



ECONOFLAME R18 ATMOSPHERIC GAS FIRED BOILERS

**INSTALLATION, OPERATION & MAINTENANCE
DOCUMENTATION**

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We aim to achieve continuous improvement in our products. Therefore, specifications are subject to change without prior notice.

Due to changes the product can deviate from the information specified in this document. Therefore Stokvis rejects any responsibility for the differences between the product delivered and the information mentioned in this document.

R18 TECHNICAL DATA

Type		132	154	180	210	244	280
Nominal heat output	kW	481	558	649	756	875	1002
Nominal heat input (nett. CV)	kW	538	625	727	846	980	1122
Gas consumption							
natural gas H (10,9 kWh/m ³)	m ³ /h	49,3	57,9	67,4	78,4	90,8	104,0
propane	m ³ /h	19,0	22,1	25,7	29,9	34,7	39,7
Gas inlet pressure	(min.)	mbar	17	17	17	17	17
	(max.)	mbar	25	25	25	25	25
	propane (max.)	mbar	50	50	50	50	50
Water volume	dm ³	22,0	23,2	24,6	26,3	28,1	30,1
Max. working pressure	bar	6	6	6	6	6	6
Flue connection	D mm	450	500	550	600	650	700
Gas connection	G	2"	2"	2"	2"	DN65 PN16	DN65 PN16
Water connections	W	DN80 PN16	DN80 PN16	DN80 PN16	DN80 PN16	DN80 PN16	DN80 PN16
Pressure relief valve connection		1¼"	1¼"	1¼"	1½"	1½"	1½"
	relief connection	1½"	1½"	1½"	2"	2"	2"
	standard setting	bar	3	3	3	3	3
Electrical supply	V	230	230	230	230	230	230
Frequency	Hz	50	50	50	50	50	50
Fuse	A	6	6	6	6	6	6
Max. electrical consumption	kW	0,35	0,35	0,35	0,35	0,35	0,35
Dimensions	B mm	1430	1430	1430	1430	1400	1400
	H mm	1795	1795	1795	1795	1895	1895
	L mm	1461	1636	1842	2080	2350	2636
Weight, empty, ± 5 %	kg	620	660	705	760	820	885

Table 1 Technical Data

- Heat output measured with : 60 - 80 °C
- Gas consumption at : 1013 mbar, 15 °C, dry
- Gas specification : II_{2H3P}
- Appliance category : B11
- Protection degree : IP30

Changes in specifications and dimensions

The manufacturer reserves the right to change the above mentioned dimensions without prior notice.

Because of manufacturing tolerances, the above mentioned dimensions can vary slightly.

Dimensions

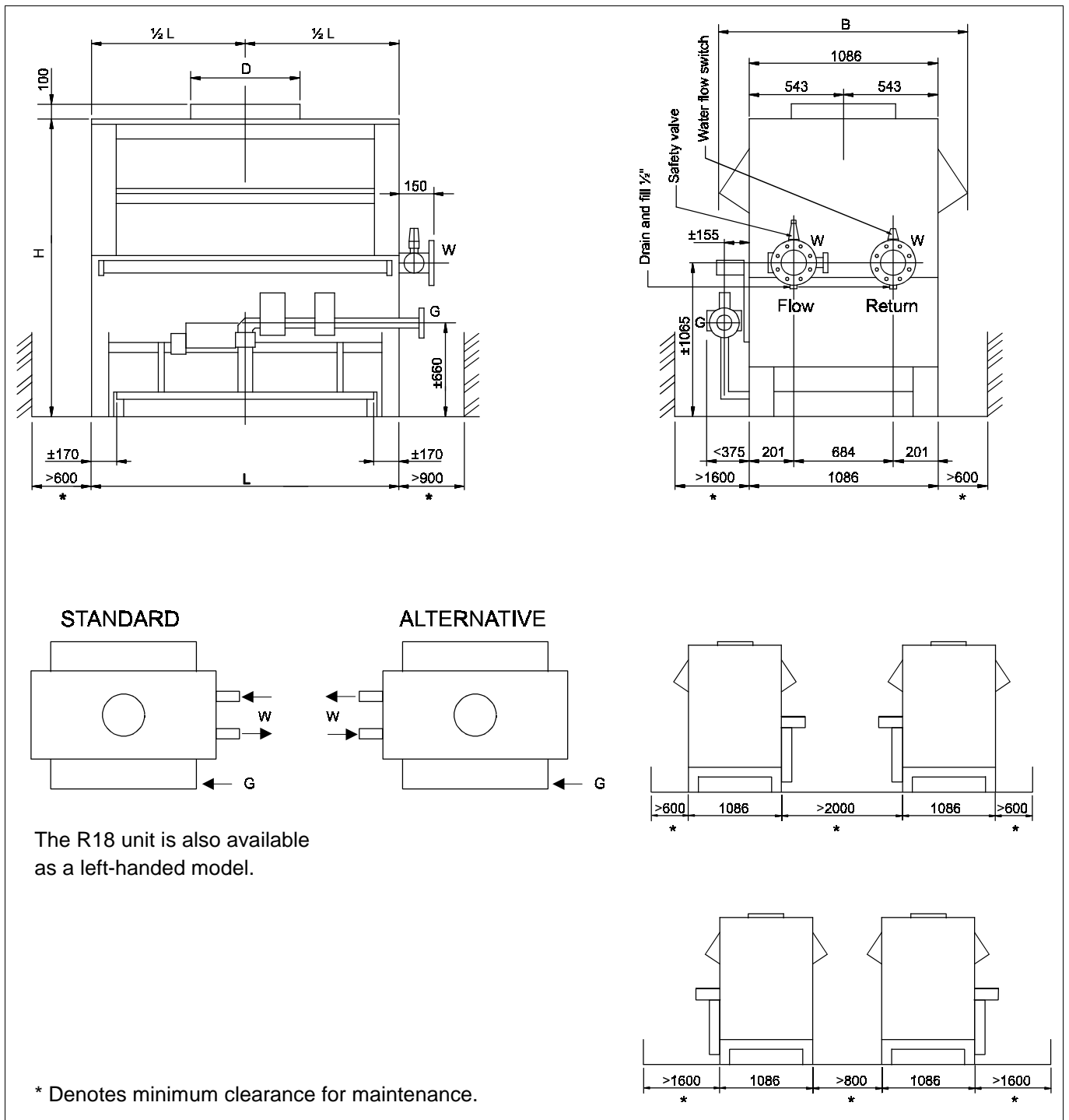


Fig. 1 Dimensions

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1 INTRODUCTION

1.1 Stokvis..... Since its beginning in 1985, Stokvis has built up a strong reputation in industry for the development, production and marketing of gas-fired, high efficiency boilers and water heaters in the 60 to 1200 kW range.

ISO9002

Through their unique construction, these central heating units and water heaters are renowned for their:

- high thermal efficiency
- environmental friendliness
- light weight and small dimensions
- durability
- low noise production
- large regulating range
- available with many different options.

Continual research and development means that R.S. Stokvis & Sons Ltd. remains at the forefront of boiler and water heater technology.

1.2 Supplier **STOKVIS ENERGY SYSTEMS.**
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Surrey KT8 0DL
Tel.: 08707 707 747
Fax: 08707 707 767

1.3 This manual This documentation has been produced to aid the following target groups:

- the consulting engineer
- the heating installer
- the service engineer
- the user.

Because these target groups require mostly similar information and also specific information, our technical documentation has been integrated to provide these target groups with the necessary general and specific information to install, service and operate this product.

The supplier (see 1.2) will be able to provide any further or supplemental information.

The following aspects will be explained:

- general description
- technical specifications
- necessary services for system design and unit installation
- example systems
- maintenance instructions.

Operating instructions for the user can be found on the unit.
See also chapter 7.

1.4 Service For commissioning and assistance in maintenance matters, please contact your supplier's service department. For more details see section 1.2.

1.5 Reservation The application, installation and maintenance of Stokvis products must always be carried out in accordance with the requirements (legal or otherwise), specifications and standards applicable to such installations.

All data, information and suggestions provided by Stokvis in relation to its products are based on careful investigation. Nevertheless, neither Stokvis . nor any other organisation connected with Stokvis accepts any liability for applications or installations that occurs outside its sphere of influence.

Changes may be incorporated without prior notice. Stokvis accepts no obligation to adapt previously delivered products to incorporate such changes.

2

DESCRIPTION

2.1 General information

The Econoflame R18 series boilers are atmospheric open flued, low thermal capacity gas-fired boilers. These high efficiency boilers are designed to provide heating and hot water services for a wide variety of industrial and commercial premises.

The R18 series of boilers are available in 6 types: 132, 154, 180, 210, 244 and 280.

The type number indicate the number of burner bars present in the burner assembly. The load at nett calorific value is approximately 3,5 kW per burner.

All boiler types are fitted with an 18-tube heat exchanger of the 2 pass type.

The use of extruded copper fin pipes in the heat exchanger leads to higher efficiency.

Thermal radiation losses are minimised by the optimal construction of the combustion chamber in which high-grade insulation is integrated.

The advanced construction of the R18 enables swift assembly and dismantle, which simplifies maintenance and inspection.

All boilers have full sequence automatic control with overheat cut off, water flow switch, modulating turn down on gas and combustion air (for improved efficiency at varying heat loads) and fault indicators.

The R18 has a PID temperatur regulator and electronic protection and ignition system indicator by the letters EM.

Appliance category B11.

The R18 series have CE approval for all relevant European countries. The series are registered under the Product Identification Number 0063AQ6600.



2.2 Main components

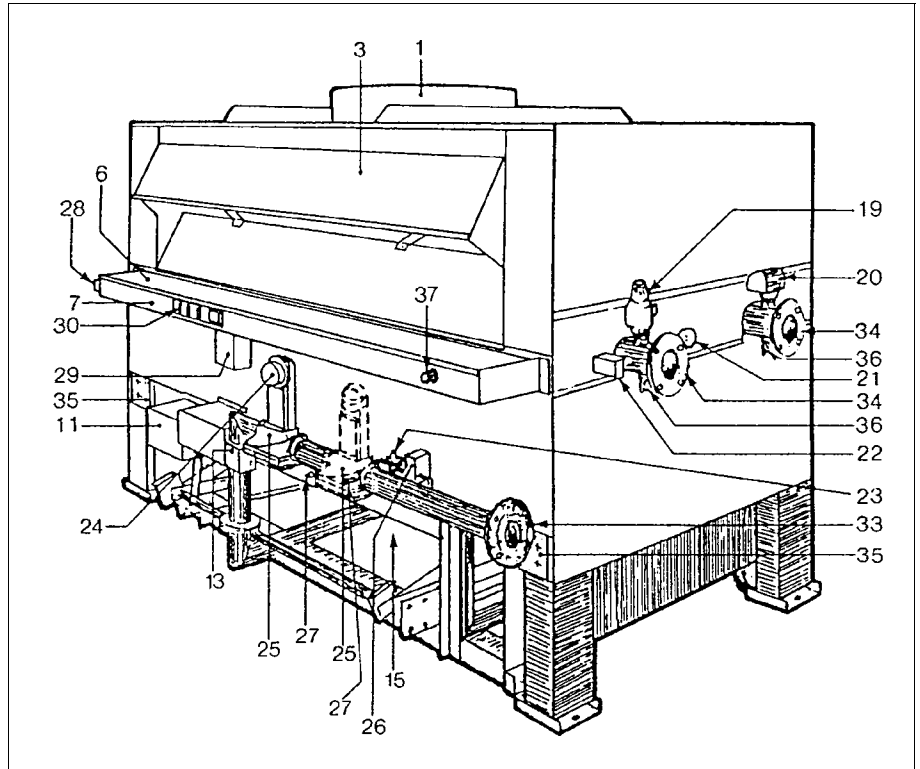


Fig. 2 View of the R18 series

- | | |
|---|-------------------------------------|
| 1. Flue outlet socket | 24. Gas governor |
| 3. Draught diverter | 25. Main gas valve |
| 6. Cover for electrical connection tray | 26. Solenoid valve for pilot burner |
| 7. Connection tray | 27. Pressure test points |
| 11. Servomotor (air damper/gas input) | 28. Temperature control unit |
| 13. Modulating gas valve | 29. Safety system control box |
| 15. Modulating air damper | 30. Control panel |
| 19. Safety valve | 33. Gas connection |
| 20. Water flow switch | 34. Water connections |
| 21. Pressure gauge/thermostat | 35. Air deflector |
| 22. Flow temperature sensor | 36. Fill/drain cock |
| 23. Pilot governor | 37. High limit thermostat |

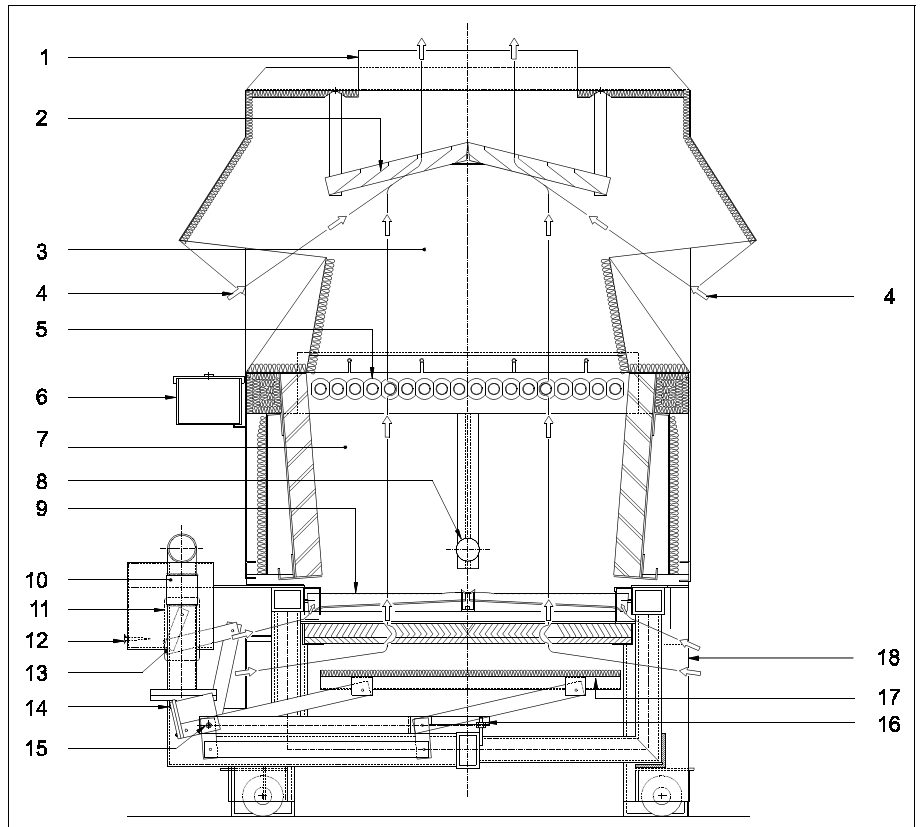


Fig. 3 Cross-section of the R18 series

- | | |
|-----------------------|---|
| 1. Flue outlet socket | 10. Modulating gas valve |
| 2. Deflector | 11. Servo motor |
| 3. Draught diverter | 12. Front adjustment screw for air damper |
| 4. Air in-take | 13. Linkage assembly |
| 5. Heat exchanger | 14. Adjustment screw |
| 6. Connection tray | 15. Lock screw for air damper |
| 7. Combustion chamber | 16. Rear adjustment screw for air damper |
| 8. Sight glass | 17. Modulating air damper |
| 9. Burner assembly | 18. Air deflector |

Draught diverter

The R18 is fitted with a draught diverter. It is possible to connect the flue outlet connection on the top cover to a standard flue pipe.

The inside of the draught diverter is made of aluminium.

The galvanized plate mantle is easily removed without the use of any special tools by means of a click system.

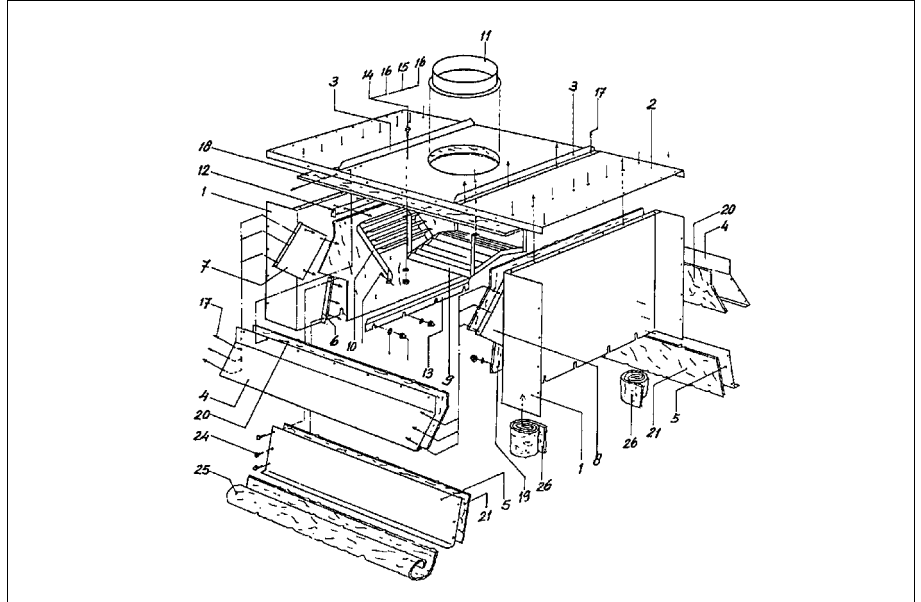


Fig. 4 Draught diverter

Combustion chamber

The chassis consists of two side frames with steel supports. Dura blanket type thermal insulation is sandwiched between the vermiculite refractory blocks and front, rear and side panels of the combustion chamber housing. These vermiculite refractory blocks are mounted so as to allow freedom of expansion. The refractory blocks backed with the Dura blanket insulate form the combustion chamber.

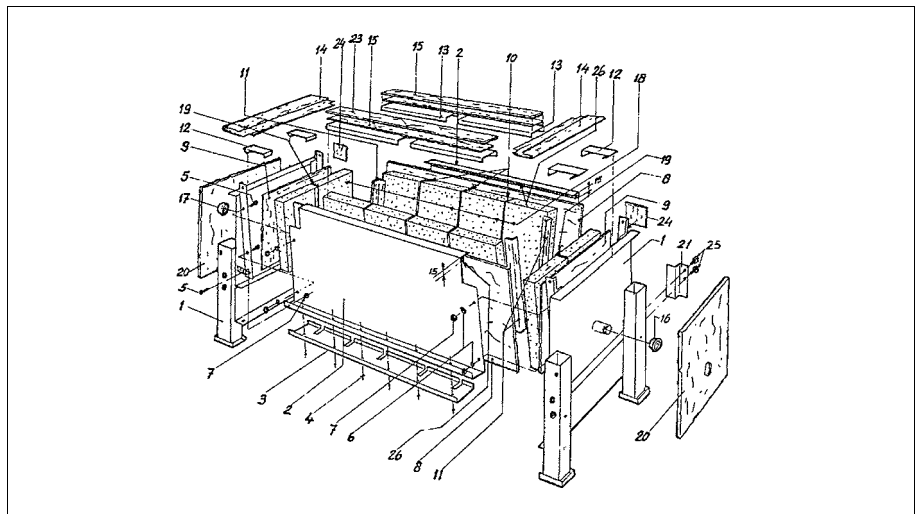


Fig. 5 Combustion chamber

Heat exchanger

The heat exchanger (type 2-pass) is mounted on the chassis. To ensure proper heat transfer of the combustion gases, the copper fin tubes are arranged side by side and expanded laterally into a mounting plate. The baffles on the copper fin tubes optimize the efficiency of the heat exchanger. The supply and return pipes together with the water manifolds form the heat exchanger.

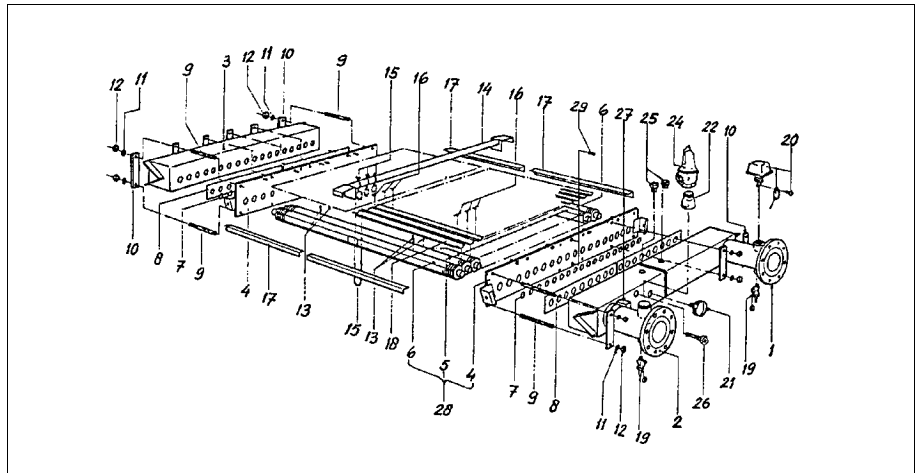


Fig. 6 Heat exchanger

Burner

The burner is mounted under the combustion chamber in the chassis. The burner bars, mounted in the burner trolley are manufactured from stainless steel. Each burner bar is supplied by its own injector nozzle mounted on the gas manifold.

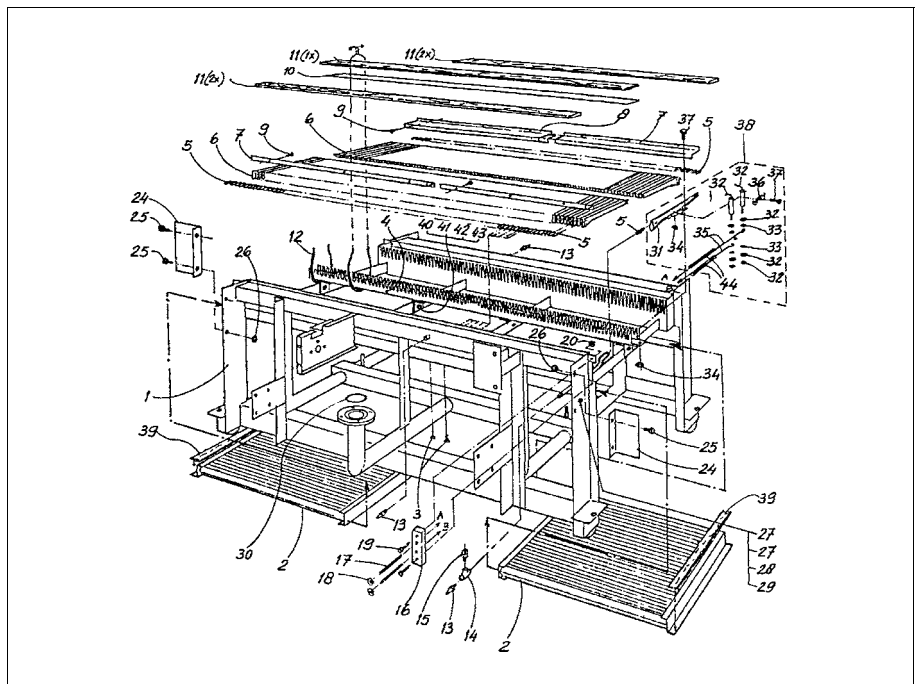


Fig. 7 Burner

Combustion air damper

A combustion air damper is situated underneath the burners.

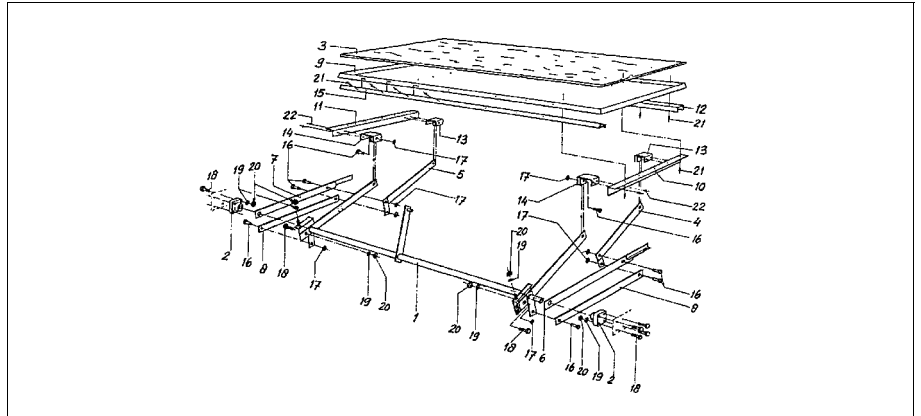


Fig. 8 Combustion air damper

Gas train

The principal components of the gas train are main governor and two main gas valves or combined main governor and main gas valve. The quantity of gas is adjusted in proportion of the quantity of air being supplied by the air damper opening. The pilot flame has a separate pilot line with pilot governor and gas valve.

2.3 Principle of regulation

The flow temperature can be constant or weather compensated. Several boilers can be connected by using cascade switching. With the EM Control option you can reduce electricity consumption, both boiler and boiler primary pump can be switched off by the cascade control box.

2.3.1 EM Control

Electronic Modulating version

This type of boiler control regulation (indicated by the EM control option) uses a built-in PID regulator to maintain a constant flow temperature to within a minimum temperature deviation of +1 to -1 K.

This system allows the user to fine-tune the reaction of the boiler to the heating system or application process. An added bonus with this “EM” control system is that it allows a Building Management system to influence the flow temperature using a 0 - 10 VDC control signal.

Boiler temperature controller RWF40

A Process value (actual temperature)

B Set point (temperature)

C Burner enable (not applicable)

D Mod. indicator (decrease fire rate)

E Mod. indicator (increase fire rate)

F Two-stage firing (not applicable)

G Limit comparator

H Manual operation

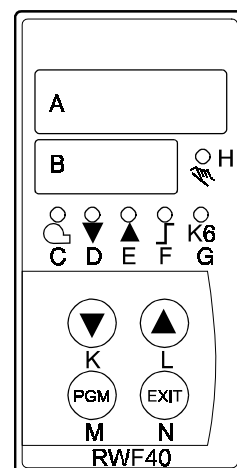
The keys K-L-M-N are used for displaying values and changing parameters in the temperature controllers configuration.

K Down key (reduce value)

L Up key (increase value)

M Programme key

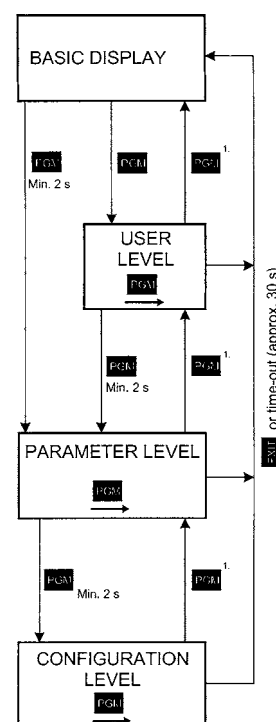
N Exit key



Assignment of levels

All levels can be accessed from the basic display via the **PGM** button, as shown in the diagram. The upper actual value display (red) indicates the actual value and the parameter values for the various levels. The setpoint and the parameters are indicated in the lower setpoint display (green).

1. After using *PGM+ to step through all the parameters of a level, an automatic return occurs after the last parameter has been confirmed.



2.3.2 EW Control option

Electronic Modulating version with outside temperature compensation and night-time temperature reduction

This system (indicated by the EW control option) uses the above mentioned PID regulator to regulate the boiler. The “EW” control system maintains the advantages of the “EM” type boiler and adds to it the possibility of automatically changing the flow temperature according to the outside temperature and the required heating curve. The unit’s built-in week-clock also means that a night-time and weekend temperature reduction is possible with a “EW” control system.

Weather-dependent setpoint shift

The RWF40 can be configured in such a way that, if a Ni1000 outside sensor (e.g. QAC22) is connected, a weather-dependent setpoint shift is implemented.

The minimum and maximum setpoint values can be set by the lower setpoint limit ***SPL+** and the upper setpoint limit ***SPH+**. Parameter ***P+** can be used to apply a parallel displacement to the heating curve.

- ☞ Each RWF40 must have its own separate outside sensor connected (no parallel connection)!

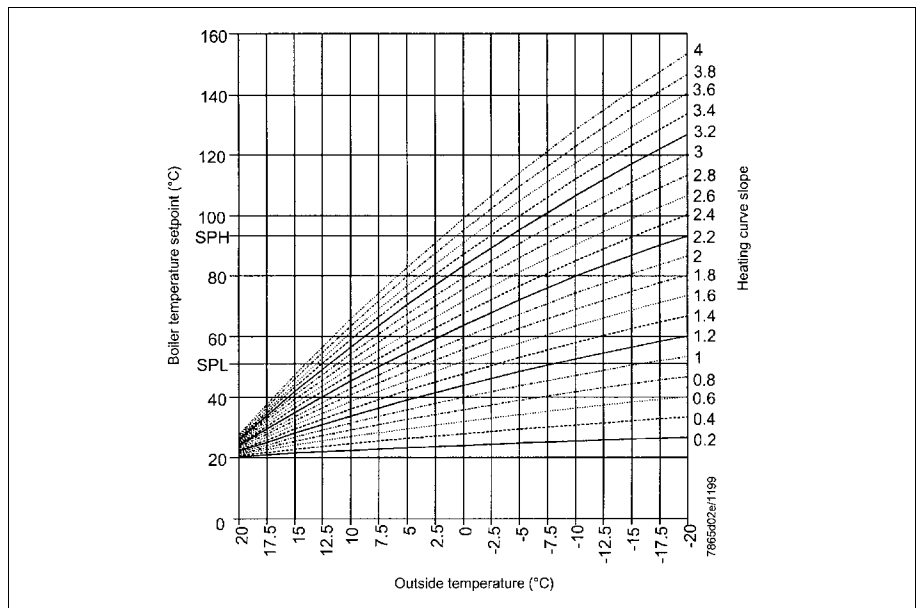


Fig. 9 Parallel displacement of the heating curve

Heating curve slope

Slope ***H+** of the heating curve can be used to adjust the setpoint in response to the outside temperature, as shown in the diagram. The common origin of the heating curves is set at (20 °C / 20 °C). The effective range of the weather-adjusted setpoint is restricted by the setpoint limits ***SPH+** and ***SPL+**.

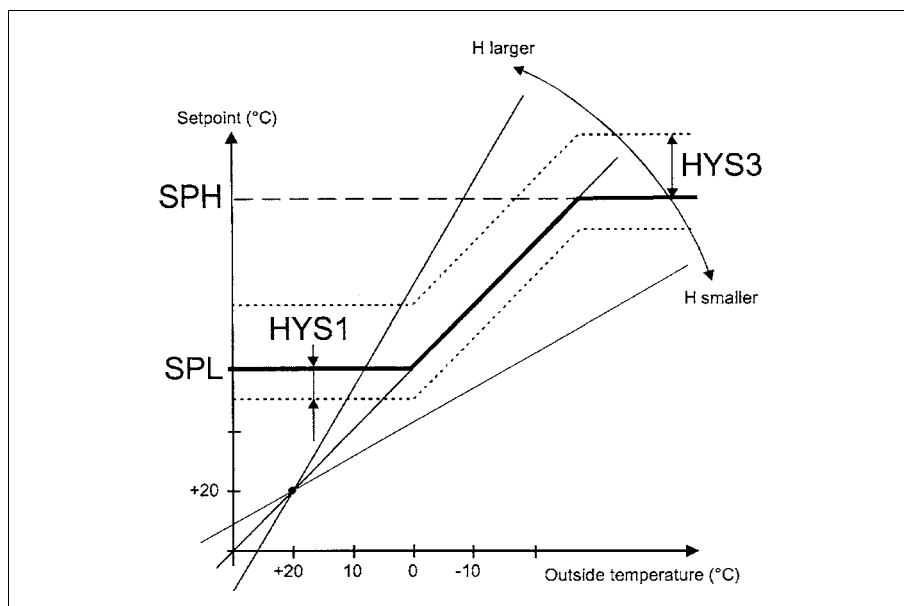


Fig. 10 Heating curve slope

***HYS1+** is the switch-on point for the burner, and ***HYS3+** is the switch-off point. As already described, they act with the set shift relative to the weather-controlled setpoint.

Process data

Parameter	Display	Value range	Factory setting
Setpoint 1 ₁	SP1	SPL-SPH	0
Setpoint 2 (option) ₁	SP2	SPL-SPH	0
Digital setpoint shift (option) ₁	dSP	SPL-SPH	0
Outside temperature (option) ₁	tA	*C111 Inputs+	-
Predefinition of external setpoint ₁	SP.E	SPL-SPH	-

Parameter level

Parameter	Display	Value range	Factory setting
Limit value of limit comparator ₁	AL	-1999...+9999 digit	0
Switching differential for limit comparator ₁	HYS t	0...999,9 digit	1
Proportional band ₁	Pb.1	0,1...999,9 digit	10
Derivative time	dt	0...9999 s	40
Integral action time	rt	0...9999 s	10
Contact spacing ₁	db	0,0...999,9 digit	1
Actuator running time	tt	10...3000 s	15 s
Switch-on threshold burner/stage II ₁	H Y S 1	0,0...-199,9 digit	-5
Switch-off level stage II ₁	H Y S 2	0,0... HYS3 digit	3
Upper switch-off threshold ₁	H Y S 3	0,0...999,9 digit	5
Response threshold	q	0,0...999,9	0
Heating curve slope	H	0,0...4,0	2
Parallel displacement ₁	P	-90...+90	0

2.4 Boiler protection

Configuration level

Parameter	Display	Factory setting
Analog input 1, 2 and 3; setpoint changeover / shift	C111	9930
Limit comparator; controller type; setpoint 1; locking	C112	5010
Unit address; decimal place / unit signal for out-of-range	C113	0
Measurement range start analog input 1 ₁	SCL	0
Measurement range analog input 1 ₁	SCH	100
Measurement range analog input 2 ₁	SCL2	0
Measurement range analog input 2 ₁	SCH2	100
Lower setpoint limit ₁	SPL	30
Upper setpoint limit ₁	SPH	95
Actual value correction, analog input 1 ₁	OFF1	0
Actual value correction, analog input 2 ₁	OFF2	0
Actual value correction, analog input 3 ₁	OFF3	0
Filter time constant for digital filter, analog input 1	dF1	1

₁ These parameters are affected by the setting for the decimal place.

The R18 is protected by the following systems:

water flow switch

The water flow switch is installed in the flow manifold and monitors continuously the water flow. As soon as the water flow stops, the burner is shut down and goes to lock-out. The water flow switch is factory set and should only be adjusted authorized personnel.

high limit thermostat

In the event of failure of the control thermostat, a preset high limit thermostat will shut down the burner and go to lock-out.

pressure relief valve

The maximum operating pressure of the R18 boiler is 11 bar. The standard safety valve supplied is **set to 3 bar**. If a different pressure setting is required this should be specified and will be set at the factory.

gas burner control

The burner control unit provide control and supervision of the atmospheric burner. The sequence controller is coupled to the spindle of the control circuit and to the flame supervision unit displaying the status, the symbol appearing above the reading mark indicates the firing sequence or lock-out condition. The pilot flame is supervised by ionisation current detection.

SAFETY

Installation requirements

Please read these requirements before commencing installation.

The product has to be installed by a recognized installer fully according to the current national and local demands, norms and standards.

The installation procedure should only be used for heating systems with a maximum water temperature of 95 °C.

We emphasize that you should always give priority to the above mentioned standards and regulations and that the installation regulations should be considered as an addition to these standards and regulations.

Explanation of the icons used in this manual



Instruction of extreme importance in order to guarantee proper functioning of the boiler.



Not following the operation procedures can cause serious damage to the boiler, personal injuries or environmental pollution.



Electric shock hazard.



Useful information.

Maintenance

Work on the electrical installation should only be carried out by approved technicians and in accordance with the electro technician regulations.

Work on the gas and hydraulic systems should only be carried out by approved technicians and in accordance with the safety regulations for gas installations.



Keep unauthorized people away from the installation. Do not place any objects on the boiler. Keep away from the hot water connections in order to prevent burns.

Always disconnect the boiler from the electric mains and close the gas service cock in the gas supply pipe before commencing maintenance and servicing operations.

Check the system for leaks afterwards.



In addition to the information in this documentation, always follow the standard safety regulations to prevent accidents. Cover panels should only be removed for maintenance and servicing tasks. Replace all panels after completing these maintenance and servicing tasks.



Safety precautions

The installation should never be switched on with panels removed or when boiler protection devices are not operational.



Instruction and warning stickers

Never remove or cover any of the instruction and warning stickers. They should always be legible throughout the life span of the boiler.

Immediately replace any damaged or illegible stickers.

Modification

Modification of the installation should only be carried out after obtaining prior written permission from the manufacturer.

Danger of explosion

Follow the health and safety regulations for working in hazardous areas when working in the boiler room.

Installation

The boiler should be installed by a recognized installer in accordance with current regulations and the regulations of the local electric companies (see supplement).

Make sure that you follow all safety instructions properly.

Operation

In case of gas leakage, switch off the boiler and close the gas service cock.

Open doors and windows, and notify the proper authorities.

Follow the instructions in the manual when you use the boiler again.

Technical specifications

Do not exceed the specifications as laid down in the installation and maintenance instructions.

4 DELIVERY AND TRANSPORT

4.1 Delivery Before delivery, the R18 boiler is fully assembled and tested in the factory. The R18 is protected by a wooden band and covered in a "heat-shrink" protective wrapper.

Check for damage after removing the boiler's protective covering.

Check whether the boiler conforms to the order requirements.

Check whether the circuit diagram and gas-train diagram number is in accordance with the offer, order confirmation and the data on the boiler's data number plate.

4.2 Unit protective packaging For transportation the R18 boiler is protected by a wooden band and covered in a "heat-shrink" protective covering. The panel-work is also covered in a protective polyethylene layer. Before final installation in the boiler room the boiler must be removed from the pallet and all protective coverings removed. The protective coverings should be disposed of in an environmentally friendly way. Contact your local authority.

4.3 Transport Refer to the technical specifications on weight and dimensions when transporting the boiler.



WARNING:



- Incorrect moving or lifting of the boiler may cause damage
- Remove the protective covering after transport and installation in the boiler room.

Pallet cart and/or forklift truck

When moving the boiler with a pallet cart or forklift truck, the forks should be placed at a back of the boiler.

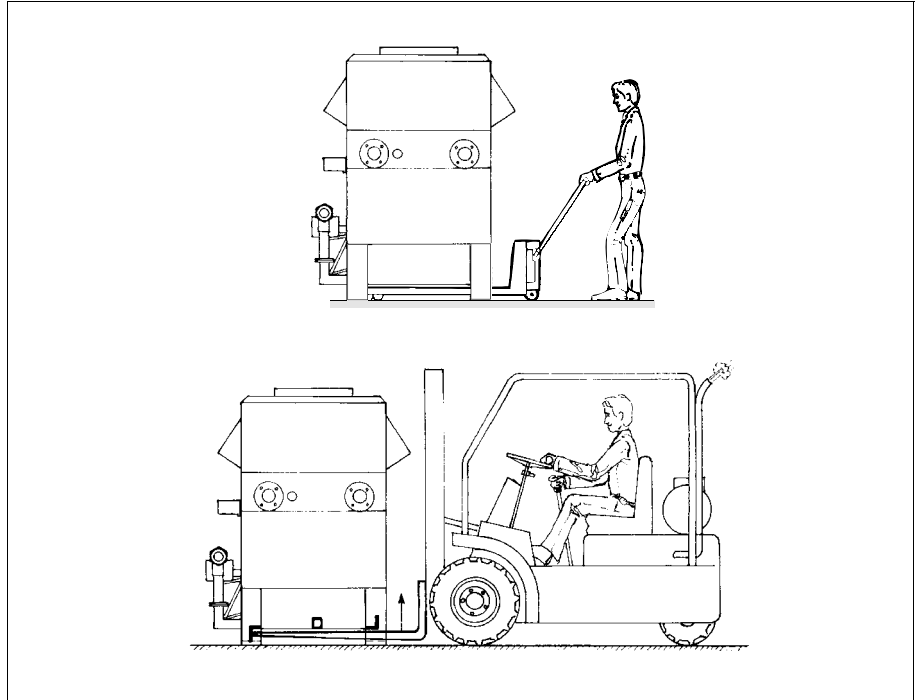


Fig. 11 Moving

Using a crane



- Never swing the load over bystanders.
- Always use special lifting harnesses which should be placed on the boiler
- Make sure that during lifting the harness does not damage the draught diverter.

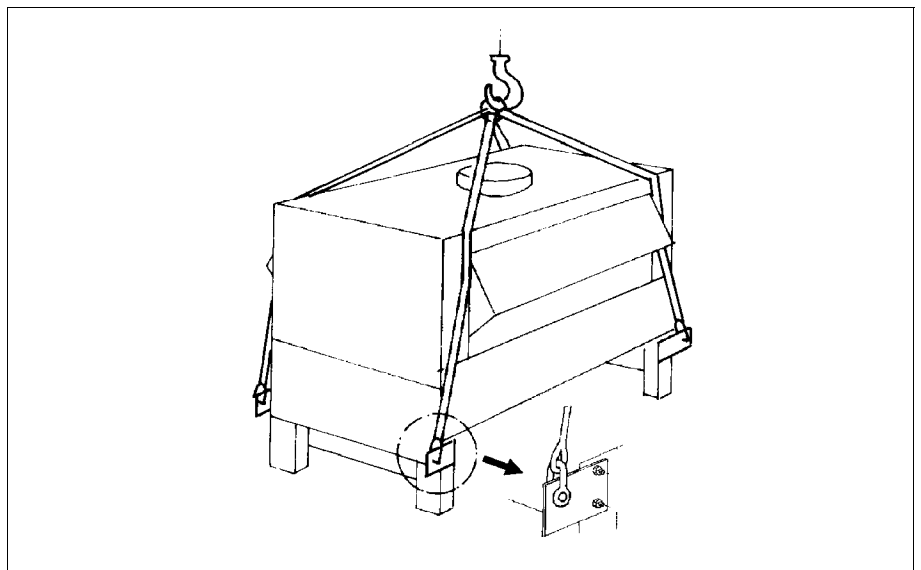


Fig. 12 Lifting

5 INSTALLATION

5.1 Boiler room Installation of the R18 should only be carried out by a recognized installer in accordance with the current national and local demands, norms and standards (see supplement).

5.1.1 Siting Install the boiler as close to the chimney as possible. A plinth base is not required.



To maintain ease of access and therefore ease of maintenance refer to clearances in figure 1.

If these dimensions are not met, maintenance operations could be seriously inhibited.

5.1.2 Boiler room ventilation The product has to be installed by a recognized installer fully according to the current national and local demands, norms and standards.

5.2 Unit connections

5.2.1 Gas supply The product has to be installed by a recognized installer fully according to the current national and local demands, norms and standards (see supplement).

Gas connection can be found at the side of the boiler.



We recommend the use of a gas filter.

The main gas service cock and gas filter should be supplied by a qualified heating engineer. Install the main gas service cock and the gas filter as close to the boiler as possible.

The R18 series of boilers are suitable for connection to a 25 mbar gas network.

The minimum supply pressure **must never fall below 18 mbar**. With a lower gas pressure it is possible that the boiler will not run at 100% capacity. At the same time the boiler can be more prone to failures.

Adjust the burner pressure with a supply pressure of 20 mbar before the boiler.

5.2.2 Electrical supply The product has to be installed by a recognized installer fully according to the current national and local demands, norms and standards.

The boiler is wired according to the circuit diagram which is supplied with the boiler. The boiler must be protected by a 6 amp fuse.



The boiler must have electrical supply voltage of 230 VAC. Do not cross connect 'live' and 'neutral'! 'Live' is connected to the terminal marked with "L" (brown), and 'neutral' is connected to the terminal marked with "N" (blue). 'Earth' is connected to the terminal "⊥" (yellow/green).

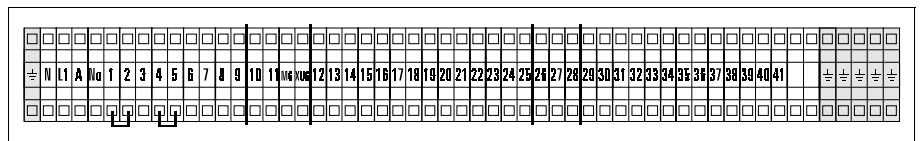


Fig. 13 Electrical terminal block

External control

It is possible to externally control the unit. The following terminals on the terminal block have the following functions:

- 1 common
- 1 - 2* up signal
- 1 - 3 down signal
- 4 - 5* enable
- 6 - No cascade signal (240 V)
- M6 - XU6 0 - 10 VDC control signal to shift set point
- 32 - No external main gas valve
- A - No alarm signal (240 V)

For more information on the RWF40 see par. 2.3.2

* remove jumper.

Pump switching



The boiler's circulation pump must be in operation before the boiler is switched on. When the boiler is switched off, the circulation pump should continue to run for several minutes in order to reduce the amount of heat present in the boiler. If the pump is switched off too soon, the water temperature can rise above the maximum water temperature, as a result of which the maximum thermostat will cause the boiler to fall into "Lock-out".

5.2.3 Hydraulic connections The product has to be installed by a recognized installer fully according to the current national and local demands, norms and standards.

As standard all boiler types are fitted with a boiler **pressure relief valve, set to 3 bar.**

If requested the manufacturer can also install relief valves which are set to between 3 and 6 bar.

The water connections are found as standard on the right-hand side of the boiler, a left-handed version is optional.

Fill and drain cocks are standard.



It is necessary to support the unit's flow and return pipes. To ensure easy disassembly and reassembly, a removable spacer-pipe should be mounted to the unit's flow and return pipes as shown in fig. 14.

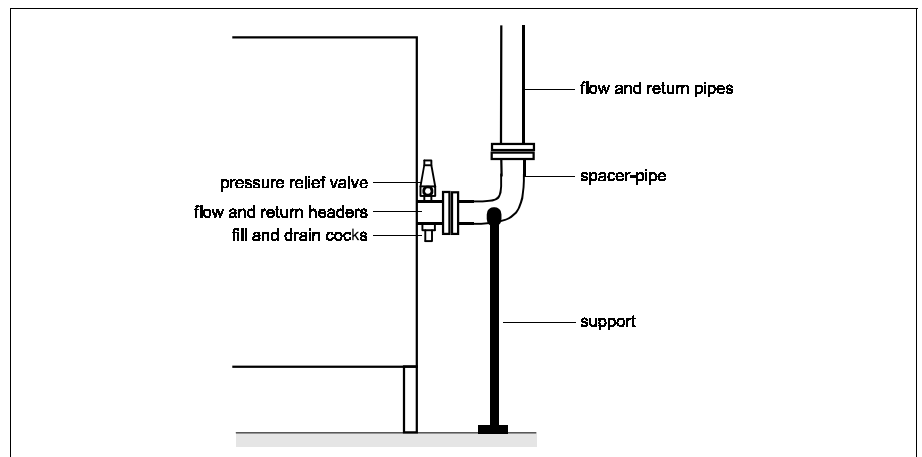


Fig. 14 Support flow and return pipes

5.2.4 Boiler room ventilation

The product has to be installed by a recognized installer fully according to the current national and local demands, norms and standards.

Ventilation openings should be placed so that the boiler room is equally ventilated. More inlet openings in roof top boiler rooms should be used and situated at regular distances. By internally or externally casing the inlet openings the negative influence of wind on the boiler room can be minimised (see fig. 17).

In general, approximately half of the heat transmission in a boiler room is used to heat the room itself and the other half is lost through the draught diverter to the outside. To prevent air stratification, and therefore greater losses, the high level outlets should be situated as high as possible.

Incorrect or poorly sited boiler room ventilation can lead to high temperatures in the boiler room, poor combustion and early failure of control and regulation equipment caused by the higher ambient temperatures.

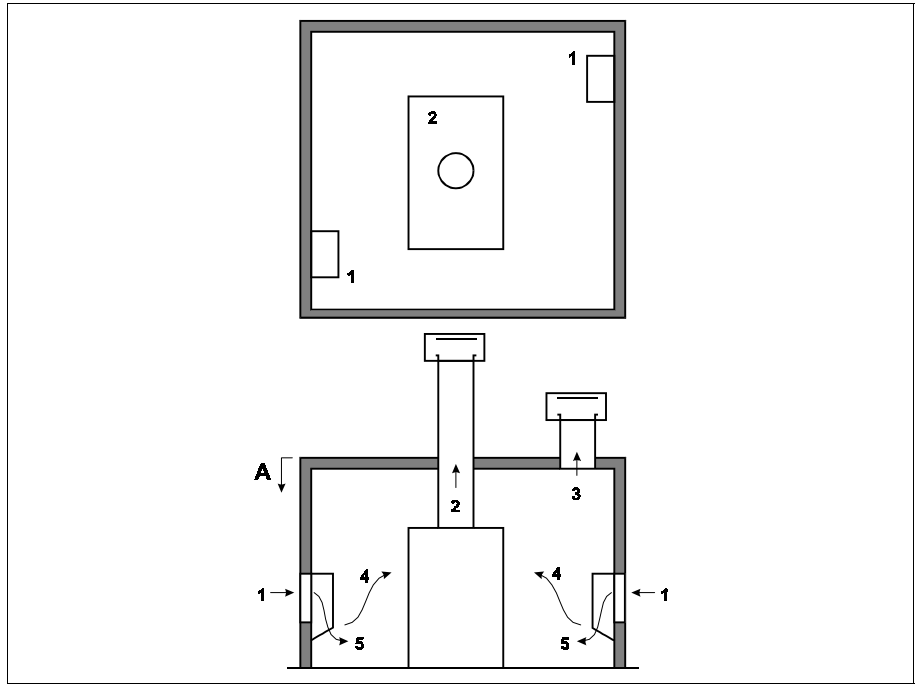


Fig. 15 Ventilation and flue placements

5.2.5

Air supply and ventilation

Natural ventilation

Where natural ventilation is required, permanent openings at low and high level, communicating directly with the outside air, shall be provided.

The openings shall be sited so that they cannot be easily blocked or flooded. The grilles shall have a total minimum free area as follows, taking account of all fuel burning appliances.

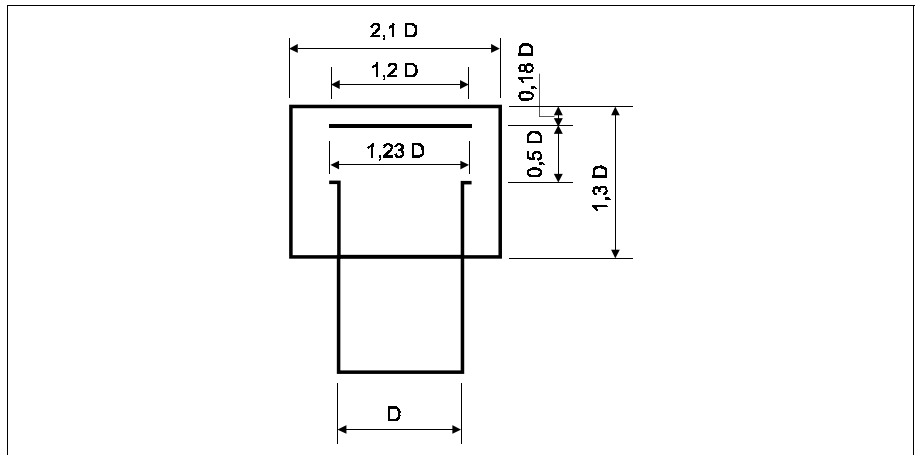


Fig. 16 Extraction cap

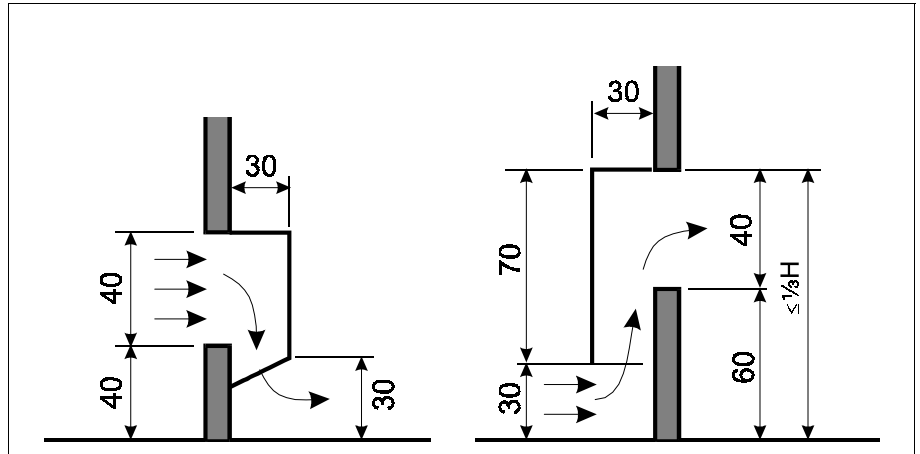


Fig. 17 Air inlet openings

Low level inlet

540 sq. cm plus 4,5 cm² per kilowatt in excess of 60 kW total rated input.

High level outlet

270 sq. cm plus 2,25 cm² per kilowatt in excess of 60 kW total rated input.

Mechanical ventilation

The supply of air by mechanical means shall be by mechanical inlet with natural or mechanical extractions, mechanical extract with natural inlet must not be used.



The minimum flow rates with mechanical ventilation are as follows:

Inlet air (combustion ventilation) - 1,1 m³ per second per 1000 kW total rated heat input.

Extract air (ventilation) - 0,45 m³ per second per 1000 kW total rated heat input.

Further details regarding air supply are given in BS 6644.

5.2.5

Flues

Flue dimensions

The boiler has its own integral draught diverter and does not require any other draught diverter in the flue.

The flue socket at the top of the boiler is sized for the direct attachment of single wall metal flue pipe.

Optional adapters can be obtained for twin wall metal pipe and BS 835 type flue pipe.

It is recommended that the boiler be connected to its own individual open flue systems, although some open flue systems can be used for multiple installations of the same type of boiler.

This section should be used for guidance only. A flue specialist should be contacted to check a flue design.

You can use the following information to assist in flueing:

Type	Q flue m ³ /h	Chimney diameter mm
132	1770	450
154	2062	500
180	2421	550
210	2811	600
244	3270	650
280	3751	700

Table 2 Flue gas volumes

Heat input:	100 %
Flow temperature:	90 °C
Return temperature	70 °C
Flue gas temperature:	130 °C
CO ₂	5,5 %

Flue condensation

Flue gases transfer heat when they pass through the chimney. If the flue gas temperature falls below dew-point, condensation will occur in the flue. Under normal conditions condensation will not occur. To prevent condensation the flue should be insulated. More atmospheric boilers can be connected to a single flue.

Fan diluted flue system

A fan diluted flue system can be used with this type of boiler. The principle is to mix the products of combustion with fresh air drawn from the outside atmosphere to reduce the CO₂ value below 1 % and so permit the flue discharge to be located at low level. Duct diameters are selected to give a duct exit velocity less than 8 m/sec.



5.3

Water quality



The composition and quality of the system water has a direct influence on the performance of the whole system and the life of the appliance. Unsuitable addition and use of chemicals, water softeners, oxygen binders, de-aerators, aerators, and water filters all increase the possibility of faults.

Corrosive elements in certain additives can attack the system, resulting in leakage; deposits of undesirable sediments can lead to damage to the boiler heat exchanger.

For water hardness, a distinction must be made between:

a Temporary hardness

This is also referred to as carbonate hardness. Deposits are formed at higher temperatures and are easy to remove.

b Permanent hardness

Minerals (for example, calcium sulphate) dissolved in the water can be deposited as a function of very high surface temperatures.

In the United Kingdom, water hardness is expressed in mg/litre (ppm) and is given the following divisions:

Very soft	less than	50	ppm
Soft	approx.	50 - 160	ppm
Moderately hard	approx.	160 - 250	ppm
Hard and very hard	over	250	ppm.



The system must contain soft to moderately hard water with a water hardness not exceeding 250 ppm with a supply temperature of 80 °C and $\Delta T = 20$ K.

During the construction of larger installations, one of the appliances may be operational. New circuits may be regularly switched in, which must occur together with the addition of fresh water. In addition, it can happen that, because of leakage, some circuits must be disconnected, repaired and re-filled. In these circumstances the only appliance in operation often functions at full capacity and the chance of boiler scale formation is present. For this reason the make-up water must be softened. To ensure proper functioning of the appliance and the system, the use of water softeners is recommended.

Large stationary bubbles with widely different compositions can form at “dead points” in the system (in addition to oxygen and nitrogen, hydrogen and methane have also been detected). Oxygen promotes corrosion. Corrosion products, together with other pollutants, form a sludge deposit (magnetite) which causes pitting under the influence of oxygen.

The use of an air separator with an automatic de-aerator is strongly recommended. This should preferably be fitted in a horizontal section of the return pipe to the pump. If a vertical distributor is employed, the air separator should be fitted above the distributor.

To reduce the effects of unnecessary wear and blockages resulting from any pollution present we advise the use of a filter system with a mesh opening of 100 microns. Always fit this in the return pipe of the secondary part of the system.

In order to guarantee a well functioning system and a long life, any suspended and corrosion producing particles must be removed with the aid of a well chosen and fitted filter system. The analysis of system water and the cleaning of filters must form part of the periodic inspection procedure.

If there is an intention to add chemicals (such as inhibitors) to the water, contact must be made with your supplier.



There is a relationship between the maximum water flow temperature, the system pressure and the water volume which flows through the boiler per unit time at a specified boiler load. In case of high water flow temperature, low water velocity in the heat exchanger and low pressure, steam forming may occur. Figure 19 shows the relationship between water volume and differential pressure over the heat exchanger.

5.4 Hydraulic system **System pressure**

By system pressure we mean the water pressure measured at the heat exchanger in cold condition. With a correctly sized expansion system the system pressure will not change much under variable temperature conditions.

5.4.1 Flow and resistance

The next figure shows an example of a hydraulic system. System pressure is calculated using the following formula:

$$p = p_{\text{exp.}} + H - Rk$$

p = water flow temperature

$p_{\text{exp.}}$ = pressure expansion vessel

H = pump head

Rk = pressure loss boiler.

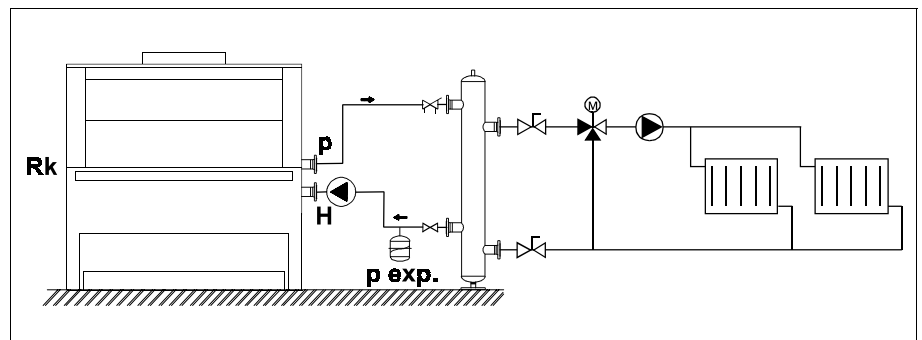


Fig. 18 Example of a hydraulic system

Minimum and maximum water volume per hour

A too low flow rate through the copper fin tubes can lead to cavitation. Also a too high flow rate can cause erosion. To protect the heat exchanger from these two extremes, the flow rate (Q) should be set using the table below.

Type	Water flow rate versus pressure drop					
	minimum flow rate		nominal flow rate		maximum flow rate	
	Q m ³ /h	pressure drop mbar	Q m ³ /h	pressure drop mbar	Q m ³ /h	pressure drop mbar
132	20	76	34	176	48	380
154	24	112	36	230	48	400
180	26	130	37	270	48	425
210	28	160	38	290	48	450
244	32	220	40	340	48	475
280	36	290	42	390	48	500

Table 4 Water flow rate versus pressure drop

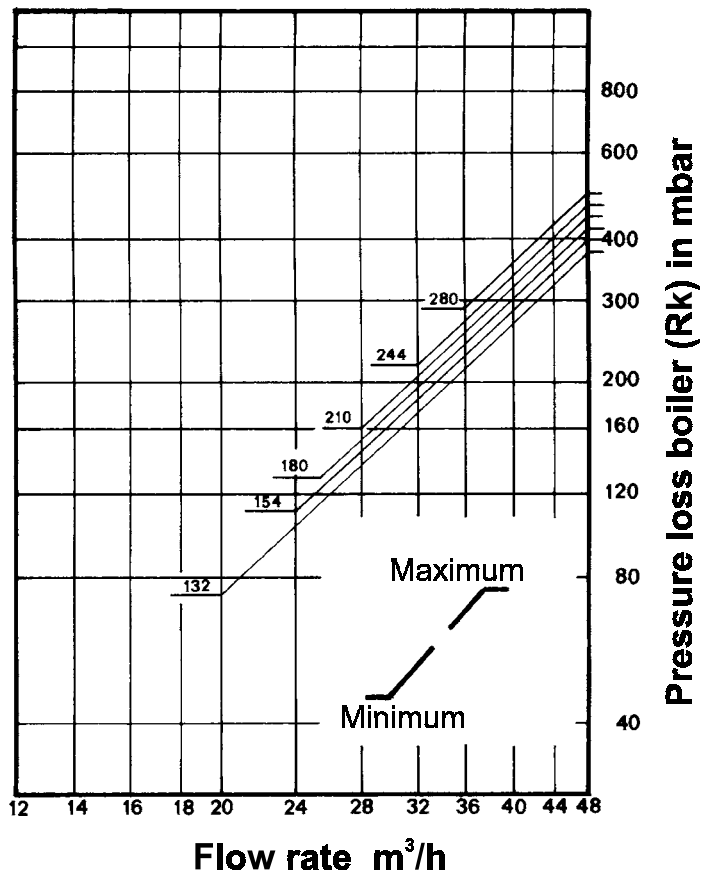


Fig. 19 Water volume

Positioning the pump and expansion vessel

We advise that the pump should be mounted in the return pipe in the following order: expansion vessel, pump, boiler. If you mount the pump in the flow pipe, the lifespan of the pump will be reduced.



Always connect the expansion vessel to the suction side of the boiler pump.

If the boiler is installed on the roof, you should take into account the maximum permitted pressure in radiators on the ground floor and that the flow and return connections are taken upwards from the boiler before descending to ensure the heat exchanger is filled with water.

Pump switching

It is necessary to electrically switch the boiler in such a manner that it will never operate before the installation and boiler pump is running. It is essential that an overrun switch is used to allow the pump to operate for at least 5 minutes after the boiler has turned off.

The effect of flow velocity of the installation on boiler water temperature



ALWAYS MOUNT SECONDARY MOTORIZED OR MIXING VALVES IN THE SECONDARY WATER CIRCUIT WITH AN OPENING TIME OF AT LEAST 120 SECONDS!

Fast acting mixing valves in the secondary water circuit may give the boiler regulator insufficient time to make proper corrections.

This may lead to an unacceptable high temperature, as a result of which the maximum thermostat may lock-out the boiler.



Such a problem may also occur if all flow governors close simultaneously. The flow governors should therefore close one after the other.

The sudden disconnection of an important warm air heating unit may cause the same problem.

If a large fan can be switched off immediately, you should consider switching off the boilers first (temporarily if necessary), and subsequently the fan using a time relay.

When the flow governors are opened for night time temperature reduction for example, it is essential that **the return water temperature of the heat exchanger does not fall below 40 °C** (as condensation may occur).

If an installation is to be optimized, the primary water circuit consisting of boilers, boiler pumps and open header should be started before the system is switched on.

Open the groups subsequently one after the other by using a return water temperature regulator for example, adjusted to 40 °C. Switch on the secondary pumps one after the other.



The primary circuit must have a low water volume. This enables faster heating and reduces the condensing time of the boiler. The recommended maximum volume of water in a primary circuit is 200 litres per a 100 kW of boiler capacity. When the installation is switched off, the boilers must be switched off first. After approximately 5 minutes the boiler pumps and the heating groups can be switched off.

5.4.2

Examples hydraulic system

The hydraulic systems shown are only examples. They must not be employed in practice without professional analysis.

Low velocity header

The low velocity header must be dimensioned such that at full capacity the pressure difference between the supply to the flow and the return collector does not exceed 50 mmwg (approximately 0.5 m/s). The diameter of the low velocity header can be determined using the formula:

$$\varnothing = \sqrt{\frac{\frac{Q}{3600} \times 1,28}{v}}$$

Where: \varnothing = the diameter of the low velocity header in m
 Q = the water flow rate in m³/h of the boiler circuit or the secondary circuit, whichever is the greater
 v = the speed in m/s.

Example of a low velocity header with isolating valves and an expansion tank.

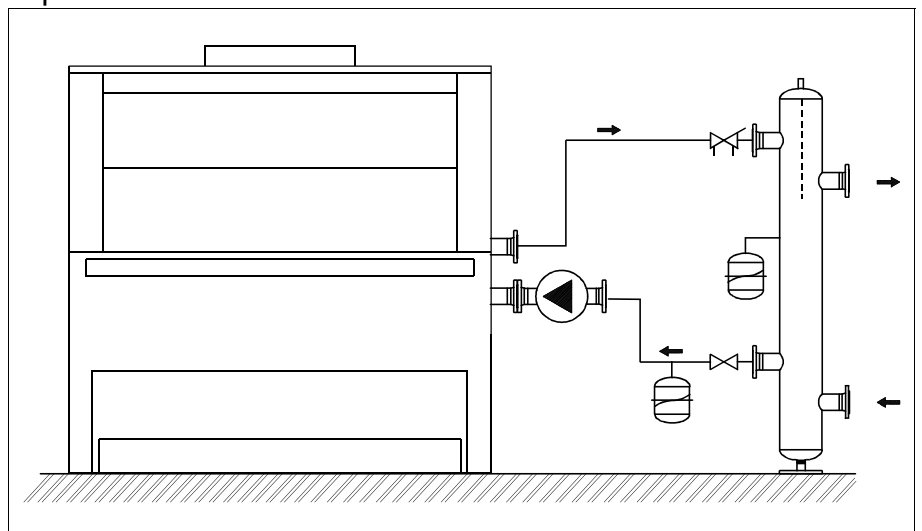


Fig. 20 Installation with a low velocity header, isolating valves and expansion tank

Mounting the low velocity header vertically has additional advantages: the upper section functions as an air separator and the lower section serves as a drain.

When air heaters (for ventilation or air treatment) are included in the system it is generally desirable to have a small ΔT over the air heaters. Because of this, the water flow rate through the whole secondary circuit is usually greater than that through the boilers.



The low velocity header must be so sized that the water speed does not exceed 0.5 m/s. In this case the diameter of the low velocity header must be calculated on the basis of the water flow through the secondary circuit. Because the flow rate of the water flow in the secondary system is greater than that in the primary circuit (boiler), there will be a water circulation in the opposite direction to that of the primary circulation through the low velocity header. A mixed temperature will then exist which is lower than the supply temperature from the boiler. The regulation system will react to this and will open the regulator functions (valves, etc.) in the system. Generally, the temperature of the water supply from the boiler(s) will need to be corrected to obtain the desired temperature in the connected circuits.

Systems with a separate flow header and a return header

Flow headers in combination with return headers are often used in renovation projects. Several circuits operate with mixing valves or diverting valves. In both cases a low velocity header or a bypass is necessary.

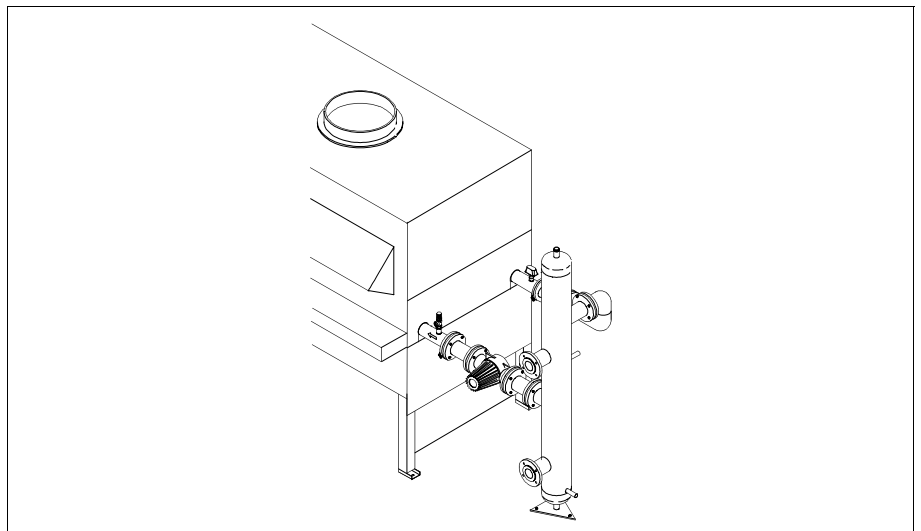


Fig. 21 Boiler with vertically mounted low velocity header arranged with right hand connections

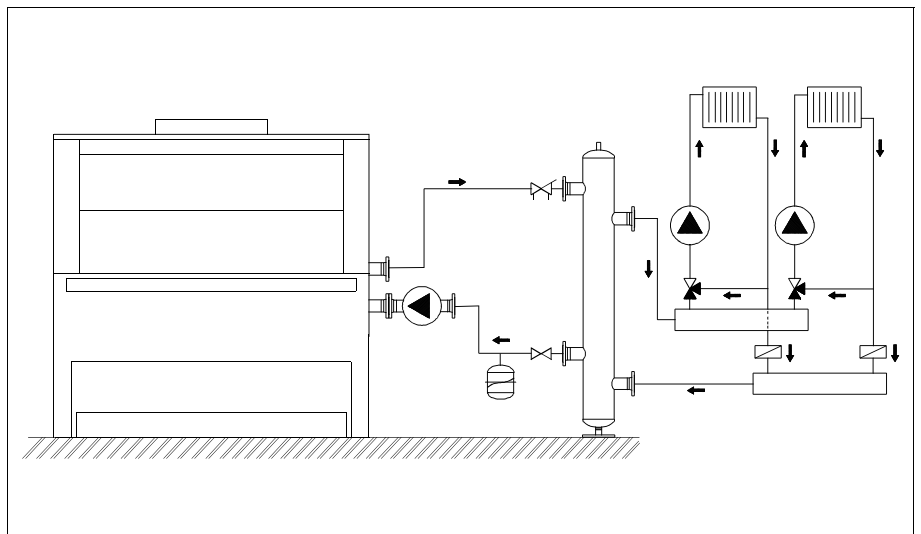


Fig. 22 Low velocity header with multiple heating circuits in a mixing control arrangement without a main pump

Open vent and cold feed

An open vent pipe must be fitted in open systems not more than one meter along the flow pipe and must rise continuously by the shortest route to the venting point without valving and with frost protection where necessary.

Vent pipes and cold feed pipes should be sized as follows.

Rated output (kW)	Open vent	Cold feed
Below 60	25 mm (1")	19 mm (¾")
60 - 150	32 mm (1¼")	25 mm (1")
150 - 300	38 mm (1½")	32 mm (1¼")
300 - 600	50 mm (2")	38 mm (1½")
Above 600	63 mm (2½")	50 mm (2")

Table 5 Vent pipes and cold feed pipes size

See Technical data table for individual boiler outputs.

Sealed systems

Normal operating pressure with nominal flow rate.

Flow temperature °C	Minimum operating pressure bar
80	>1,5
90	>2

Table 6 minimum operating pressures

Standard pressure release setting 3 bar.

Installations with multiple appliances

For installations in which each appliance is fitted with a pump, the pump is switched off after the boiler has been shut down.

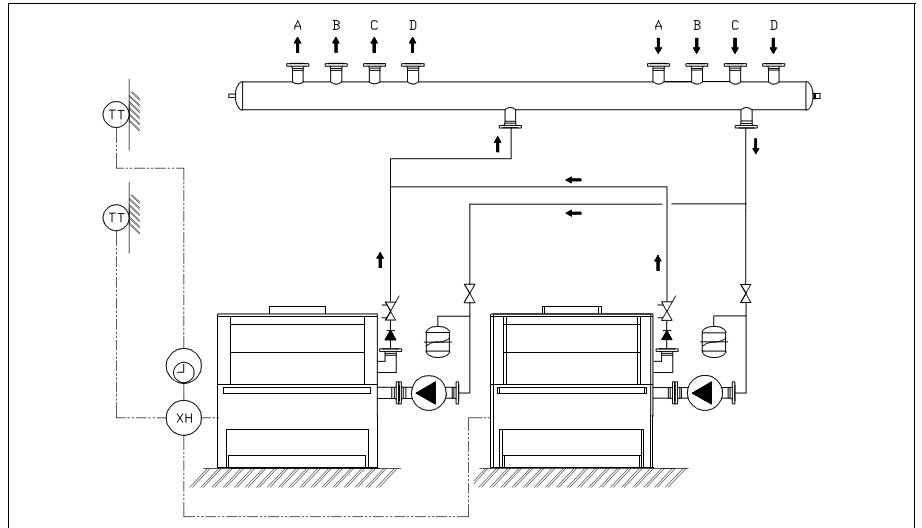


Fig. 23 Installation with multiple appliances

Hydraulic short-circuit

In order to avoid a short circuit over a non-operating appliance, we advise the use of non-return valves. These may be either mechanically or electrically operated valves.

Installations with multiple appliances without non-return valves

The total resistance of the system (boiler, isolating valves and pipework) will be much greater than the resistance of the low velocity header. The baffles "X" (see fig. 24) prevent undesirable circulation through the non-operating boiler.

When two appliances are switched in cascade, it is advisable to employ this system. When appliances are controlled by a building management system using weather compensation or a compensating unit, the common flow temperature sensor must be mounted at the common flow pipe as TT indicated in the drawing.

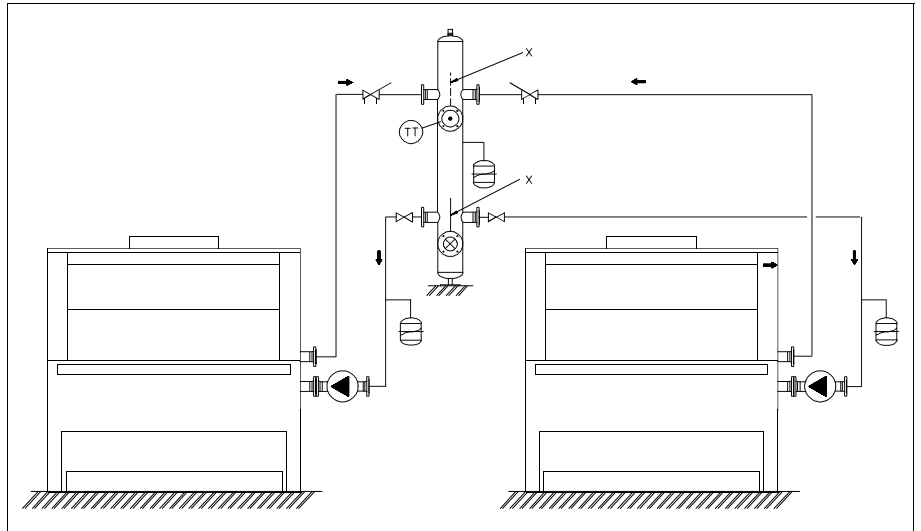


Fig. 24 Installation with more than one appliance, without non-return valves and making use of a low velocity header for two boilers

These hydraulic systems are examples only and should not be used without specialist advice.

6

COMMISSIONING

- 6.1 General** COMMISSIONING OF THE BOILER MUST BE CARRIED OUT BY PROPERLY QUALIFIED AND AUTHORISED PERSONNEL. OTHERWISE, THE GUARANTY WILL BECOME VOID.

Never deviate from the instructions in this manual.

Flushing the system

To prevent damage from rust, sealing compounds, sand, metal particles etc., the system must be flushed thoroughly, before the system is switched on. Also ensure that the heat exchanger is free of any such deposits after flushing the system.

Water heating system

- fill the system up to the standard set pressure
- bleeding the system
- switch on all pumps and check for correct direction of rotation
- close the stop-valves in the secondary groups.



Electrical connection

- check the boiler electrical connection
- switch on the boiler with the ON/OFF switch
- adjust the temperature regulator to the desired flow water temperature.

Gas connection

- open the gas service cocks
- bleed the gas pipe.
NB: Insure adequate ventilation during bleeding
- connect the measuring equipment to check:
 - * pre-pressure
 - * burner pressure
 - * boiler ionisation.

6.2 Pre-lighting checks and dry run

The following is a list of appliance checks to be carried out.

6.2.1 Check 1 ***With the boiler gas inlet service cock closed and electricity supply switched off***

- I) Ascertain from the gas supplier or the customer that the meter installation is operational.
- II) Ensure that the gas installation pipework up to and including the gas inlet service cock has been tested for gas soundness in accordance with IM/5 or BS 6891 as appropriate.
- III) Ensure that the gas installation pipework to the gas inlet service cock has been purged in accordance with IM/2 or BS 6891 as appropriate.
- IV) Check that all electrical supplies are isolated
- V) Check electrical earth continuity between the boiler gas pipework and the mains supply.
- VI) Check the electrical components are of the correct voltage range, particularly low voltage ancillary controls.
- VII) Check the pump motor current and adjust the starter overload settings.
- VIII) Fill and vent the water system and check for leaks.

6.2.2 Check 2 ***With the boiler gas inlet service cock closed, electrical supply switched on but on/off switch on boiler control panel switched off***

- I) Check that the direction of rotation of the pump(s) is correct.

Components within the connection tray (Remove cover from electrical connection tray)

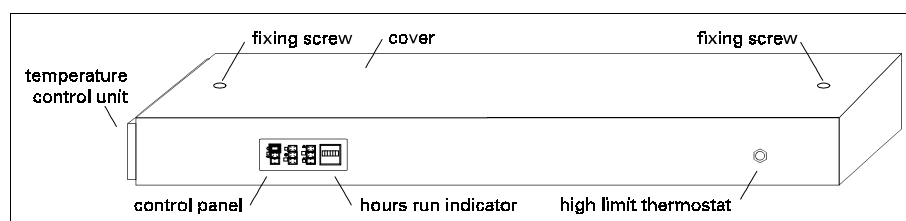


Fig. 25 Connection tray

- II) Check the setting of the modulating combustion air damper situated underneath the burners, there should be a gap of **8 mm with the damper in the fully closed** position against the stops.

Burner trolley assembly

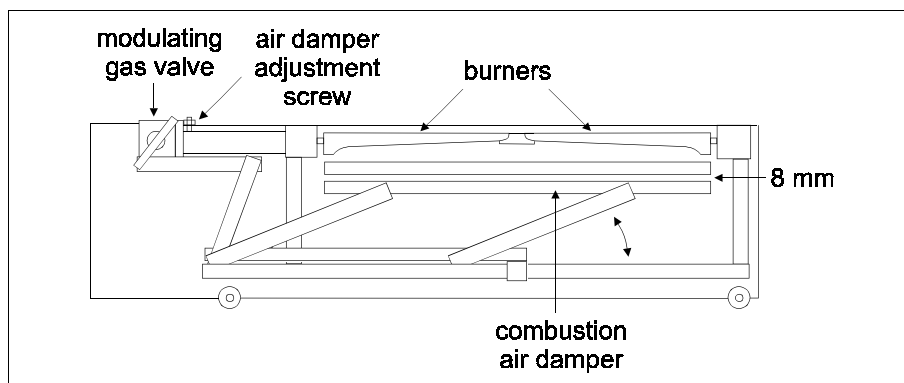


Fig. 26 Burner trolley assembly

- III) Check the operation and interlocking of any air inlet and extract fans.
- IV) Check the correct connection and operation of any external controls.
- V) With the control thermostat on a high setting turn on the on/off switch at the boiler control panel, check that the combustion air inlet damper cycles open and then closes, that there is a spark at the ignition electrode, that the pilot safety shut off valve is heard to be opening and that the boiler goes to lock-out in approximately 5 secs later as there is no gas.

6.2.3

Check 3

With the electricity supply switched off check the gas train downstream of the gas inlet service cock as follows:

Refer to Gas trains, fig. 34 for particular boiler model.

1. Ensure that gas service cock and pilot manual cock are closed.
2. Unseal and connect a pressure gauge to test point 10/1 and unseal test point 10/2.
3. Open and then close the gas service cock to pressurise up to the 1st safety shut off valve and the pilot manual cock.
4. Allow 1 min. for temperature stabilisation and then check for any loss of pressure during the next 2 minutes.
5. If there is a pressure loss the pipework up stream of the 1st safety shut off valve should be checked with a suitable leak detection fluid with the gas service cock open.
6. If no leak is found, this indicates that the 1st safety shut off valve is letting by and should be replaced.
7. With test points 10/1 and 10/2 unsealed connect them together with a short piece of flexible tubing which incorporates a tee connection to the pressure gauge.
8. Open and close the gas service cock to pressurise up to

-
- the 2nd safety shut off valve.
9. Allow 1 min. for temperature stabilisation and then check for any loss of pressure at the gauge during the next 2 minutes.
 10. If there is a pressure loss the pipework between the 1st and 2nd safety shut off valve should be checked with a suitable leak detection fluid with the gas service cock open.
 11. If no leak is found this indicates that the 2nd safety shut off valve is letting by and should be replaced.
 12. Seal test point 10/2, replace pressure gauge on unsealed test point 10/1 and open pilot manual cock.
 13. Open and close the gas service cock to pressurise up to the pilot safety shut off valve.
 14. Allow 1 minute for temperature stabilisation and then check for any loss of pressure at the gauge during the next 2 minutes.
 15. If there is a pressure loss the pipework upstream of the pilot safety shut off valve should be checked with a suitable leak detection fluid with the gas service cock open.
 16. If no leak is found this indicates that the pilot safety shut off valve is letting by and should be replaced.

Adjusting the burner pressure

The burner pressure must be adjusted when the boiler has been running for 20 minutes at high load (state of equilibrium).

Natural gas H (G20) Gas service pressure 20 mbar Nozzle diameter 1,85 mm				
minimum load (20 %)				
Type	Burner pressure	Pilot pressure	Air damper opening closed	Cascade out
	(mbar)	(mbar)	(mm)	(mbar)
132	0,8	3,5	8	1,6
154	0,8	3,5	8	1,6
180	0,8	3,5	8	1,6
210	0,8	3,5	8	1,6
244	0,8	3,5	8	1,6
280	0,8	3,5	8	1,6
full load (100 %)				
Type	Burner pressure	Pilot pressure	Air damper opening maximum open	Cascade in
	(mbar)	(mbar)	(mm)	(mbar)
132	10,5	3,5	125	8,2
154	10,4	3,5	125	8,2
180	10,2	3,5	125	8,2
210	10,0	3,5	125	8,2
244	9,9	3,5	125	8,2
280	9,8	3,5	125	8,2

Table 7a Burner pressure Natural gas

Liquid Propane Gas Gas service pressure 50 mbar Nozzle diameter 1 mm				
minimum load (20 %)				
Type	Burner pressure start/min.	Pilot pressure	Air damper opening closed	Cascade out
	(mbar)	(mbar)	(mm)	(mbar)
132	7	11	11	7,4
154	7	11	11	7,4
180	7	11	11	7,4
210	7	11	11	7,4
244	7	11	11	7,4
280	7	11	11	7,4
full load (100 %)				
Type	Burner pressure	Pilot pressure	Air damper opening maximum open	Cascade in
	(mbar)	(mbar)	(mm)	(mbar)
132	46	11	125	33
154	46	11	125	33
180	46	11	125	33
210	46	11	125	33
244	46	11	125	33
280	46	11	125	33

Table 7b Burner pressure Propane

6.3 Live run check

- a. Disconnect the electrical connections to the 1st and 2nd safety shut off valves by removing the plug from the front electrical tray.
Open the gas service cock and pilot manual cock and with the control thermostat on a high setting turn on the electrical supply and the on/off switch on the front control panel.
Check that the combustion air inlet damper cycles to the fully open position and back before ignition of the pilot burner commences.
Using the sight glass at the lower right hand side of the boiler check that the ignition electrode ignites the pilot burner and that the pilot burner is stable in operation.
Check that the boiler goes to lockout approximately 5 secs later and that the pilot burner is extinguished. (It may be necessary to purge the ignition system if there is air in the gas supply; although seven minutes must be allowed between each attempt to ensure that any gas has been dispersed from the combustion chamber).
Press reset button to override boiler lockout.



-
- b. Carry out step a) above and close the pilot manual cock once the pilot burner has ignited. Check that the boiler proceeds to lock-out.
 - c. Connect a pressure gauge to pressure test point 10/3 (see gas train fig. 34) and carry out step a) above. Check that pilot burner pressure is as indicated in table 8, with the pilot burner on test the pilot pipe and connections from the pilot manual cock to the burner connection or gas sound.
 - d. Connect a pressure gauge to the main burner manifold, test point 10/4 and re-connect the electrical connections from the main safety shut off valves into the front electrical tray.

Switch the on/off switch to on and the boiler will ignite in the sequence described in a) above with the main burners igniting from the pilot burner at minimum rate.

Check ignition of the main burners is smooth. Observe that the modulating air damper opens and the gas rate increases to maximum. Check the main burner pressure on maximum is as indicated in table 7 and adjust if necessary.

Check all pipework and connections downstream of the safety shut off valves for gas leaks with a suitable leak detection fluid.

Switch off the boiler, remove pressure gauge and reseal test point.

- e. Connect a μA -meter (0 - 50 μA) in series with the flame detection circuit. While measuring ionisation the main burner should stay switched off. To do this, disconnect the main gas valve by breaking the electrical connection by removing the plug. Connect the black wire (-) (1) of the μA -meter with the ionisation connector electrode (2) on the boiler (fig. 27). Connect the red wire (+) (3) of the μA -meter with the ionisation cap (4). The ionisation of the pilot burner must show a minimum of 5 μA over 10 seconds after which the burner falls into flame detection lockout. Wire the main gas valve back to its original condition. Repeat the test by starting the boiler and allowing to fire up to maximum operation. Check that the μA -meter reads at least 5 μA after 10 seconds.
- f. Switch on the boiler. Check for spillage of products of combustion from the draught diverter opening with a smoke detector or other suitable apparatus, ensuring that any openable windows, doors etc., fitted in the boiler space are shut and any extract fans are operating. Spillage checks should be done with the boiler cold and when the system has heated up, both on maximum and minimum rates.



- h. Re-check the main burner pressure at maximum and by modulating the damper down also check the main burner pressure at minimum against that indicated in table 7, adjust if necessary at the main burner governor. Check this against a gas rate reading at the installation gas meter.
- i. Check the operation of the water flow switch by gradually closing down one of the boiler isolating valves. The boiler should go to lock-out.
- j. Check that the pump overrun is operating correctly when the boiler is switched off and that any time controls are operational.
- k. Check the correct operation of the water flow switch lamp on the control panel as the pumps are turned on and off.

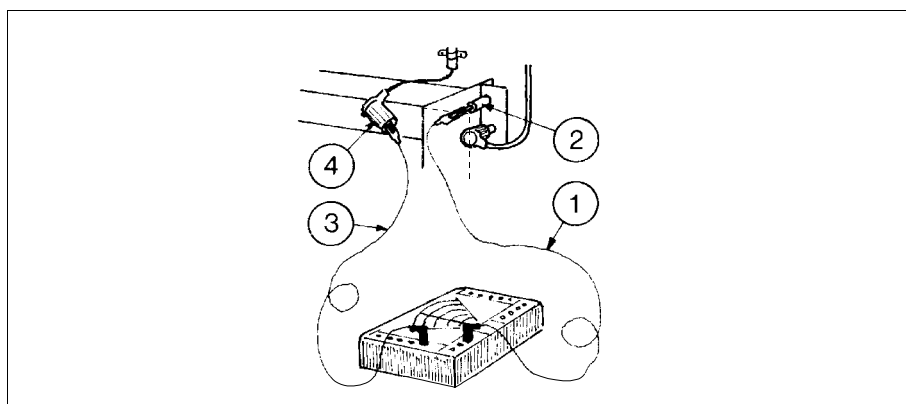


Fig. 27 Measuring ionisation

6.4 Instructions to user

Upon satisfactory completion of commissioning hand the Technical documentation to the person responsible for the plant and explain the method of safe operation. Ensure that he/she is fully conversant with the starting, shut down, general operation and emergency shut down procedures. Explain the operation of the high limit thermostat, by pressing button in right hand upper side tray, but stress that in case of repeated overheating of the boiler that the fault should be corrected by a competent person. Stress the importance of regular servicing for safe and efficient operation and that if a gas leak is detected to turn off the boiler at the gas service cock and to call the local gas supplier.

Boiler failure

In case of boiler failure the system will fall into lock-out. Reset the boiler with the reset button on the control panel. Repeat this several times if necessary. If the boiler still does not start, refer to chapter 'Operation and fault finding' (7).

7

OPERATION AND FAULT INDICATION

7.1 Function The boiler starts up in the sequence described below: Heat demand. Ignition of pilot flame. As soon as pilot flame is detected, an ionisation current will pass to the flame safeguard control box. The main gas valve opens and gas ignites over complete burner tray. Main burner flame is detected by a sensing electrode. The modulating control will commence from low fire condition.

7.2 Regulation The burner (input) is controlled through a butterfly valve and modulates between 20 % and 100 % heat demand. If the heat demand is smaller than 20 %, the burner will remain off. The temperature is controlled through an electronic PID regulator (EM- or EW-version).

7.3 Control panel To assist with fault finding the control panels incorporate a number of warning indicators and switches.

- 1 Power on/off switched indicator
- 2 Boiler lock-out indicator (ionisation)
- 3 Reset switch
- 4 Overheat temperature indicator (off when boiler overheated, see 7.4)
- 5 Insufficient water flow indicator
- 6 Low gas pressure indicator (optional)
- 7 Gas leak indicator (optional)
- 8 High gas pressure indicator (optional)
- 9 By pass switch for high limit test
- 10 Hours run indicator

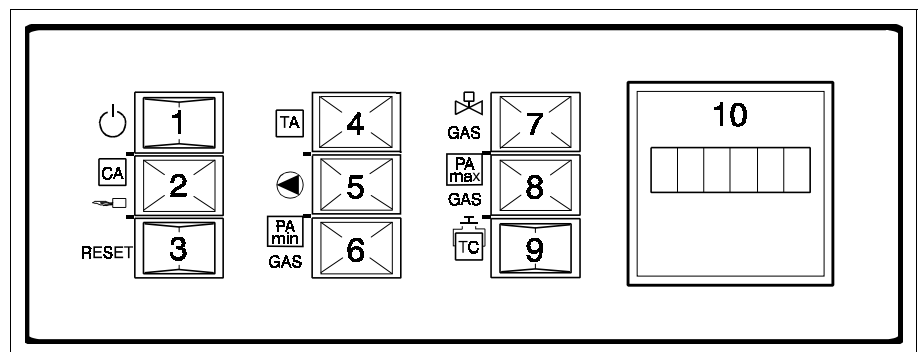


Fig. 28 Control panel

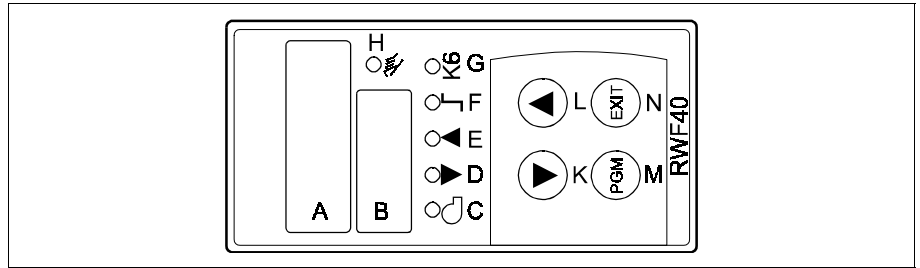


Fig. 29 Electronic temperature regulator Rwf40

RWF40

- A Process value (actual temperature)
- B Set point (temperature)
- C Burner enable (not applicable)
- D Mod. indicator (decrease fire rate)
- E Mod. indicator (increase fire rate)
- F Two-stage firing (not applicable)
- G Limit comparator
- H Manual operation

The keys K-L-M-N are used for displaying values and changing parameters in the temperature controllers configuration.

- K Down key (reduce value)
- L Up key (increase value)
- M Programme key
- N Exit key

7.4 Fault indications

If there is insufficient water flow the boiler will turn off and lock-out. Red lamps 2 and 5 on. Reset by pushing button 3.


If the flow temperature exceeds the **high limit** setting, the boiler will mechanically lock out and red lamp 2 illuminates. Reset by pushing button 3 and allow the unit to fire. If lamp 4 TA then illuminates, reset button in high limit thermostat. Remove the high limit thermostat cap nut placed at the right hand side of the cover (see sticker high limit thermostat) with a 17 mm ring-spanner. Press a screwdriver against the green peg until a light click is heard. Lamp 4 turns off. Refit cap nut. Then press button 3 to reset red lamp 2 (CA).

If an ionisation failure occurs, red lamp 2 will light, burner will switch off. Reset by pushing reset button 3.

The pilot flame on the main burner can be observed through the sight glass on the lower left hand side of the boiler.

-
- 7.5 Start-up** Ensure that gas and electric supplies are connected.
Start sequence:
A Turn manual gas cock open
B Turn the pumps on
C Ensure that all hot water outlets are closed
D Turn the supply voltage to the boiler on and turn the boiler on using the power switch 1
E In case of failure, observe type of failure, take necessary steps to rectify, refer to section 4 for details
F Set temperature regulator as required.

- 7.6 Shut-down** A To turn off for short periods switch boiler off by using the power switch 1
B For long periods switch the pump off and after 6 minutes close the main gas cock and main electrical supply.

- 7.7 Warnings** Non operation of boiler during the winter time can cause freezing. By draining the water out of the heat exchanger, using the drain taps mounted on the under-side of the flow and return header manifold.

Damage to boiler will then be avoided.

WARNING

In case of failure obtain assistance from a qualified CORGI gas/heating engineer. Don't repair yourself.

7.8 Fault finding table

Fault	Possible cause	Solution
Boiler does not attempt to light	No electrical supply to boiler	check whether switched indicator (1) is alight Check all external controls for continuity
	No heat demand	Check control thermostat is set high enough
	High limit thermostat has operated	If lamp 2 is illuminated, press reset button and allow unit to fire. If lamp 4 then illuminates, reset button in high limit thermostat (see 7.4)
	End switch gas valve is not in rest position	Check end switch gas valve
	Insufficient water flow indicator (5) alight	check water system Check air damper relais, replace if necessary
	Control panel fuse blown	check fuse
Air damper cycles and boiler does not light	Faulty control box	change box
Air damper cycles and boiler does not light	Micro switch minimum setting (II) servo motor is set above 20 %	Readjust minimum setting micro switch (II) servo motor
Heat demand Servo motor does not react	Closed control switch main gas valve is inoperative	Check and repair
	Turn open relay inoperative	Replace turn open relay
	Up signal is present at contact 22	Check servo motor connector, if operative replace servo motor
Heat demand Servo motor turns the airdamper only open but not close	Micro switch maximum setting (I) is not set correctly	Readjust maximum setting micro switch (I)
	Micro switch contact is coroded or broken, no voltage at contact 23	Replace servo motor
	There is voltage at contact 23 but close down relay does not react	Replace close down relay
Heat demand Servo motor opens en closes the airdamper but boiler does not start	No voltage at contact 21	Check 20 % setting micro switch, readjust. If this does not correct problem replace servo motor
	Voltage at contact 21 and 20 % micro switch is operative. Check pre requisite relay	If relay does not react replace requisite relay

Fault	Possible cause	Solution
Air modulating damper cycles, no ignition spark and boiler then goes to lockout, indicator (2) alights	HT lead disconnected or faulty Ignition electrode incorrectly set or faulty Faulty ignition generator Faulty control box	correct check setting or replace change change box
Ignition sparks, pilot burner does not light and boiler then goes to lock-out indicator (2) alights	Gas supply turned off Pilot manual cock turned off Air in gas line Check ionisation probe Faulty pilot safety shut off valve or Connections Pilot injector blocked Pilot governor set too low	turn on turn on purge air if damaged, replace rectify clean adjust
Pilot burner ignites but boiler then goes to lock-out, indicator (2) alights. Main burners do not light	Check flame probe Flame probe lead(s) not connected or faulty Faulty connections to main safety shut off valve(s) Faulty main safety shut off valves Faulty control box Check ionisation current, as per instructions	if damaged, replace rectify rectify change valves replace
Boiler operates but then goes to overheat indicator (4) alights	Fault in water system Main burner pressure set too high Pump overrun inoperative Boiler does not shut down	rectify reset rectify min. fire is set below minimum setting, reset servomotor.

8

MAINTENANCE

- 8.1 Safety** Always wear the proper protective clothing and shoes when servicing the boiler. Wearing jewelry and loose clothing can contribute to unsafe situations.
- 8.2 General information** In order to keep the R18 in a safe working condition, the boiler should be inspected and serviced at least once every year and cleaned if necessary.



Frost protection

When boiler is not in operation for a long period of time, the heat exchanger should be protected against frost. This can be achieved by draining water from the heat exchanger.

- 8.3 Inspection** ***Inspecting the draught diverter***
The draught diverter and heat exchanger can be inspected and cleaned with the minimum of tools and time. Place yourself in the draught diverter and execute the following:

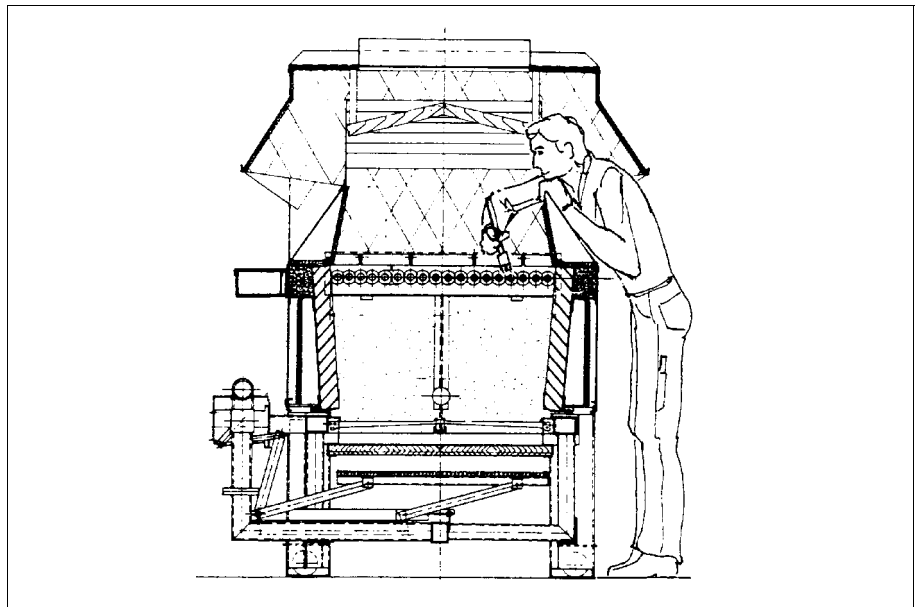


Fig. 30 Inspection and cleaning of the draught diverter and heat exchanger

Heat exchanger (external inspection)

As you inspect the inside of the draught diverter, the top of the heat exchanger can also be inspected. Check for dirt and sooting. For cleaning the heat exchanger, refer to chapter 'Cleaning'.

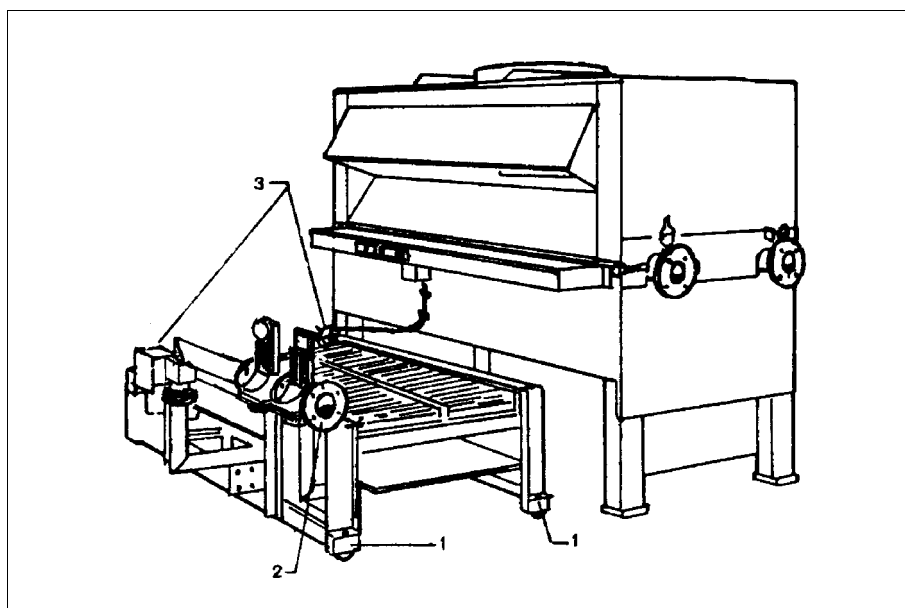


Fig. 31 Removing the burner

After removing the burner, the combustion chamber and the underside of the heat exchanger can easily be inspected.

Heat exchanger (internal inspection)

Internal inspection must be carried out by qualified and authorised personnel.

Sight glass

A sight glass can be found on the left hand side (on alternative handings the sight glass will be located on the right side) of the burner assembly for inspection of:

- boiler ignition
- combustion
- pilot flame.

Burner tray

The burner manifold and the gas regulator are connected by means of a coupling.



Remove the burner for inspection as follows:

- 1 Close the gas service cock and disconnect the burner manifold and gas regulator
- 2 Release the burner from the boiler frame (4 bolts)
- 3 Disconnect the spark plug, ionisation caps, servo-motor plugs and solenoid valve plugs and remove the 'earth' lead
- 4 Carefully withdraw the burner from the boiler unit. Inspect for dirt and clean the burner bars if necessary.

8.4

Cleaning Before using chemicals and cleaning agents in the boiler, please contact your supplier for advise.



Always read the instructions on the bottle of the cleaning agents before using them.

Heat exchanger (external cleaning)

Remove the baffles before cleaning the heat exchanger.

- Use compressed air when the heat exchanger is lightly soiled
- Use a stiff brush and soap when the heat exchanger is very dirty, do not allow the refractory brick-work to get wet.



NB.

The heat exchanger may become heavily soiled (soot for example), when the instructions are not followed properly.

This may be caused by:

- insufficient ventilation
- condensate on the heat exchanger.

If this is the case, clean the complete heat exchanger, including the baffles. Furthermore, the cause of the problem should be ascertained and rectified.

Heat exchanger (internal cleaning)

Descale the heat exchanger with the correct chemicals.

Filter inspection

When the pressure loss over the gas regulator gets too high, the burner pressure will decrease noticeably. A dirty gas filter may be the cause. The filter should be inspected at least once every year. To allow access to the filter element, first remove the side cover of the gas regulator assembly. Then remove the filter and replace it if necessary. Replace the cover and check for leaks.

8.5

Servicing **WARNING: ONLY COMPETENT PERSONS SHOULD CARRY OUT SERVICING ON THIS BOILER IN ACCORDANCE WITH THE GAS SAFETY (INSTALLATION AND USE) REGULATIONS 1984.**



Ensure that both gas and electrical supplies are switched off before carrying out any service operation.

After carrying out any service operation it is important to check for gas soundness and re-commission the boiler as described in Section 6 - Commissioning.

Ensure that any panels covering live connections are replaced securely upon completing any service operation. Wiring diagrams and components lists are supplied separately.

Routine maintenance

The frequency of routine maintenance depends on the use and environment in which the boiler is used although it must be carried out at least annually.

The scope of routine maintenance includes the following:

- I Cleaning the heat exchanger
- II Cleaning the burner assembly and inspect the condition of the burner and ignition components
- III Checking the gas train for soundness
- IV Inspecting the adjustment of the air damper and operation of the modulating gas valve and servo-motor
- V Checking the effectiveness of natural or mechanical ventilation
- VI Inspecting the flue system including terminal, for damage and ensure it is evacuating the products of combustion without any leakage or spillage
- VII Check gas pressure settings, safety lock-out systems and water flow switch
- VIII Inspect condition of refractory lining.

Procedure

Release the gas train.

Disconnect all the plugs from the front electrical panel, release the screws at all 4 sides of the burner trolley. The burner trolley can now be withdrawn from underneath the boiler.

Remove the stainless steel sidebaffles down holders by releasing two screws in either side and remove the flueway baffles from the top of the heat exchanger. Inspect the heat exchanger for deposits and clean if necessary, check condition of the copper fin tubes and replace flueway baffles when damaged.

Check the condition of the boiler for any possible corrosion damage. Also check the condition of the combustion chamber insulation panels, replacing if necessary.

With the burner trolley removed each individual burner bar can be removed and cleaned, with the exception of the pilot burner bar. This is done by first removing the insulation covered stainless steel channels, located at the front and rear of the burner assembly, removing the stainless steel control cover and hold down wires and then removing the burner bar by first lifting the end of the burner out of its locating notch and then withdrawing the burner from its injector (avoid damaging the electrodes when removing the pilot burner assembly).

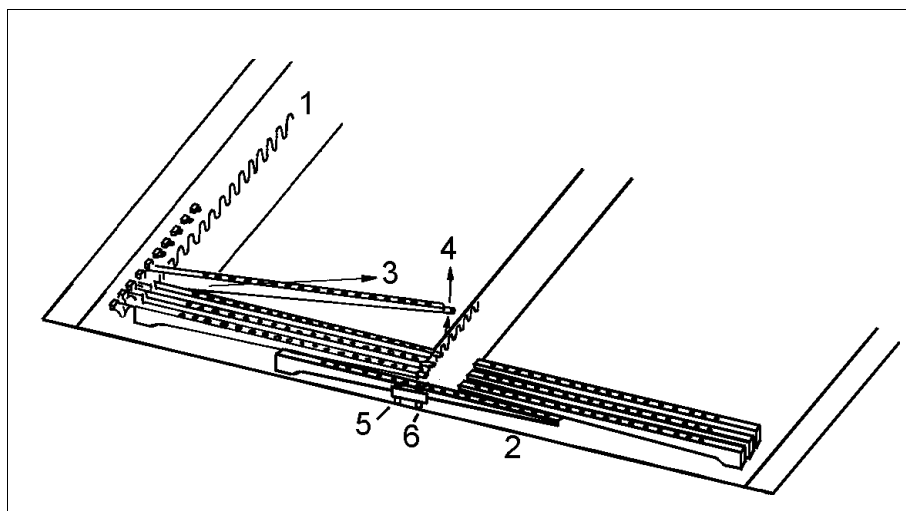


Fig. 32 Burner assembly

- 1 Burner location tabs
- 2 Burner assembly frame
- 3 Withdrawal direction from holder & injector
- 4 Lift burner out of notch at end
- 5 Ignition electrode
- 6 Sensing electrode

Each burner bar can be withdrawn from its injector. With the burners removed check the injectors for any blockage and if necessary clean in spirit. Remove the air guides located beneath the burners and clean. Check the setting of the modulating combustion air damper. See fig. 26, there should be **a gap of 8 mm with the damper in the fully closed position** against the stops (Natural gas) (see table 7a and 7b).

Check the condition of the ignition and sensing electrode at the right hand end of the burner assembly. There should be no burning of the metal tip and the ceramic should not be cracked. Replace the burners starting with the pilot burner. Ensure that the shaped venturi end at each burner locates properly over the injector and that the tab at the end of the burner bar locates fully in its notch.

Ensure that the insulation covered stainless steel channels are correctly positioned as they guarantee the correct location of the burners. The front tip of the channels locates over the burner location tabs, see fig. 32.

Ensure that the ignition and sensing electrodes are correctly positioned as shown in fig. 33. If the position or gaps are not correct the electrodes must not be bent. In that case the electrodes have to be replaced.

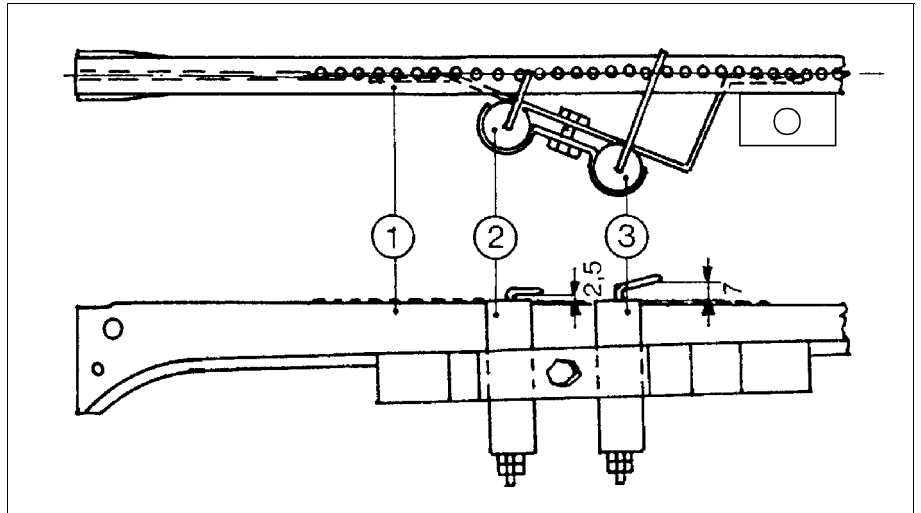


Fig. 33 Electrodes

Check that the modulating combustion air/gas control linkages are in good working order and that there is no play in the gas control spindle.

Replace the burner trolley and bolt into position. Re-connect the electrical connectors to the connection tray. Re-commission the boiler as described in Section 6 commissioning.

Gas trains

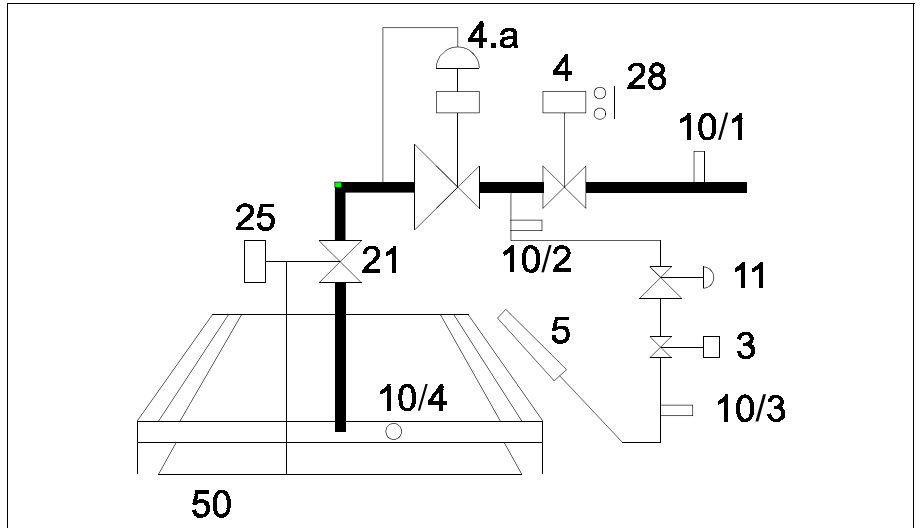


Fig. 34 Gas train

Electrodes

Remove the burner trolley as described earlier. The ignition and sensing electrodes can now be replaced as follows:

Disconnect the aluminium wire from the base of the electrodes. Remove central bolt securing the electrodes to the pilot burner bar and lift off the electrodes.

When re-assembling ensure that the electrodes are correctly replaced (refer to fig. 33) with the pilot burner bar in position. Check operation of electrodes by carrying out the relevant parts of section 6, commissioning.

Burner bars

Remove the burner trolley as described earlier. Remove the insulation covered stainless steel channels.

With the exception of the pilot burner bar, the burner bars are removed by first lifting the end of the burner out of its locating notch and then withdrawing the burner from its injector.

To remove the pilot burner assembly, disconnect the wiring to the sensing electrode and the ignition electrode. Avoid damaging the electrodes. Replacement of the burner bars is described in section Servicing. Ensure that the burners are not damaged or warped.

Injectors

Remove the burner trolley and burner bars as described before. With the burner bars removed the injectors can be unscrewed from the gas manifold.

Ensure that injectors are unblocked and are the correct size - 1.85 mm diameter (natural gas).

Use an approved pipe sealant on the injector thread to ensure a gas sound seal.

Replace components in the reverse order of removal.

Gas train

(including gas train components).

Ensure that the gas service cock is closed, release the gas union, disconnect the plugs from the front electrical tray and release the bolts at all 4 sides of the burner trolley and withdraw the burner trolley. Solenoid valve heads can be replaced with valve in situ by releasing the appropriate fixing on the valve head. Ensure that the new valve head is wired in accordance with the separate supplied wiring diagrams.

The main gas train is removed as follows:

Remove first the cover plate from the servo-motor coupling. Loosen the grub screw securing the keyed shaft of the modulating valve servomotor to its coupling and remove the motor by unscrewing fixing screws. It is not necessary to remove the gas train if only replacing this component.

Remove the pin connecting the modulating air damper to its actuating arm at the modulating valve by releasing the clip. Remove the pilot supply pipe by releasing the union nut at each end. Unscrew the four screws that secure the modulating valve to its flange connection on the gas manifold being careful not to loose the "O" ring, and withdraw the gas train from its locating "U" clamp in the burner trolley, the various controls in the main gas train can now be replaced by unscrewing from the gas train. The pilot solenoid valve can also be unscrewed at its outlet connection and replaced.

An approved thread sealant should be used when re-connecting any pipe threads. Ensure that any controls replaced are fitted squarely on the gas train, the "O" ring seal on the outlet of the modulating valve is in good condition and correctly located and the modulating valve drive shaft and linkages are correctly assembled.

Upon replacement if components carry out the relevant portions of section 6 commissioning.

Ignition generator

Disconnect all of the plug-in electrical connections from the electrical connection tray and remove the cover by releasing the two screws at each side of the cover lid. Disconnect the ignition transformer electrical connection from within the electrical connection tray and release the ignition electrode lead from the transformer. Replace the transformer by releasing its screw fitting and reconnect the electrical connections according the separate supplied wiring diagram.

Control panel components

Release the fixing screws from the cover of the electrical connection tray.

Refer to fig. 25 for the locations of the various controls.

Replace components by removing electrical connections and screw fixings. It is necessary to drain the boiler when replacing the water flow switch as it incorporates water connections.

The temperature sensing phials for both the control thermostat and the high limit thermostat are contained within a thermostat pocket in the flow header immediately beneath the control panel. The phials are released by first removing the securing clip.

The control thermostat is fixed to the front left or right hand side of the boiler and its fixing screws can be accessed via the electrical connection tray.

Re-connect any electrical connections in accordance with the separate supplied wiring diagrams.

Replacing fin tubes

Header and manifold removal

Release water pressure and drain the unit.

Disconnect the system water-pipes at the manifold flanges.

Remove all pressure and temperature sensors from the flow/return manifolds immersion tubes then electrically disconnect the flow-switch.

Remove the manifold and header retaining bars (10) and carefully remove the water manifolds, spacer plate and 'O'-rings.

Fin-tube replacement

Refer to fig. 6 for the locations of the various part numbers.

Cut a hole in the side panel directly above the tube to be replaced close to the tube mounting plate. This hole should be large enough to pass the replacement fin-tube through.

From the top of the heat exchanger remove the fin-tube supporting bridge (14) and the baffles (18), one on either side of the damaged fin-tube (5),

Using a suitable tool carefully saw through the damaged fin-tube and remove from the fin-tube mounting plates (4).

The fin-tube will be de-finned approximately 80 mm on one side. The end of the fin-tube should be passed through the hole and slotted into mounting plate at the other end of the unit.

Once the tube has been slotted fully into the mounting plate it will be possible to position the replacement fin-tube between the two mounting plates ensuring that the protruding ends are equidistant at both ends.

Clean the bore of the replacement tube of swarf, dirt and metal particles.

Using a small 'G'-clamp, clamp the replacement tube to a neighbouring tube in order to hold the replacement tube in the correct position.

Using the correct expanding tool, expand the free tube end.

When a torque of **20 - 25 Nm** has been reached the expanding process is complete.

Remove the 'G'-clamp and expand the other end also to a torque of **20 - 25 Nm**.



Replace the spacer pins, baffles (13, 16).

Wrap a suitable insulating material (article No. GIK 080) around the exposed area to against overheating.

Patch the hole in the side panel and insulate.

Refit the fin-tube supporting bridge (14), the baffles (18) and replace the stainless steel wire ties (15).

Inspection of the headers and the fin-tube mounting plate mating surfaces

Inspect the mating surfaces of the water header, flow/return

manifolds and the fin-tube mounting plate. These should be clean, smooth and undamaged.

O-ring replacement

Fit new O-rings to all finned-tubes



Fitting and retensioning the water heater and flow/return manifold

Refit the header spacer plate.

Carefully replace the header and hold it in place with one of the retaining bars with the nuts screwed in finger tight.

Refit the rest of the header retaining bars also with the nuts screwed in finger tight.

Tighten the retainer bars in four stages and in the sequence shown in the drawing below to a torque of 25 Nm.

Refit the manifold spacer plate.

Carefully replace the manifolds and hold them in place with one of the retaining bar with the nuts screwed in finger tight.

Refit the rest of the manifold retaining bars also with the nuts screwed in finger tight.

Tighten the retainer bars as above (in four stages and in the sequence shown in fig. 36 to a torque of 25 Nm).

The remainder of the heat exchanger assembly is a reversal of the removal procedure.

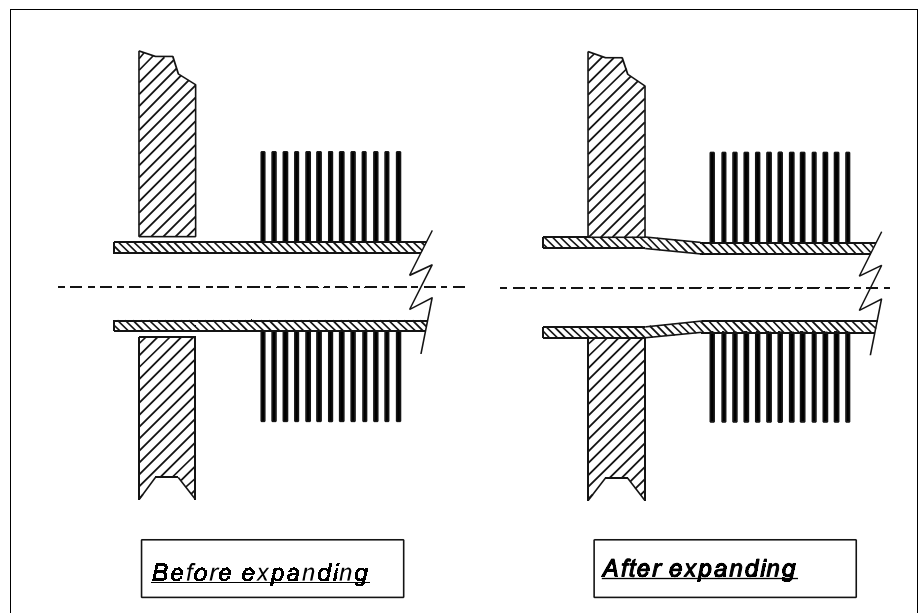


Fig. 35 Expanding the fin-pipe ends

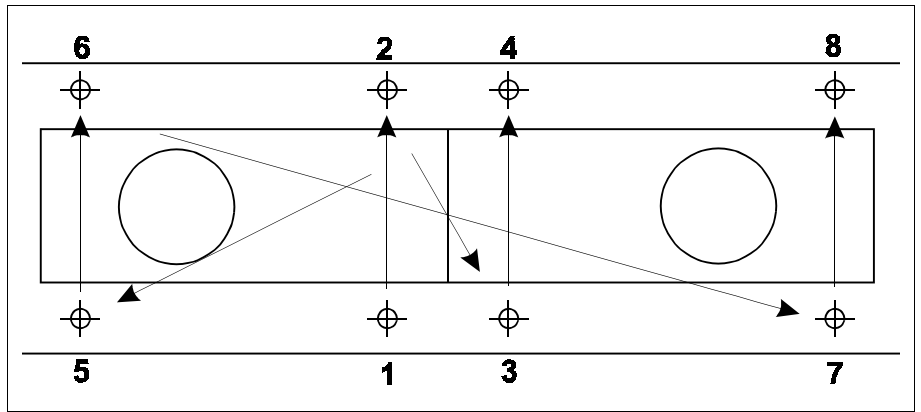


Fig. 36 Tightening the manifold nuts

8.7

Service

For service and maintenance the service department of your supplier can be contacted.

LIST OF SPARE PARTS

A list of spare parts is available from your supplier by quoting the boiler model and serial number.

SUPPLEMENT

At the time of printing the following regulations and standards were taken into account:

British Standard

1. **BS 5440** - parts 1 + 2 (fluing and ventilation).
2. **BS 6644** - Installation of gas fired water heaters (60 kW - 2 MW).
3. **BS 6700** - Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.
4. **BS 6891** - Installation of low pressure gas pipework.

The following British Gas publications may be helpful:

- IM/2** - Purging procedures of non domestic gas installations
- IM/5** - Soundness testing procedures for industrial and commercial gas installations.
- IM/11** - Flues for commercial and industrial gas installations.
- IM/16** - Guidance notes on the installation of gas pipework boosters and compressors.

Any other requirements currently in force.

These boilers are tested to **BS 5978** part 1 by British Gas plc for use on natural gas.

The following regulations should also be taken into consideration:

Gas Safety (Installation and Use) Regulations.

Building Regulations.

Local fire regulations

Regulations from the local gas distribution agency.

New Water Regs - The water supply (water fittings) Regulation 1999

