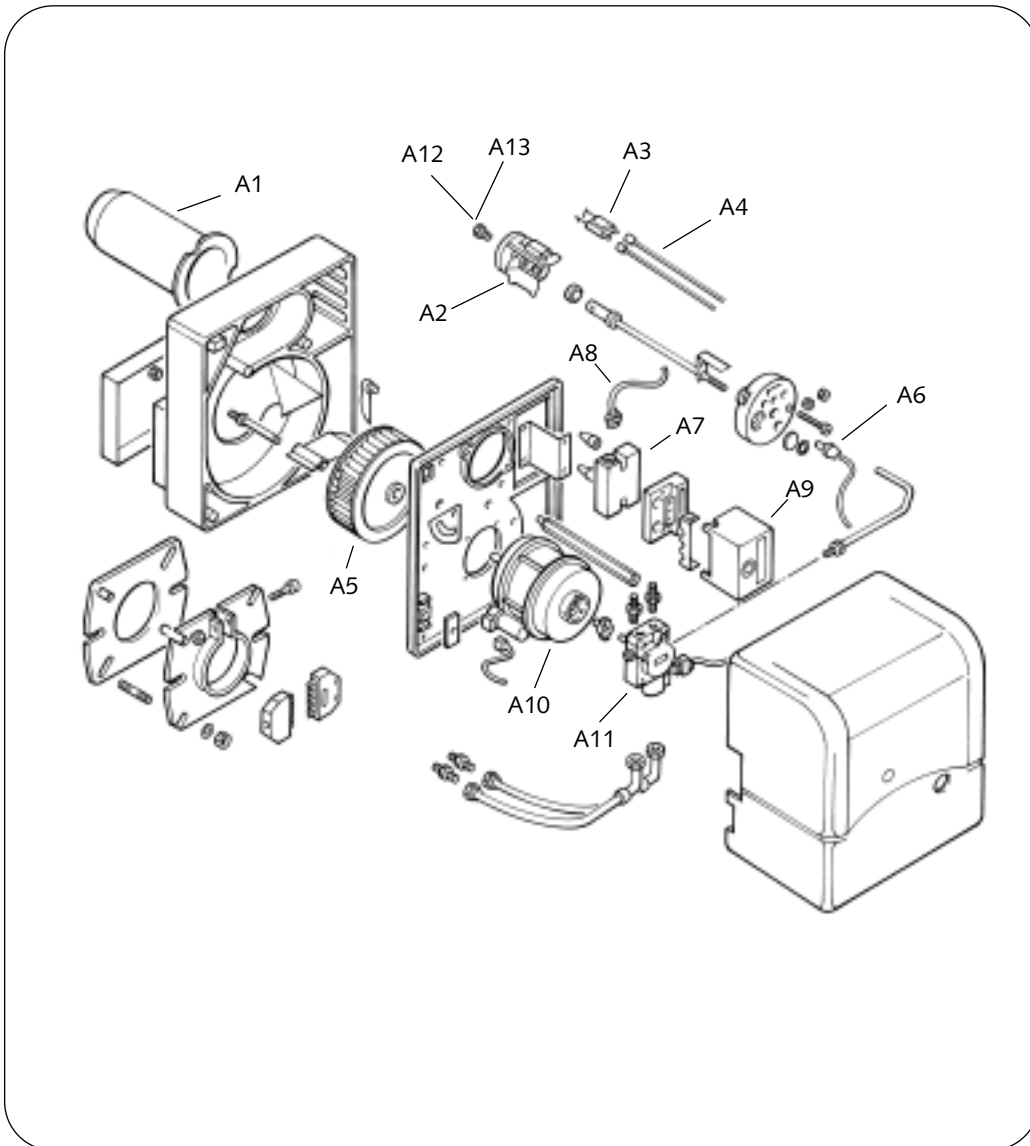
FAULT	ACTION
1. BURNER WILL NOT START	<ul style="list-style-type: none"> (a) Check electrical supply and ON/OFF switch is 'ON'. (b) Check thermostat circuit is made and also time clock contacts are closed and limit thermostat is set. (c) Check if locked out. Re-set. (d) Check continuity of burner motor windings. (e) Check if fuel pump is seized. (f) Replace faulty parts.
2. BURNER MOTOR RUNS - BURNER GOES TO LOCKOUT	<ul style="list-style-type: none"> (a) Check for blocked fuel pipe, check filters in filter bowl, rear of pump and rear of nozzle are clean, and suction pipework for air leaks. (b) Disconnect nozzle output pipe from fuel pump. Switch burner on momentarily and check for delivery of fuel. (c) If fuel not delivered from pump, check pump/motor drive dog. (d) If pump is turning and no fuel is delivered replace pump. (e) Check solenoid valve is opening and trace supply from control box. (f) Check for blocked nozzle. (g) Check fuel in tank.
3. FUEL REACHES NOZZLE BUT FAILS TO IGNITE	<ul style="list-style-type: none"> (a) Check electrode adjustment. (b) Check for dirty or cracked electrodes. (c) Check HT leads and connections. (d) Check electrical input to transformer. (e) Replace faulty parts.
4. BURNER LIGHTS BUT RUNS TO LOCKOUT	<ul style="list-style-type: none"> (a) Carry out checks 2-3 as above. (b) Check that photo-cell is correctly located in holder. (c) Check photo-cell is clean and not cracked. (d) Replace photo-cell. (e) Replace control box.
5. BURNER RUNS BUT SMOKE EMITTED FROM FLUE	<ul style="list-style-type: none"> (a) Check fuel quality. Fuel should be free from water and dissolved material such as engine oil or anti-freeze. (b) Check for blocked fuel filter or pick-up pipe. (c) Check nozzle is tight in holder. (d) Check burner settings.
6. WATER TEMPERATURE TOO LOW	<ul style="list-style-type: none"> (a) Reset the higher temperature. (b) Check pressure at burner.
7. NOT ENOUGH HOT WATER	<ul style="list-style-type: none"> (a) Check pressure at burner. (b) Check amount of water being used against recovery rate given on Data Plate.
8. WATER DRIPPING FROM BASE OF HEATER	<ul style="list-style-type: none"> (a) Check if water stops dripping when water in heater is hot. If water stops problem is condensation caused by incorrectly designed flue or by tank cooling excessively i.e. more hot water being used than recovery rate of the heater. (b) If water continues to drip when heater is hot. Problem is a leaking joint or storage vessel.
9. RUMBLING NOISE (KETTLING)	<ul style="list-style-type: none"> (a) Scale formation in heater, consult water treatment specialist. Heater must be descaled and suitable water treatment provided to avoid problem re-occurring.

**HEATER
SPARES
OFS25**



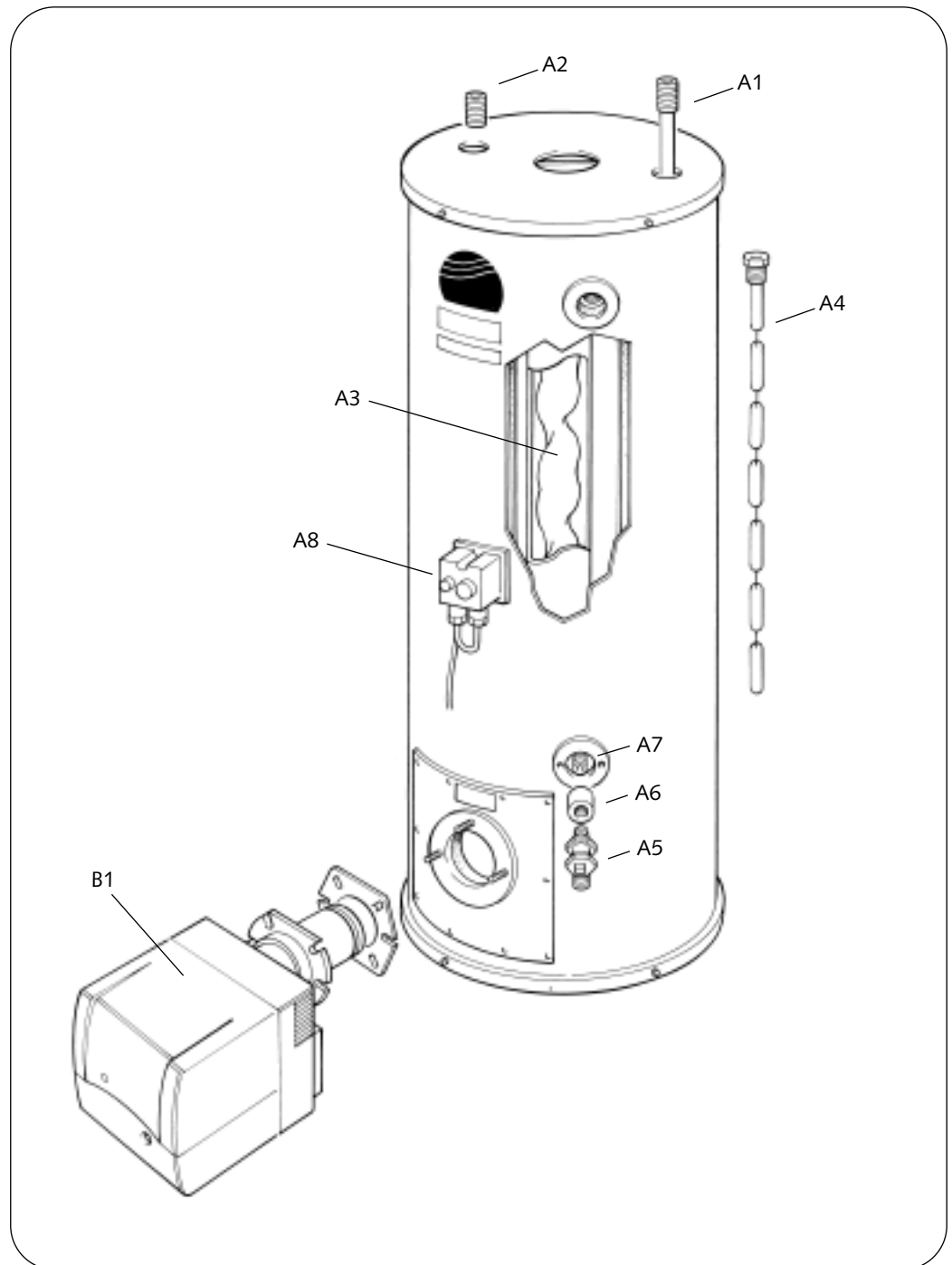
Ref.	Part No.	Description	Qty.
A1	E707	Cold Inlet Dip Tube	1
A2	E708	Hot Outlet Nipple Anode	1
A3	E709	Flue Baffle (Hinged)	1
A4	C333	Articulated Service Anode	1
A5	C381	Drain Valve	1
A6	C103	Drain Valve Socket	1
A7	C247	Drain Valve Nipple	1
A8	C719	Control/High Limit Thermostat	1
B1	E729	Burner Assembly	1

**BURNER
SPARES
BTL4
OFS25**



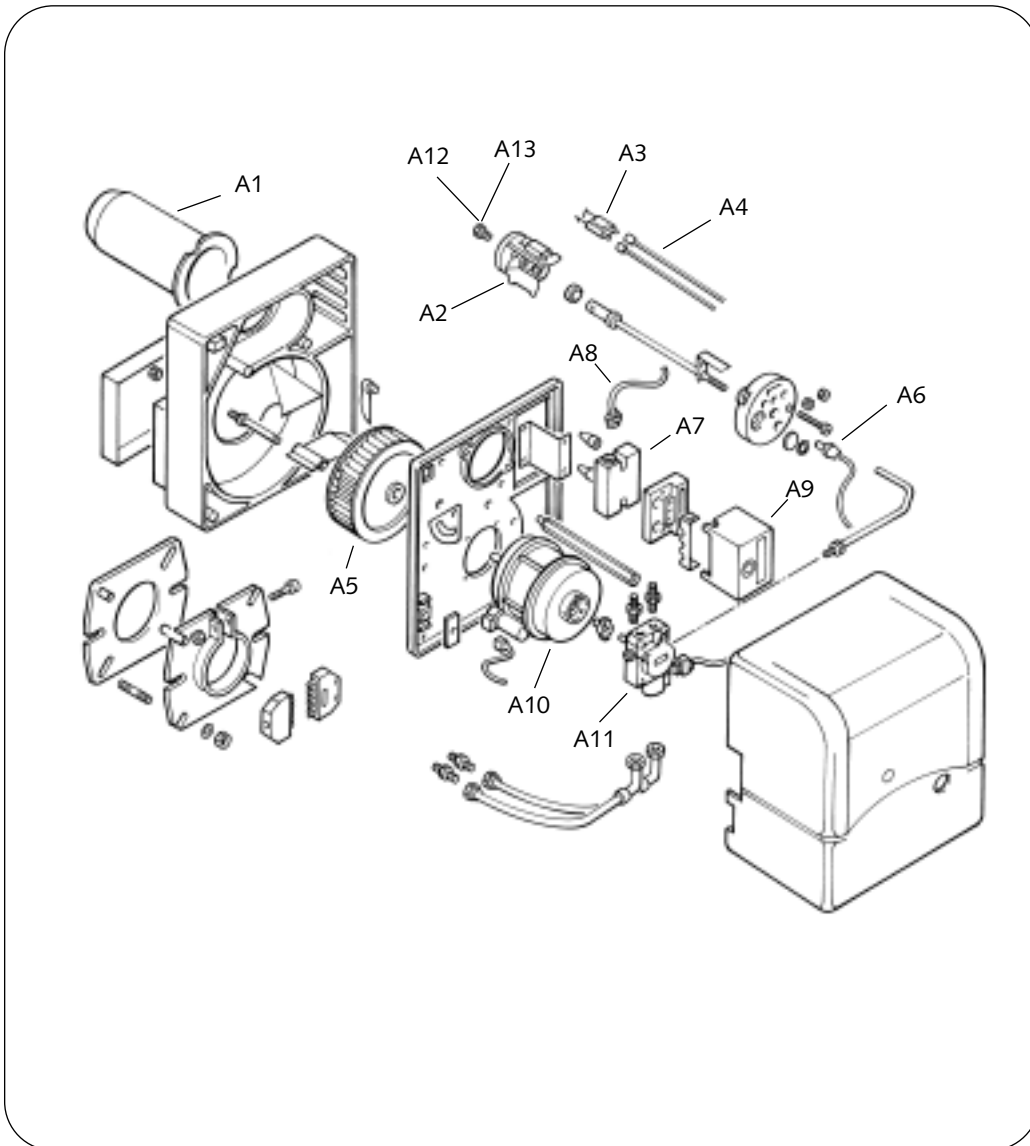
Ref.	Part No.	Description	Qty.
A1	E676	Blast Tube	1
A2	E679	Brake Plate	1
A3	E683	Electrode	2
A4	E685	H.T. Cable	2
A5	E687	Fan	1
A6	E689	Photocell	1
A7	E691	Transformer	1
A8	E694	Transformer Cable	1
A9	E696	Control Box	1
A10	E699	Motor	1
A11	E702	Pump	1
A12	E725	Nozzle - Kerosene - 0.75 x 80's	1
A13	E726	Nozzle - Gas Oil - 0.55 x 80's	1

HEATER SPARES OFS 29



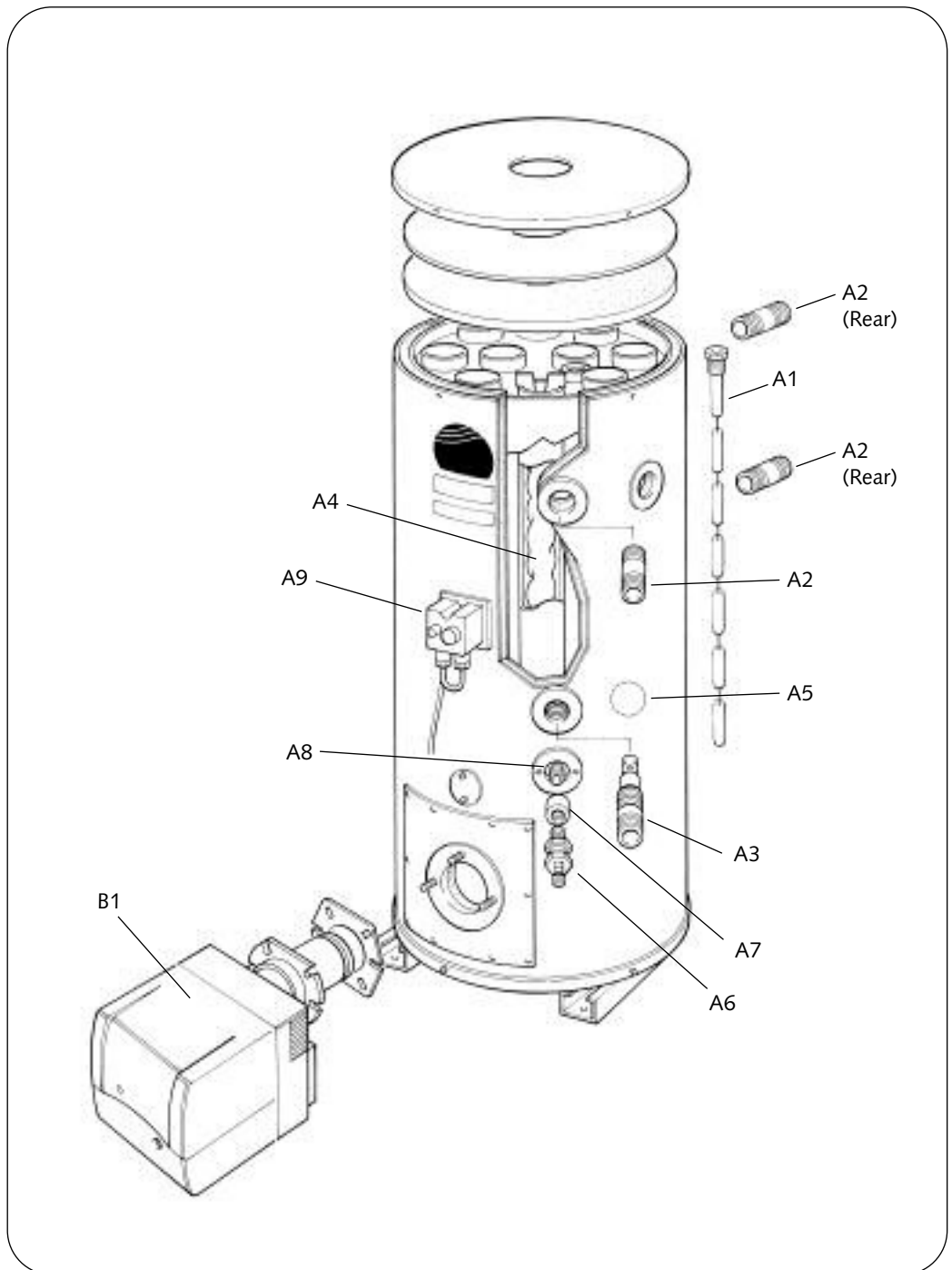
Ref.	Part No.	Description	Qty.
A1	E710	Cold Inlet Dip Tube	1
A2	E711	Hot Outlet Nipple Anode	1
A3	E712	Flue Baffle (Hinged)	1
A4	C333	Articulated Service Anode	1
A5	C381	Drain Valve	1
A6	C103	Drain Valve Socket	1
A7	C247	Drain Valve Nipple	1
A8	C719	Control/High Limit Thermostat	1
B1	E730	Burner Assembly	1

**BURNER
SPARES
BTL 4
OFS 29**



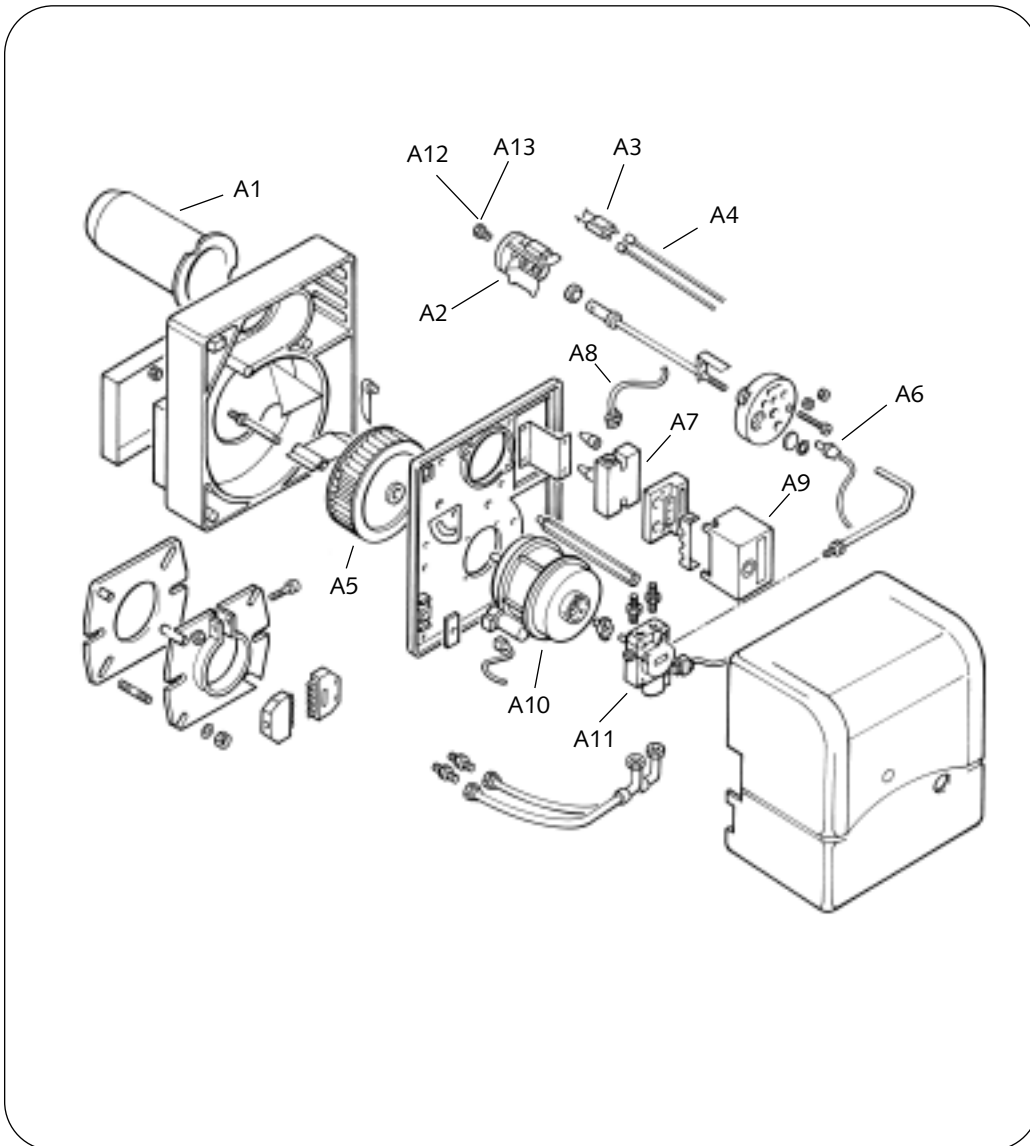
Ref.	Part No.	Description	Qty.
A1	E676	Blast Tube	1
A2	E679	Brake Plate	1
A3	E683	Electrode	2
A4	E685	H.T. Cable	2
A5	E687	Fan	1
A6	E689	Photocell	1
A7	E691	Transformer	1
A8	E694	Transformer Cable	1
A9	E696	Control Box	1
A10	E699	Motor	1
A11	E702	Pump	1
A12	E703	Nozzle - Kerosene - 0.85 x 80's	1
A13	E607	Nozzle - Gas Oil - 0.60 x 80's	1

HEATER SPARES OFS 63



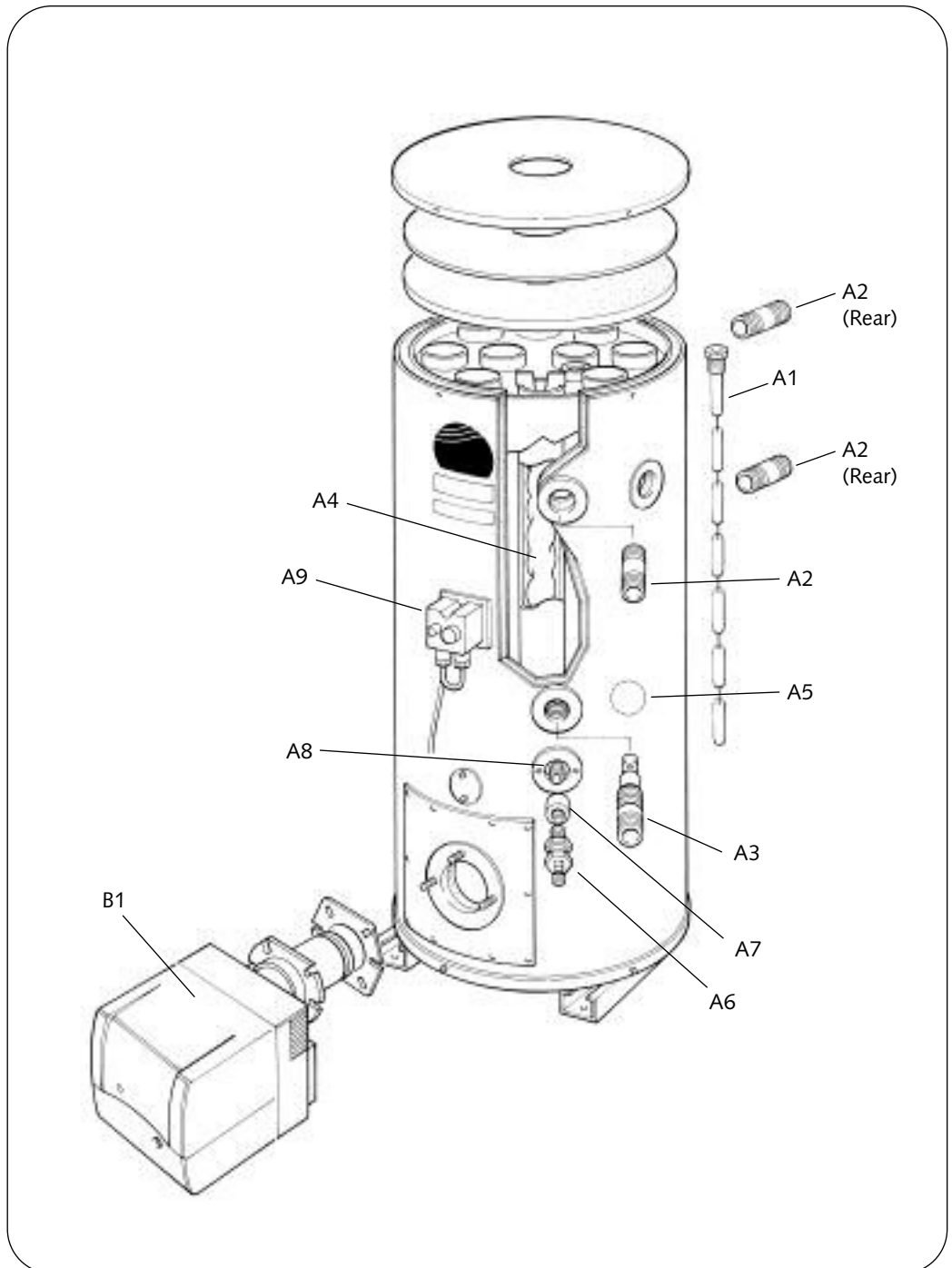
Ref.	Part No.	Description	Qty.
A1	C333	Articulated Service Anode	3
A2	C534	Hot Outlet Nipple 1.5 BSP	3
A3	E050	Hydrojet Hot Outlet / Cold Inlet Nipple 1.5 BSP	1
A4	E713	Flue Baffle	11
A5	C299	Cleanout Pad Seal	1
A6	C381	Drain Valve	1
A7	C103	Drain Valve Socket	1
A8	C247	Drain Valve Nipple	1
A9	C719	Control/High Limit Thermostat	1
B1	E731	Burner Assembly	1

**BURNER
SPARES
BTL6
OFS63**



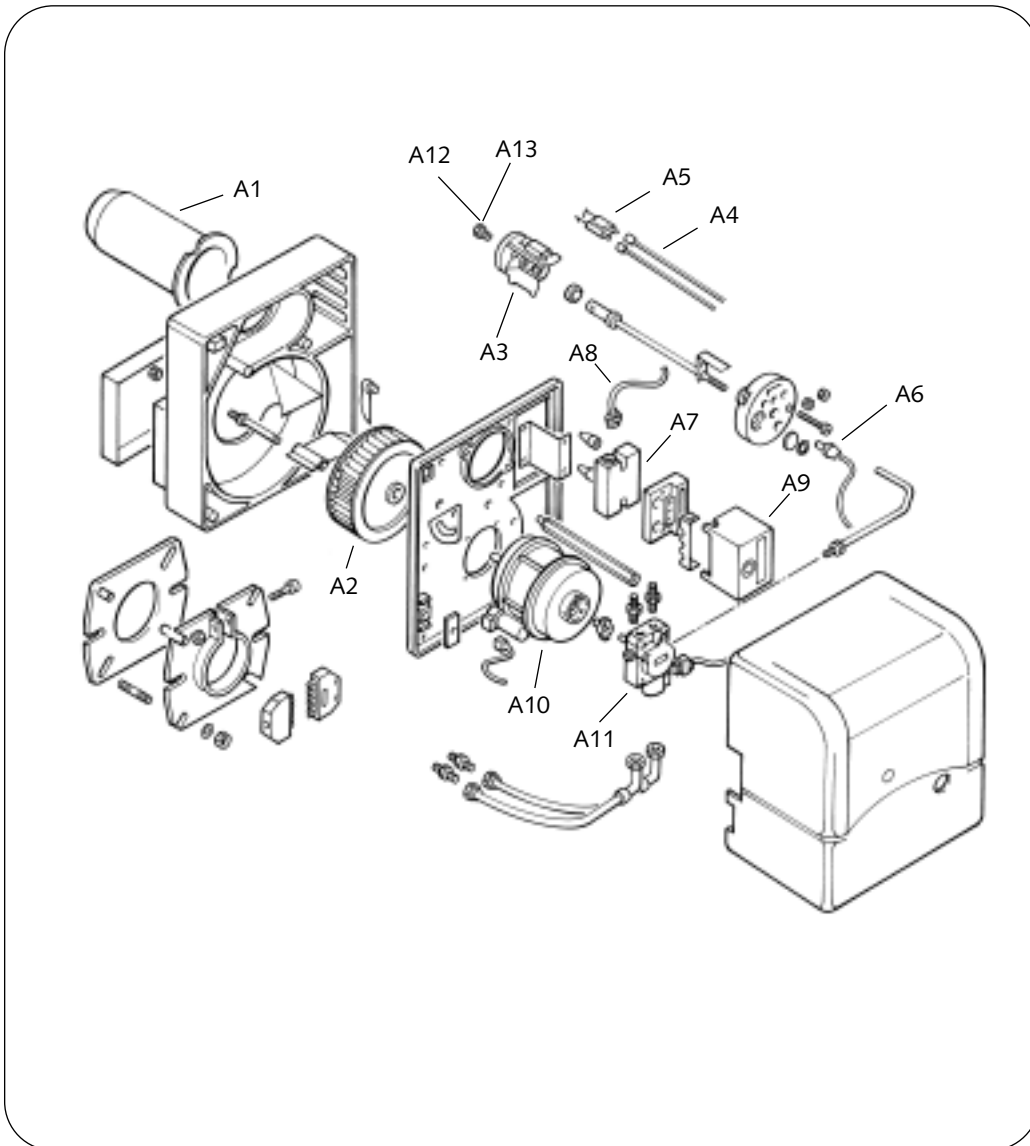
Ref.	Part No.	Description	Qty.
A1	E676	Blast Tube	1
A2	E680	Brake Plate	1
A3	E683	Electrode	2
A4	E685	H.T. Cable	2
A5	E687	Fan	1
A6	E689	Photocell	1
A7	E691	Transformer	1
A8	E694	Transformer Cable	1
A9	E696	Control Box	1
A10	E699	Motor	1
A11	E702	Pump	1
A12	E610	Nozzle - Kerosene - 1.65 x 80's	1
A13	E704	Nozzle - Gas Oil - 1.25 x 80's	1

HEATER SPARES OFS 90



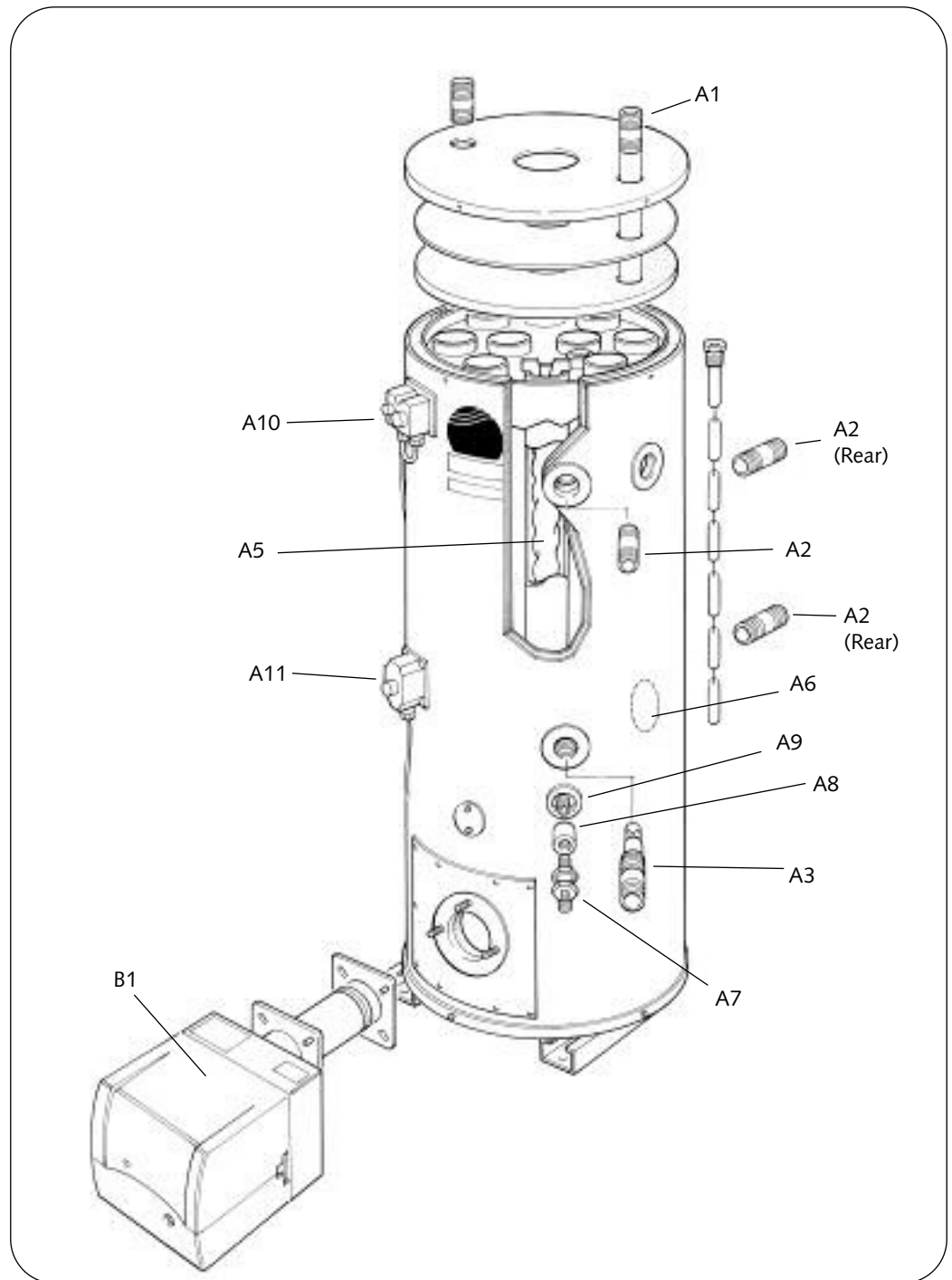
Ref.	Part No.	Description	Qty.
A1	C333	Articulated Service Anode	3
A2	C534	Hot Outlet Nipple 1.5 BSP	3
A3	E050	Hydrojet Hot Outlet / Cold Inlet Nipple 1.5 BSP	1
A4	E713	Flue Baffle	11
A5	C299	Cleanout Pad Seal	1
A6	C381	Drain Valve	1
A7	C103	Drain Valve Socket	1
A8	C247	Drain Valve Nipple	1
A9	C719	Control/High Limit Thermostat	1
B1	E732	Burner Assembly	1

**BURNER
SPARES
BTL10
OFS90**



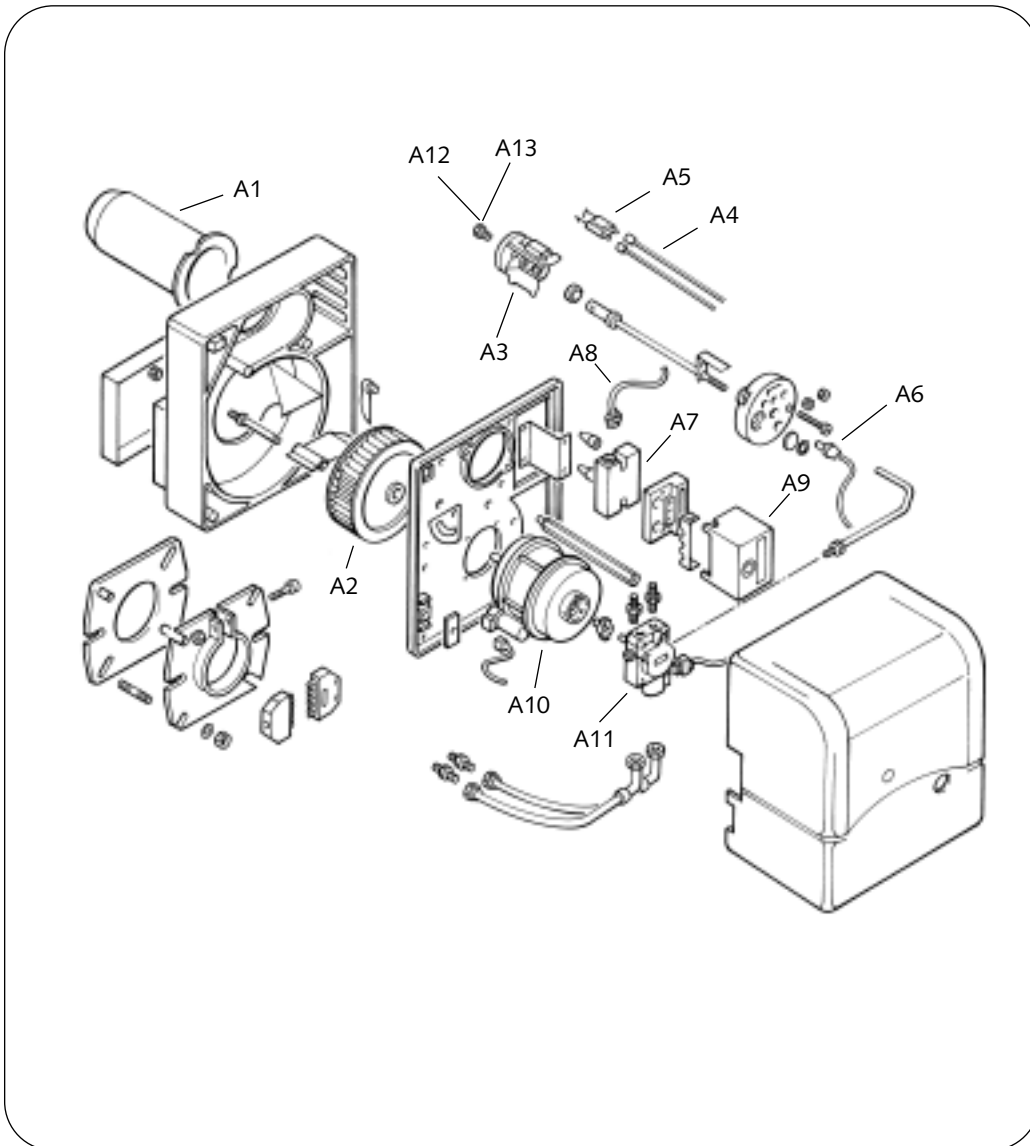
Ref.	Part No.	Description	Qty.
A1	E677	Blast Tube	1
A2	E687	Fan	1
A3	E681	Brake Plate	1
A4	E685	H.T. Cable	2
A5	E683	Electrode	2
A6	E689	Photocell	1
A7	E692	Transformer	1
A8	E694	Transformer Cable	1
A9	E697	Control Box	1
A10	E700	Motor	1
A11	E702	Pump	1
A12	E614	Nozzle - Kerosene - 2.50 x 80's	1
A13	C921	Nozzle - Gas Oil - 1.75 x 80's	1

HEATER SPARES OFS108



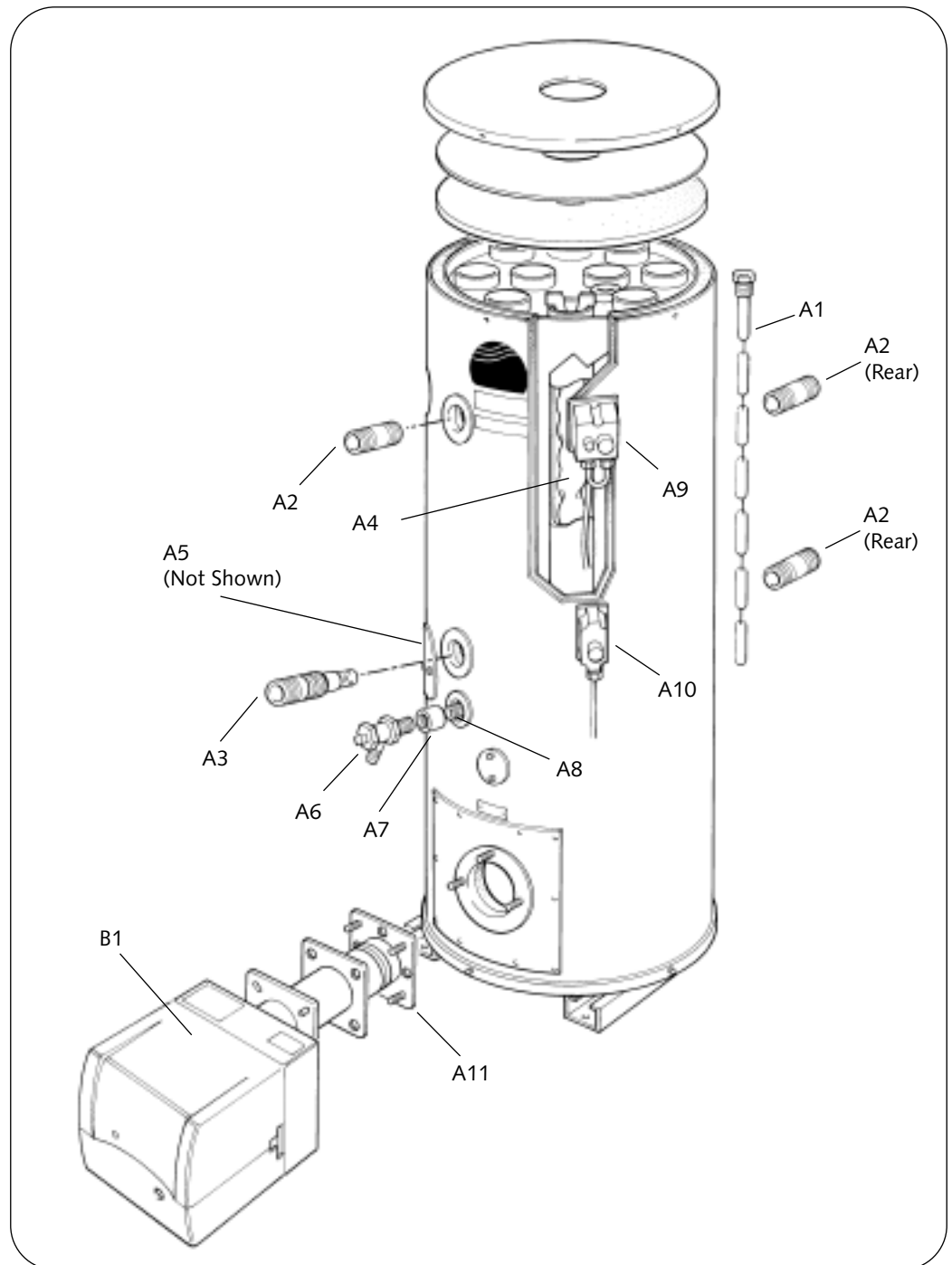
Ref.	Part No.	Description	Qty.
A1	E714	Cold Inlet Dip Tube	1
A2	C534	Hot Outlet Nipple 1.5 BSP	2
A3	E050	Hydrojet Hot Outlet / Cold Inlet Nipple 1.5 BSP	1
A4	C333	Articulated Service Anode	4
A5	E715	Flue Baffle	12
A6	E716	Cleanout Pad Seal	1
A7	C381	Drain Valve	1
A8	C103	Drain Valve Socket	1
A9	C247	Drain Valve Nipple	1
A10	C719	Control/High Limit Thermostat	1
A11	C927	Control Thermostat	1
B1	E733	Burner Assembly	1

**BURNER
SPARES
BTL10
OFS108**



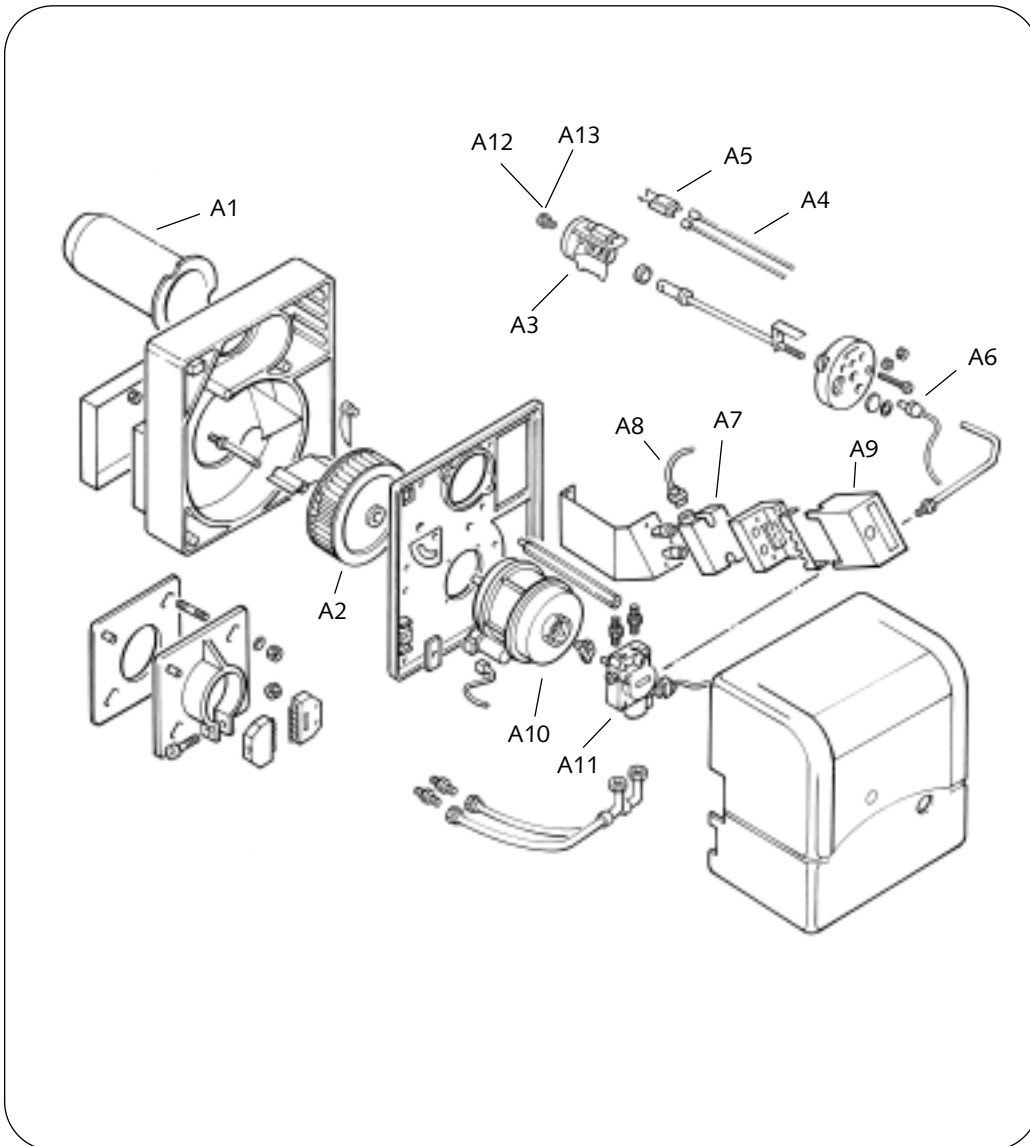
Ref.	Part No.	Description	Qty.
A1	E677	Blast Tube	1
A2	E687	Fan	1
A3	E681	Brake Plate	1
A4	E685	H.T. Cable	2
A5	E683	Electrode	2
A6	E689	Photocell	1
A7	E692	Transformer	1
A8	E694	Transformer Cable	1
A9	E697	Control Box	1
A10	E700	Motor	1
A11	E702	Pump	1
A12	E705	Nozzle - Kerosene - 3.00 x 80's	1
A13	E612	Nozzle - Gas Oil - 2.25 x 80's	1

HEATER SPARES OFS163



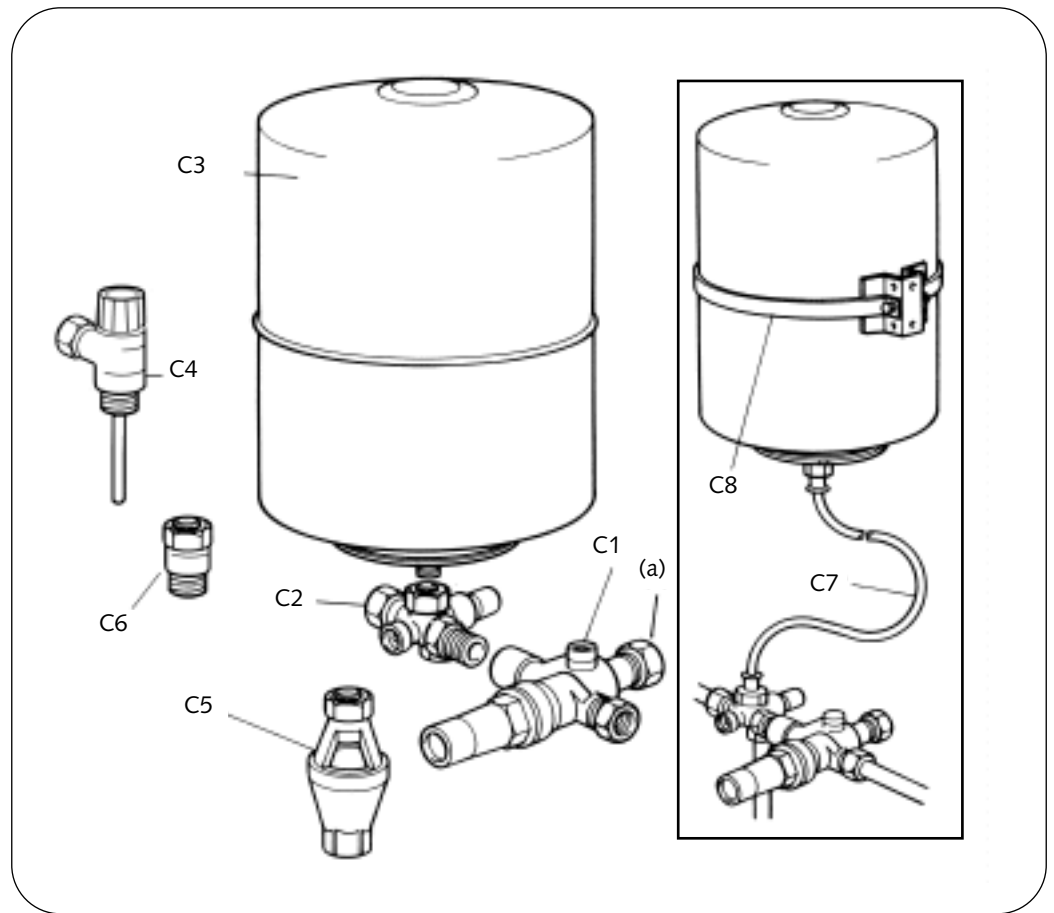
Ref.	Part No.	Description	Qty.
A1	C333	Articulated Service Anode	4
A2	C534	Hot Outlet / Cold Inlet Nipple 1.5 BSP	1
A3	E050	Hydrojet Cold Inlet Nipple 1.5 BSP	1
A4	E717	Flue Baffle	20
A5	C299	Cleanout Pad Seal	1
A6	C381	Drain Valve	1
A7	C103	Drain Valve Socket	1
A8	C247	Drain Valve Nipple	1
A9	C719	Control/High Limit Thermostat	1
A10	C927	Control Thermostat	1
A11	E718	Burner Adaptor Flange	1
B1	E734	Burner Assembly	1

**BURNER
SPARES
BTL20
OFS163**



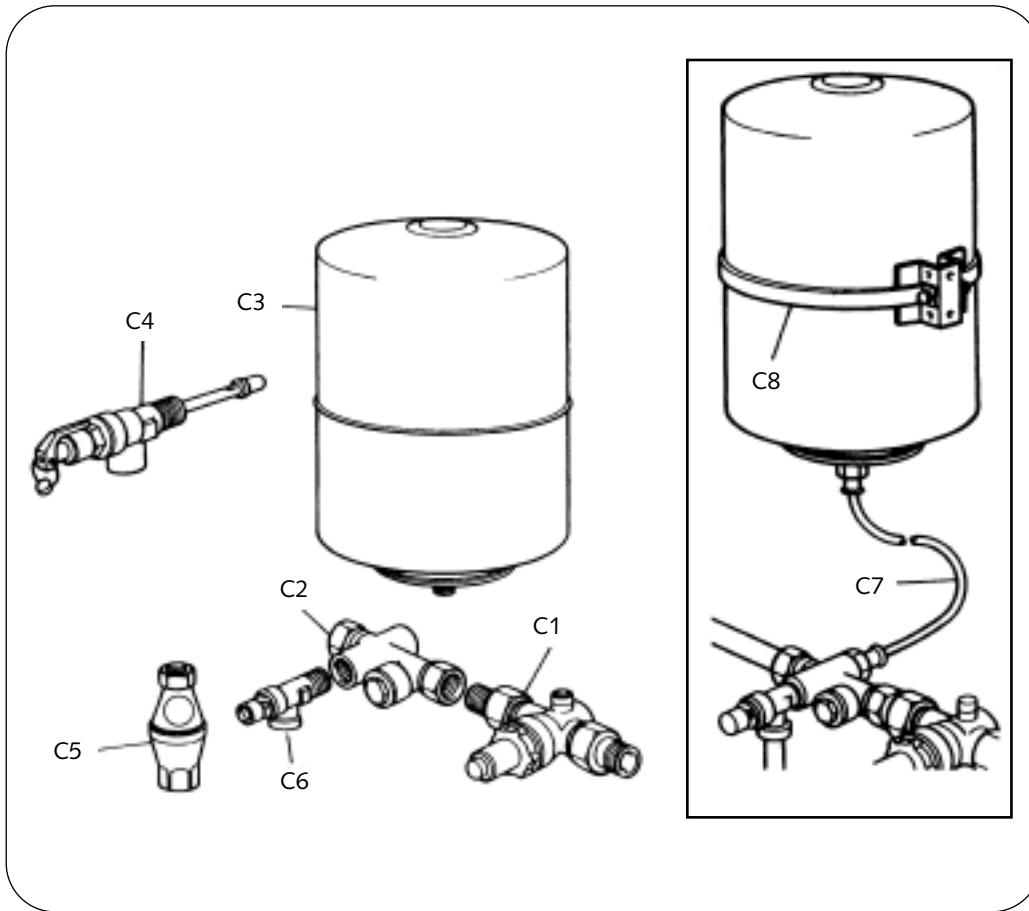
Ref.	Part No.	Description	Qty.
A1	E678	Blast Tube	1
A2	E688	Fan	1
A3	E682	Brake Plate	1
A4	E686	H.T. Cable	2
A5	E684	Electrode	2
A6	E690	Photocell	1
A7	E693	Transformer	1
A8	E695	Transformer Cable	1
A9	E698	Control Box	1
A10	E701	Motor	1
A11	E702	Pump	1
A12	E706	Nozzle - Kerosene - 4.50 x 80's	1
A13	C923	Nozzle - Gas Oil - 3.50 x 80's	1

**UNVENTED
SYSTEM KIT
OFS25 & OFS29**



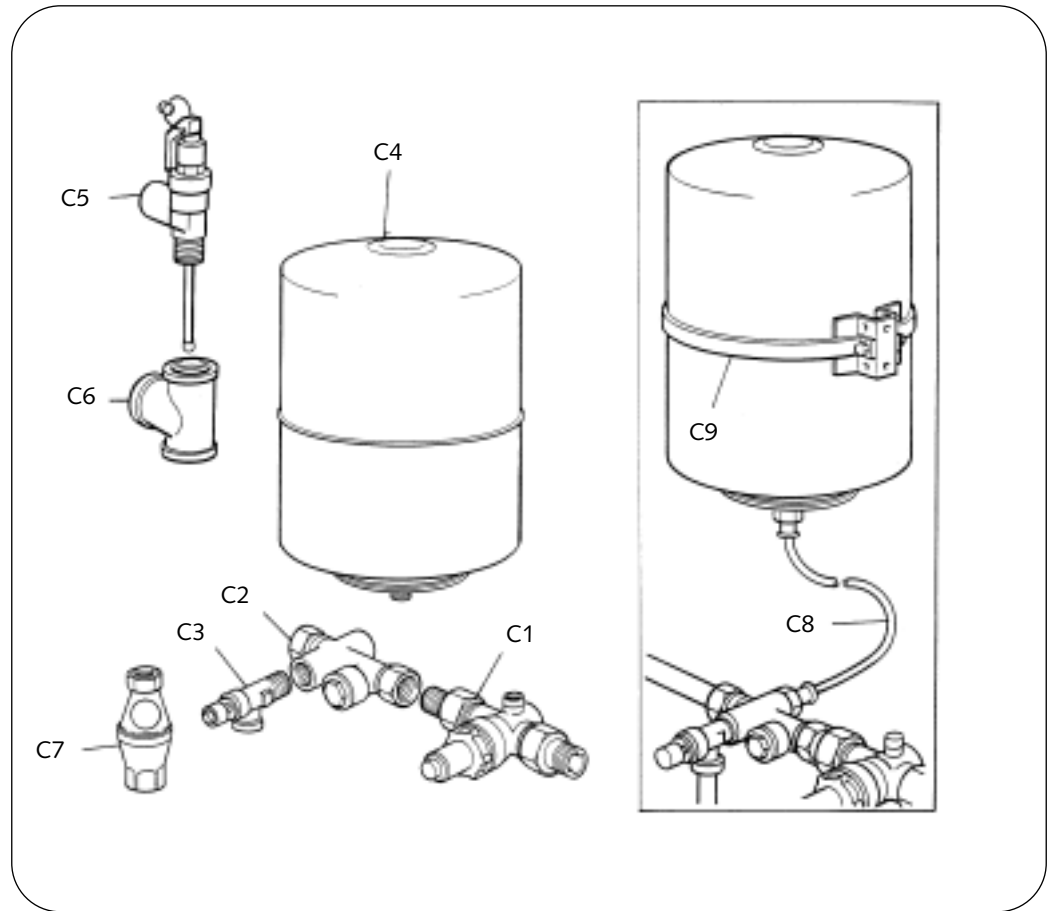
Ref.	Part No.	Description	Qty.
	B171	Unvented Systems Kit Complete	1
C1	C780	Pressure Reducing Valve/Strainer	1
C2	C781	Check Valve / Expansion Valve	1
C3	C782	Expansion Vessel	1
C4	E462	Temperature/Pressure Relief Valve	1
C5	C783	Tundish	1
C6	C772	Adaptor	1
	B173	Wall Mounting Kit for Expansion Vessel	
C7	C788	Hose Assembly	1
C8		Wall Bracket Assembly	1

**UNVENTED
SYSTEM KIT
OFS63 & OFS90**



Ref.	Part No.	Description	Qty.
	B172	Unvented Systems Kit Complete	1
C1	C784	Pressure Reducing Valve/Strainer	1
C2	C785	Check Valve	1
C3	C782	Expansion Vessel	1
C4	C380	Temperature/Pressure Relief Valve	1
C5	C384	Tundish	1
C6	C786	Expansion Valve	1
	B173	Wall Mounting Kit (Optional)	
C7	C788	Hose Assembly	1
C8		Wall Bracket Assembly	1

**UNVENTED
SYSTEM KIT
OFS108 &
OFS163**



Ref.	Part No.	Description	Qty.
	B267	Unvented Systems Kit Complete	1
C1	C784	Combined Reducing Valve/Strainer	1
C2	C785	Check Valve	1
C3	C786	Expansion Valve	1
C4	C782	Expansion Vessel (25 Litre)	1
C5	E675	Temperature/Pressure Relief Valve 2"	1
C6	C908	2" Square Equal Tee	1
C7	E497	Tundish from Expansion Valve and T/P Valve 2 x 2½"	1
	B173	Wall Mounting Kit (Optional)	
C8	C788	Hose Assembly	1
C9		Wall Bracket Assembly	1

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