BENSON

OLYMPIC OIL FIRED CABINET HEATER RANGE

INSTALLATION, COMMISSIONING, SERVICING AND USER INSTRUCTIONS

CE

Certificate Number
FM 14923

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1.0 Compliance notices

The Olympic range of oil fired Cabinet Heaters detailed herewith is manufactured by Benson Environmental Limited within a strictly controlled quality environment within the parameters of ISO 9001.

The Olympic WH range has been independently tested and assessed, and has been found to meet The Essential Requirements of the following European Directives.

Machinery Directive (89/392/EEC)

Low Voltage Directive (73/23/EEC & 93/68/EEC)

Electromagnetic Compatibility Directive (89/336/EEC & 91/31/EEC)

Product Liability Directive (65/374/EEC)

The manufacturer has taken reasonable and practical steps to ensure that Olympic Cabinet Heaters are safe and without risk when properly used. These heaters should therefore only be used in the manner and for the purpose for which they were intended, and in accordance with the recommendations detailed herewith. The heaters have been designed, manufactured, assembled, inspected, and tested, with safety and quality in mind, there are certain basic precautions which the installer and user should be aware of, and they are strongly advised to read the appropriate sections of the information pack accompanying the heater, prior to installation or use.

Benson Environmental Limited supports all new products being supplied to their customers with a comprehensive information pack; this clearly defines mandatory instructions for the safe installation, use, and maintenance, of the appliance(s).

Where proprietary items are incorporated into Benson Environmental Ltd products, detailed information and instructions are also provided as part of the information pack.

It is the responsibility of the installer, owner, user, or hirer, of such products supplied by Benson Environmental Ltd, to ensure that they are familiar with the appropriate information/manuals, supplied by the manufacturer, and that they are suitably aware of the purpose of the manuals and the safety instructions. In addition, operators must be suitably trained in the use of the appliance so as to ensure its continued safe and efficient use.

Benson Environmental Ltd has a commitment to continuous improvement, and therefore reserves the right to amend or change the specification of the Olympic WH Cabinet Heater range subject to compliance with the appropriate European,national and local regulations.

Contained within the text of the manual, the words **'Caution'** and **'Warning'** are used to highlight certain points.

Caution is used when failure to follow or implement the instruction(s) can lead to premature failure or damage to the heater or its component parts.

Warning is used when failure to heed or implement the instruction(s) can lead to not only component damage, but also to a hazardous situation being created where there is a risk of personal injury.

The Olympic WH range of gas fired cabinet heaters conform to the following harmonised standards;

BS EN 292 - Part 1 : 1991
Safety of Machinery - Basic Concepts, General Principles for Design
Basic terminology, methodology

BS EN 292 - Part 2 : 1991
Safety of Machinery - Basic Concepts, General Principles for Design
Technical Principles and Specifications

BS EN 60204 - Part 1 : 1993
Safety of Machinery - Electrical Equipment for Machines
Specification for General Requirements

BS EN 60335 - Part 1 : 1988
Safety of Household and Similar Electrical Appliances
General Requirements

BS EN 55014 - 1993
Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus

prEN 50165 - 1995
Electrical Equipment of non-electric heating appliances for household and similar purposes, safety requirements

1.1 Certificates of conformity

Certificates are available from the Quality Control Department at Benson Environmental Limited.

1.2 General product information

The Olympic WH models have an output range from approximately 60kW to 375kW, and are available in a configuration that will allow for down flow, horizontal or floor mounting.

The Olympic units can suit either ducted applications, or be used as free blowing units, but each heater must be connected to its own individual open flue.

Each heater is fitted with a forced draught burner which has been test fired and pre-set prior to dispatch. The safety functions of the burner are by way of a fully sequential control box fitted to the burner.

Note

Neither asbestos nor soft soldered joints are used in the construction or manufacture of the Olympic range of Cabinet Heaters. The materials selected for use can withstand the mechanical, chemical, and thermal stresses which they will be subject to during foreseen normal use when installed in accordance with the manufacturers recommendations.

1.3 General requirements

Caution

Ensure that the fuel supply is in accordance with the manufacturer's recommendations and is as stated on the appliance data plate.

Installation, commissioning, and servicing must only be carried out by appropriately qualified and competent persons.

Warning

Unauthorised modifications to the appliance, or departure from the manufacturers guidance on intended use, or installation contrary to the manufacturers recommendations may constitute a hazard.

Note

To ignore the **warning** and **caution** notices, and to ignore the advice from the manufacturer on installation, commissioning, servicing, or use, will jeopardise any applicable warranty, moreover, such a situation could also compromise the safe and efficient running of the appliance itself, and thereby constitute a hazard.

The installation of the appliance must meet all the relevant European, national, and local criteria. (See sections 3 and 9).

Prior to installation the following points should be considered;

a) The position of the heater for the optimum efficient distribution and circulation of warm air

b) The position of the heater relative to the route of the flue

c) The position of the heater relative to the supply of fuel

d) The position of the heater relative to the electrical services, and if appropriate, any additional controls.

e) The position of the heater relative to the supply of fresh air

f) The position of the heater relative to service and maintenance requirements

Caution

The heater **must not** be installed within an area where the conditions are unsuitable, e.g. where the atmosphere is highly corrosive, has a high degree of salinity, or where high wind velocities may affect burner operation. Suitable protection should be provided for the appliance when it is located in a position where it may be susceptible to external mechanical damage from; for example, fork lift trucks, overhead cranes etc.

1.4 Delivery and pre-installation checks

The heater is supplied wrapped in heavy duty protective polythene. On receipt of the heater, the following checks should be carried out;

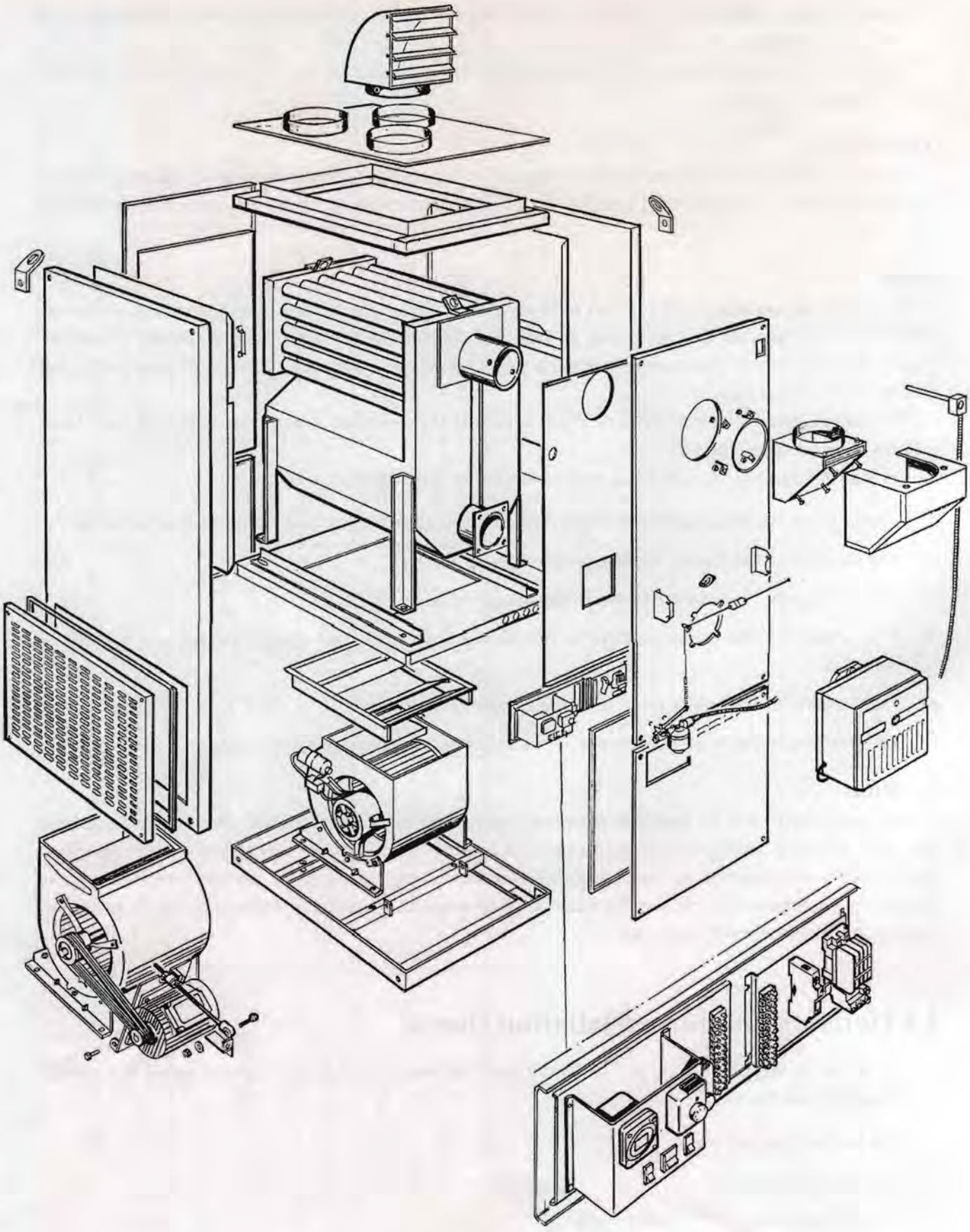
a) The model is as per order

b) That it is undamaged

c) That it is suitable for the fuel supply

d) That it is suitable for the electrical supply

Fig 1 - Exploded View



If any of these points are not satisfied then contact should be made with the Sales Office at Benson Environmental Ltd as soon as possible by telephoning 01547-528534. In the case of claims for damage, this must be reported in writing within 24 hours of delivery, in order to comply with insurance criteria.

1.5 Warranty

The heater is supplied with a 2 year warranty made up as follows; first year covering parts and labour, and second year covering parts only. In addition to this there is also a 10 year time related warranty on the combustion chamber/heat exchanger. The warranty commences from the date of dispatch from the manufacturer, and is subject to the terms detailed within the Benson Environmental Ltd *'conditions of business'*.

Note (i)

The warranty may be invalidated if -

a) The warranty registration/commissioning card has not been completed and returned to Benson Environmental Ltd

b) The installation is not in accordance with the general requirements of this manual

c) The flue arrangement and air supply for the heater are not in accordance with the manufacturers recommendations, codes of practice, or similar standards

d) Air flow through the heater is not in accordance with the manufacturers technical specifications

e) Internal wiring on the heater has been tampered with or unauthorised service/repairs undertaken

f) The main electrical supply input to the heater has been interrupted during the heating mode

g) The heater has been subject to and affected by the ingress of water in any form

h) The heater is not operated at the rating(s) laid down in the manufacturers technical specifications

i) The heater has not been operated or used within the normal scope of its intended application

j) The manufacturer's recommended minimum service requirements have not been complied with

Note (ii)

All warranty claims must contain the following information to enable processing to take place; (1) heater model (2) heater serial number (3) order reference/date of order, together with full installation details (name and address) (4) details or symptoms of fault (5) installers name and address.

Faulty parts must be returned to the Knighton Spares Department, the address of which is provided on the back cover of this manual and section 10.8. Any such parts will undergo inspection to verify the claim. Replacement parts supplied prior to this may be charged, and a credit supplied upon subsequent validation of the warranty claim. Consumable items are specifically not included within the scope of the warranty.

Note (iii)

Notification is required immediately a fault is suspected. The manufacturer will not accept responsibility for any additional damage that has been caused, expense incurred, or consequential loss resulting from any failure of the heater(s).

2.0 Location/positioning

Warning

All of the basic criteria must be satisfied prior to commencing installation and commissioning, additionally, the Cabinet Heater must be positioned and installed so as to comply with all the relevant standards and guidelines (see section 9.0), as well as meeting national and local fire regulations and insurance criteria, especially if it is proposed that that heater is to be installed within a special risk area (e.g. where petrol engined vehicles are stored or parked, where cellulose spraying takes place, where woodworking machinery is operated, etc,).

Indirect fired heaters **must not** be located in hazardous areas, however, it is permissible for the heater to supply air to such areas.

The heater **must not** be installed within an environment where there is a high concentration of chlorides, fluorides, salts, or other aggressive or volatile chemicals/compounds. Nor should the heater be positioned where the burner could be adversely affected by high winds or draughts.

The location chosen for the heater must allow for the fitting of an effective flue system. The location must also allow for adequate clearance for the air supply, return air circulation, oil supply, electrical supply, whilst also providing good and safe working access.

The heater must be installed on a flat and level surface made from non-combustible material, which is sufficiently robust to withstand the weight of the heater and any ancillary equipment. Any combustible material adjacent to the heater or flue system must be so placed or shielded so that its surface temperature does not exceed 65°C.

In areas where it is proposed that more than one heater is to be installed, a general scheme of circulation should be drawn up and maintained, thereby offering the best heat distribution.

All Olympic Cabinet Heaters are fitted with a pressure relief facility, this is incorporated into the design of the flue gas exit duct. Care should therefore be taken in siting service connections and controls well away from the pressure relief vent.

Warning

Under no circumstances must the pressure relief be restricted, blocked, or have the free exit of exhaust gas impaired or re-directed.

2.1 Fuel supply - general

The Olympic WH range of oil fired cabinet heaters are all manufactured and pre-set for use with 35 second gas oil delivered to the burner via a suitable piped system from the oil storage tank.

The constraints of the application will, to a large extent, determine whether it is preferable to use a single pipe gravity feed system, or whether the two pipe pumped system is more appropriate. Where more than one appliance is to share a common supply it will be necessary to use a pressurised ring main system. All pipework must be constructed and installed so that it does not permit the ingress of air.

The contruction, size, and position of the oil storage tank must take account of the current regulations, as well as suiting the requirements of the installation.

Note

Please refer to figures 2 - 8 for additional information.

Caution

On pumped systems always check that the pump is correctly set up prior to running, and always ensure that valves are open allowing a free flow of oil through the system.

2.2 Fuel

In order to promote trouble free operating it is necessary that the oil within the storage tank and oil line does not fall below the *cold filter plugging point* (cfpp), in this country and with class D fuel (also referred to as gas oil), the critical temperature is -4°C for the summer grade. The cfpp critical temperature for the winter grade is -12°C. If summer grade fuel is stored for winter use in areas prone to severe frosts and low temperatures it will be necessary to insulate or even heat the supply tank and pipework.

Note

The fuel supplier should be contacted prior to installation so that any requirements concerning delivery, transport, storage and use can be addressed before work commences.

Warning

The pump pressure must not exceed a maximum of 0.4 bar, this is because beyond this point gas is liberated from the oil.

2.3 Storage tank

Any externally painted steel storage tank to BS 799 part 5 1987 is required, and must include the following;

- a fuel level gauge (not made from glass)
- a vent pipe with a diameter greater than that of the filler and featuring a weather proof termination
- a sludge valve
- an outlet valve situated at the opposite end of the tank to the sludge valve
- a filler pipe connection situated at the opposite end to the outlet valve

The size of the storage tank must take account of the estimated consumption and any quantity price breaks offered by the oil supplier. It is preferable to install the tank outside, however, if this is not practicable and the tank has to be installed indoors advice must be sought about its siting, especially so far as fire regulations are concerned. If a separate fire resistant chamber cannot be provided for indoor installations, a catchment pit with a capacity ten percent greater than that of the storage tank must be provided. Storage tanks can if necessary be sited on a roof, but this is subject to special regulations as well as local authority approval and compliance with fire regulations, reference to BS 5410 part 2 1978 is strongly suggested.

It is advisable to leave the tank unpainted on the inside, but to paint the outside with a proprietary grade of anti-corrosive paint. A galvanised or open topped tank is strictly not allowed.

If a medium density polyethylene oil tank is to be used then it must be OFTEC certified to OFS T-100. Local, national, European and fire regulations must also be complied with.

2.4 Single pipe system (gravity feed)

For installation where the oil tank is 200mm or more above the level of the fuel pump the principle of gravity feed may be used. The draw off point for the supply to the burner must not be positioned any lower than 100mm above the bottom of the tank. Where a return valve is fitted this must be tamper proof to prevent inadvertent operation.

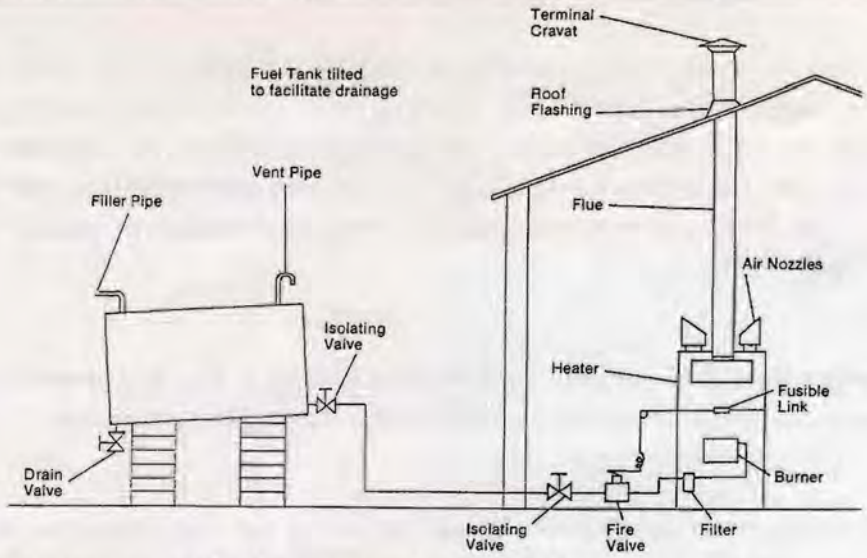
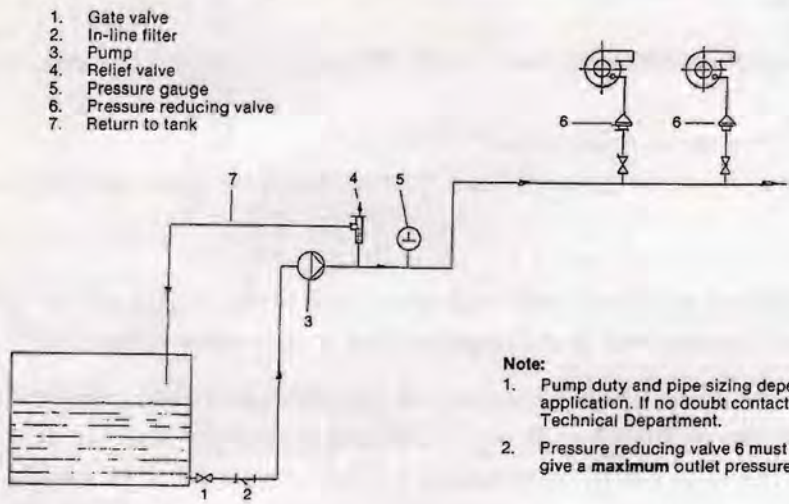


Fig 2. Typical arrangement of oil storage tank and single pipe system

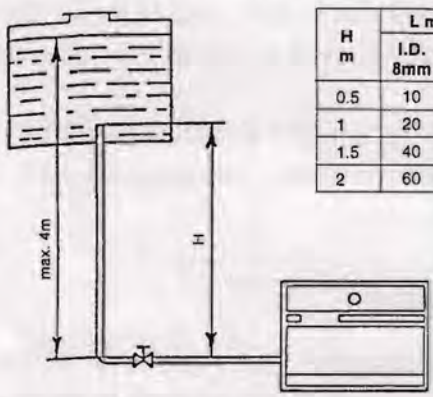


Note:

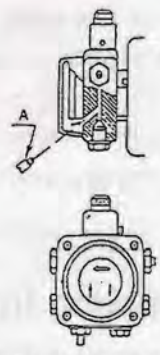
1. Pump duty and pipe sizing depend upon application. If no doubt contact our Technical Department.
2. Pressure reducing valve 6 must be set to give a **maximum** outlet pressure of 4 p.s.i.

Fig 3. Pressurised oil feed system

Warning: Before starting the burner make sure that the return pipeline is not clogged; any obstruction would cause the pump seals to break.



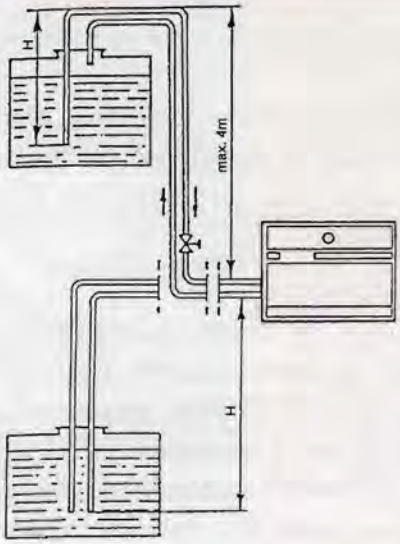
H m	L metres	
	I.D. 8mm	I.D. 10mm
0.5	10	20
1	20	40
1.5	40	80
2	60	100



Note: All burners are despatched suitable for gravity feed installations.

Fig 4. Burner oil pump details for heater models WH60 - WH175 - Oil Lines

H=Difference of level; L=Length of the suction line; I.D.=Internal diameter of the oil pipes.



H m	L metres	
	I.D. 8mm	I.D. 10mm
0	35	100
0.5	30	100
1	25	100
1.5	20	90
2	15	70
3	8	30
3.5	6	20

The pump suction should not exceed a maximum of 4 metres (13ft). Beyond this limit gas is released from the oil.

Oil lines must be completely airtight.

The return line should terminate within the oil tank at the same level as the suction line; in this case a non-return valve is not required.

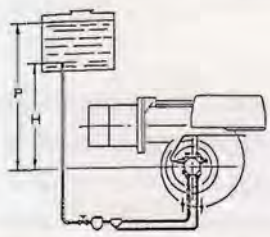
Should, however, the return line terminate over the fuel level, a non-return valve is essential.

This solution, however, is less safe than the previous one, due to the possibility of leakage of the valve.

Priming the pump: start the burner and await priming. Should lock-out occur prior to the arrival of the fuel, wait at least 20 seconds before repeating the operation.

Fig 5. Burner oil pump details for heater models WH60 - WH175 - Oil Lines

H=Difference of level; L=Length of the suction line; I.D.=Internal diameter of the oil pipes.



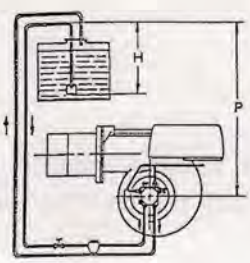
H		L			
		I.D. 8mm 0.315"		I.D. 10mm 0.394"	
m	ft	m	ft	m	ft
0.5	1' 6"	5	16	10	33
1	3' 0"	10	33	20	66
1.5	4' 6"	15	49	30	99
2	6' 0"	20	66	40	130

The dimension P should not exceed 4m (13'), to avoid damage to the pump seals.

Fig 6. Burner oil pump details for heater models WH235 - WH375 - Gravity Feed from the bottom of the oil-storage tank

H=Difference in height; L=Total length of suction line, including the vertical length within the tank

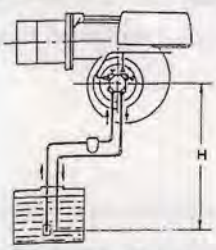
The dimension P should not exceed 4m (13'), to avoid damage to the pump seals.



H		L			
		I.D. 8mm 0.315"		I.D. 10mm 0.394"	
m	ft	m	ft	m	ft
0	0	32	105	70	230
0.5	1' 6"	28	92	62	200
1	3' 0"	24	79	55	180
1.5	4' 6"	20	65	48	157
2	6' 0"	16	52	40	130
3	9' 0"	7	23	25	83
3.5	10' 6"	—	—	10	33

Fig 7. Burner oil pump details for heater models WH235 - WH375 - Gravity Feed over the top of the oil-storage tank

H=Difference in height; L=Total length of suction line, including the vertical length within the tank



The pump suction must not exceed 4m (13'); beyond this value the pump becomes noisy.

The return valve must terminate at the same level as the foot valve, otherwise the pump may become air-locked.

Fig 8. Burner oil pump details for heater models WH235 - WH375 - Suction Feed

H=Difference in height; L=Total length of suction line, including the vertical length within the tank

Caution

If the valve is closed when the pump is running the oil pressure can be increased sufficiently so as to cause damage to the seals within the pump.

The return oil should preferably be discharged through an elbow onto a tank plate situated within the tank, this should be positioned so as not to introduce air or air bubbles into the draw off pipe.

2.5 Two pipe system

This is used where the oil storage tank is lower than the pump. Access for the fuel feed to the burner should be via a suitable tapping made in the top of the tank, and the fuel feed pipe should extend to not less than 100mm above the bottom of the tank. A none return valve with a metal to metal seat should be fitted, especially if the return pipework is terminated at a level above the draw off tube. The none return valve must be removable for service and maintenance purposes, and the return pipe from the pump must therefore be extended down into the tank to the same level as the suction pipe. The presence of a tamper proof isolating valve fitted within the return pipe is only required if there is a risk that oil will siphon out of the tank if the return pipe is disconnected at the pump during maintenance or servicing and if the none return valve has been omitted.

2.6 Pressurised ring main system

This system is used to supply a number of units from a common storage tank. A booster pump is used to provide the pressure storage tank. A booster pump is used to provide the pressure to push the oil around the ring main and back to the tank. Pressure reducing valves should be fitted on the delivery pipe to each heater to ensure that the pressure at the burner pump is less than 6 psi.

Caution

The internal by-pass plug must be removed from the pump when used in a pressurised ring main application.

2.7 Pipework and fittings

Caution

Galvanised pipework and fittings must not be used. All joints must be sealed properly, if necessary using PTFE tape or other approved sealing media. The pipework must be effectively sealed so as to prevent the ingress of air.

It is advisable to check all pipework prior to installation to ensure that there is no loose debris or scale present. Black iron pipes can be hammered to assist in the removal of these contaminants.

Note

The oil feed to each heater must be fitted with a fire check valve and isolating valve. The fire check valve must be operated by way of a fusible link positioned so that it is above the burner.

2.8 Electrical supply

Wiring external to the cabinet heater must be installed in accordance with any local, national, and European regulations, as well as meeting the appropriate requirements of IEE regulations.

The means of connection to the main electrical supply must allow for complete electrical isolation of the heater(s), furthermore, in the case of heaters wired for a three phase supply, the

supply should only be used to serve the heater(s). The position of the isolation switch must be such that it is adjacent to the heater(s) and easily accessible at all times, additionally the isolator itself must have a contact separation of not less than 3mm (as per BS 5991 clause 20.2). The main isolator fuse ratings are detailed on the appliance data plate.

Warning

Ensure that the electric and oil supplies are turned off before any electrical work is carried out on the heater. Ensure that wiring cannot make contact with any surfaces liable to be subject to high temperatures or where the insulation of the wiring could be impaired as a result of such contact. All Olympic cabinet heaters must be earthed.

Caution

The main electrical supply must not be switched off or disconnected as a method for stopping the heater, the exception to this is in an emergency, or during servicing, when the heat exchanger has been allowed to cool sufficiently to prevent any damage from occurring.

Claims for damage will not be considered if they have resulted from incorrect wiring or the incorrect use of the heater.

2.9 Air supply

Provision must be made for the existence of an air supply for both combustion and ventilation.

It is a requirement that the area where the air heater is located must have a permanent air vent of negligible resistance direct to the outside air. Such air vents must be positioned so as not to become blocked or flooded, nor should they be placed so as to introduce undesirable matter (e.g. flammable, volatile, or aggressive chemicals/compounds or potentially hazardous or harmful substances) either direct from the outside, or through their proximity to an adjacent extraction system.

The criteria necessary for establishing the minimum size of natural vents is detailed below;

Position of vent	Area of vent direct to outside
Low level (inlet)	540cm² + 4.5cm² per kW of rated input per heater
High level (outlet)	270cm² + 2.25cm² per kW of rated input per heater

Where mechanical ventilation is used it is a requirement that the inlet is of the mechanical type, and the outlet is either mechanical or natural.

Caution

Systems of ventilation that employ mechanical extraction and natural inlet must **not** be used. Furthermore, where the air supply is by way of a mechanical means the inlet must be positioned at low level and be capable of providing a minimum throughput as detailed in section 8 of this manual. The natural extraction air vents must have a minimum area as per above, and it is strongly recommended that natural extraction vents are situated at high level. Additionally, an automatic control interlocked to the burner must be fitted to ensure burner shutdown in the event of air flow failure or restriction.

If the heater is to be installed within its own separate building or plant room, the above details do still apply, as does the requirement for minimum space.

2.10 Minimum space requirements

The minimum space requirements for single and multiple heater applications are detailed in section 3.3 later within this manual.

2.11 Air distribution system

All materials used within the construction of the delivery and return air ducts must not represent a fire hazard and should be made from thermally inert materials. The selection of materials must take account of the environment into which the heater and its air delivery system is expected to work, it must also take account of the stresses and loadings placed upon it during its normal working life. Where interjoist spaces are used to route ducting these must be lined with fire resistant insulation material.

In installations where forced recirculation is a feature, a full and unobstructed return air path to the heater(s) must be provided, with return air grilles connected by ducting directly to the return air inlet on the heater. The limit for recirculation should not be greater than 85% recirculated air to 15% fresh air.

Where the heater is installed within a compartment or plant room the return air and discharge air arrangement must be such that the air circulation fan does not interfere with the operation of the flue. The return air intake and warm air outlet should therefore be fully ducted to and from the heater respectively, within the compartment or plant room. If the inlet air is ducted to the outside, then the lowest edge of the inlet air duct must be at least 500mm above the outside floor or ground level, it must also be fitted with an access point(s) to allow for cleaning and servicing to occur. The openings in the structure of the plant room, through which the duct work passes must be of fire resistant material and constructed to prevent the likelihood of any fire from spreading.

In ducted applications the ductwork must be designed so as to give a static pressure within the limits stated in section 8 of this manual. It should be noted that if the static pressure is too high, nuisance shut-down will occur when the heater goes out on the overheat limit thermostat, if the static pressure is too low, then damage can be caused to the fan motor.

Warm air outlets on ducted applications must be such that they cannot be closed or become blocked, which again would lead to an increase in static pressure and nuisance shut-down. The outlets must not be sited so that warm air can be discharged onto combustible materials, if necessary, guard rails should be used to ensure that effected areas are kept clear. Return air intakes must not be located so that potentially harmful or hazardous contaminated air can be drawn into the system.

2.12 Flue system

Warning

It is essential that the products of combustion are flued to the outside of the building. Each heater must have its own separate flue, with a flue diameter of not less than is detailed in section 8 within this manual. The minimum vertical length of flue must not be less than 3m. The flue should rise vertically, and the number of bends should be kept to a minimum. It is strongly advised that BS 5854; 1980, and BS 5440; parts 1 and 2, are used as consultative documents when considering flue requirements.

Care should be taken to ensure that the flue terminal is not situated in a high pressure area, the proximity of buildings and other obstacles which will influence this must be taken into account, preferably at the design stage. See figures 9 - 19.

Provision must be made for the disconnection of the flue for inspection and service requirements, and it is strongly advised that where bends are fitted inspection covers are included.

The materials from which the flue is constructed must be non-combustible, resistant to internal and external corrosion, and be capable of withstanding the stresses and loadings associated with normal use.

When designing the flue system the prevention of the formation and entrapment of condensation must be a key consideration. Twin wall or insulated systems are recommended as they tend to inhibit the formation of condensates. Where condensation is unavoidable traps should be included to encourage the condensates to flow freely to a point from which they may be released, preferably into a gully. The condensate pipe from the flue to the disposal point must be made from corrosion resistant pipe of not less than the internal diameter of the drain point.

If the flue passes through a wall, ceiling, or roof made from combustible material then it has to be sleeved so as to provide a minimum of a 25mm void between the exterior of the flue and the internal wall of the sleeve. The maximum permitted temperature of any adjacent combustible material is 65°C.

The position of the flue and its terminal should be such that it does not impair the combustion process. It should terminate in an exposed position so as to allow the escape and dissipation of the flue gases without risk of their re-entering the property through windows, ventilation ports, etc. The flue should extend to at least 1m above the height of any object within 3.5m of the terminal.

Flue terminals should be fitted on all flues, the terminal must be of the approved type, and have outlet grilles on all sides giving a total free area of at least double that of the flue.

Caution

It is imperative that the flue should be properly sealed where it passes through the roof, this can best be achieved by using the approved method of roof flashing plate and cravat.

Note

It should be noted that claims made under warranty and attributed to the ingress of water may not be considered especially if an approved method of sealing has not been used, or if the design of the flue has not made provision for possible condensation problems.

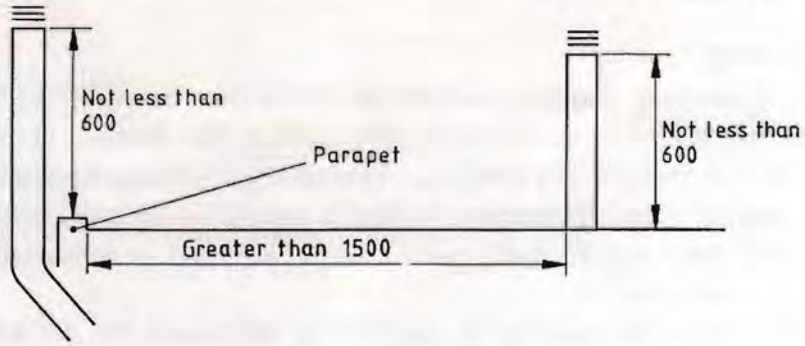


Fig 9. Flat roof, with parapet

All dimensions are in millimetres.

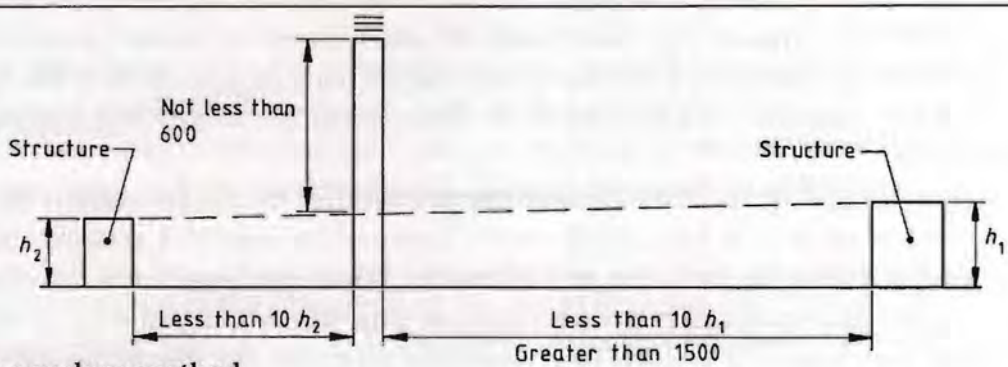


Fig 10. Flat roof, envelope method

All dimensions are in millimetres.

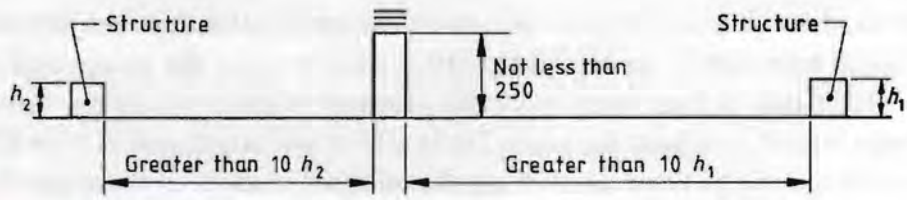


Fig 11 Flat roof, where the flue outlet is more than 10 heights *(h)* away from all structures

All dimensions are in millimetres.

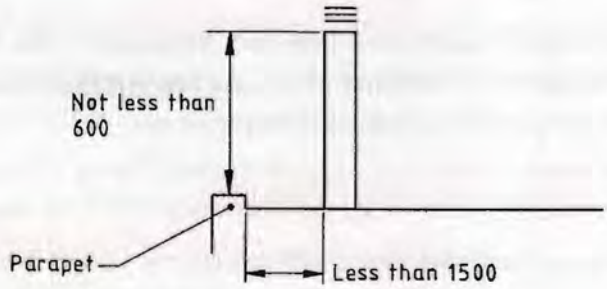


Fig 12. Flat roof, with flue close to parapet

All dimensions are in millimetres.

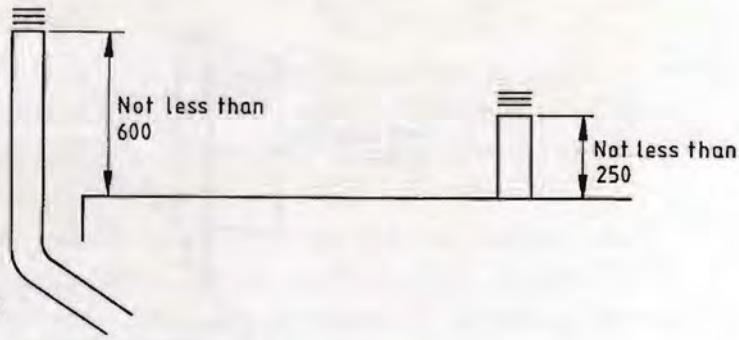


Fig 13. Flat roof, with no parapet
All dimensions are in millimetres.

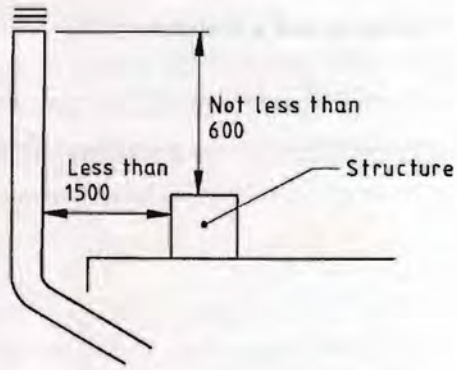


Fig 14. Flat roof, with structure close to flue outlet
All dimensions are in millimetres.

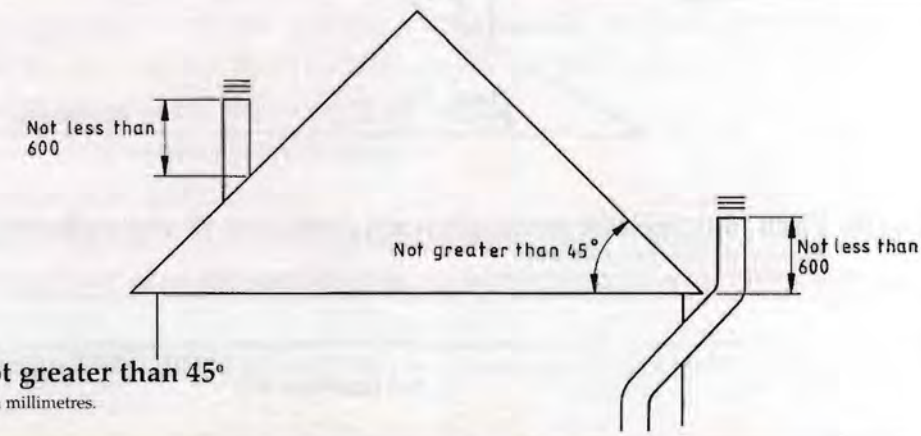


Fig 15. Pitched roof, not greater than 45°
All linear dimensions are in millimetres.

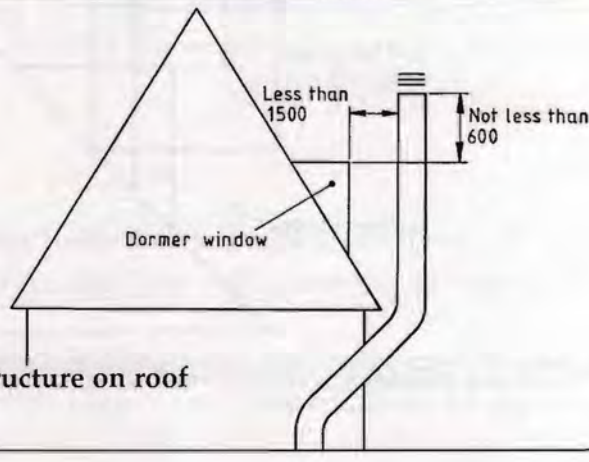


Fig 16. Pitched roof, within 1.5m of a structure on roof
All dimensions are in millimetres.

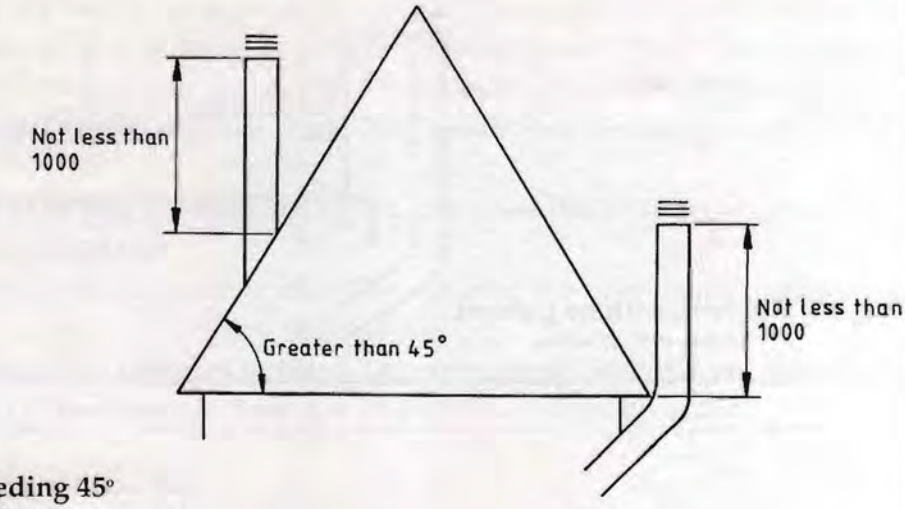


Fig 17. Pitched roof, exceeding 45°
All linear dimensions are in millimetres.

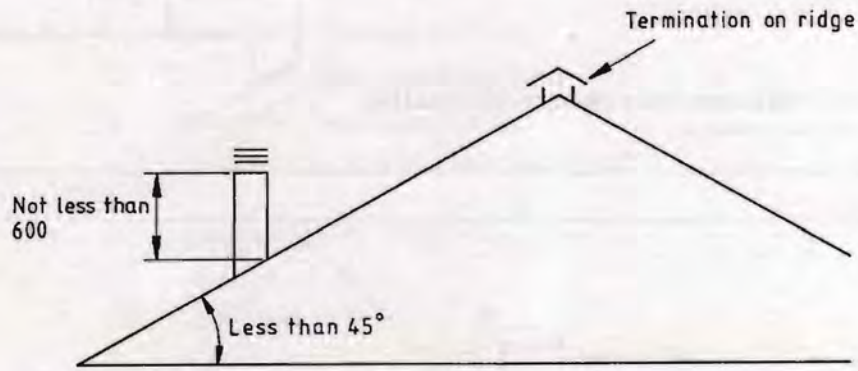


Fig 18. Pitch roof, internal route, pitch not exceeding 45° and ridge termination
All linear dimensions are in millimetres.

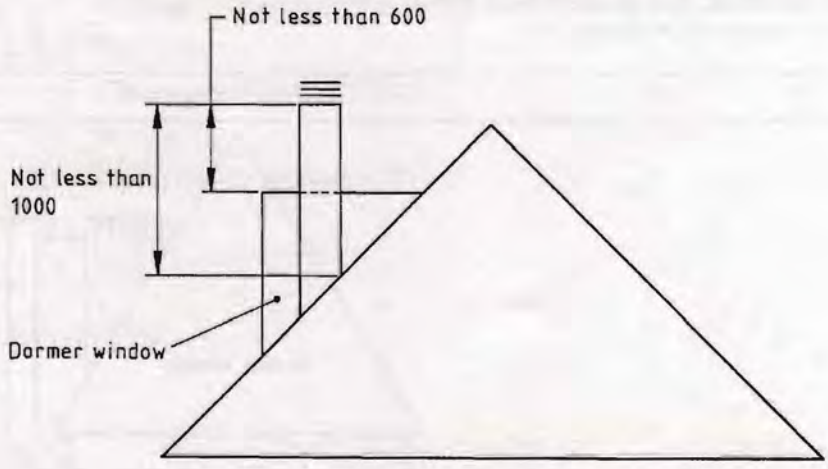


Fig 19. Pitch roof, chimney within 1.5m from dormer window measured horizontally
All dimensions are in millimetres.

3.0 Installation

It is strongly advised that the installer reads Section 2 and Section 3 of this manual prior to starting any installation work. It is a requirement that only qualified and competent personnel may undertake installation, commissioning, and servicing.

Warning

Always ensure that the appropriate personal protective equipment is used.

3.1 Packaging/siting

The heater will usually be supplied wrapped in heavy gauge polythene, non-assembled parts will be supplied separately. Prior to installation, the assembly of the heater should be completed, it is advisable that this is undertaken in the area where the heater is scheduled to be sited.

Caution

It is strongly advised that when positioning the heater the lifting eyes are used, thereby reducing the risk of inadvertent damage being occasioned to the heater.

Prior to installation the heater must be correctly positioned before any final assembly work is completed. The bonnet top and outlet nozzles must be securely attached before installation can commence.

3.2 Flooring and supports

The heater must be installed on a level non combustible surface capable of supporting the weight of the heater and any ancillary equipment.

3.3 Minimum clearances

The following minimum clearances (in metres) must be observed when installing the heater.

Model	top	lhs	rhs	front	back
WH 60 - 301	0.9	0.9	0.9	0.5	1.35
WH 375	2.0	0.9	0.9	2.0	2.0

3.4 Assembly

The following sub-assembly parts should be assembled to allow installation to continue.

Place Nozzle Base plate onto the top of the heater, align holes, and secure. Fit the nozzles to the spigots, turning the nozzles to give the required approximate direction for air flow. Adjust louvres to give the desired angle of warm air down flow. Secure nozzles to spigots, when correctly positioned, by means of drilling and inserting self tapping screws.

3.5 Flue Installation

An integral flue spigot is fitted to all Cabinet Heaters thereby allowing the flue to connect directly to the heater. The design of the flue must ensure that it can be disconnected to allow for cleaning and servicing, furthermore, all of the flue section joint sockets must face upwards, and the seal between the sections achieved through mechanical joints or through the use of approved caulking string and grout. It is strongly advised that BS 5854 and BS 5440 parts 1 and 2 are referred to, see also figs 9 - 19.

Where condensation is likely to be a problem provision should be made preferably at the design stage (see section 2.11).

3.6 Oil Installation/connection

The oil tank must be positioned so that there is a fall of 7.5mm (+/- 2.5mm) for every 30mm away from the outlet and towards the sludge/drain valve, which must be sited at the lowest point in the tank. If the tank is positioned on supports then there must be an adequate protective layer between tank and support to prevent damage or deterioration through corrosion. It is strongly suggested that reference is made to BS 5410; part 2; 1978. It is also suggested that the installer is familiar with the detail and requirements contained within sections 2.1 through to section 2.6 of this manual prior to commencing installation.

Warning

Prolonged exposure and contact with Gas Oil can result in the natural oils being removed from the skin, sensitisation can result in dermatitis.

Always ensure that the appropriate personal protective equipment is used.

3.7 Electrical Installation/connection

Olympic WH cabinet heaters are available either for 415V 50Hz 3PH or 230V 50Hz 1PH supplies depending upon the model specified. It is recommended that reference is made to the wiring diagrams contained within section 7 of this manual prior to installation or connection to the supply. The electrical supply must be as specified and suitable for the heater, and must be run within conduit to a point adjacent to the heater, and be terminated to provide an isolation point that will prevent remote or inadvertent activation. Cables, conduit, and fittings that are used to make the connection between the isolator and the heater must conform to the appropriate IEE regulations. All heaters are supplied fused and pre-wired, all must be earthed. Final connections for any additional external controls must be completed on site, and must be carried out according to IEE regulations.

Separate user information is provided for the time control unit and the burner, and forms part of the product information pack which accompanies every heater when dispatched (see section B).

Warning

Always isolate from the electrical supply before commencing work on the heater.

Always ensure that the appropriate personal protective equipment is used.

3.8 Air Distribution Installation

The materials selected must be of low heat capacity, and it is preferable that all warm air ductwork is thermally insulated. Where ducting may be subject to deterioration from exposure to moisture or high humidity material selection and insulation are prime considerations. Joints and seams must be air tight and fastened securely and designed to remain so, even when operating at high temperatures. Adequate support must be designed into the layout of the ductwork to ensure that the integrity of the seams and joints is maintained. The support must be independent and separate from the heater and the ducting, to allow for free movement during expansion and contraction. Where ducting passes through walls or partitions sufficient clearance must be left, irrespective of any fire stop requirement, to allow for expansion and contraction. Failure to adhere to these latter two points can result in the generation and transmission of excess noise. Where ducting is installed in concrete flooring a permanent membrane must be used to isolate the ducting from the corrosive effect of the alkaline salts within the concrete. Care should be taken to ensure that soft insulation material does not become compressed and thereby lose its effectiveness.

3.9 Warm Air Registers

In order that vertical temperature gradients are minimal thereby providing a more even heat distribution, it is preferable to install warm air registers at low wall levels or at floor level, with the size, number, and position commensurate with the requirement of the application. To minimise noise levels the registers should be set away from corners, a good seal between the register frame and the wall is important, particularly on high level positions, if unsightly staining through warm air/particulate deposition is to be avoided.

3.10 Heater Control Installation

Warning

Isolate heater from mains before undertaking any electrical work.

All Cabinet Heaters are manufactured with the following controls pre-wired and installed. See figs 20 and 21.

(a) On/off switch

(b) Ventilation/heat switch (summer/winter switch)

(c) Manual/automatic switch

(d) Thermostat

(e) Time clock

(f) Frost stat

All of the above controls are located on a removable panel which when separated from the heater can be re-positioned so as to offer a remote facility. However, to facilitate this, it is necessary to order and fit an electrical panel cover and front panel blanking plate to the heater in place of the control unit.

4.0 Commissioning

Note

It is a requirement that only suitably qualified and competent personnel are allowed to undertake the commissioning of the heater. It is also strongly recommended that prior to commissioning the engineer familiarises himself with the information contained within the information pack that accompanies the heater, the heater itself, and with the specific requirements of the installation/application. The following checks should be carried out after the familiarisation process.

Warning

All Cabinet Heaters undergo a rigorous test programme prior to being dispatched, whilst such a programme does involve pre-commissioning and setting up the heater to operate efficiently and well within its designed operational limits, this **does not** mean that on site commissioning is less important than might otherwise be the case. The idiosyncrasies of each installation can only ever be allowed for, through the use of thorough on site commissioning carried out by trained and experienced personnel equipped with the correct tools and apparatus.

Note

It is strongly recommended that equipment used for the sampling and analysis of flue gases is accurate to within +/- 0.1% and maintained so that it is regularly calibrated.

Fig 20 - Heater Control Panel

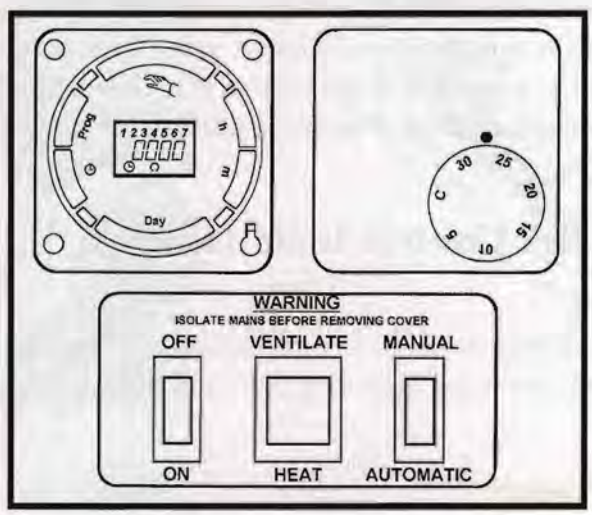
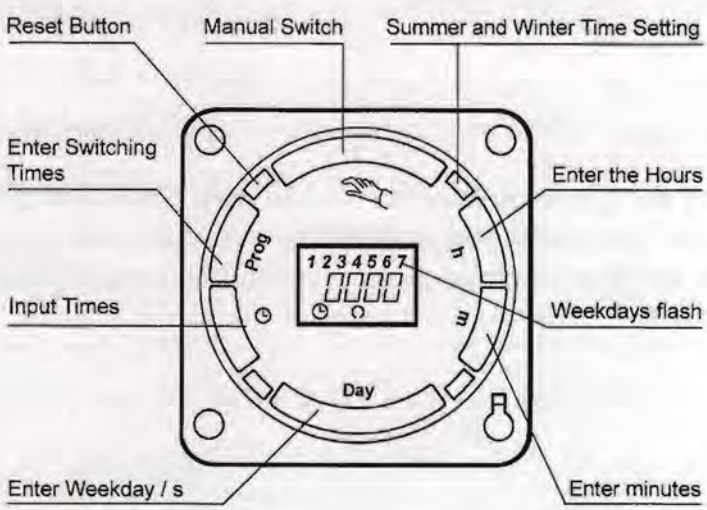


Fig 21 - Time Clock Controls



4.1 Commissioning - Pretest

Check to ensure electrical safety, and inspect and check the oil installation, testing for leaks.

(a) Ensure that the electrical supply is turned off.

(b) Ensure that the oil supply is turned off.

(c) Check that all panels and fasteners are secure and in place.

(d) Check that the heater is installed so that it is square and that the support is adequate.

(e) Ensure that warm air delivery outlets are open and that ducting is adequately supported.

(f) Ensure that if filter assemblies are fitted that they are secure and correctly located.

(g) Check that air inlets are clear and that return air paths are adequate.

(h) Ensure that the flue is secure, adequately supported, and that the various joints are properly sealed.

(i) Check that condensate trap and drain facilities are adequate.

(j) Check that there is provision for flue gas sampling and that this sample point can be plugged and sealed after commissioning.

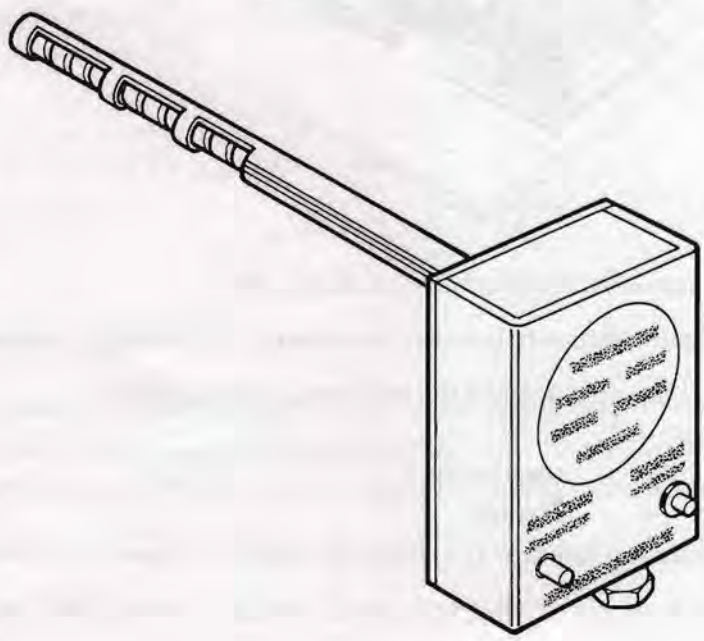
(k) Check that fan and limit stat settings have not been disturbed and are as follows

fan on	-	60°C
overheat limit	-	100°C
fan off	-	30°C

Also check that the white buttom (automatic) is pulled outward and that the red button (reset) is pushed inwards to the reset position. See fig 22.

(l) Remove lower panel and check motor and fan drive system for integrity of joints, check pulley alignment, fan rotation, and belt tension (see section 5.2 and figs 23, 24 and 25).

Fig 22- Fan and Limit Thermostat



Fan and Motor Assemblies

Fig 23

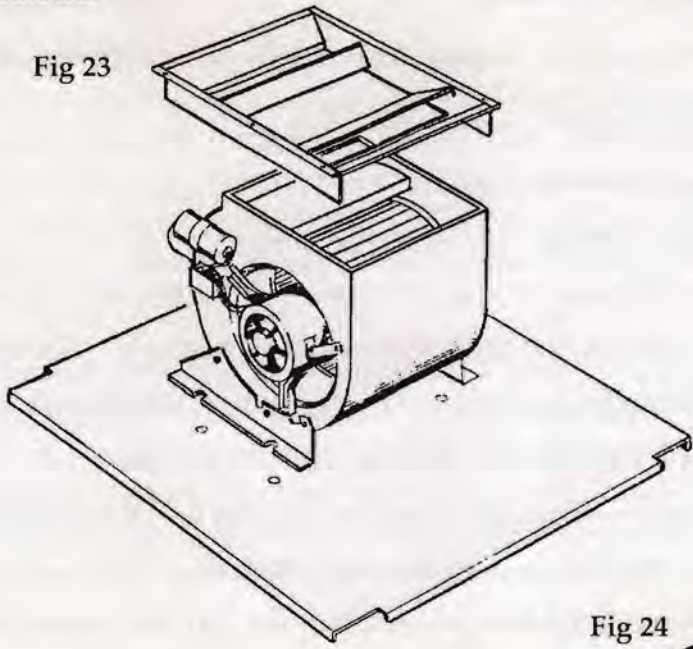


Fig 24

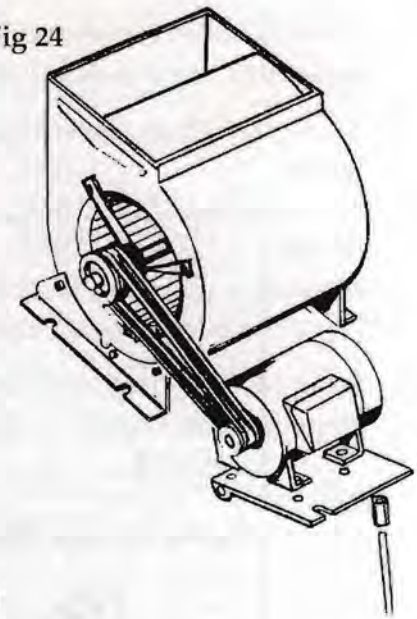
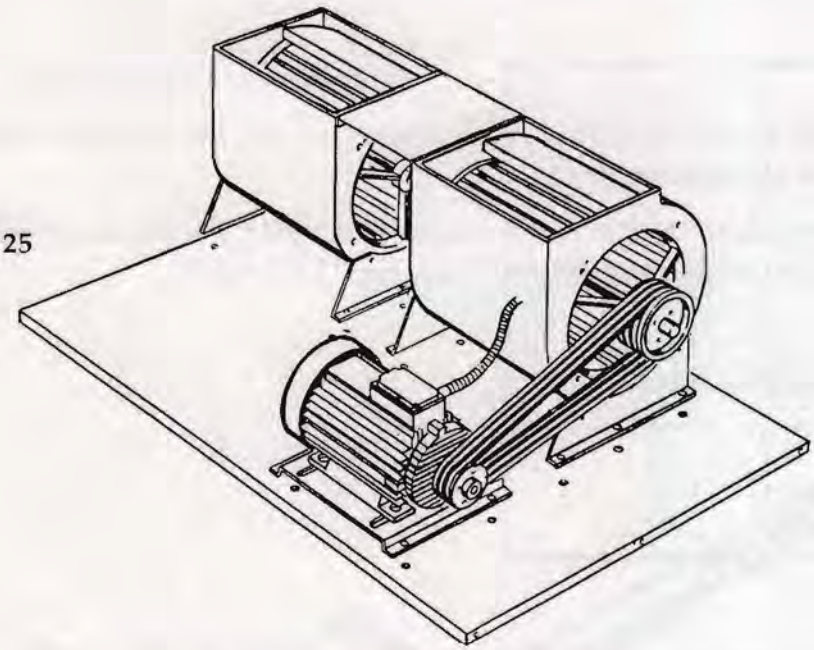


Fig 25



(m) Ensure that the burner is securely attached to the heater.

(n) Test for electrical earth continuity between the heater, oil pipework, and mains supply.

(o) Turn on main electrical supply, select the following switch settings

on/off	-	on
heat/ventilation	-	ventilation
manual/automatic	-	manual

The fan will start enabling fan direction etc to be verified. Reset on/off switch to off position.

(p) Turn mains electrical supply to off, replace and secure lower lourved panel covering fan and motor assembly.

(q) Set room thermostat and time clock to 'demand' positions.

4.2 Commissioing - Ignition

Warning

Do not proceed with commissioning unless all the criteria detailed within sections 4.0 and 4.1 have been satisfied.

(a) Ensure that the electrical supply is turned off.

(b) Ensure that the oil supply is turned off.

(c) Select the following switch settings on the heater

on/off	-	off
heat/ventilation	-	heat
manual/automatic	-	automatic

(d) Turn on main electrical supply.

(e) Select 'on' position for heater on/off switch.

(f) Check for the following burner sequence

	Interval	Operand
1	<5s	Combustion air damper actuated, burner fan motor initiates purge cycle. . .
2	<15s	Solenoid valve opens, ignition transformer provides spark for pilot ignition. . .
		E I T H E R
3	>15s	Ignition failure caused by oil starvation resulting in burner lock-out/shut-down. . .

(g) Set heater on/off switch to 'off' position

(h) Attach oil manifold (bleed screw and pressure gauge)

(i) Open oil supply valves and bleed air from pipework and adjust burner oil pressure as datailed in burner manual (section B)

(j) Repeat steps 4.1 q and 4.2 c, e, f.

		O R
3	>15s	Burner ignition. . . flame detection. . .
4	<20s	Burner ignition cycle complete.

Note

It is strongly recommended that the separate manual concerning the operational details of the burner supplied with the heater as part of the information package is studied prior to commissioning.

Time intervals within the ignition sequence will vary slightly from one model to another.

Warning

If burner ignition is not satisfactorily accomplished, commissioning **must not** proceed until the

reason or fault has been identified and rectified, if necessary by reference to the separate burner information or to section 6 of this manual.

(k) Repeat steps 4.2 c,a,

(l) Repeat steps 4.2 d,e,f, allowing the heater to reach thermal equilibrium.

(m) Adjust room thermostat to its highest setting, and allow the heater to continue to fire.

(n) Gradually reduce the temperature setting on the room thermostat until the burner shuts down, (@ °C < ambient) and then gradually increase the temperature setting on the thermostat until heat is called for, (@ °C > ambient) and the burner automatically re-fires.

(o) Re-set time clock to a minimum off period, checking that the burner shuts down, and then automatically re-lights once the minimum off period has elapsed. (Separate information on the time clock is contained within the information package supplied with the heater).

(p) Check fan and limit stat by depressing and holding in the fan motor overload re-set button, located on the heater electrical panel. The time between the fan stopping and burner shut down should be noted, once the burner has shut down the overload on the motor should be released. If the time interval between fan stop and burner shut down is greater than 90 seconds further checks should be made. These are as follows:

(i) Check settings on fan and limit stat are correct, ie, fan on 60°C, fan off 30°C, limit 100°C.

(ii) Check that the position of the unit is correct, ie, equi-distant between heat exchanger body and heat shield panel.

(iii) Check integrity of unit, ensuring that neither the bi-metalic strip nor its casing is damaged.

(q) Undertake flue gas analysis using approved and calibrated analysing equipment recording data on the commissioning card, ie, CO, CO_2, net and gross flue temperatures. Record burner oil pump pressure, ambient temperature, barometric pressure,and smoke reading (0 - 1 Baccarach scale).

Note (i)

The burner air and oil pressure settings should be only very finely adjusted to achieve a CO_2 reading of 12.5% ($^+$/- 0.5%).

Note (ii)

The gross efficiency must be approximately 80 percent.

Note (iii)

All Cabinet Heaters are test fired and pre-commissioned as part of the manufacturing process, if however, during on site commissioning the data are found to be not in accordance with the manufacturers data, then the following action is recommended:

* Re-check all readings and calculations.
* Adjust burner as per manufacturers instructions.
* Consult Benson Environmental Ltd Technical Department.

(r) Complete commissioning card and provide operating instructions for the user, high-light the fact that the manufacturer recommends that in the interests of safety and efficiency the heater is serviced on a regular basis only by qualified and competent persons. The completed commissioning card must be returned to Benson Environmental Ltd Service Department immediately after the satisfactory completion of commissioning, failure to do so can invalidate any subsequent warranty claim.

(s) Set all controls to the requirements of the user.

4.3 Commissioning - air delivery system

Caution

On ducted applications it is necessary that the system is balanced in order to optimise the efficiency of the heater and the air distribution and delivery system. Failure to balance the system can result in fan motor overloading and premature component failure, it can also result in an inefficient heating/ventilation system.

(a) Check that the amount of fan produced air volume is in accordance with the heater specification, if the volume is too great the fan can be overloaded. Ensure that the running current is as per that stated on the heater data plate. Alternatively, the static pressure should be measured at the start of the ductwork to confirm that it is within the permissible tolerance.

(b) If the current drawn is greater than the stated running current, in most probability this will be caused by insufficient static pressure within the ductwork, in which case system resistance should be increased through the introduction of a damper placed as close to the start of the ductwork as possible, thereby resulting in a reduction in drawn current. The damper should be adjusted until the current is in accordance with that stated on the data plate.

(c) If the current drawn is too low the duct outlet grilles will require opening to reduce static pressure and increase air volume, if this is not the case overheat cut outs can be caused.

4.4 Commissioning - hand over

(a) Upon full and satisfactory completion of commissioning, a record of commissioning information (contact, date, etc) should be left with the heater, a copy of which must also be forwarded to Benson Environmental Ltd Service Department.

(b) The commissioning engineer must ensure that the user is familiar with the safe and efficient use of the heater, detailing the function of all controls, and main components.

(c) The user should be made aware of the following in particular
   (i) Lighting, shutdown, and operational information.
   (ii) Safety features, data plate, and labelling.
   (iii) The requirement for regular inspection - especially if the heater is within a more demanding environment - and the need for regular servicing, carried out by competent and qualified persons.

(d) Section C 'User Instructions' should be left with the customer upon satisfactory completion of the commissioning and hand-over.

Caution

After approximately 100 hours of running, the tension of the fan belts must be checked to ensure that they are correct and that they have not stretched. See section 5.2 for further instructions.

5.0 Servicing

Warning

Servicing must be carried out on a regular basis, the maximum interval between services being 1 year. It is a requirement that only suitably qualified and competent persons are allowed to undertake servicing.

Before any maintenance or servicing work is carried out, the heater must be shut down and allowed to cool, and have the oil and electric supplies to it turned off at the supply valve and isolator respectively.

Caution

Certain component parts are factory sealed and are designed so as to be tamper proof. Usually such items do not require servicing, and therefore should not be tampered with. Failure to comply with this can invalidate any warranty, and can also lead to premature failure. The following parts fall within this category: room thermostat, time clock, frost thermostat, sequential controller, and fan and motor.

Additionally, the fan and limit stat has been factory set, and **must not** be re-set without formal consent from Benson Environmental Ltd.

Reference should be made to the separate information covering the operational details of the burner and timer.

Only approved spare/replacement parts can be fitted, failure to comply with this can compromise the safe and efficient running of the heater, and can also invalidate any warranty claim.

5.1 Planned Servicing

In order to maintain the efficient operation of the heater it is recommended that the following planned servicing and preventative maintenance programme is adopted by the user.

Quarterly Inspection

(a) Visual inspection of the burner
(b) Clean and check spark electrode
(c) Clean and check photo cell
(d) Check overheat safety is operational

Bi-Annual Inspection

(a) As per quarterly inspection, plus. . .
(b) Combustion check
(c) Smoke test

Annual Inspection

(a) As per half year inspection, plus. . .
(b) Heat exchanger and cleaning
(c) Electrical connections
(d) Main fan motor
(e) Main fan assembly
(f) Pulleys
(g) Fan belts
(h) Oil supply including filter
(i) Burner
(j) Air delivery system
(k) Flue
(l) Report

5.2 Servicing Procedure - Major Component Parts

Flue

A visual inspection should be carried out to ensure that the flue remains adequately supported, both internally as well as externally, and that the various joints are effectively sealed. Inspection covers, where fitted, should be removed and the flue checked to see whether cleaning is required. If inspection covers are not fitted the gas exit duct and flue spigot will provide not only an indication of the cleanliness of the flue, but will also enable access for cleaning. The presence of the flue terminal should be checked.

If a condensate trap and drain facility is fitted this should be checked to ensure that it continues to function correctly, and the drainage of condensates is not impaired.

Main Fan Motor

Remove access panel. Dust and other foreign matter should be cleaned by blowing over with compressed air and through the use of a soft bristle brush and cloth. Solvent wipes may be used to remove heavy soiling from the motor casing. Traces of surplus lubricants spreading from the bearings should also be cleaned away. Where motors are fitted with grease nipples bearings should be lubricated with the correct grade of lubricant. Motors which do not have grease nipples feature sealed bearings which are lubricated during manufacture for their life.

The electrical connections should be checked as follows. The cover to the terminal box should be removed by undoing the screws which secure it. Check connections for signs of corrosion, tightness, and ensure that there are no stray strands which could form a short circuit. Clean, tighten, and replace as necessary. Replace cover and secure.

Main Fan

Remove dust and other foreign matter by blowing off with compressed air or through the use of a soft bristle brush. Check that the bearings do not show signs of excessive wear. It should be noted that these bearings **do not** require lubricating. If the bearings require replacing the following procedure should be followed.

(a) Remove belt(s).

(b) Loosen set screw on eccentric collar and tap the collar in the opposite direction to fan rotation.

(c) Remove collar and bearing.

(d) Check shaft for alignment and straightness.

(e) Locate the bearing in its seat and place on the shaft with the cam facing outwards.

(f) Fit the eccentric collar and engage the cams.

(g) Tighten initially by rotating, and then by tapping in the direction of the fan rotation.

(h) Replace fasteners and secure.

(i) Turn by hand to ensure free fan rotation.

Pulleys

Check pulleys for alignment using a straight edge, if necessary reposition either or both of the pulleys and the fan motor. Check for excessive wear within the root and sides of the grooves, and check for any other signs of wear or damage, if necessary replace the pulley as follows.

(a) Release tension on belts and remove.

(b) Release the taper locks by slackening the securing screws by several complete turns.

(c) Fully remove one screw from the taper lock, and having oiled it, insert into the threaded jacking point.

(d) Tighten screw until the taperlock is free.

(e) Remove taperlock and pulley.

(f) Fit taperlock in new pulley, and provisionally position on the shaft.

(g) Remove the screw from the jacking point, and tighten both screws in their clamping points until the pulley can just be moved on the shaft by hand.

(h) Align pulleys using a straight edge, and by gradual alternative tightening of the screws clamp in position.

(i) Refit belts and check for the correct amount of tension.

Fan Belts

Check belts for signs of wear. Frayed or split belts must be replaced using belts with a common batch code. Belt tension must be checked, and if on multi-belt units it is found that one belt contains more slack than its accompanying belts, then all the belts on the unit must be replaced, again using a common batch code. Replacement and tensioning is carried out as follows.

Note

The maximum displacement at the mid point of the top edge of the belt must not be greater than 16mm per metre of span, when a force of 3kg is applied in a plane perpendicular to the belt.

(a) Loosen fan motor securing bolts on chassis.

(b) Loosen fan motor slide adjustment bolt.

(c) Slide fan motor towards fan to slacken belts.

(d) Replace belts, pull fan motor away from fan until belts are tight.

(e) Tighten adjustment bolt to hold motor.

(f) Tighten fan securing bolts ensuring that the fan is square and that the pulleys are aligned.

(g) Check belt tension, making final adjustments as necessary.

(h) Tighten and clamp fasteners to hold fan motor in position.

Heat Exchanger

The heat exchanger requires a visual inspection at least once per year, this should be accompanied by cleaning. It is recommended that a flue brush and vacuum cleaning are used to facilitate this. Access to the heat exchanger is gained through the removal of the rear upper panel and heat shield. Servicing and cleaning should be performed as follows.

(a) Remove brass nuts and cover from heat exchanger end assembly to expose heat exchanger tubes.

(b) Remove any accumulated deposits from the tubes by pushing through the full length with a flue brush.

(c) The flue brush should be withdrawn so as to pull any deposits back into the bottom of the flue box where they can then be removed by using a vacuum cleaner.

(d) Particular attention should be paid to the upper internal surfaces of the tubes, where through convection heavier deposition is likely to occur.

(e) Any deposits which may have accumulated within the combustion chamber can be removed with a vacuum cleaner once the burner is removed.

Note

It is most important that a build up of deposits is not allowed to occur as this can have an adverse effect upon the efficiency of the heater and reduce the life of the heat exchanger.

(f) The heat exchanger and combustion chamber should be visually inspected for signs of splits, cracks, and distortion.

If the condition of the heat exchanger gives cause for concern the Service Department at Benson Environmental Ltd should be advised pending a more detailed examination.

(g) All gaskets should be checked to ensure that they continue to provide a gas tight seal, if there is an element of doubt then they should be replaced.

Electrical Supply

All connections must be checked to ensure that they are secure, and free from corrosion. Terminals and connections should also be checked to ensure that no stray strands are bridging terminals. Electrical continuity should also be checked.

Oil Supply

The oil supply pipework, tank, and fittings should all be inspected to ensure that they are free from corrosion, and to ensure that where brackets have been fitted these remain secure and offer adequate support. The oil filter should be replaced with a new one, and the system should be checked for leaks. If the oil level is such as to allow removal of any sludge or other contaminants from the tank this too should be undertaken, particularly if there have been problems of poor firing associated with contaminants reaching the burner.

Note

Any waste oil or sludge must be disposed of correctly. Never dispose of it by dumping or tipping it down drains or into water courses where ground water can become polluted and environmental damage caused.

Burner

Service requirements for the burner fitted to the cabinet heater are covered in the separate manual prepared by the burner manufacturer.

Note

It is most important that the burner is serviced regularly and in accordance with the manufacturers instructions.

Air Delivery System

A visual inspection should be undertaken to ensure that the air delivery system is in good order, that it remains adequately supported and that the various joints are effectively sealed.

Report

A full and detailed service report should be prepared, it is advised that the report is not completed until the heater has been re-commissioned, where upon the completed report can then be run through with the user.

5.3 Service Re-commissioning

The heater must be re-commissioned as follows; as per section 4.1 through to section 4.4 inclusive. This must be regarded as a necessary part of the heater service by the servicing engineer.

6.0 Fault Diagnosis

Fig 26

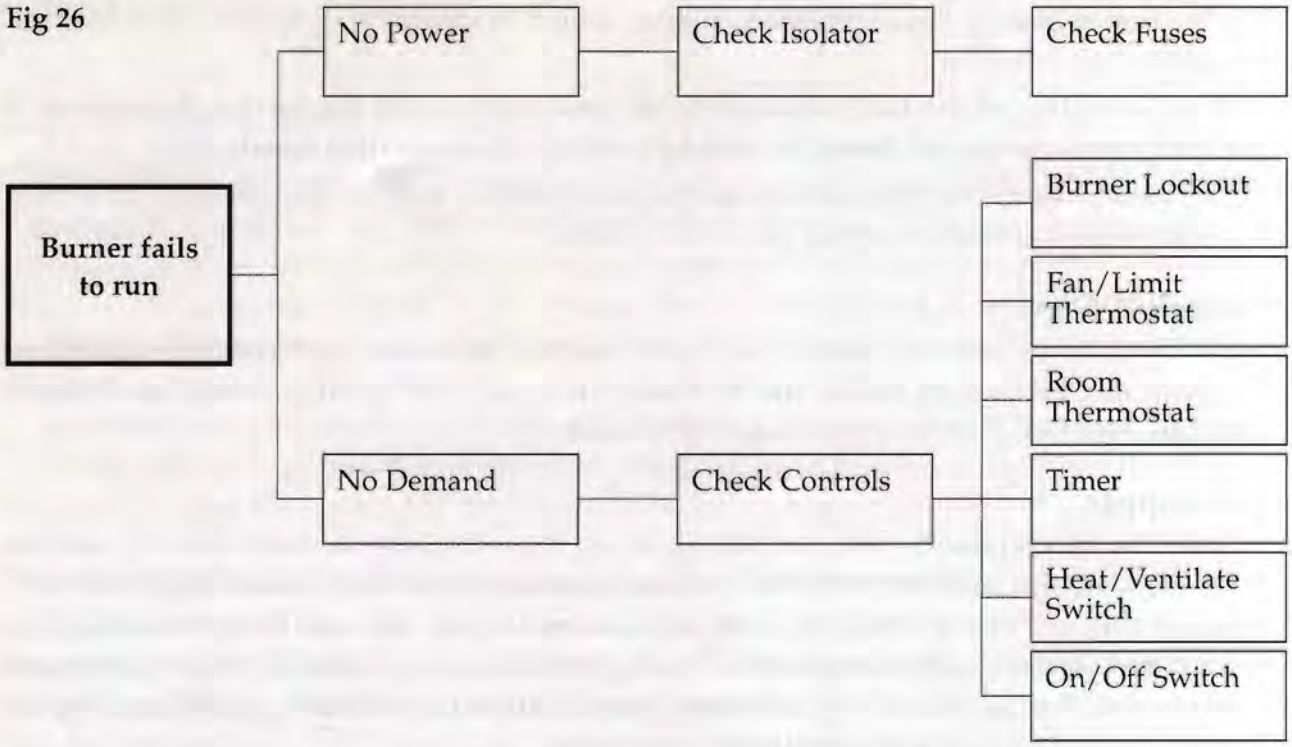


Fig 27

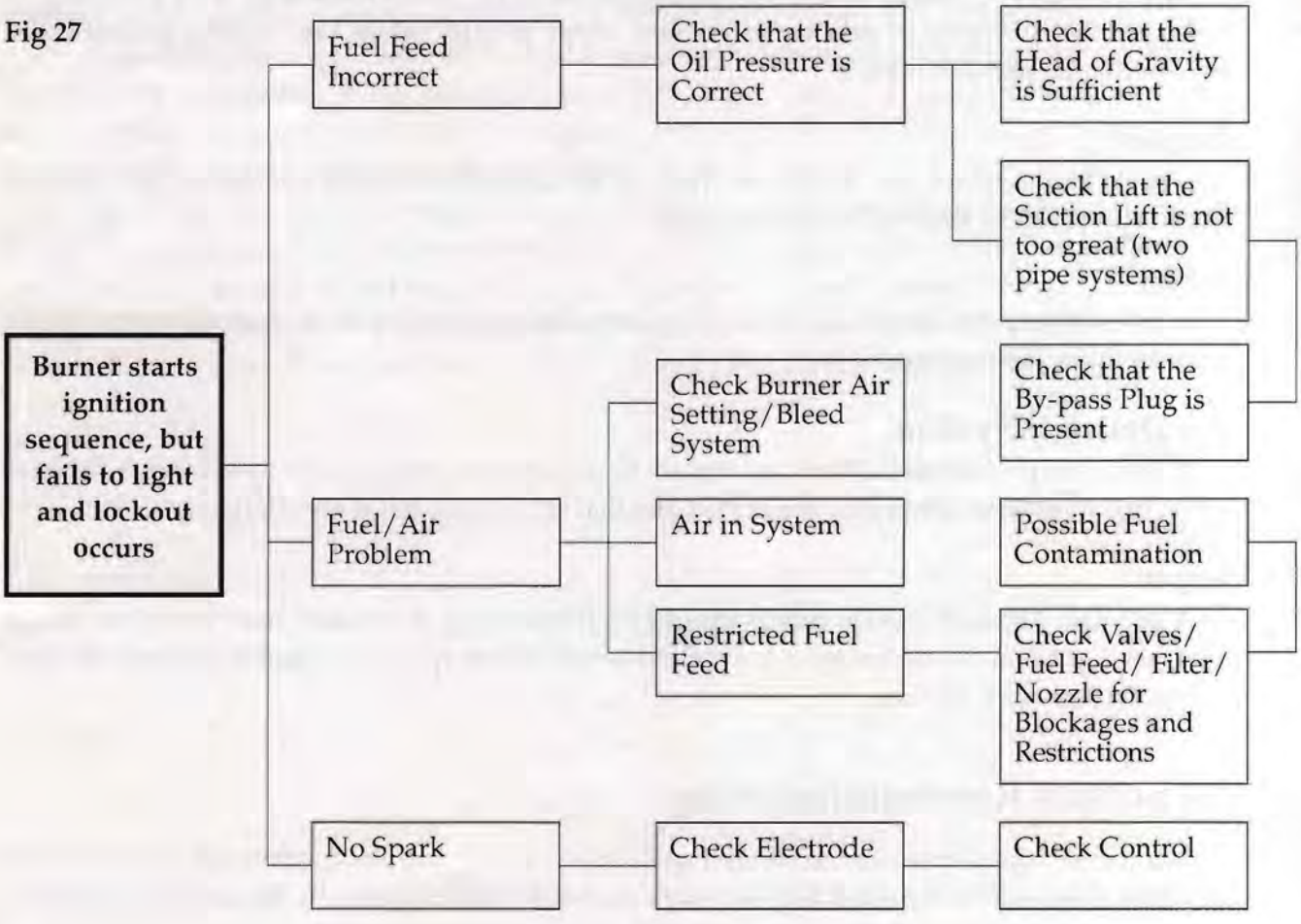


Fig 28

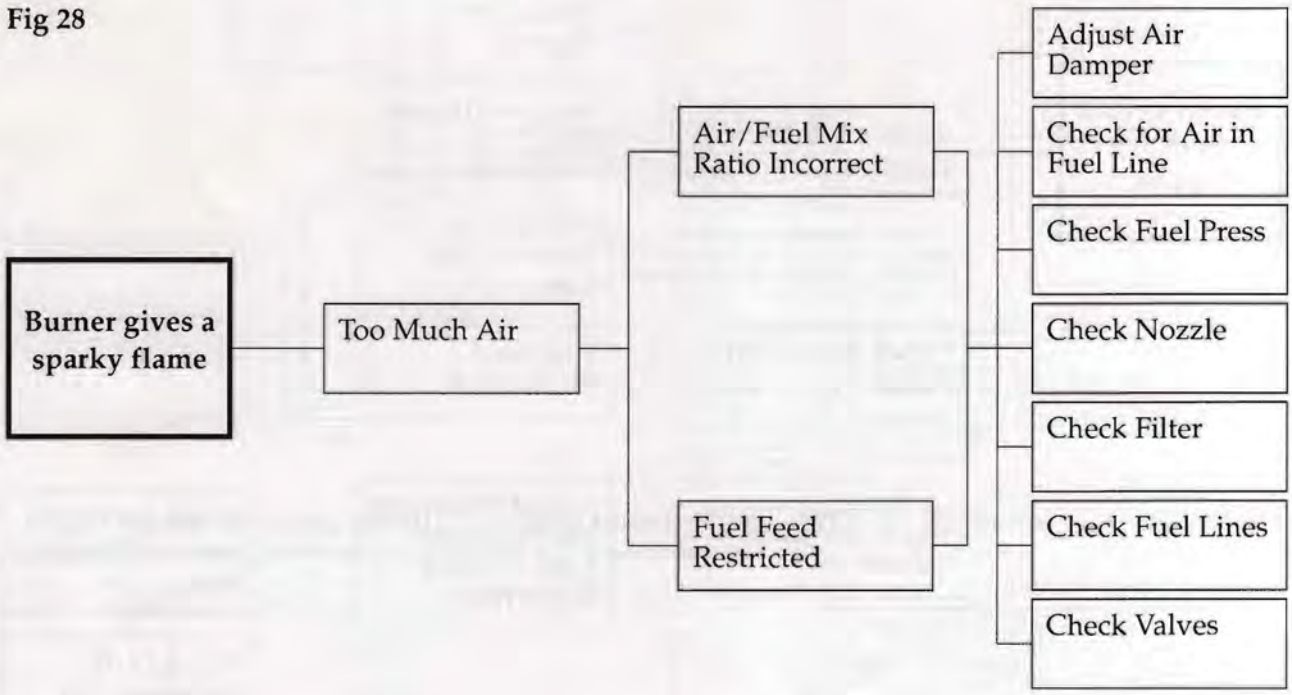

Burner gives a sparky flame
Too Much Air
Air/Fuel Mix Ratio Incorrect
Fuel Feed Restricted
Adjust Air Damper
Check for Air in Fuel Line
Check Fuel Press
Check Nozzle
Check Filter
Check Fuel Lines
Check Valves

Fig 29

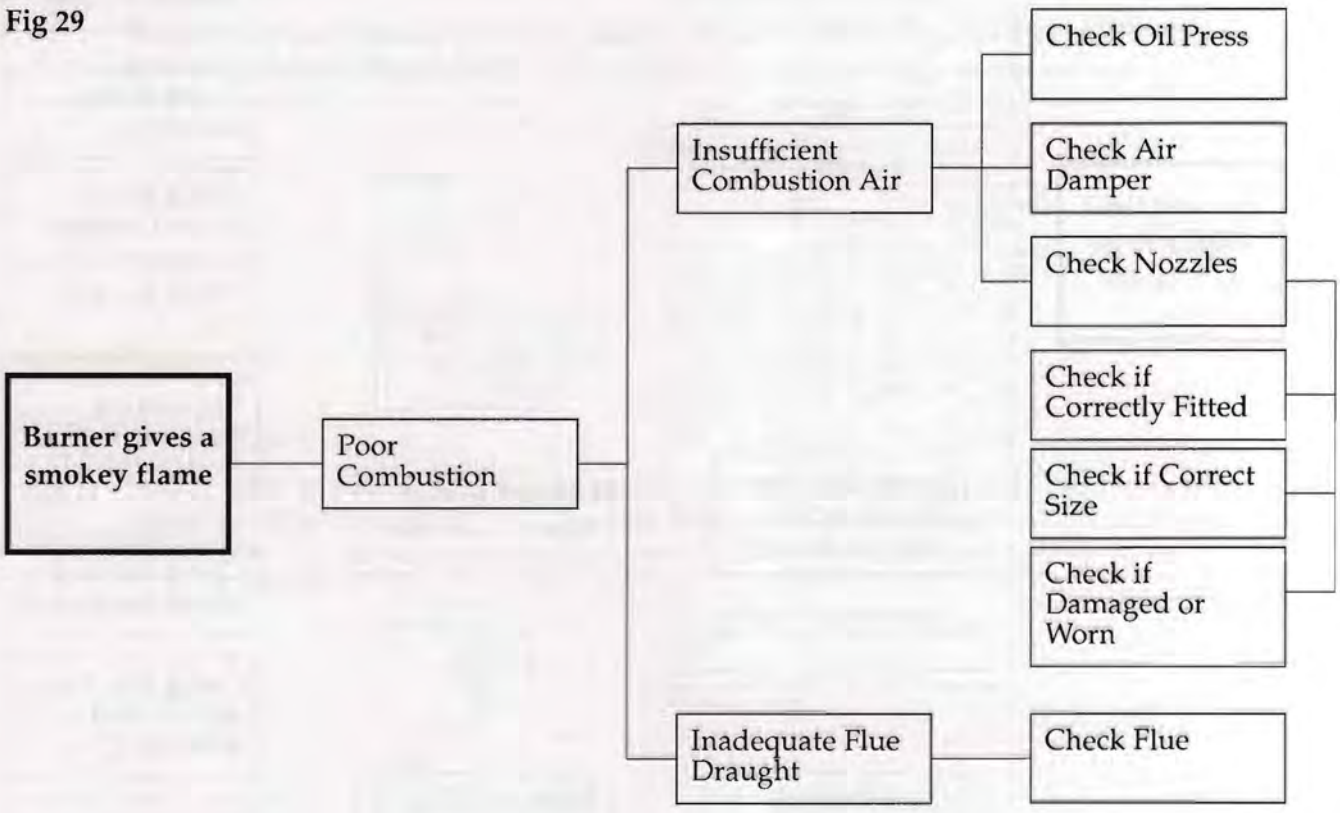

Burner gives a smokey flame
Poor Combustion
Insufficient Combustion Air
Inadequate Flue Draught
Check Oil Press
Check Air Damper
Check Nozzles
Check if Correctly Fitted
Check if Correct Size
Check if Damaged or Worn
Check Flue

Fig 30

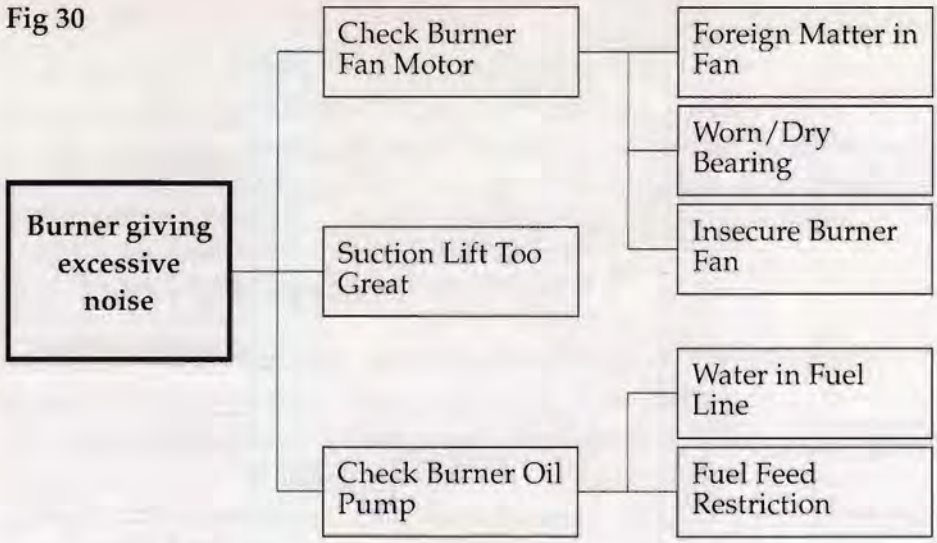
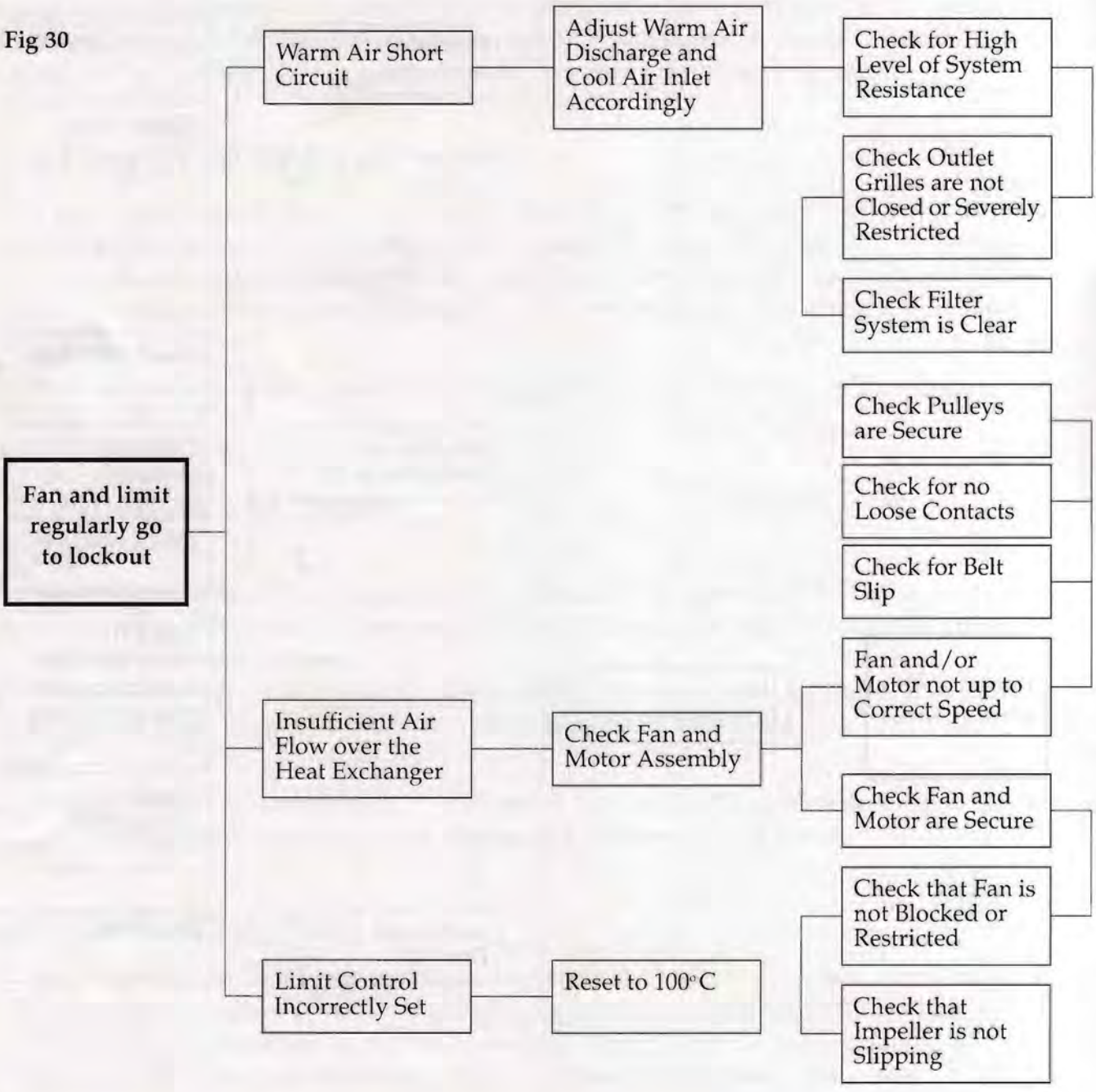
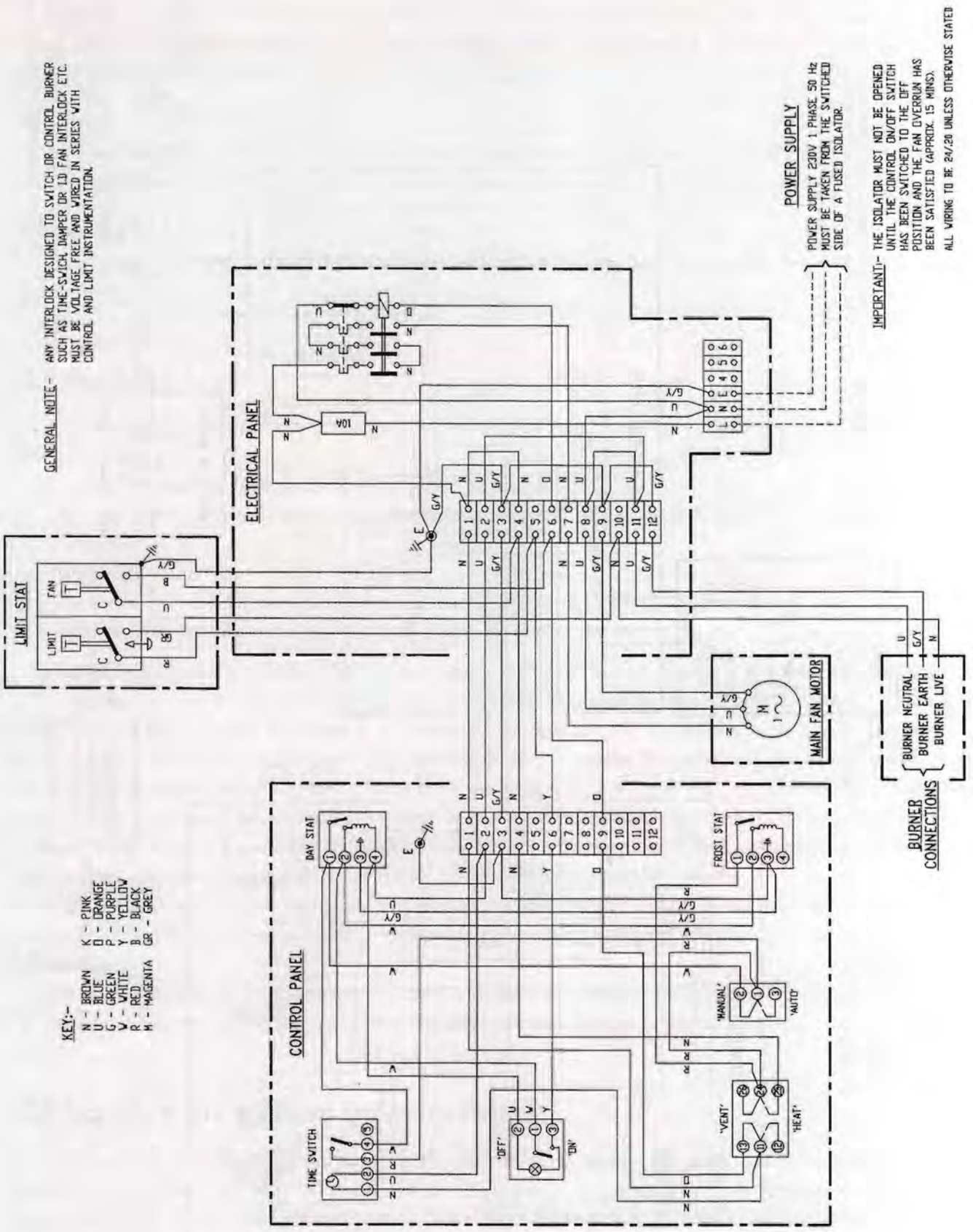

Burner giving excessive noise
Check Burner Fan Motor
Foreign Matter in Fan
Worn/Dry Bearing
Insecure Burner Fan
Suction Lift Too Great
Check Burner Oil Pump
Water in Fuel Line
Fuel Feed Restriction

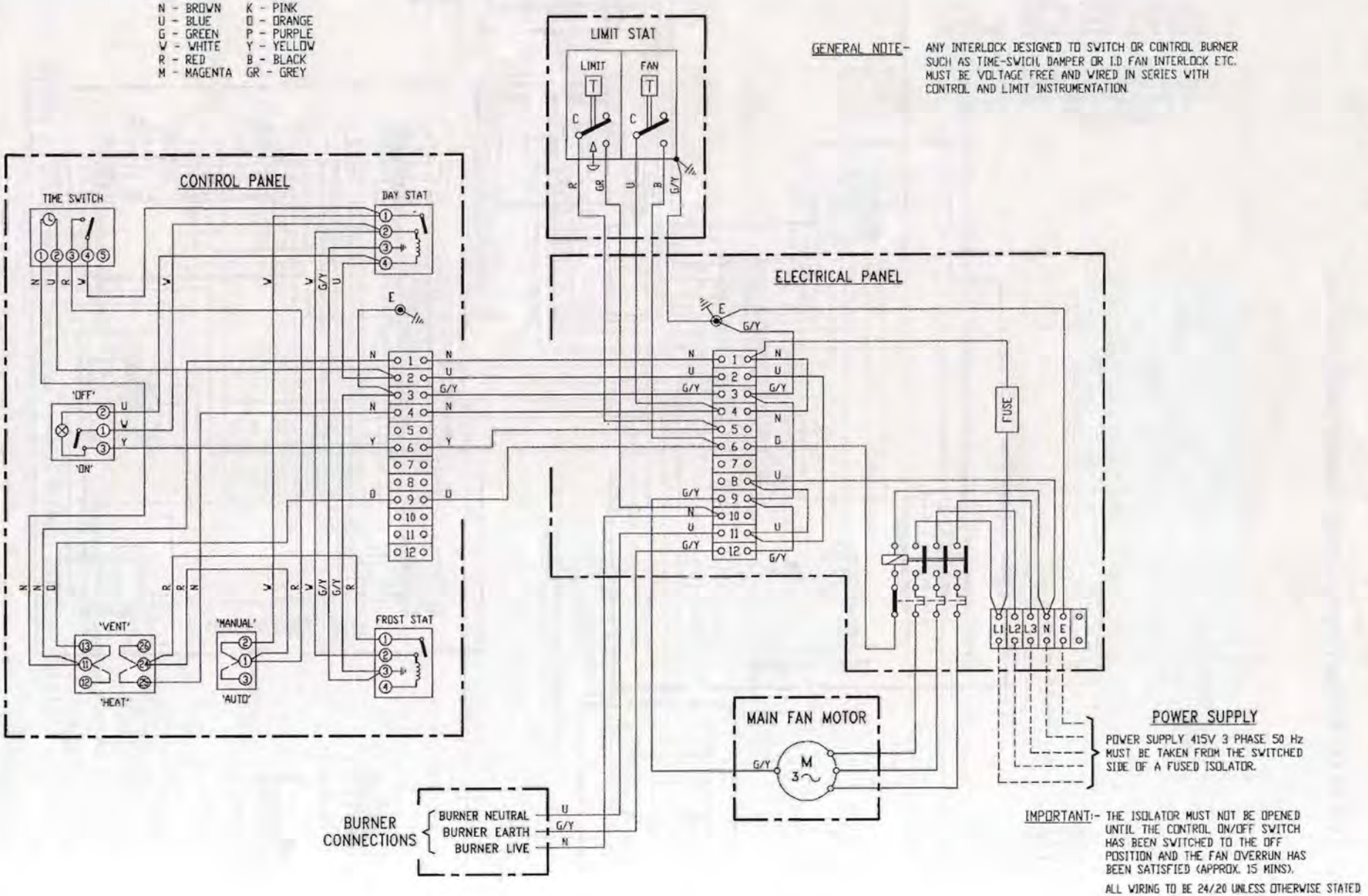
Fig 30

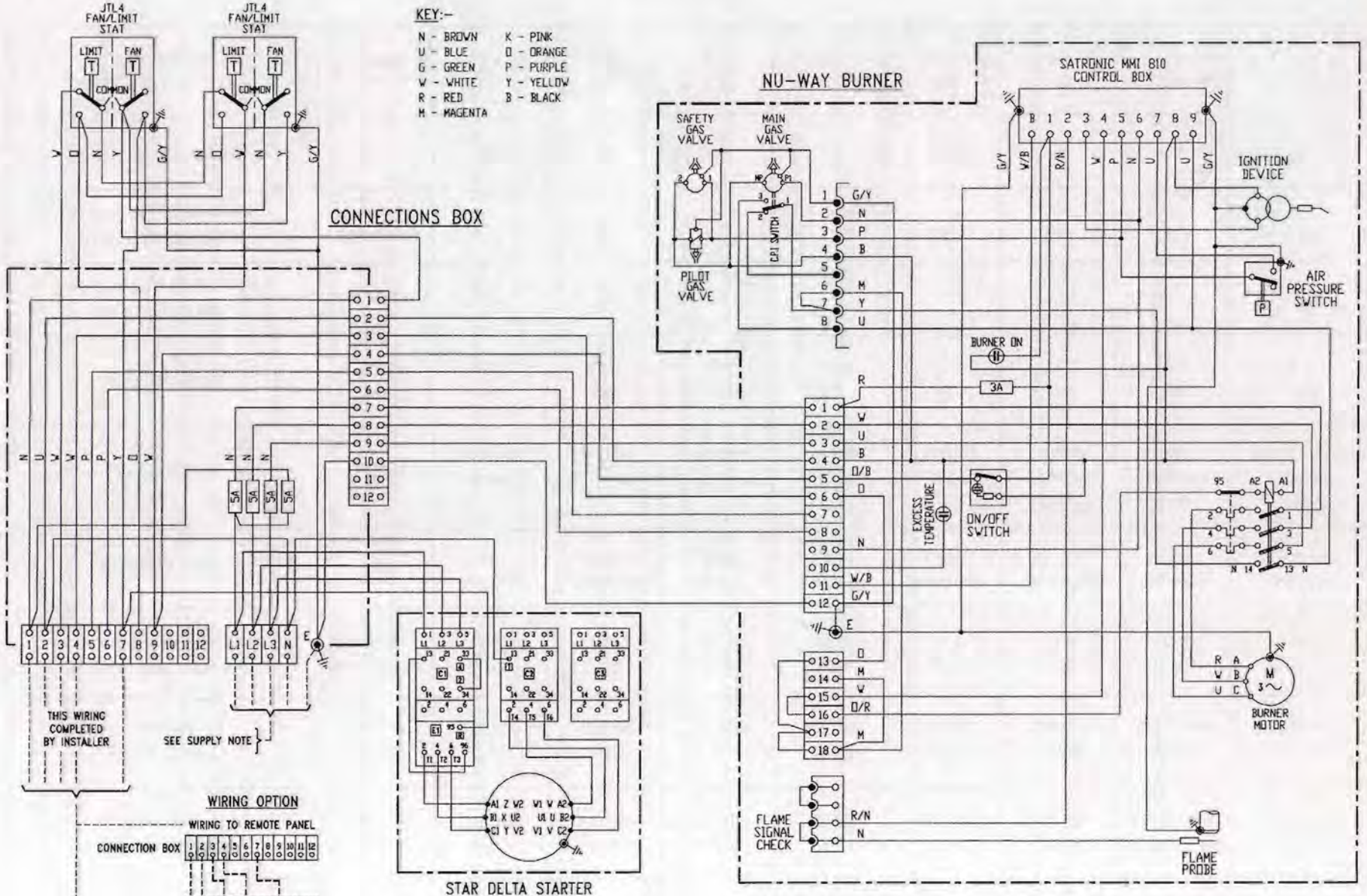

Fan and limit regularly go to lockout
Warm Air Short Circuit
Adjust Warm Air Discharge and Cool Air Inlet Accordingly
Check for High Level of System Resistance
Check Outlet Grilles are not Closed or Severely Restricted
Check Filter System is Clear
Insufficient Air Flow over the Heat Exchanger
Check Fan and Motor Assembly
Check Pulleys are Secure
Check for no Loose Contacts
Check for Belt Slip
Fan and/or Motor not up to Correct Speed
Check Fan and Motor are Secure
Limit Control Incorrectly Set
Reset to 100°C
Check that Fan is not Blocked or Restricted
Check that Impeller is not Slipping

7.0 Wiring Diagrams

7.0.1 On/Off Oil Burner 230V 1ph 50Hz Models WH60 - WH150




KEY:-
N - BROWN
U - BLUE
G - GREEN
W - WHITE
R - RED
M - MAGENTA
K - PINK
O - ORANGE
P - PURPLE
Y - YELLOW
B - BLACK
GR - GREY
LIMIT STAT
LIMIT
FAN
GENERAL NOTE- ANY INTERLOCK DESIGNED TO SWITCH OR CONTROL BURNER SUCH AS TIME-SWICH, DAMPER OR I.D FAN INTERLOCK ETC. MUST BE VOLTAGE FREE AND WIRED IN SERIES WITH CONTROL AND LIMIT INSTRUMENTATION.
CONTROL PANEL
TIME SWITCH
DAY STAT
'OFF'
'ON'
'VENT'
'HEAT'
'MANUAL'
'AUTO'
FROST STAT
ELECTRICAL PANEL
FUSE
L1 L2 L3 N E
MAIN FAN MOTOR
M 3~
POWER SUPPLY
POWER SUPPLY 415V 3 PHASE 50 Hz MUST BE TAKEN FROM THE SWITCHED SIDE OF A FUSED ISOLATOR.
IMPORTANT:- THE ISOLATOR MUST NOT BE OPENED UNTIL THE CONTROL ON/OFF SWITCH HAS BEEN SWITCHED TO THE OFF POSITION AND THE FAN OVERRUN HAS BEEN SATISFIED (APPROX. 15 MINS).
ALL WIRING TO BE 24/20 UNLESS OTHERWISE STATED
BURNER CONNECTIONS
BURNER NEUTRAL
BURNER EARTH
BURNER LIVE



SUPPLY NOTE – POWER SUPPLY 415V 3 PHASE 50 Hz MUST BE TAKEN FROM THE SWITCHED SIDE OF A FUSED ISOLATOR. IMPORTANT:- THE ISOLATOR MUST NOT BE OPENED UNTIL THE CONTROL ON/OFF SWITCH HAS BEEN SWITCHED TO THE OFF POSITION AND THE FAN OVERRUN HAS BEEN SATISFIED (APPROX. 15 MINS).

GENERAL NOTE– ANY INTERLOCK DESIGNED TO SWITCH OR CONTROL BURNER SUCH AS TIME-SWICH, DAMPER OR I.D FAN INTERLOCK ETC. MUST BE VOLTAGE FREE AND WIRED IN SERIES WITH CONTROL AND LIMIT INSTRUMENTATION.

MODEL		WH60	WH88	WH117	WH150	WH175	WH235	WH301	WH375
HEAT OUTPUT High Fire	kW/hr Btu/hr	58.6 200,000	88.0 300,000	117.2 400,000	146.5 500,000	175.8 600,000	234.5 800,000	301.0 1,027,000	375.0 1,279,500
HEAT INPUT (GROSS)	kW/hr Btu/hr	73.2 250,000	103.8 375,000	116.8 500,000	193.2 625,000	239.6 750,000	243.0 1,000,000	376.3 1,284,000	480.8 1,640,000
FUEL CONSUMPTION Gas Oil (Class D, 35 Sec)	Imp gall/hr litre/hr	1.52 6.9	2.28 10.4	3.04 13.8	3.80 17.3	4.56 20.7	6.08 27.6	7.8 35.4	9.97 45.3
BURNER TYPE		Reillo 40 G10	Riello 40 G10	Riello 40 G20	Riello 40 G20S	Riello 40 G20S	Nu-Way NOL13	Nu-Way NOL13	Nu-Way NOL2023
OIL NOZZLE	USGPH	1.35x60°S Danfoss	2.0x60°S Danfoss	2.75x60°S Danfoss	3.5x60°S Danfoss	4.0x45°S Danfoss	2.0x60°S 3.5x60°S Danfoss	2 off 3.5x60°S Danfoss	5.0x60° 3.5x60° Monarch PLP
OIL PRESSURE	psi bar	180 12.2	180 12.2	180 12.2	165 11.2	180 12.2	180 12.2	180 12.2	180 12.2
HEAD SETTING at Zero Flue Resistance	Number	2.5	5	2.5	3.5	-	-	-	-
AIR FLAP SETTING at Zero Flue Resistance	Number	3.5	5.0	3.5	L/F 3 H/F 5.5	TBA	TBA	TBA	TBA
OIL CONNECTION	BSP	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
AVAILABLE OUTLET PRESSURE	pa Ins WG	125 0.5	100 0.4	125 0.5	125 0.5	163 0.65	125 0.5	200 0.8	250 1.0

MODEL		WH60	WH88	WH117	WH150	WH175	WH235	WH301	WH375
NOZZLE DISCHARGE VELOCITY	m/sec ft/min	6.1 1200	6.1 1200	7.62 1500	8.8 1730	10.56 20.80	6.75 1300	8.36 1650	10.3 2028
AIR THROW (approx)	m ft	16 60	18 52	21 70	23 75	27 90	25.3 80	30 100	45 150
AIR DELIVERY	m^3/hr ft^3/min	3,694 2,175	5,096 3,000	7,992 4,720	10,440 6,200	11,988 7,080	16,128 9,482	20,484 12,057	30,240 17,800
TEMPERATURE RISE THROUGH HEATER (nominal)	°C °F	50 90	50 90	50 90	50 90	50 90	50 90	50 90	50 90
SOUND LEVEL	Dba	69	72	72	74	76	78	80	81
COMBUSTION CHAMBER INTERNAL PRESSURE	mm	4	4	6	6	6	5	9	9
FLUE RESISTANCE	Min mbar Max mbar	-0.2 0.6	-0.2 0.6	-0.2 0.6	-0.2 0.6	-0.4 1.6	-0.4 1.6	-0.4 1.6	-0.4 0.6
GROSS FLUE TEMPERATURE (20°C AMBIENT)	°C	260	295	270	305	300	290	300	300

MODEL		WH60	WH88	WH117	WH150	WH175	WH235	WH301	WH375
FLUE DIAMETER	mm	150	175	175	175	175	225	225	254
ELECTRICAL SUPPLY		230V 1ph 50Hz	230V 1ph 50Hz	415V 3ph 50Hz	415V 3ph 50Hz	415V 3ph 50Hz	415V 3ph 50Hz	415V 3ph 50Hz	415V 3ph 50Hz
RUNNING CURRENT	Amperes	6.0	7.2	3.9	4.9	7.6	8.5	9.0	14.0
RATED INPUT	kW	1.1	1.3	1.5	2.4	2.98	4.1	5.5	11.0
WEIGHT	kg lbs	254 558	257 567	362 797	370 814	436 960	630 1386	646 1421	1090 2400

9.1 Parts Listing

Part/Description	60 / 88	Notes	Part/Description	117 / 150	Notes
Heat exchanger assy	20-45-047		Heat exchanger assy	20-46-108	
Fan hood assy	20-45-048		Fan hood assy	20-46-048	
Base frame weld assy	20-45-055		Base frame weld assy	20-46-099	
Frame assy	20-45-057		Frame assy	20-46-055	
Diaphragm plate	20-45-051		Diaphragm plate	20-46-104	
Side panel	20-45-060		Side panel	20-46-102	
Heat shield side panel	20-45-063		Heat shield side panel	20-46-107	
Heat shield deflector	20-45-061		Heat shield deflector	20-46-110	
Heat shield front panel	20-45-062		Heat shield front panel	20-46-061	
Heat shield back panel	20-45-075		Heat shield back panel	20-46-062	
Front bottom panel	20-45-076		Front bottom panel	20-46-075	
Back bottom panel	20-45-074		Back bottom panel	20-46-087	
Electrical back plate	20-45-077		Electrical back plate	20-46-077	
Blanking piece back	20-45-080		Blanking piece back	20-48-085	
Stack box cover assy	20-45-094		Stack box cover assy	20-45-094	
Fan and limit stat	28-60-021		Fan and limit stat	28-60-021	
Fan and limit stat gasket	20-33-549		Fan and limit stat gasket	20-33-549	
Sight glass	20-30-061		Sight glass	20-30-061	
Sight glass holder	20-30-151		Sight glass holder	20-30-151	
Heat exchanger cover plate	20-30-207		Heat exchanger cover plate	20-31-036	
Front top pnl (V, H-DH1, R)	20-45-073		Front top pnl (V, H-DH1, R)	20-46-101	
Front top pnl (H-DH2)	20-45-066	*H* only	Front top pnl (H-DH2)	20-46-145	*H* only
Motorised fan - 1 phase	28-09-002		Motor - 1 phase	28-10-009	WH117 only
Motorised fan - 3 phase	20-32-042		Motor - 3 phase	28-10-008	WH117 only
Overload - 1 phase	28-11-056	WH60 only	Drive pulley	28-65-065	WH117 only
Overload - 3 phase	28-11-066	WH60 only	Driven pulley	28-65-093	WH117 only
Overload - 1 phase	28-11-055	WH88 only	V - belt	09-16-116	WH117 only
Overload - 3 phase	28-11-053	WH88 only	Overload - 1 phase	28-11-054	WH117 only
Contactor	28-11-057		Overload - 3 phase	28-11-053	WH117 only
Digital time clock	28-15-030		Contactor - 1 and 3 phase	28-11-057	WH117 only
Thermostat room/frost	28-16-031		Motor - 1 phase	28-10-016	WH150 only
Rocker switch - red neon	28-40-072		Motor - 3 phase	28-10-015	WH150 only
Rocker switch - dual	28-40-073		Drive pulley	28-65-063	WH150 only
Rocker switch	28-40-074		Driven pulley	28-65-092	WH150 only
12-way terminal block	A 20-09-136		V - belt - 1 phase	09-16-110	WH150 only
Fuse holder	28-07-050		V - belt - 3 phase	09-16-116	WH150 only
Fuse - 1 phase	28-07-049		Overload - 1 phase	28-11-089	WH150 only
Fuse - 3 phase	28-07-048		Overload - 3 phase	28-11-056	WH150 only
6-way terminal block	28-03-007		Contactor - 1 phase	28-11-088	WH150 only
Stackbox assy	31-24-074	WH60 only	Contactor - 3 phase	28-11-057	WH150 only
Stackbox assy	31-27-123	WH88 only	Digital time clock	28-15-030	
Access plate	20-30-225		Thermostat room/frost	28-16-031	
Stackbox gasket	31-27-121		Rocker switch - red neon	28-40-072	
Fan air restrictor	31-30-016		Rocker switch - dual	28-40-073	
Top weld assy (nozzled)	20-45-072	TBA	Rocker switch	28-40-074	
Nozzle assy	31-30-167	TBA	12-way terminal block	A 20-09-136	
Duct spigot assy	20-45-071		Fuse holder	28-07-050	
Oil burner assy. 4th shift no.	31-24-993	WH60 only	Fuse - 1 phase	28-07-049	
Oil burner assy. 4th shift no.	31-24-994	WH88 only	Fuse - 3 phase	28-07-048	
Oil burner	29-99-453		6-way terminal block	28-03-007	
Fire valve	28-30-102		Stackbox assy	31-27-123	
Stud coupling	29-00-094		Access plate	20-30-225	
Adaptor	29-00-166		Stackbox gasket	31-27-121	
Support bracket (2 off)	31-30-095		Top weld assy (nozzled)	20-46-116	TBA
Fuel filter	29-15-071		Nozzle assy	31-30-159	TBA
Oil nozzle	27-00-427		Duct spigot assy	20-46-113	
Manual - oil	20-45-078		Oil burner assy. 4th shift no.	31-27-986	WH117 only
			Oil burner assy. 4th shift no.	31-27-987	WH150 only
			Oil burner	29-99-454	WH117 only
			Oil burner	29-99-455	WH150 only
			Fire valve	28-30-102	
			Stud coupling	29-00-094	
			Adaptor	29-00-166	
			Support bracket (2 off)	31-30-095	
			Fuel filter	29-15-071	
			Oil nozzle	27-00-044	WH117 only
			Oil nozzle	27-00-078	WH150 only
			Manual - oil	20-45-078	

V = Vertical *H* = Horizontal *R* = Reverse flow (Common, unless otherwise indicated)

9.1 Parts Listing

Part/Description	60 / 88	Notes	Part/Description	117 / 150	Notes
Heat exchanger assy	20-45-047		Heat exchanger assy	20-46-108	
Fan hood assy	20-45-048		Fan hood assy	20-46-048	
Base frame weld assy	20-45-055		Base frame weld assy	20-46-099	
Frame assy	20-45-057		Frame assy	20-46-055	
Diaphragm plate	20-45-051		Diaphragm plate	20-46-104	
Side panel	20-45-060		Side panel	20-46-102	
Heat shield side panel	20-45-063		Heat shield side panel	20-46-107	
Heat shield deflector	20-45-061		Heat shield deflector	20-46-110	
Heat shield front panel	20-45-062		Heat shield front panel	20-46-061	
Heat shield back panel	20-45-075		Heat shield back panel	20-46-062	
Front bottom panel	20-45-076		Front bottom panel	20-46-075	
Back bottom panel	20-45-074		Back bottom panel	20-46-087	
Electrical back plate	20-45-077		Electrical back plate	20-46-077	
Blanking piece back	20-45-080		Blanking piece back	20-48-085	
Stack box cover assy	20-45-094		Stack box cover assy	20-45-094	
Fan and limit stat	28-60-021		Fan and limit stat	28-60-021	
Fan and limit stat gasket	20-33-549		Fan and limit stat gasket	20-33-549	
Sight glass	20-30-061		Sight glass	20-30-061	
Sight glass holder	20-30-151		Sight glass holder	20-30-151	
Heat exchanger cover plate	20-30-207		Heat exchanger cover plate	20-31-036	
Front top pnl (V, H-DH1, R)	20-45-073		Front top pnl (V, H-DH1, R)	20-46-101	
Front top pnl (H-DH2)	20-45-066	*H* only	Front top pnl (H-DH2)	20-46-145	*H* only
Motorised fan - 1 phase	28-09-002		Motor - 1 phase	28-10-009	WH117 only
Motorised fan - 3 phase	20-32-042		Motor - 3 phase	28-10-008	WH117 only
Overload - 1 phase	28-11-056	WH60 only	Drive pulley	28-65-065	WH117 only
Overload - 3 phase	28-11-066	WH60 only	Driven pulley	28-65-093	WH117 only
Overload - 1 phase	28-11-055	WH88 only	V - belt	09-16-116	WH117 only
Overload - 3 phase	28-11-053	WH88 only	Overload - 1 phase	28-11-054	WH117 only
Contactor	28-11-057		Overload - 3 phase	28-11-053	WH117 only
Digital time clock	28-15-030		Contactor - 1 and 3 phase	28-11-057	WH117 only
Thermostat room/frost	28-16-031		Motor - 1 phase	28-10-016	WH150 only
Rocker switch - red neon	28-40-072		Motor - 3 phase	28-10-015	WH150 only
Rocker switch - dual	28-40-073		Drive pulley	28-65-063	WH150 only
Rocker switch	28-40-074		Driven pulley	28-65-092	WH150 only
12-way terminal block	A 20-09-136		V - belt - 1 phase	09-16-110	WH150 only
Fuse holder	28-07-050		V - belt - 3 phase	09-16-116	WH150 only
Fuse - 1 phase	28-07-049		Overload - 1 phase	28-11-089	WH150 only
Fuse - 3 phase	28-07-048		Overload - 3 phase	28-11-056	WH150 only
6-way terminal block	28-03-007		Contactor - 1 phase	28-11-088	WH150 only
Stackbox assy	31-24-074	WH60 only	Contactor - 3 phase	28-11-057	WH150 only
Stackbox assy	31-27-123	WH88 only	Digital time clock	28-15-030	
Access plate	20-30-225		Thermostat room/frost	28-16-031	
Stackbox gasket	31-27-121		Rocker switch - red neon	28-40-072	
Fan air restrictor	31-30-016		Rocker switch - dual	28-40-073	
Top weld assy (nozzled)	20-45-072	TBA	Rocker switch	28-40-074	
Nozzle assy	31-30-167	TBA	12-way terminal block	A 20-09-136	
Duct spigot assy	20-45-071		Fuse holder	28-07-050	
Oil burner assy. 4th shift no.	31-24-993	WH60 only	Fuse - 1 phase	28-07-049	
Oil burner assy. 4th shift no.	31-24-994	WH88 only	Fuse - 3 phase	28-07-048	
Oil burner	29-99-453		6-way terminal block	28-03-007	
Fire valve	28-30-102		Stackbox assy	31-27-123	
Stud coupling	29-00-094		Access plate	20-30-225	
Adaptor	29-00-166		Stackbox gasket	31-27-121	
Support bracket (2 off)	31-30-095		Top weld assy (nozzled)	20-46-116	TBA
Fuel filter	29-15-071		Nozzle assy	31-30-159	TBA
Oil nozzle	27-00-427		Duct spigot assy	20-46-113	
Manual - oil	20-45-078		Oil burner assy. 4th shift no.	31-27-986	WH117 only
			Oil burner assy. 4th shift no.	31-27-987	WH150 only
			Oil burner	29-99-454	WH117 only
			Oil burner	29-99-455	WH150 only
			Fire valve	28-30-102	
			Stud coupling	29-00-094	
			Adaptor	29-00-166	
			Support bracket (2 off)	31-30-095	
			Fuel filter	29-15-071	
			Oil nozzle	27-00-044	WH117 only
			Oil nozzle	27-00-078	WH150 only
			Manual - oil	20-45-078	

V = Vertical *H* = Horizontal *R* = Reverse flow (Common, unless otherwise indicated)

Part/Description	175	Notes
Heat exchanger assy	20-46-051	
Fan hood assy	20-46-048	
Base frame weld assy	20-46-049	
Frame assy	20-46-055	
Diaphragm plate	20-46-057	
Side panel	20-46-056	
Heat shield side panel	20-46-060	
Heat shield deflector	20-46-082	
Heat shield front panel	20-46-061	
Heat shield back panel	20-46-062	
Front bottom panel	20-46-075	
Back bottom panel	20-46-087	
Back top panel	20-46-088	
Electrical back plate	20-46-077	
Blanking piece back	20-48-085	
Stack box cover assy	20-45-094	
Fan and limit stat	28-60-021	
Fan and limit stat gasket	20-33-549	
Sight glass	20-30-061	
Sight glass holder	20-30-151	
Heat exchanger cover plate	20-31-036	
Front top pnl (V, H-DH1, R)	20-46-073	
Front top pnl (H-DH2)	20-46-098	*H* only
Motor - 3 phase only	28-10-026	
Fan	20-09-003	WDMB155
Drive pulley	28-65-061	
Driven pulley	28-65-092	
V - belt	09-16-116	
Overload - 3 phase	28-11-055	
Contactor - 3 phase	28-11-057	
Digital time clock	28-15-030	
Thermostat room/frost	28-16-031	
Rocker switch - red neon	28-40-072	
Rocker switch - dual	28-40-073	
Rocker switch	28-40-074	
12-way terminal block	A 20-09-136	
Fuse holder	28-07-050	
Fuse - 3 phase	28-07-048	
6-way terminal block	28-03-007	
Stackbox assy	31-27-123	
Access plate	20-30-225	
Stackbox gasket	31-27-121	
Top weld assy (nozzled)	20-46-072	TBA
Nozzle assy	31-30-159	TBA
Duct spigot assy	20-46-071	
Oil burner assy. 4th shift no.	20-46-981	
Oil burner	29-99-455	
Fire valve	28-30-102	
Stud coupling	29-00-094	
Adaptor	29-00-166	
Support bracket (2 off)	31-30-095	
Fuel filter	29-15-012	
Oil nozzle	27-00-054	
Manual - oil	20-45-078	

Part/Description	235 / 301	Notes
Cabinet casing assy	20-47-051	WH235 only
Cabinet casing assy	20-47-052	WH301 only
Front lower louvred panel	20-47-021	
Rear lower louvred panel	20-47-022	
Side lower louvred panel	20-47-039	
Burner gasket	20-47-066	
Electrical back plate	31-29-026	
Overload	28-11-111	
Contractor	28-11-057	
Fan and limit stat 200mm	28-60-023	
Fan and limit stat gasket	20-33-549	
Base frame sub assy	20-47-045	
Base frame sub assy	20-47-050	
Diaphragm panel	20-47-009	
Outlet frame weld assy	20-47-010	
Front panel	20-47-036	
Front panel heat shield	20-47-037	
Sight glass	20-30-061	
Sight glass holder	20-30-151	
Base frame weld assy	20-47-008	
Fan assembly	28-09-043	
Motor mounting plate	20-47-034	
Motor (5.5Hp 415V 3ph)	28-10-026	WH235 only
Motor (7.5Hp 415V 3ph)	28-10-021	WH301 only
Drive pulley - 85mm x 3	28-65-042	WH235 only
Drive pulley - 90mm x 4	28-65-073	WH301 only
Taper bush - 28mm	28-66-028	WH235 only
Taper bush - 38mm	28-66-038	WH301 only
Driven pulley - 180mm x 3	28-65-049	WH235 only
Driven pulley - 180mm x 4	28-65-054	WH301only
Taper bush (fan)	28-66-136	WH235 only
Taper bush (fan)	28-66-137	WH301 only
Motor adjusting screw	20-33-022	
Swivel bolt	20-27-048	
Side panel	20-47-017	
Side heat shield	20-47-018	
Heat exchanger weld assy	20-47-030	
Heat exchanger cover plate	20-33-039	
Rear panel	20-47-014	
Rear heat shield	20-47-015	
Gas exit duct cover assy	20-47-065	
Gas exit duct weld assy	20-27-048	
Cover plate gasket	31-29-045	
Cover plate	31-29-044	
Digital time clock	28-15-030	
Thermostat room/frost	28-16-031	
Rocker switch - red neon	28-40-072	
Rocker switch - dual	28-40-073	
Rocker switch	28-40-074	
12-way terminal block	A 20-09-136	
Fuse holder	28-07-050	
Fuse 6A	28-07-048	
Duct spigot weld assy	20-47-027	
Bonnet weld assy	20-47-024	
Nozzle assy	31-30-157	
Oil burner assy. 4th shift no.	20-47-993	WH235 only
Oil burner assy. 4th shift no.	20-47-994	WH301 only
Oil burner	29-99-189	
Fire valve	28-30-102	
Stud coupling	29-00-094	
Adaptor	29-00-166	
Support bracket (2 off)	31-30-095	
Fuel filter	29-15-020	
Fuel pipe flexible	29-02-016	
Oil nozzle	27-00-032	WH235 only
Oil nozzle	27-00-078	WH235 only
Oil nozzle (2 off)	27-00-078	WH301 only
Manual - oil	20-45-078	

V = Vertical *H* = Horizontal *R* = Reverse flow (Common, unless otherwise indicated)

Part/Description	375	Notes
Main frame assy	20-27-074	
Main frame panel assy	20-27-075	
Rear panel	20-27-013	
Top rear heat shield	20-27-011	
Bottom rear heat shield	20-27-010	
Burner end panel	20-27-012	
Burner end heat shield	20-27-009	
Fan frame assy	20-27-305	
Fan frame panel assy	20-27-085	*V* only
Fan frame panel assy	20-27-124	*H* and *R*
Side panel	20-27-057	*V* only
Side panel	20-27-120	*H* and *R*
End panel	20-27-080	*V* only
End panel	20-27-118	*H* and *R*
End panel motor end	20-27-079	*V* only
End panel motor end	20-27-119	*H* and *R*
Motor access panel	20-27-078	
Motor mounting frame RH	20-27-318	
Motor mounting frame LH	20-27-319	
Fan unit	20-27-316	
Impellor	20-27-317	
Fan shaft	20-27-312	
Fan foot RH	20-27-321	
Fan foot LH	20-27-322	
Heat exchanger assy	20-27-073	
Gas exit duct assy	20-27-090	*V* only
Gas exit duct assy	20-27-092	*H* only
Gas exit duct assy	20-27-091	*R* only
Explosion relief door	20-27-020	
Outlet assy (nozzled)	20-27-094	*V* only
Outlet assy (nozzled)	20-27-148	*H* only
Outlet assy (nozzled)	20-27-138	*R* only
Outlet assy (ducted)	20-27-028	
Top plate	20-27-035	
Nozzle hood	20-27-034	*V* only
Nozzle hood	20-27-036	*H* and *R*
Electrical assy (nozzled)	20-27-621	
Electrical assy (ducted)	20-27-622	
Fan drive assy (nozzled)	20-27-526	
Fan drive assy (ducted)	20-27-527	
Motor (nozzled)	28-10-024	
Motor (ducted)	28-10-025	
Drive pulley (nozzled)	28-65-047	
Drive pulley (ducted)	28-65-053	
Driven pulley (nozzled)	28-65-049	
Driven pulley (nozzled)	28-65-054	
Taper lock bush-drive (nozzled)	28-66-013	
Taper lock bush-drive (ducted)	28-66-042	
Taper lock bush-driven (nozzled)	28-66-013	
Taper lock bush-driven (ducted)	28-66-019	
V-belt (3 off per heater)	09-16-126	
Penn control	28-60-012	
Oil burner assy. 4th shift no.	20-27-617	
Oil burner	29-99-161	
Top nozzle	27-00-275	
Bottom nozzle	27-00-260	
Fire valve	28-30-102	
Stud coupling	29-00-094	
Adaptor	29-00-166	
Support bracket (2 off)	31-30-095	
Fuel filter	20-30-527	
Manual - oil	20-45-078	

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