Technical documentation

R2000
Water Heaters

Andrews Water Heaters
Wednesbury one
Black Country New Road, Wednesbury
West Midlands WS10 7NZ
tel.: 0121 506 7400
fax: 0121 506 7401

Edition B, 22-10-2001

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 Andrews Water Heaters rejects any responsibility for the differences between the product delivered and the information mentioned in this document.

R2000 WATER HEATER TECHNICAL DATA

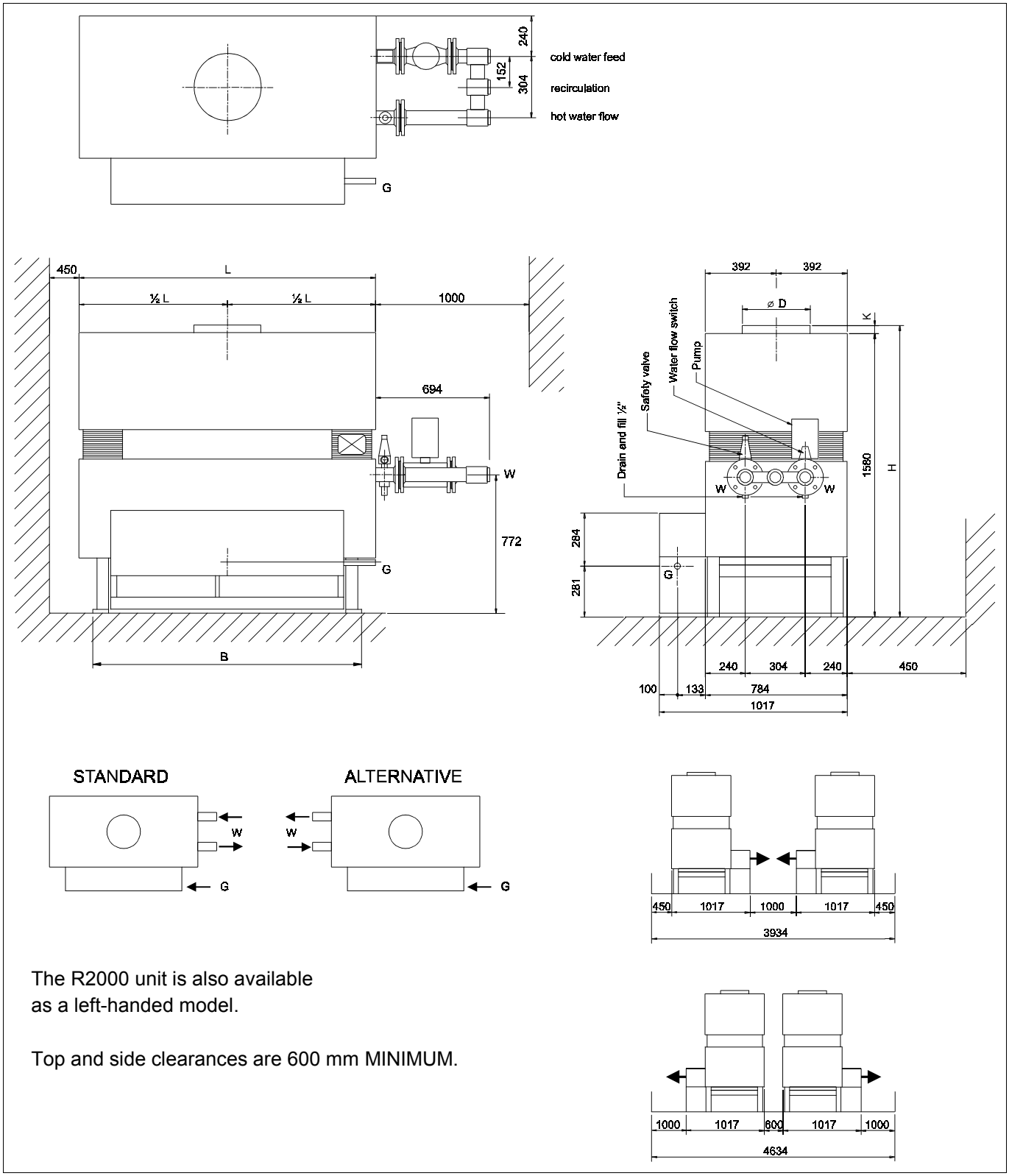
Type			R2017	R2022	R2028	R2034	R2041	R2048	R2056	R2066	R2077	R2090	R2105	R2122
Nominal heat output		kW	57,7	74,6	95,8	116,7	139,1	162,7	190,7	222,1	261,1	309,0	361,0	425,0
Nominal heat input (nett. CV)		kW	65,5	84,8	107,7	131,6	158,6	185,5	217,4	253,3	296,2	348,0	403,9	470,7
Gas consumption														
natural gas H (10,9 kWh/m³)		m^3/h	6,0	7,9	9,9	12,2	14,7	17,2	20,2	23,5	27,5	32,3	37,4	43,6
propane		m^3/h	2,3	2,9	3,8	4,7	5,6	6,6	7,7	8,9	10,5	12,3	14,3	16,6
Gas inlet pressure	(min.)	mbar	17	17	17	17	17	17	17	17	17	17	17	17
	(max.)	mbar	25	25	25	25	25	25	25	25	25	25	25	25
	propane (max.)	mbar	50	50	50	50	50	50	50	50	50	50	50	50
Water volume		dm^3	5,6	5,9	6,2	6,5	6,9	7,3	7,7	8,3	8,9	9,6	10,5	11,4
Max. working pressure		bar	11	11	11	11	11	11	11	11	11	11	11	11
Flue connection	D	mm	200	225	250	250	300	300	350	350	400	400	450	450
Gas connection	G		¾"	¾"	1"	1"	1"	1"	1½"	1½"	1½"	1½"	1½"	1½"
Water connections														
cold water feed + hot water flow	W		2"	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"	2"
recirculation			1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"	1½"
Pressure relief valve	connection		½"	½"	½"	¾"	¾"	¾"	1"	1"	1"	1"	1¼"	1¼"
	relief connection		½"	½"	½"	¾"	¾"	¾"	1¼"	1¼"	1¼"	1¼"	1½"	1½"
	standard setting	bar	5	5	5	5	5	5	5	5	5	5	5	5
Electrical supply	water heater 1N~	V	230	230	230	230	230	230	230	230	230	230	230	230
	pump 3N~	V	400	400	400	400	400	400	400	400	400	400	400	400
Frequency		Hz	50	50	50	50	50	50	50	50	50	50	50	50
Fuse		A	6	6	6	6	6	6	6	6	6	6	6	6
Max. electrical consumption														
water heater		kW	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04	0,04
pump		kW	0,25	0,25	0,25	0,37	0,37	0,37	0,37	0,37	0,37	0,75	0,75	0,75
Dimensions	B	mm	704	783	879	974	1085	1196	1323	1482	1657	1863	2101	2371
	H	mm	1612	1612	1612	1612	1612	1612	1612	1612	1632	1632	1652	1652
	K	mm	32	32	32	32	32	32	32	32	52	52	72	72
	L	mm	820	898	994	1090	1200	1312	1438	1598	1772	1978	2216	2486
Weight, empty, ± 5 %		kg	225	240	255	270	290	310	335	360	395	430	470	520

Table 1 Technical Data

- Heat output measured with : 60 - 80 °C
- Gas consumption at : 1013 mbar, 15 EC, dry
- Gas specification : I_{2H}
- Appliance category : B11
- Protection degree : IP20

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



The R2000 unit is also available as a left-handed model.

Top and side clearances are 600 mm MINIMUM.

Fig. 1 Dimensions

R2000 SUPA FLO PLUS with BT 300 litre tank

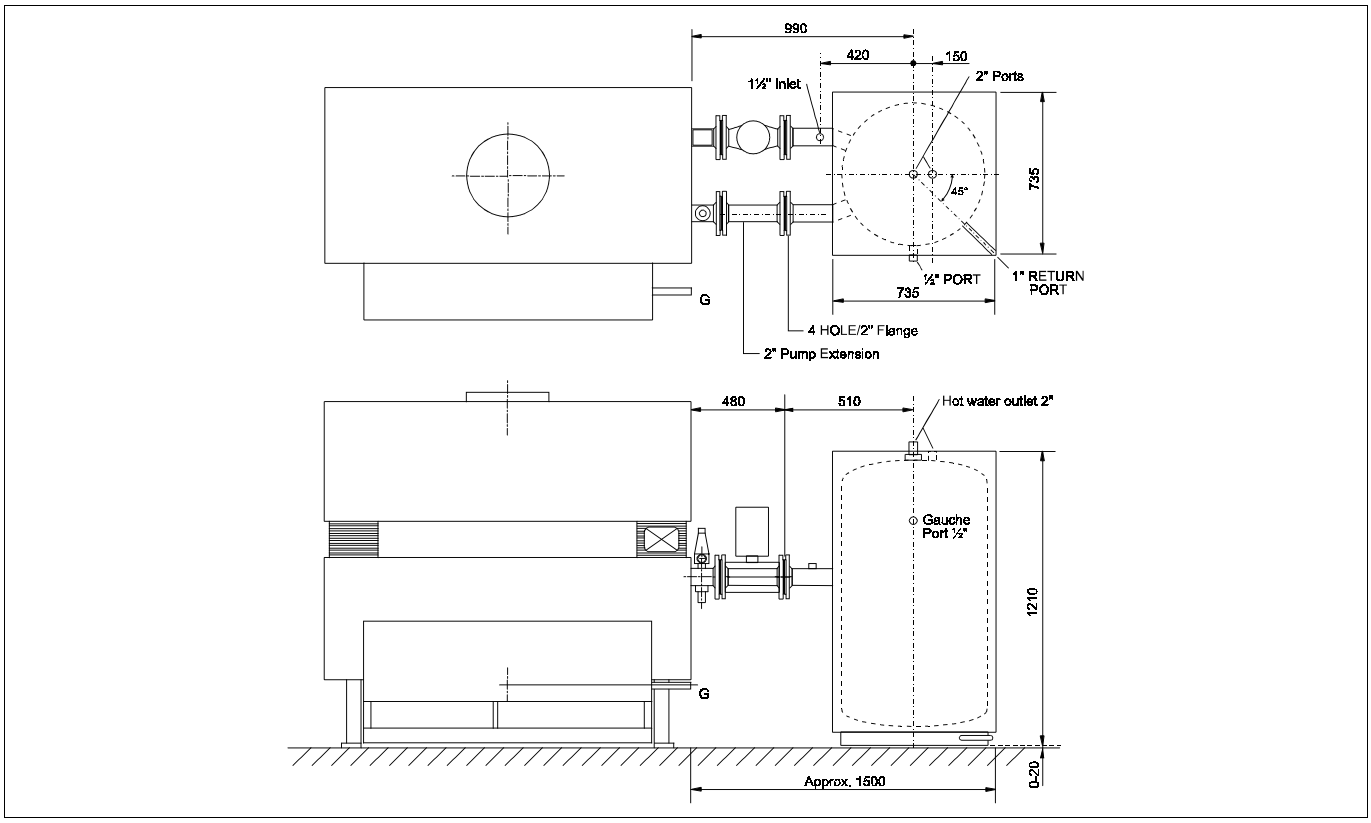


Fig. 2 Dimensions 300 litre tank

R2000 SUPA FLO PLUS with BT 500 litre tank

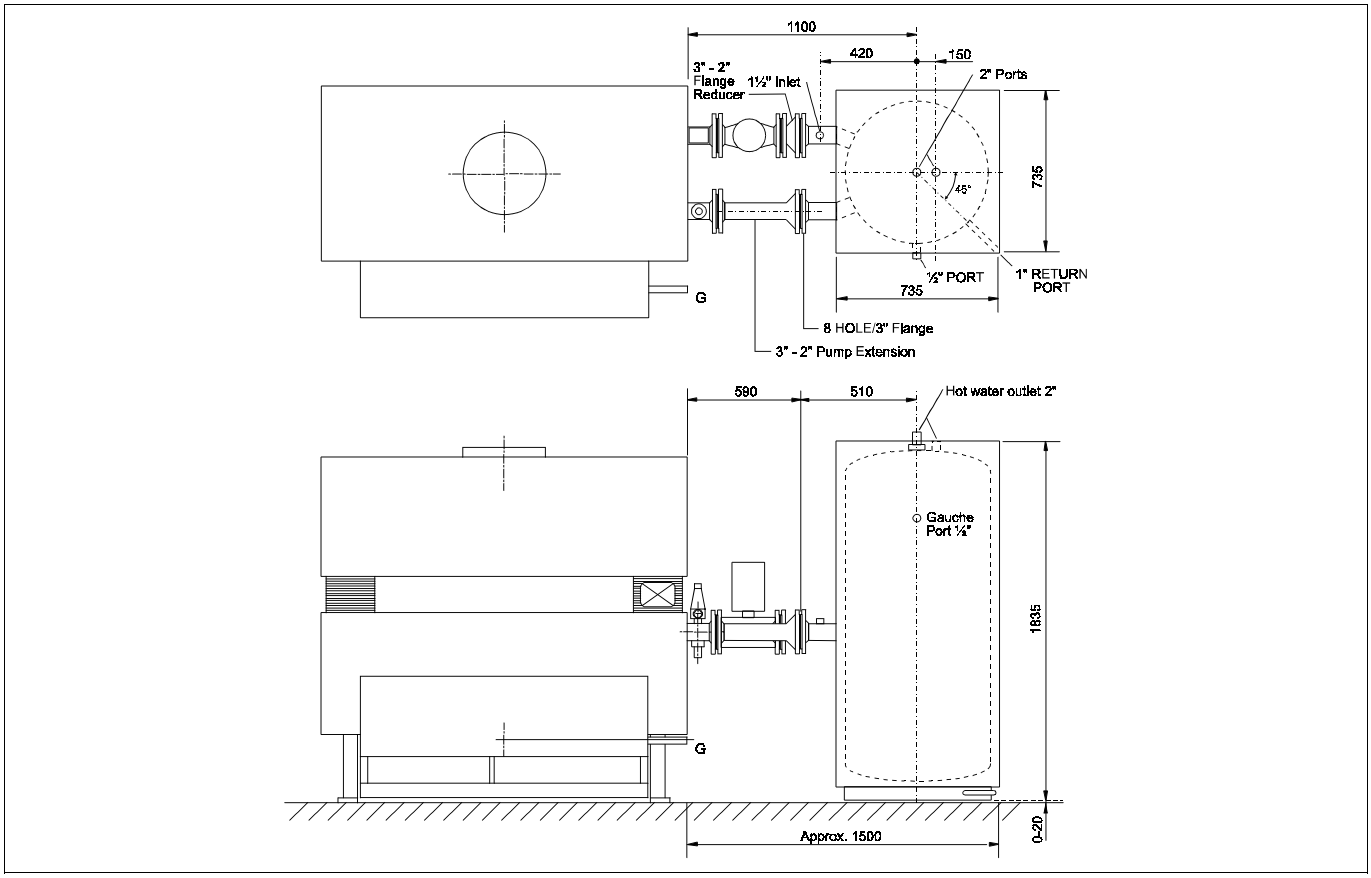


Fig. 3 Dimensions 500 litre tank

INDEX

1 INTRODUCTION

1.1 General

Through their unique construction, these 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 Andrews remains at the forefront of boiler and water heater technology.

1.2 Supplier

Andrews Supa Flo water heaters are sold throughout the United Kingdom by:

Andrews Water Heaters
Wednesbury one
Black Country New Road, Wednesbury
West Midlands WS10 7NZ
tel.: 0121 506 7400
fax: 0121 506 7401
For advice or more information with regard to our products contact Andrews Water Heaters.

1.3 This manual

This documentation has been 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

It is the law that the installation be carried out by a competent person. The water heater should be installed in accordance with the British Standards and Codes of Practice referred to in this manual, the Gas Safety (installation & use) Regulations 1994, Building Regulations, Model Water Bye-laws and any Requirements of the Local Gas Supplier, Local Authority, Water and Fire Authorities and I.E.E. Regulations.

Health & Safety at Work Act, 1974
Under Section 6 of the above Act, it is the duty of manufacturers and suppliers of products for use at work to ensure, so far as it is reasonable practicable, that such products are safe and without risk to health when properly used and to make available to users of such products adequate information about their safe and proper operation.
Andrews water heaters should only be used in the manner and purpose for wich they were intended, and in accordance with the recommendations detailed in this manual. Our heaters have been designed, produced and inspected with safety in mind, but there are certain basic precautions, wich should be taken by the user and, in particular attention is drawn to the safety precautions in this manual and to the operating instructions on the heater.
It is imperative, therefore, that all persons who make use of our heaters have all the information and instructions they require to ensure that they are fully aware of any hazard, and that they know both the purpose and correct manner of use of our heaters.
The manufacturer can alter its products without any preceding notification and is therefore not obliged to adapt earlier delivered products.

2 DESCRIPTION

2.1 General information

The R2000 series water heaters are atmospheric open flued, low thermal capacity gas-fired water heaters.
These high efficiency water heaters are designed to provide hot water to various industrial and commercial applications where there can be varying demands and fluctuating loads.
Several models are available with heat inputs from 65,5 kW to 470,7 kW and recovery rates from 1219 litres per hour to 8577 litres per hour, based upon a temperature rise of 44 K or 976 litres per hour to 6862 litres per hour, based upon a temperature rise of 56 K.

The R2000 series of water heaters are available in 12 types: R2017, R2022, R2028, R2034, R2041, R2048, R2056, R2066, R2077, R2090, R2105, R2122.

The last three digits of the type number indicate the number of burner bars present in the burner assembly. The load at nett calorific value is approx. 3,5 kW per burner.
All water heater types are fitted with a 9-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 minimized by the optimal construction of the combustion chamber in which high-grade insulation is integrated.
The advanced construction of the R2000 enables swift assembly and dismantle, which simplifies maintenance and inspection.

All water heaters 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 R2000 has an **electronic protection and ignition system**, indicated by **E**.
The electronic PID version controlled by a simple to operate regulator is indicated in the **M version**.

Appliance category B11.

CE

The R2000 series is CE approved for the following countries: Great Britain, Belgium, Denmark, France, Ireland, Italy, Spain and Sweden under Product Identification Number 0063AQ6600.

2.2 Main components

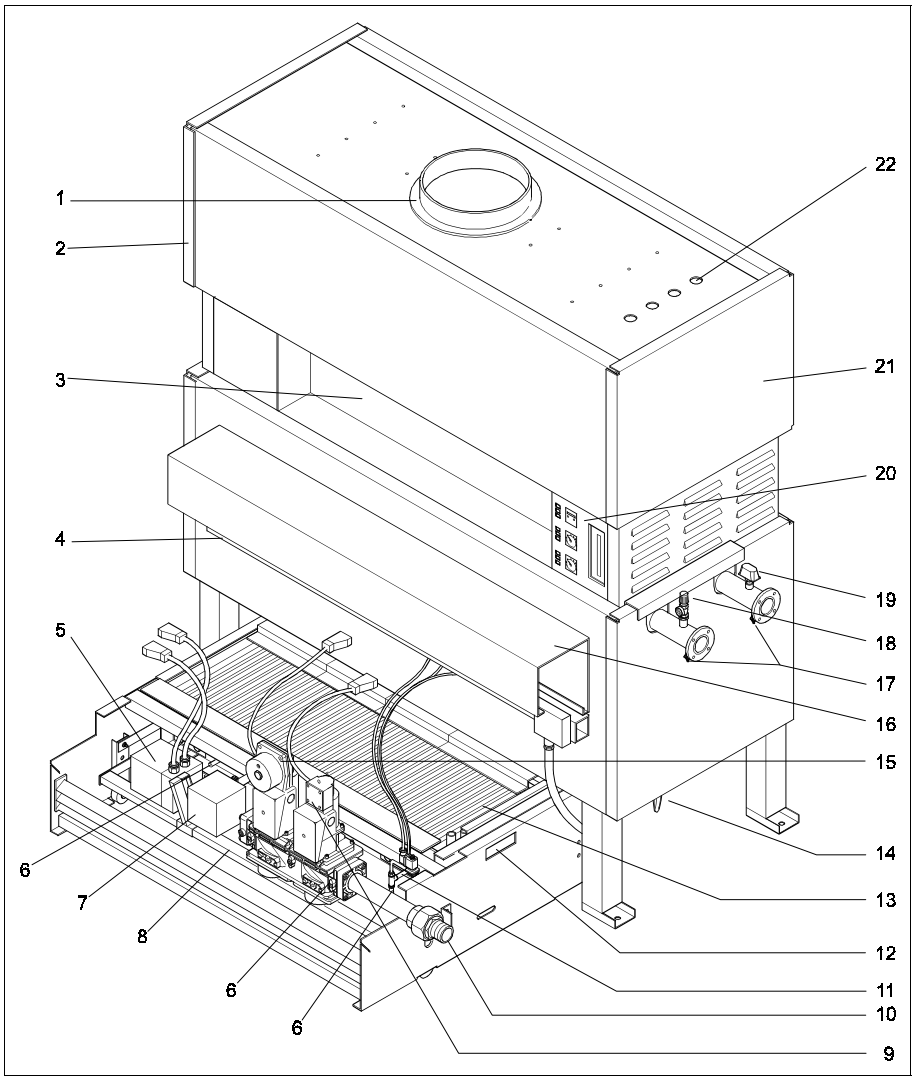


Fig. 4 View of the R2000 series

1. Flue outlet socket
2. Draught diverter
3. Air supply opening
4. Connection box
5. Servomotor (air damper/gas input)
6. Pressure test point
7. Gas modulating valve
8. Air damper
9. Main burner gas governor
10. Gas connection
11. Electrodes
12. Sight glass
13. Burner bars
14. Quick clamp (securing burner trolley at both sides)
15. Main gas valve
16. Gas train cover
17. Filling and drain valve
18. Pressure relief valve
19. Water flow switch
20. Instrumentation panel
21. Inspection panel (electrical wiring & controls)
22. Cable glands

Draught diverter

The R2000 is fitted with a draught diverter. It is possible to connect the flue outlet connection on the top cover with 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.

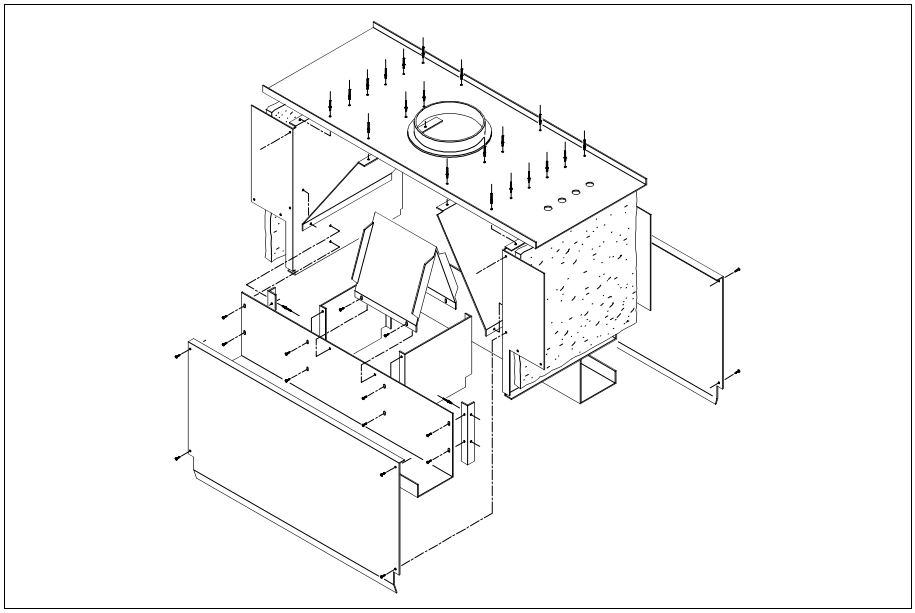


Fig. 5 Draught diverter

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.

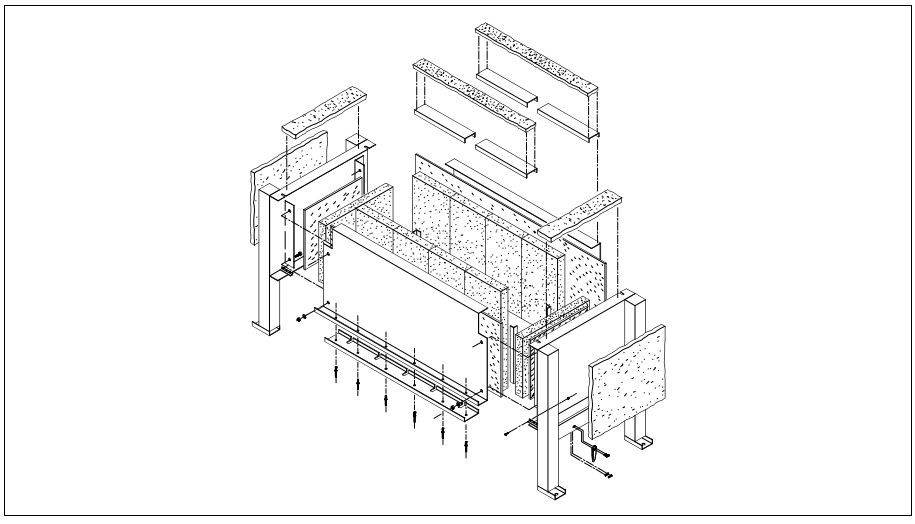


Fig. 6 Combustion chamber

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 stainless steel supply and return pipes together with the water manifolds form the heat exchanger.

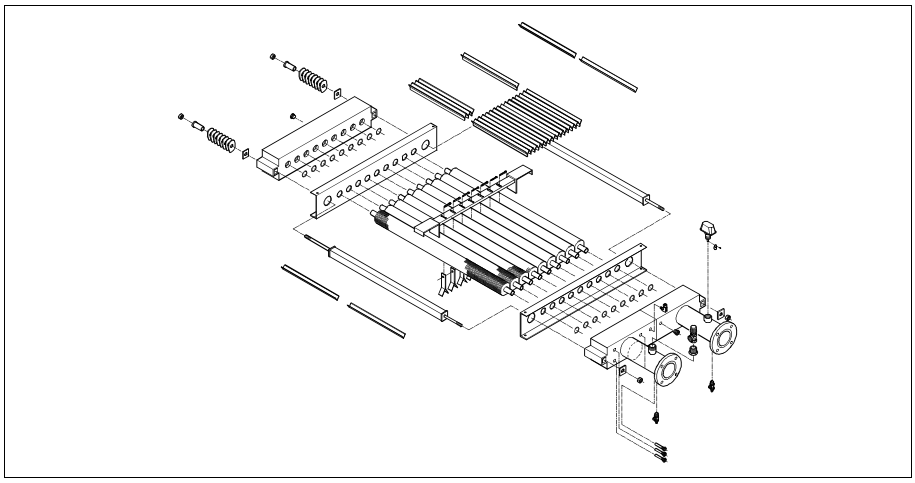


Fig. 7 Heat exchanger

Primary pump

The primary circulating pump is sized to prevent the depositing of limescale in the water heater under the following conditions.

Water hardness in ppm	Maximum temperature in °C
0 - 80	90
80 - 250	85
250 - 350	80
350 - 500	60

Table 2 Maximum temperature

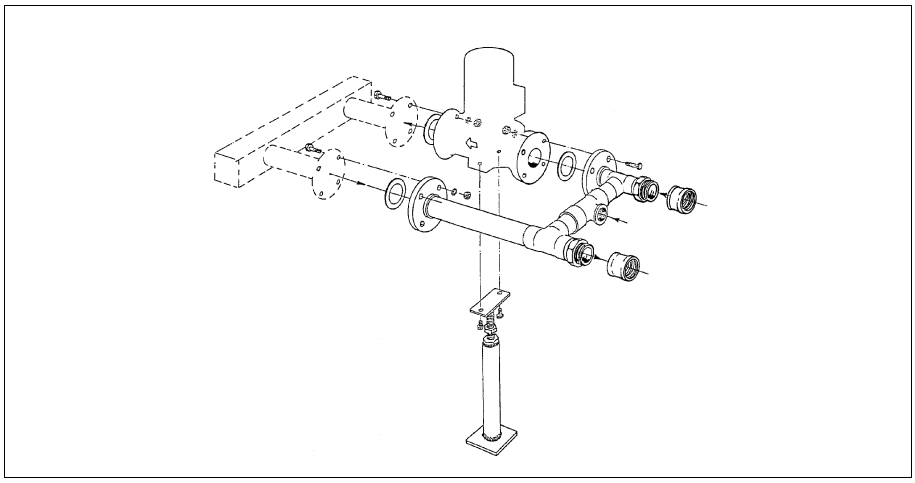


Fig.8 Pump and bypass with water connections

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.

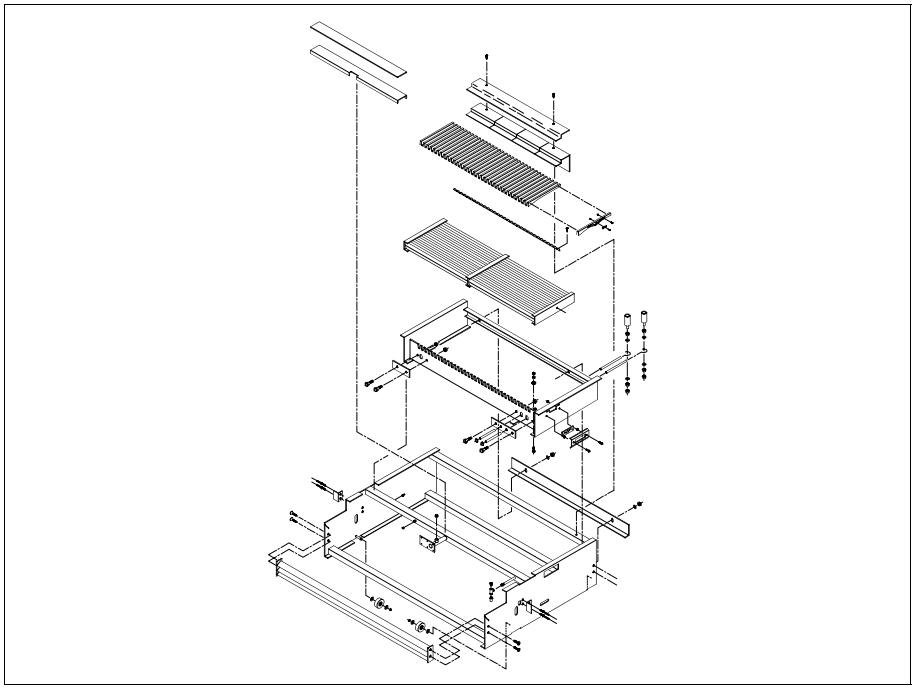


Fig. 9 Burner

Combustion air damper

A combustion air damper is situated underneath the burners.

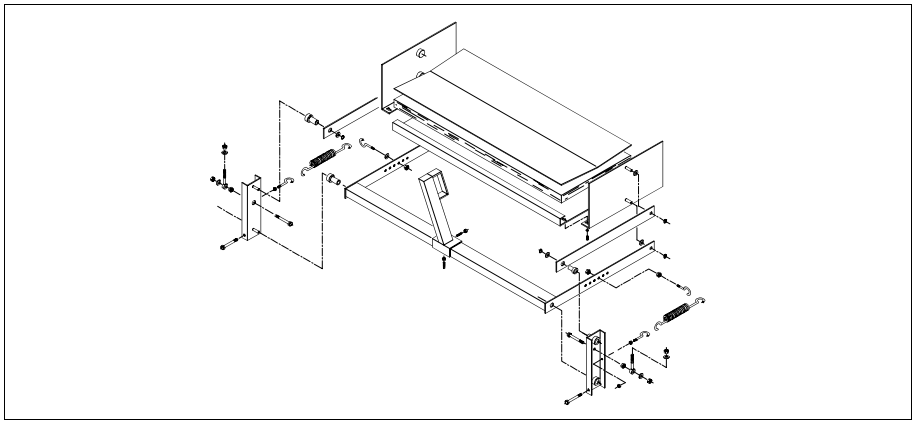


Fig. 10 Combustion air damper

Gas train

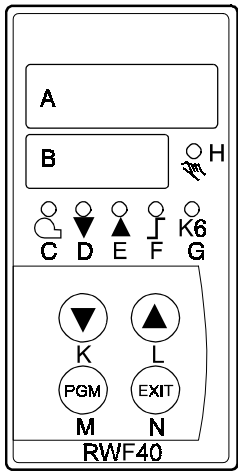
The principal components of the gas train are a main governor and two main gas valves or combined main governor and main gas valve. The quantity of gas is adjusted in proportion of the quantity of air being supplied by the air damper opening. The pilot flame has a separate pilot line with pilot governor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

2.3 Principle of regulation

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



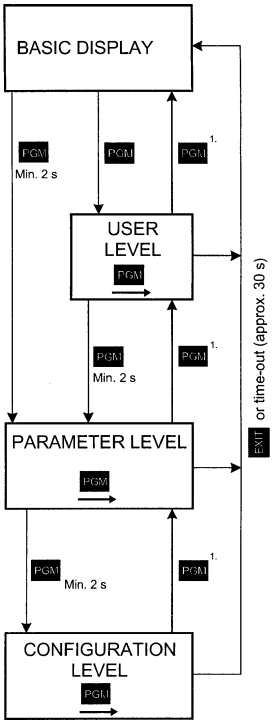
A Process value (actual temperature)
B Set point (temperature)
C Burner enable (not applicable)
D Mod. indicator (decrease fire rate)
E Mod. indicator (increase fire rate)
F Two-stage firing (not applicable)
G Limit comparator
H Manual operation

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.

2.3.1 EM 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)!

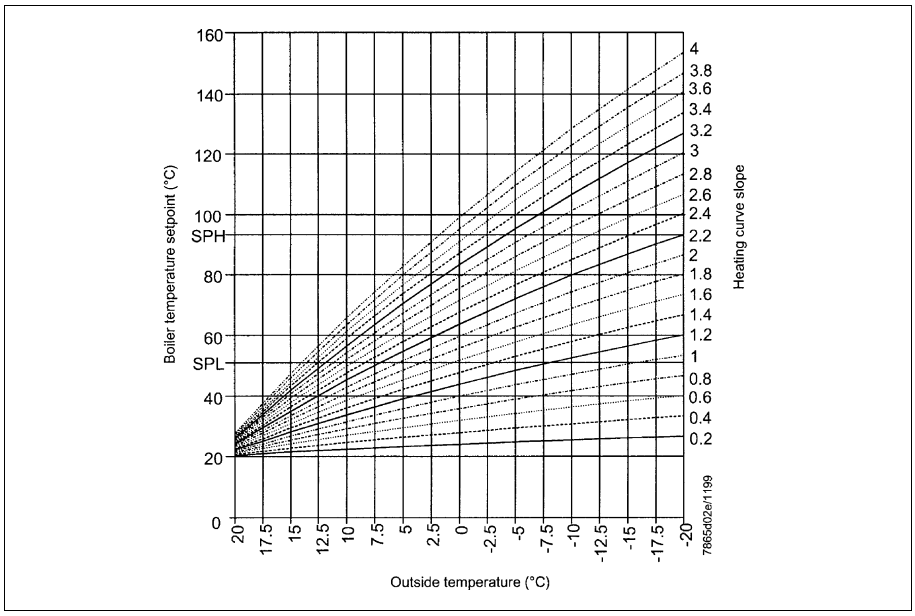


Fig. 9 Parallel displacement of the heating curve

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+**.
setpoint is restricted by the setpoint limits ***SPH+** and ***SPL+**.

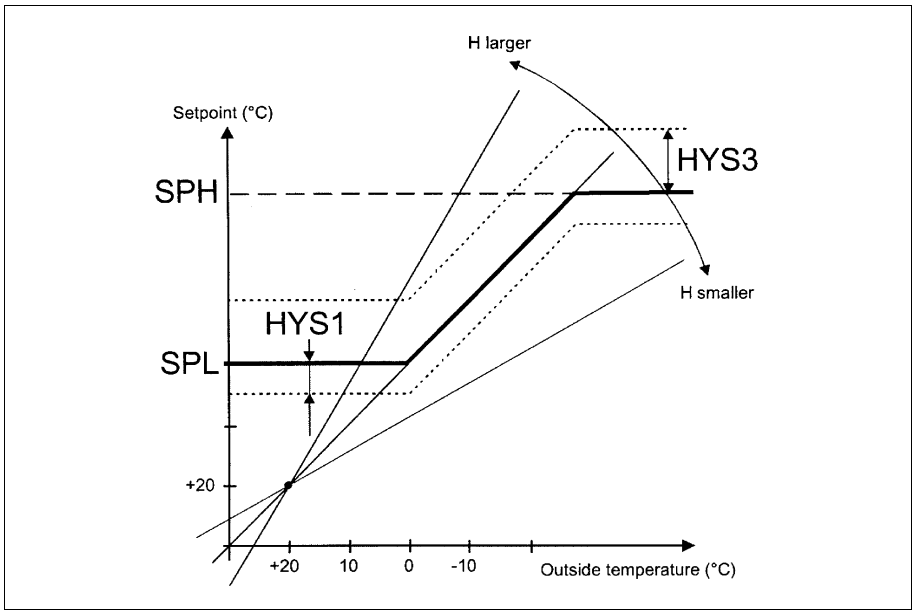


Fig. 10 Heating curve slope

***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

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 $_1$	**HYSt**	0...999,9 digit	1
Proportional band $_1$	**Pb.1**	0,1...999,9 digit	10
Derivative time	**dt**	0...9999 s	80
Integral action time	**rt**	0...9999 s	350
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

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.

2.4 Water heater protection

The R2000 is protected by the following systems:*minimum*

water flow switch
The water flow switch is installed in the flow manifold and monitors continuously the minimum water flow. If the water flow falls below a preset level, the burner is shut down and go to lock-out. The water flow switch is factory set and should not be adjusted.

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 lockout.

pressure relief valve
The maximum operating pressure of the R2000 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.

3 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 water heater.


Not following the operation procedures can cause serious damage to the water heater, 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 technic 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 water heater. Keep away from the hot water connections in order to prevent burns.

Always disconnect the water heater 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 water heater 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 water heater.
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 water heater room.

Installation
The water heater 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 water heater 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 water heater again.

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

4 DELIVERY AND TRANSPORT

4.1 Delivery

Before delivery, the R2000 water heater is fully assembled and tested in the factory. The R2000 is mounted on a pallet and covered in a "heat-shrink" protective wrapper.

Check for damage after removing the water heater's protective covering.

Check whether the water heater 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 water heater's data number plate.

4.2 Unit protective packaging

The water heater is mounted on a wooden pallet. For transportation the water heater is 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 water heater must be removed from the pallet and all protective coverings removed.
The protective coverings should be disposed of in a environmentally friendly way. Contact your local authority.

4.3 Transport

Refer to the technical specifications on weight and dimensions when transporting the water heater.

WARNING:

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

Pallet cart and/or forklift truck

When moving the water heater with a pallet cart or forklift truck, the forks should be placed at a front of the water heater.

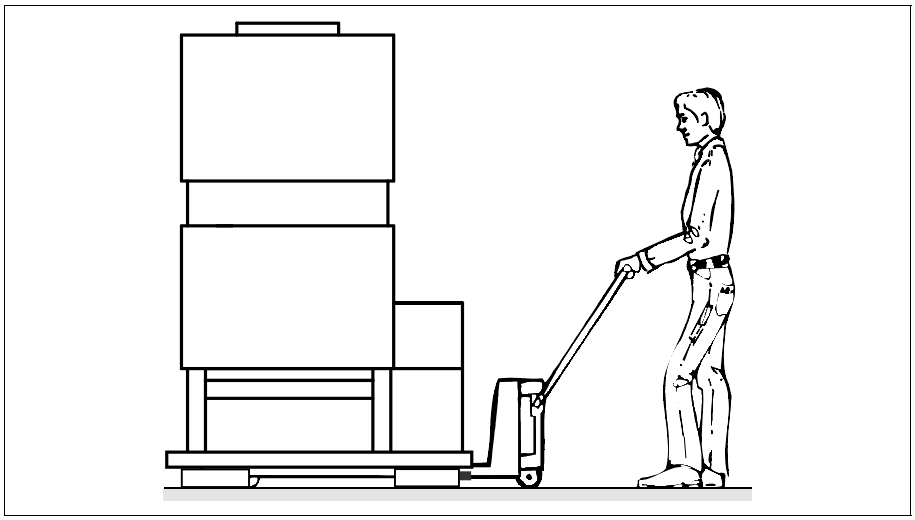


Fig. 12 Moving

Using a crane

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

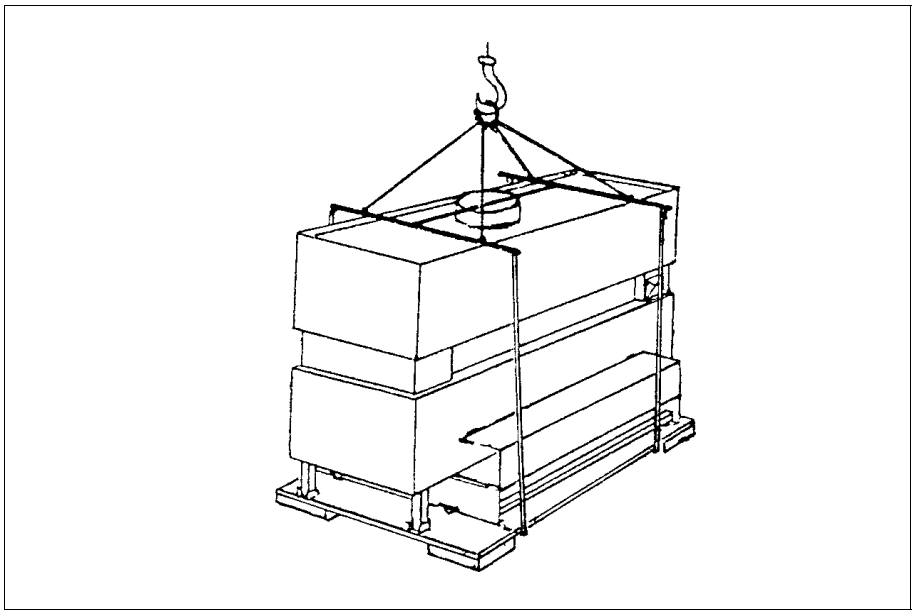


Fig. 13 Lifting

5 INSTALLATION

5.1 Boiler room

Installation of the R2000 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 water heater 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.

The location chosen for the water heater must permit the provision of a satisfactory flue system and air circulation around the boiler, see dimensions.
The water heater must be installed on a level non-combustible surface capable of supporting it's weight and any necessary equipment. **If the water heater is to be installed on a raised plynth, the plynth must carry forward by at least 1100 mm in front of the water heater** to allow removal of the burner trolley. It is important that the boiler is sited so that extraneous material cannot be stored next to it.

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.

Air supply and ventilation
It is important that there is an adequate supply of air for combustion, dilution of combustion products and ventilation of the boilerhouse.

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 fitted with grilles of negligible resistance and 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.
Low level inlet
540 sq.cm plus 4,5 sq.cm per kilowatt in excess of 60 kW total rated input.
High level outlet
270 sq.cm plus 2.25 sq.cm 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 of 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 m^3/s per 1000 kW total rated heat input.
Extract air (ventilation) - 0.45 m^3/s per 1000 kW total rated heat input. Further details regarding air supply are given in BS 6644.

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 right side of the water heater.

Always mount 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 water heater as possible.

The R2000 series of water heaters 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 water heater will not run at 100% capacity. At the same time the water heater can be more prone to failures.

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

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

The water heater 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).

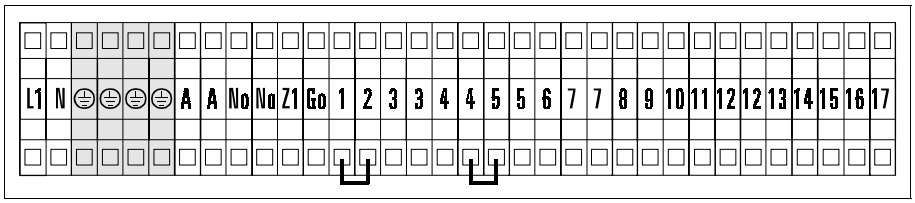


Fig. 14 Electrical terminal block

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
Z1	-	Go	0 - 10 VDC control signal (only available with EM control option)
32	-	No	external main gas valve
A	-	No	alarm signal (230 V)

* remove jumper.

A 6 Amp 230 Volt electrical supply is required for the water heater.
A 400 Volt electrical supply is normally required for the primary pump.

Pump switching

The primary pump supplied with the water heater should be wired to ensure constant operation whilst the water heater is in use and to give an over-run facility when the water heater is switched off. An automatic over-run system is available as an optional extra.

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.

The cold water feed, recirculation and hot water flow are found on the side of the water heater. As standard all water heater types are fitted with a safety valve, set to 5 bar.

If requested the manufacturer can also safety valves which are set to between 5 and 8 bar.

Type	connection	set to
R2017 - R2028	½" bsp	5 bar
R2034 - R2048	¾" bsp	5 bar
R2056 - R2090	1" bsp	5 bar
R2105 - R2122	1¼" bsp	5 bar

Table 3 Safety valves

5.2.3.1 Water system

The following notes are of particular importance to these water heaters.
A drain tap is fitted to the header at the connection end of the water heater to drain the content of the heat exchanger.
The water connections are normally on het right hand side of the water heater but can be supplied on the left hand side by special order, i.e. standard or alternative handing.
The water heater is suitable for a maximum operating pressure of 6.6 bar (220 ft wg) although certification by British Gas is limited to 4.5 bar.
It is important that a suitable sized secondary circulation pump is fitted in the return to the water heater.

Water treatment and suitable filtration is recommended for these water heaters and advice should be obtained from a reputable source.

5.2.3.1 Pump information

The primary circulating pump is sized to prevent the depositing of limescale in the water heater under the following conditions:

Water hardness in ppm	Maximum temperature in °C
0 - 80	90
80 - 250	85
250 - 350	80
350 - 500	60

Table 4 Maximum temperature

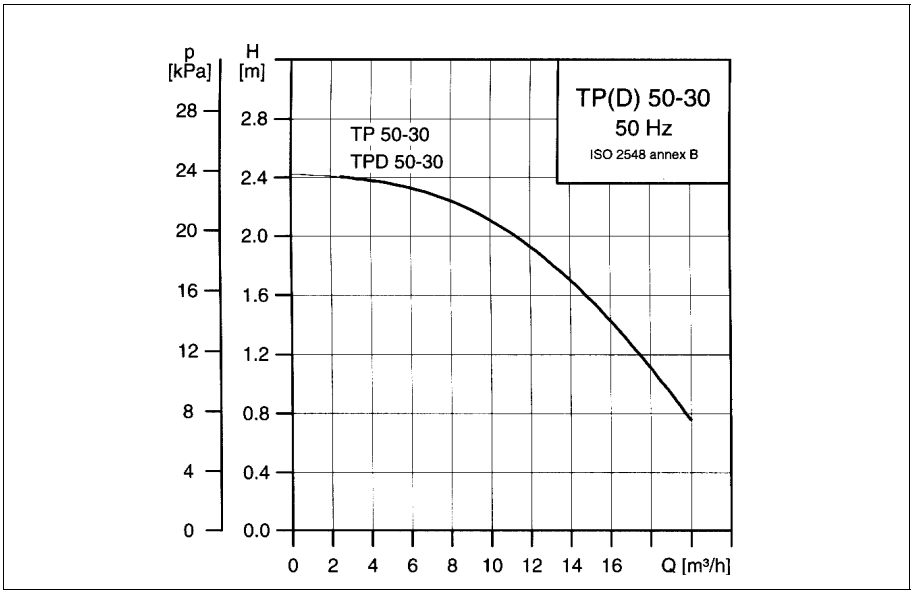


Fig. 15 TP 50 - 30

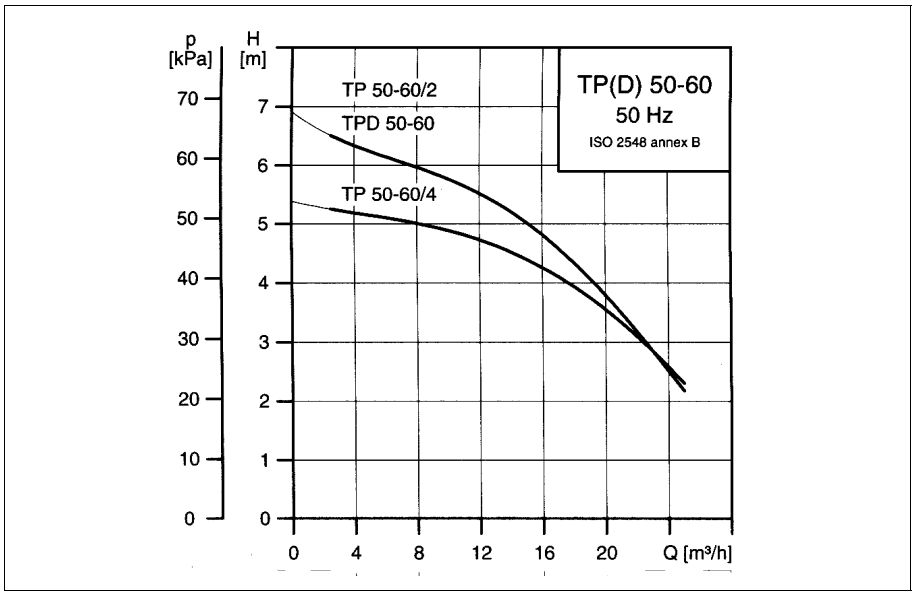


Fig. 16 TP 50 - 60

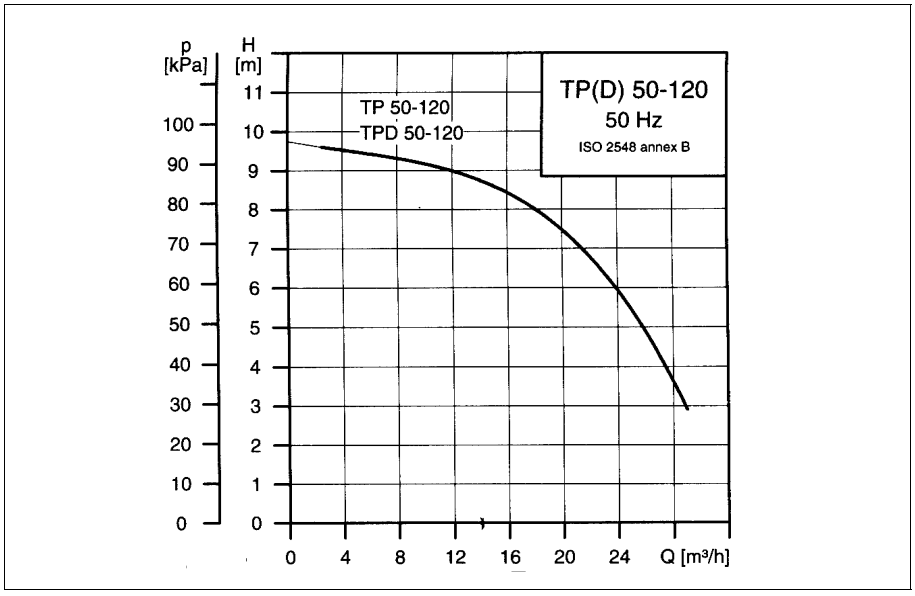


Fig. 17 TP 50 - 120

Type	Water flow rate Q in m^3/h	Pressure drop H in meter water gauche
R2017	14,5	2,1
R2022	14,0	2,2
R2028	13,5	2,4
R2034	19,5	3,0
R2041	19,0	3,1
R2048	18,5	3,2
R2056	18,0	3,35
R2066	17,5	3,45
R2077	17,0	3,55
R2090	24,5	6,6
R2105	24,0	6,8
R2122	23,5	7,1

Table 4 Water flow rate and pressure drop

Type	Grundfos pump	Pump motor rating			
R2017 R2022 R2028	TP 50 -30 PN10	3N~ 400 V or 1N~ 230 V	0,25 kW	1410 r.p.m.	0,92 A or 1,58 A
R2034 R2041 R2048 R2056 R2066 R2077	TP 50 -60 PN10	3N~ 400 V or 1N~ 230 V	0,37 kW	1410 r.p.m.	1,18 A or 2,04 A
R2090 R2105 R2122	TP 50 -120 PN10	3N~ 400 V or 1N~ 230 V	0,75 kW	2840 r.p.m.	1,86 A or 3,20 A

Table 5 Pump motor rating

A 400 V electrical supply is normally required for the primary pump.

5.2.4 Flues

Flue dimensions

You can use the following flue dimensions to assist in flueing:

Type	Q flue m^3/h	Chimney diameter mm
R2017	230	200
R2022	298	225
R2028	376	250
R2034	454	250
R2041	551	300
R2048	645	300
R2056	749	350
R2066	885	350
R2077	1013	400
R2090	1206	400
R2105	1407	450
R2122	1516	450

Table 6 Flue gas volumes

Heat input:	100 %
Flow temperature:	90 °C
Return temperature	70 °C
Flue gas temperature:	130 °C
CO_2	5,5 %

Average flue pipe resistance coefficients of various flue pipes. See also manufacturers information.	
bend 90E (R/D= 1,0)	ζ = 0,5
bend 90E (right angle)	ζ = 1,3
bend 45E	ζ = 0,5
T-piece	ζ = 2,0
outlet	ζ = 1,5

Table 7 Average flue pipe resistance coefficients

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 water heaters can be connected to a single flue.

Fan diluted flue system

A fan diluted flue system can be used with this type of water heater. The principle is to mix the products of combustion with fresh air drawn from the outside atmosphere to reduce the CO_2 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. (See for further instructions Supplement).

5.3 General recommendations

The cold water feed pipes should be installed and protected in accordance with local regulations. Generally this means that a check valve and an expansion valve should be fitted.
Hot water pipes should be thermally insulated.
In order to maintain a constant temperature at all outlets it is necessary to have a return circuit with a **secondary H/W circulator of a correct size**.
Only the water heater pump is supplied with the R2000.
The heat exchanger is made of copper, **galvanised pipes must not be used**.
With the R2000 water heater an expansion vessel should be included to avoid water being expelled via the safety valve when the temperature rises.

☞ The primary pump must run continuously when the water heater is in operation.

To avoid the formation of steam, the minimum water pressure must be 1,5 bar at a maximum temperature of 90 °C.
Some variation in water temperature can be due to an increased demand coincident with a variation in water pressure. To avoid this **a water governor should be used**.
When using a water softener it is necessary to include a non return valve.

Where there is a risk of the water pressure falling below the minimum pressure a minimum pressure switch should be included which turns off the water heater.
Under certain conditions and following a high demand it is possible for the water heater to condensate. It is necessary to maintain the water heater above the minimum condensation point of 36 °C. To achieve this, a slow operating motorised valve controlled by a thermostat in the secondary return is required.

5.4 Water temperature

For hot water for personal purposes one can generally take a temperature of 43 °C.

When this water is used for other purposes and where there are temperature losses in the pipework a temperature of 60 °C is considered suitable.

Installations supplying large kitchens demand much higher temperatures. For degreasing a temperature of 65 °C is required, for sterilising 85 °C. In this case the hot water supply unit will be operating at a temperature of 85 °C and for sanitary purposes tempered down to the required levels using thermostatic mixing valves. (See fig. 19)

5.5 Demand for hot water for sanitary use

In general the demand for hot water in sanitary hot water installations is not constant. For example, in a hotel for baths and showers the highest demand will be in the morning and early evening.
To determine the output of the water heater, it is therefore necessary to know the volume and temperature of the water during these peaks.
The following tables serve as a guide. They are derived from various sources and from extensive experience.

User	Single use or fill in litres	Temperature in °C	Demand in litres/minute
Dwellings			
kitchen sink	13 - 15	40 - 60	12 - 18
basin	7 - 10	40	6 - 8
hand washing	5	30	6 - 8
shower	60	40	8 - 12
bath	100 - 150	40	12 - 18
dishwasher	60	60	12
Hotel - motel			
basin	10	40	8 - 12
hand washing	5	30	6 - 8
shower	60 - 80	40	8 - 12
bath	120 - 180	40	12 - 18
dishwasher (ind.)	60 - 90	60 - 85	18 - 24
Industries			
basin	10	40	8 - 12
hand washing			
10 people	150 - 300	35	5 - 10 per outlet
6 people	120 - 180	35	6 - 12 per outlet
shower	60 - 80	40	10 - 15
Taps (fitting) capacity diameter in mm			
10	half open	40	5
	fully open	40	10
15	half open	40	10
	fully open	40	18
20	half open	40	25
	fully open	40	45

Table 8 Delivery from fittings

5.6 Water quality

Water hardness

The hardness of water is caused by the dissolved salts of calcium and magnesium, principally carbonates, sulfates and silicates.

Temporary hardness

When the temperature of the water is raised, part of the salts are precipitated as calcium carbonate and magnesium hydroxide. This is termed temporary or carbonate hardness.

Permanent hardness
The permanent hardness consists of minerals contained in the water which are not deposited such as calcium sulphate and calcium silicate. These salts form permanent hardness or non carbonate hardness.

Total hardness
The total hardness is the sum of the temporary hardness and permanent hardness.

Degrees of hardness
The temporary hardness of the water is expressed in mg/litre (ppm).

NOTE: 1 ppm (parts per million $CaCO_3$) = 1 mg $CaCO_3$ /litre

It is necessary to advise us of the hardness of the cold feed mains water supply in order to correctly size the circulation pump. Where the water hardness varies from season to season it is necessary to ascertain the maximum hardness.

The potential Hydrogen (pH):
The amount of hydrogen ions determines whether the water is acid or alkaline.
- A solution is acid when pH is less than 7
- A solution is alkaline when the pH is greater than 7.

The pH is measured at 25 °C. A pH of 7 corresponds to a neutral water. The pH varies with temperature. See graph A below. The pH of the water is very important as it influences precipitation of the carbonates. The pH of water is generally between 6,5 and 7,5. The temporary hardness is between 50 % and 100 % of the total hardness.

There is a relationship between water temperature and hardness. It is necessary to know the hardness of the cold feed main water supply in order to correctly the water heater pump.

If the concentration of magnesium chloride is higher than that of calcium chloride use a water softener. The use of water softeners is strongly recommended where water hardness exceeds 200 ppm.

Water hardness in ppm	**Setting of the limit thermostat in °C**
0 - 80	95
80 - 250	90
250 - 350	85
350 - 500	65

Table 9 Setting of the limit thermostat

Standard factory setting 65 °C.

For higher temperature requirements contact your supplier. They will make the necessary water quality measurements and advise you with regards to high temperature settings and the use of water softeners as required.

Water hardness in ppm	Maximum pH	Maximum operating temperature in °C
0 - 80	8,4	90
80 - 250	7,6	85
250 - 350	7,2	80
350 - 500	7,0	60

Table 10 Maximum operating level

When the operating temperature exceeds the high limit settings, the water heater will be turned off and will not go to lock-out.

5.7 Formula to calculate hot water requirements

From table 11 select the application, the number of hot water units and the formula to apply.
From table 12 as a function of the number of hot water units determine delivery in L/H at 60 °C.
From table 13 apply the formula to obtain the performance of the system.

Type of property		Hot water units *	Formula to apply **
Houses			
individual dwellings			
4 or 5 rooms, 1 bathroom		1 or 2	3
4 or 5 rooms, 2 bathrooms		2 or 3	3
flats			
3 or 4 rooms, 1 bathroom		1,5/flat	2 - 3
5 rooms, 2 bathrooms		2/flat	2 - 3
hotel, motel			
overnight visitors	*family hotel*	1/room	2
	bed and breakfast	1/room	3
resident	*touristic*	1,5/room	3
	luxury	2/room	3
Public sector			
car wash		0,5	4
restaurant		15/100 meals/sitting	4
hairdresser		3/seat	1
beauty salon		4/assistant	1
offices		1/washroom	1
Institutions			
sport club		5/shower 0,5/tap	4
school		4/shower 0,5/tap	3
factory		5/shower 1/tap	2 - 4
hospital		2 or 3/bed	1 - 2

Table 11 Application numbers

Number of hot water units *	Delivery G in litres/hour at 60 °C for numbers of hot water units***
1	700
2	1100
3	1250
4	1350
5	1400
6	1475
7	1550
8	1600
9	1675
10	1700
****15	1900
20	2100
25	2300
30	2500
40	2850
50	3200
60	3600
70	4000
80	4350
90	4750
100	5100
125	6050
150	7000
175	7950
200	8900
225	9850
250	10800
275	11700
300	12700
325	13650
350	14550
375	15500
400	16450

Table 12 Delivery

Formula for application		Hot water units *
1	Low demand	Q_{60} = G x 28 output in kW
2	Medium demand	Q_{60} = G x 35 output in kW
3	High demand	Q_{60} = G x 42 output in kW
4	Constant demand	Q_{60} = G x 57 output in kW

Table 13 Formula for application

* The hot water unit is determined as a function of the delivery from the taps.

** The formula set out in table 11 is not to be considered as a directive. To find a good formula it is necessary to compare one with another and adapt by experience.

*** The hot water units are based on a maximum delivery of 15 litres/minute for each outlet point.

**** When there is demand of less than 20 units and when high peaks are expected (sports clubs) we do recommend the use of a storage tank.

5.8 A small selection of applications

5.8.1 Single temperature system

Without storage tank using sufficient recirculation
Only applicable in projects with a constant draw or small fluctuations without large peak load. Such as hotels without catering towards the tour operators, hospitals, chemical industry, food processing, dairy produce etc.

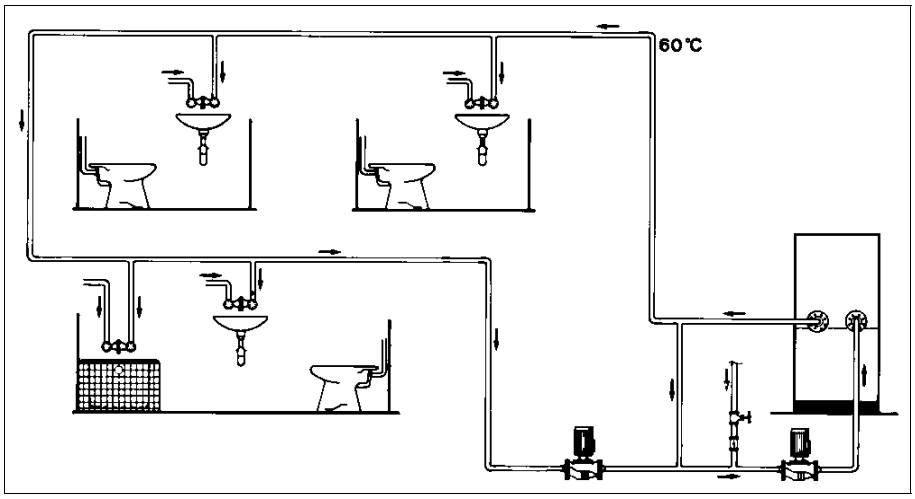


Fig. 18 Single temperature system without storage

5.8.2 Dual temperature system

With storage tank 300 l or 500 l
Applicable to projects where exact temperatures have to be adhered to or in projects with large peak loads and fast changing water demands. High rise apartments, hotels, kitchens, meat processing, fish processing industry etc.

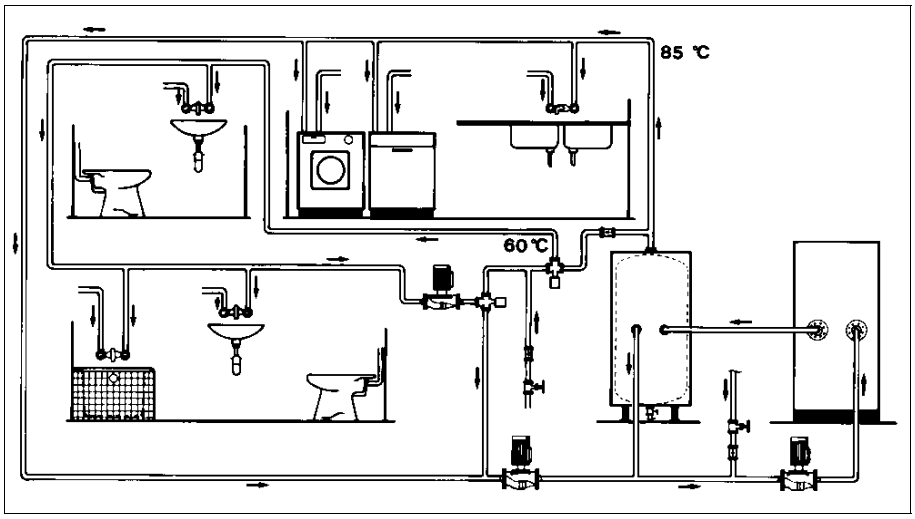


Fig. 19 Dual temperature system with storage

5.8.3 Industrial application

With storage tank 500 l +

This type of system has many applications in areas with large water demand fluctuations and variable temperatures to be kept within small tolerances. Industrial applications such as carwash (removing of protective wax layer), photo and film processing, laboratories, plating processing, slaughterhouses etc.

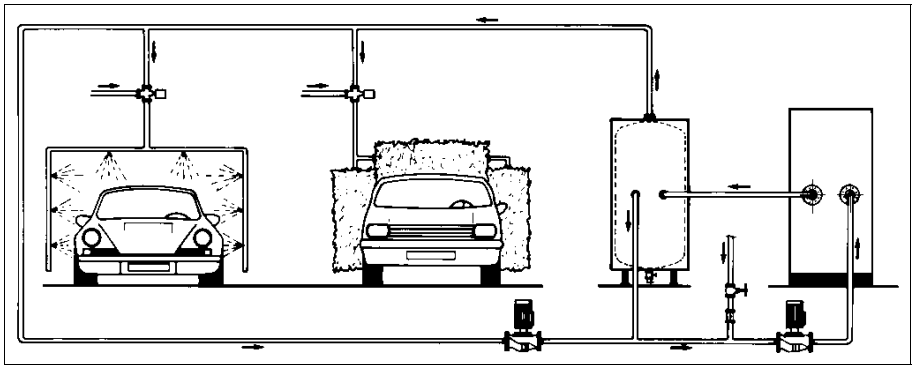


Fig. 20 Industrial applications with direct multiple temperatures

5.8.4 High peak demand use

With large storage tank

This application finds its way in projects with large peak loads in regular intervals. Schools, washing fountains at manufacturing facilities, Laundromats etc.

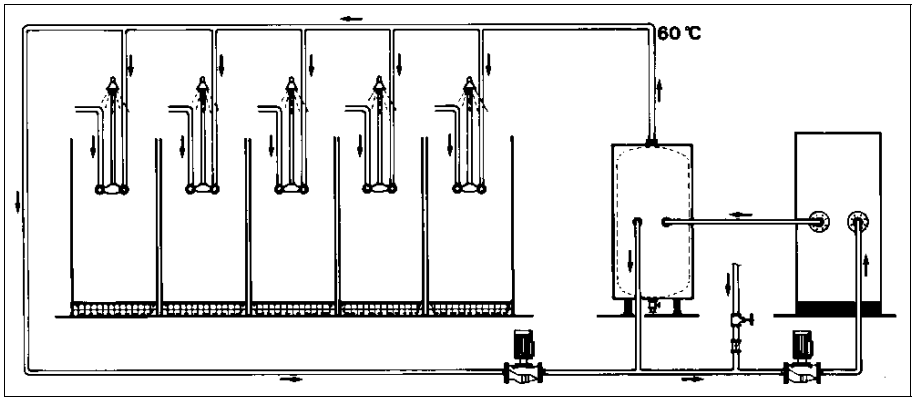


Fig. 21 High peak demand use during a short period with waiting periods

Other applications
Bottle cleaning and desinfection crate cleaning
Meat processing
Fish hatchery
Plating industrie
Film processing
In other words where ever warm or hot water is needed an Andrews Supa Flo water heater is the solution.

6 COMMISSIONING

6.1 General

COMMISSIONING OF THE WATER HEATER 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
- bleed the system
- switch on all pumps and check for correct direction of rotation
- close the stop-valves in the secondary system.

Electrical connection

- check the water heater electrical connection
- switch on the water heater 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:
  * static pressure
  * burner pressure
  * flame ionisation current

Adjusting the burner pressure

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

Natural gas H (G20) Gas service pressure 20 mbar Nozzle diameter 1,8 mm					
minimum load (20 %)					
Type	**Burner pressure (mbar)**	**Pilot pressure (mbar)**	**Air-damper opening closed (mm)**	**Burner pressure 40 % ET out/in (mbar)**	**Cascade out EM only (mbar)**
R2017	0,9	3,5	4	1,3/2	1,5
R2022	0,9	3,5	4	1,3/2	1,5
R2028	0,9	3,5	4	1,3/2	1,5
R2034	0,9	3,5	4	1,3/2	1,5
R2041	0,9	3,5	4	1,3/2	1,5
R2048	0,9	3,5	4	1,3/2	1,5
R2056	0,8	3,0	4	1,3/2	1,5
R2066	0,8	3,0	4	1,3/2	1,5
R2077	0,8	3,0	4	1,3/2	1,5
R2090	0,8	3,0	4	1,3/2	1,5
R2105	0,8	3,0	4	1,3/2	1,5
R2122	0,8	3,0	4	1,3/2	1,5
full load (100 %)					
Type	**Burner pressure (mbar)**	**Pilot pressure (mbar)**	**Air-damper opening closed (mm)**	**Burner pressure 40 % ET out/in (mbar)**	**Cascade in EM only (mbar)**
R2017	10,4	3,5	90	1,3/2	7,5
R2022	10,4	3,5	90	1,3/2	7,5
R2028	10,4	3,5	90	1,3/2	7,5
R2034	10,4	3,5	90	1,3/2	7,5
R2041	10,4	3,5	90	1,3/2	7,5
R2048	10,4	3,5	90	1,3/2	7,5
R2056	10,4	3,0	90	1,3/2	7,5
R2066	9,5	3,0	90	1,3/2	7,5
R2077	9,5	3,0	90	1,3/2	7,5
R2090	8,5	3,0	90	1,3/2	7,5
R2105	8,5	3,0	90	1,3/2	7,5
R2122	8,5	3,0	90	1,3/2	7,5

Table 14a Burner pressure Natural gas

Liquid Propane Gas Gas service pressure 50 mbar Nozzle diameter 1 mm					
minimum load (20 %)					
Type	**Burner pressure start/min. (mbar)**	**Pilot pressure (mbar)**	**Air-damper opening closed (mm)**	**Burner pressure 40 % ET out/in (mbar)**	**Cascade out EM only (mbar)**
R2017	5/2	11	8	13/18	6
R2022	5/2	11	8	13/18	6
R2028	5/2	11	8	13/18	6
R2034	5/2	11	8	13/18	6
R2041	5/2	11	8	13/18	6
R2048	5/2	11	8	13/18	6
R2056	5/2	11	8	13/18	6
R2066	5/2	11	8	13/18	6
R2077	5/2	11	8	13/18	6
R2090	5/2	11	8	13/18	6
R2105	5/2	11	8	13/18	6
R2122	5/2	11	8	13/18	6
full load (100 %)					
Type	**Burner pressure (mbar)**	**Pilot pressure (mbar)**	**Air-damper opening open (mm)**	**Burner pressure 40 % ET out/in (mbar)**	**Cascade in EM only (mbar)**
R2017	40	11	90	13/18	28
R2022	40	11	90	13/18	28
R2028	40	11	90	13/18	28
R2034	40	11	90	13/18	28
R2041	40	11	90	13/18	28
R2048	40	11	90	13/18	28
R2056	40	11	90	13/18	28
R2066	40	11	90	13/18	28
R2077	40	11	90	13/18	28
R2090	40	11	90	13/18	28
R2105	40	11	90	13/18	28
R2122	40	11	90	13/18	28

Table 14b Burner pressure Propane

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 water heater 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 water heater 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 water heater gas inlet service cock closed, electrical supply switched on but on/off switch on water heater control panel switched off*

I) Check that the direction of rotation of the pump(s) is correct.
II) Check the correct operation of the water flow switch lamp on the control panel as the pumps are turned on and off.

Components within the connection box
(Cover panel removed by removing the two screws at top of panel and lifting panel off the bottom locating pegs)

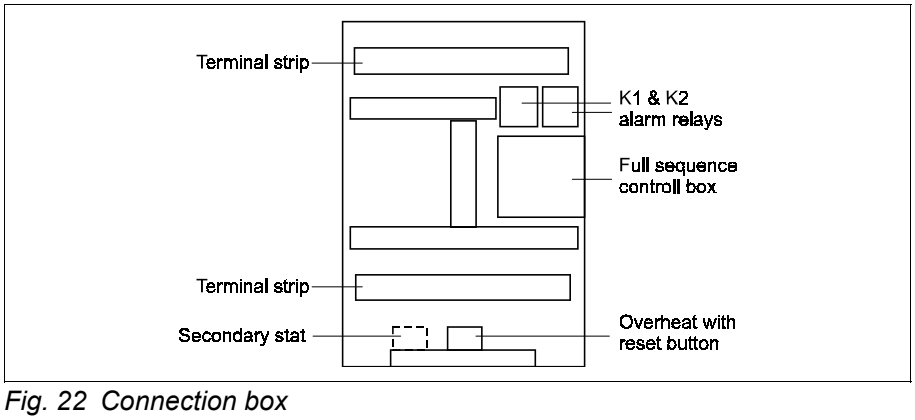


Fig. 22 Connection box

III) Check the setting of the modulating combustion air damper situated underneath the burners, there should be a gap **of 4 mm (Natural gas) or 8 mm (LPG) with the damper in the fully closed** position against the stops.

Burner trolley assembly

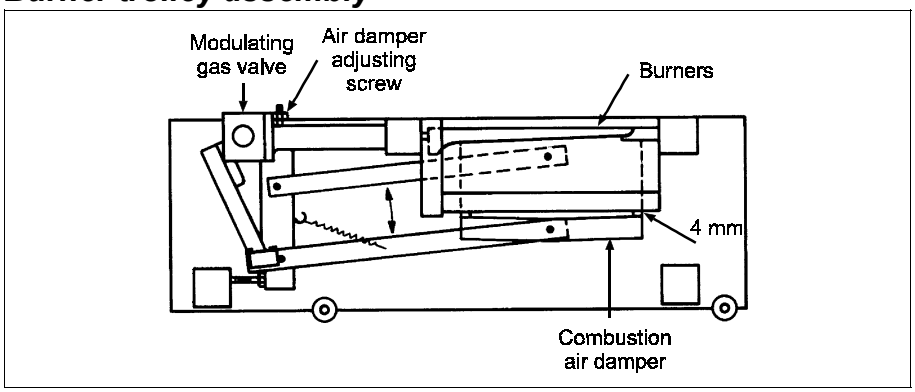


Fig. 23 Burner trolley assembly

IV) Check the operation and interlocking of any air inlet and extraction fans.

V) Check the correct connection and operation of any external controls.

VI) With the control thermostat on a high setting turn on the on/off switch at the water heater 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 water heater goes to lockout 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. 30 for particular water heater model.

1. Ensure that gas service cock and pilot manual cock are closed.
2. Connect a pressure gauge to test point 10/1 and open 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 mins.
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 (whole multi block on models R2017 and R2022).
7. With test points 10/1 and 10/2 opened 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. (Not applicable to models R2017 and R2022).
11. If no leak is found this indicates that the 2nd safety shut off valve is letting by and should be replaced (whole multi block on models R2017 and R2022).
12. Seal test point 10/2, replace pressure gauge on un-sealed 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.

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 panel.
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 water heater check that the ignition electrode ignites the pilot burner and that the pilot burner is stable in operation.
Check that the water heater 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 water heater lockout.

b. Carry out a) above and close the pilot manual cock once the pilot burner has ignited. Check that the water heater proceeds to lock-out.

c. Connect a pressure gauge to pressure test point 10/3 (see gas train fig. 30) and carry out a) above. Check that pilot burner pressure is as indicated in table 14a or 14b, with the pilot burner on test the pilot pipe and connections from the pilot manual cock to the burner connection.

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 panel.
Switch the on/off switch to on and the water heater 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 14a or 14b 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 water heater, remove pressure gauge and close the test point.

e. Remove the RH upper side panel and within the control panel remove the test link for the flame detection (see wiring diagram) and connect a µA-meter (0 - 50 µA =) in series with the flame detection circuit (see fig. 24). 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 (4a). Remove the ionisation plug (5). Connect the black wire (-) (A) of the µA-meter with the lowest contact in the plug (B) (see fig. 24). Connect the red wire (+) (C) of the µA-meter with the lowest contact in the ionisation socket (D). The ionisation of the pilot burner must show a minimum of 5 µA during 10 seconds after which the burner falls into flame detection lockout. Wire the main gas valve back to its originally conditions. Repeat the test by starting the water heater to maximum operation. Check that the µA-meter reads at least 5 µA after 10 seconds.

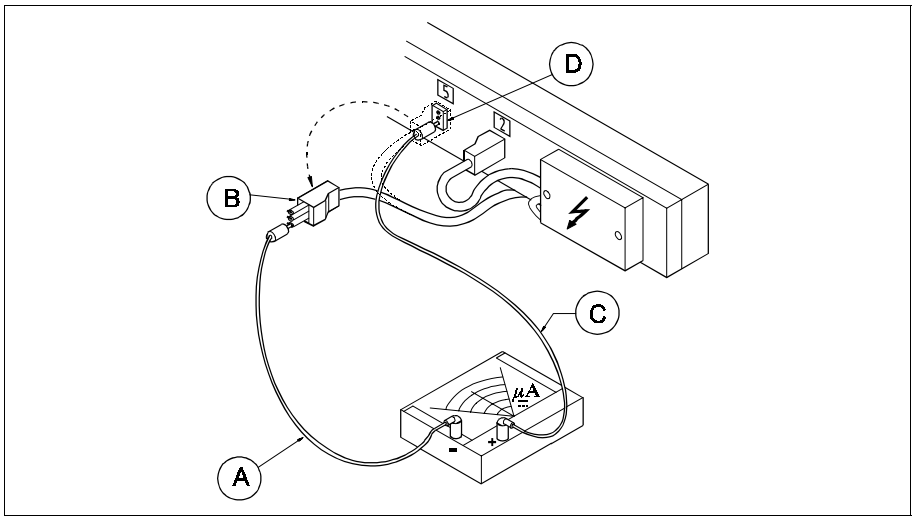


Fig. 24 Measuring ionisation

f. With the gas train cover closed switch on the water heater. 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 water heater space are shut and any extraction fans are operating. Spillage checks should be done with the water heater 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 14a or 14b, 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 water heater isolating valves. The water heater should go to lock-out.

j. Check that the pump overrun is operating correctly when the water heater is switched off and that any time controls are operational.

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 overheat control, by pressing button in right hand upper side panel, but stress that in case of repeated overheating of the water heater 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 water heater at the gas service cock and to call the local gas supplier.

Water heater failure

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

7 OPERATION AND FAULT INDICATION

7.1 Function

The water heater 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 or an electronic PID regulator (EM-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	Water heater lock-out indicator (central alarm and/or ionisation lock-out)	
3	Reset switch	
4	Overheat temperature indicator (off when water heater overheated)	
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 (EM only)	
T	Temperature Gauge	
P	Pressure Gauge	

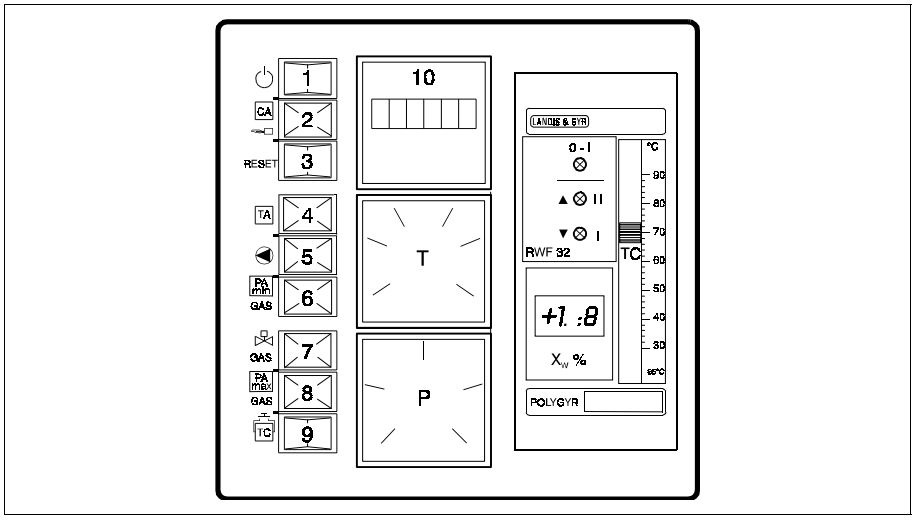


Fig. 26 Control panel electronic modulating version (version EM)

If there is **insufficient water flow** the water heater 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 water heater will mechanically lock-out and switch off. Red lamp 2 on. When resetting by pushing button 3, lamp 4 TA will light. Remove the two screws at the top of the upper right hand panel. Remove the panel by lifting up. Remove the high limit thermostat cap nut (see sticker high limit thermostat) with a 17 mm ringspanner. Press a screwdriver against the green peg until a light click is heard. Lamp 4 turns off. Refit cap nut. Refit upper right hand panel and fasten the two top screws.

7.4 Fault indications

If an **ionisation** interruption occurs, red lamp 2 will light, burner will be off. Reset by pushing reset button 3.

The pilot flame on the main burner can be observed through the sight glass on the lower right hand side of the water heater (see pos. 12, fig. 4).

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 water heater on and turn the water heater 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 water heater 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 water heater 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 & return header manifold. Damage to water heater 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
Water heater does not attempt to light	No electrical supply to water heater	check whether switched indicator (1) is alight
		Check all external controls for continuity
	No heat demand	Check control thermostat is set high enough
	Overheat control has operated	Check whether indicator (4) is alight if not reset by button through hole in upper RH side panel
	Insufficient water flow indicator (5) alight	check water system
	Control panel fuse blown	check fuse
	Faulty control box	change box
Air modulating damper cycles, no ignition spark and water heater then goes to lockout, indicator (2) alights	HT lead disconnected or faulty	correct
	Ignition electrode incorrectly set or faulty	check setting or replace
	Faulty ignition generator	change
	Faulty control box	change box
Ignition sparks, pilot burner does not light and water heater then goes to lock-out indicator (2) alights	Gas supply turned off	turn on
	Pilot manual cock turned off	turn on
	Air in gas line	purge air
	Check ionisation probe	if damaged, replace
	Faulty pilot safety shut off valve or Connections	rectify
	Pilot injector blocked	clean
	Pilot governor set too low	adjust

Fault	Possible cause	Solution
Pilot burner ignites but water heater then goes to lock-out, indicator (2) alights. Main burners do not light	Check flame probe	if damaged, replace
	Flame probe lead(s) not connected or faulty	rectify
	Faulty connections to main safety shut off valve(s)	rectify
	Faulty main safety shut off valves	change valves
	Faulty control box	replace
	Check ionisation current, as per instructions	
Water heater operates but then goes to overheat indicator (4) alights	Fault in water system	rectify
	Main burner pressure set too high	reset
	Pump overrun inoperative	rectify
	Water heater does not shut down	min. fire is set too high, reset servomotor.

8 MAINTENANCE

8.1 Safety

Always wear the proper protective clothing and shoes when servicing the water heater. Wearing jewelry and loose clothing can contribute to unsafe situations.

8.2 General information

In order to keep the R2000 in a safe working condition, the water heater should be inspected and serviced at least once every year and cleaned if necessary.

Frost protection
When water heater 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
Remove the inner and outer access panels on the draught diverter to allow internal inspection of the draught diverter and flue baffles.

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 section 8.4 ‘Cleaning’.

After removing the burner, the combustion chamber and the underside of the heat exchanger can easily be inspected by using a mirror for example.

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 right hand side of the burner assembly for inspection of:
- water heater 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 two brackets which attach the burner to the water heater frame.
3 Disconnect the spark plug, ionisation caps, servo-motor plugs & solenoid value plugs and remove the 'earth' lead.
4 Carefully withdraw the burner from the water heater unit. Inspect for dirt and clean the burner bars if necessary.

8.4 Cleaning

Before using chemicals and cleaning agents in the water heater, 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 suitable 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 WATER HEATER 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 water heater 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 water heater 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 fixings securing the gas train cover at the front of the water heater and remove carefully in the upward direction. Disconnect all the plugs from the front electrical panel and release the quick clamps at either side of the burner trolley. The burner trolley can now be withdrawn from underneath the water heater.
Release the fixing screw at the top of the right hand upper side panel covering the electrical controls. Both the right hand and left hand upper side panels can now be removed by lifting upwards and off their lower locating pegs. The front and rear upper panel can also now removed by lifting upwards off the locating pegs exposing the down draught diverter and the top of the heat exchanger.

Water heater with burner trolley removed

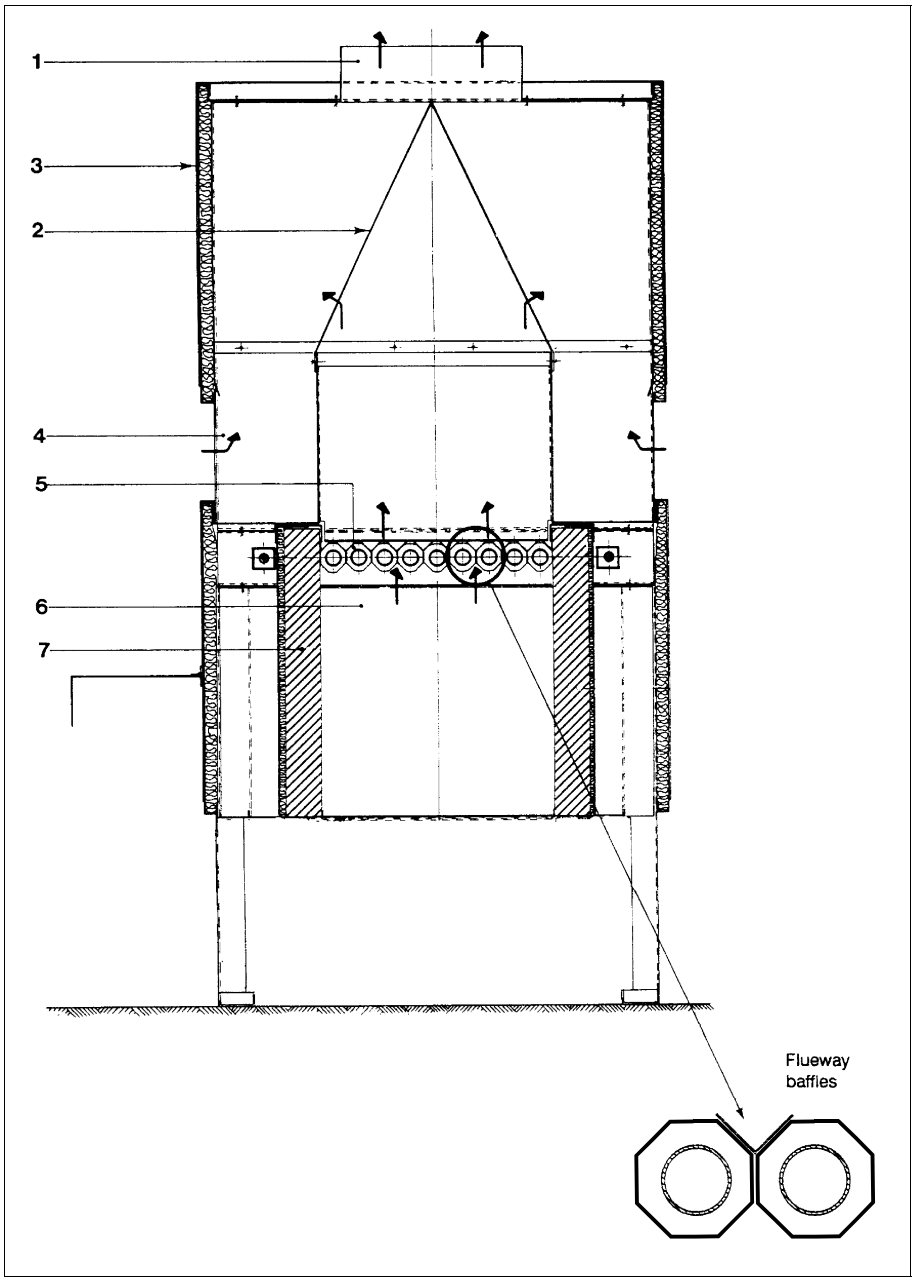


Fig. 27 R2000 with burner trolley removed

1 Flue outlet socket
2 Down draught diverter
3 Front and rear upper panels
4 Draught diverter air supply opening
5 Water heater heat exchanger
6 Combustion chamber
7 Combustion chamber insulation

Remove the down draught diverter 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 fins and replace flueway baffles.
Check the condition of the water heater 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 right hand burner bar, this is done by first removing the insulation covered stainless steel channels, located at the front and rear of the burner assembly, 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).

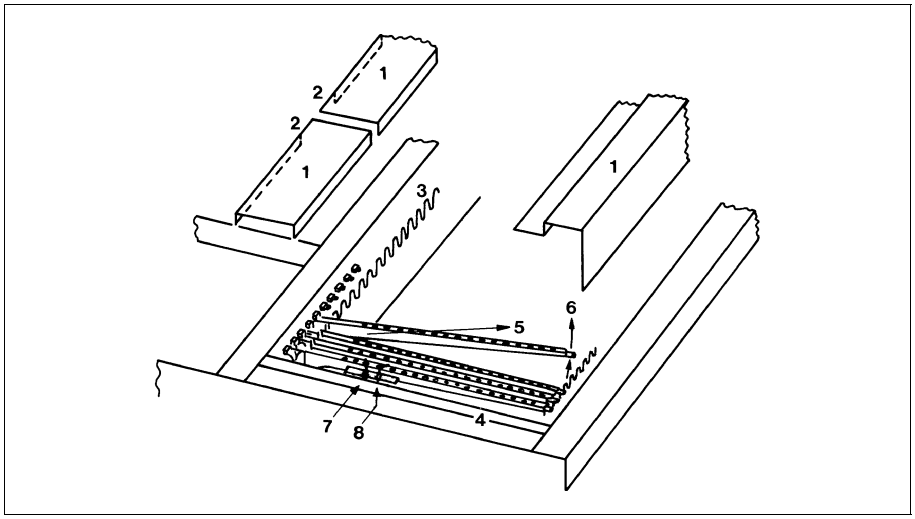


Fig. 28 Burner assembly

1 Insulation covered stainless steel channels
2 Notches to go over gas inlet pipe
3 Burner location tabs
4 Burner assembly frame
5 Withdrawal direction from holder & injector
6 Lift burner out of notch at end
7 Ignition electrode
8 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. 23, there should be **a gap of 4 mm with the damper in the fully closed position** against the stops.

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.
The two right hand burners have handed tabs to ensure that they are fitted in the correct position as they have cross lighting parts.
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. 28.
Ensure that the ignition and sensing electrodes are correctly positioned as shown in Fig. 29. If the position or gaps are not correct the electrodes must not be bent. In that case the electrodes have to be replaced.

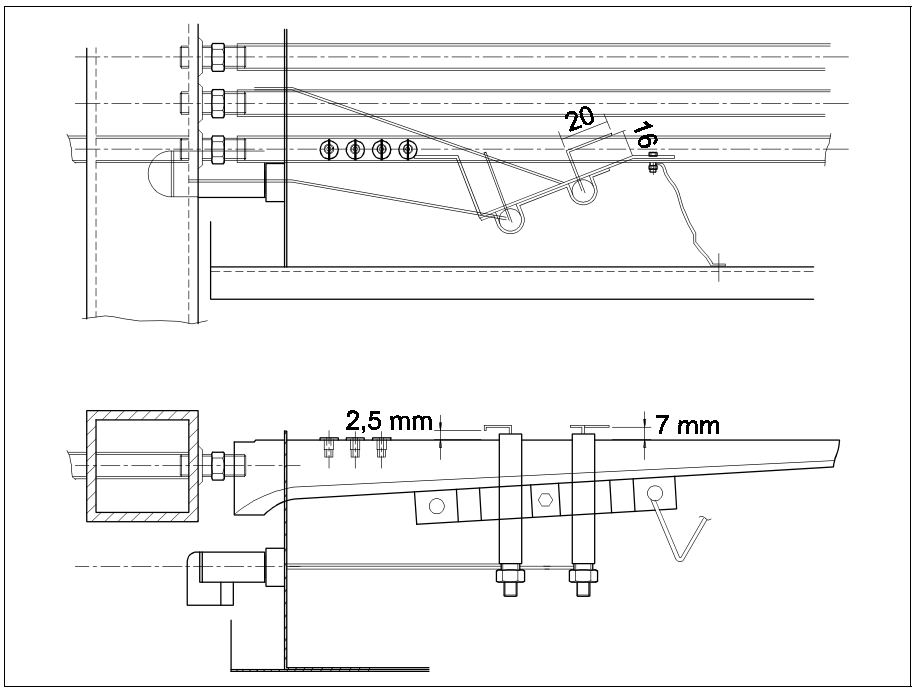


Fig. 29 Electrodes

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 various panels on the top of the water heater including the down draught diverter, replace the burner trolley and clamp into position. Re-connect the electrical connectors to the connection box.
Re-commission the water heater as described in Section 6 commissioning.

Gas trains

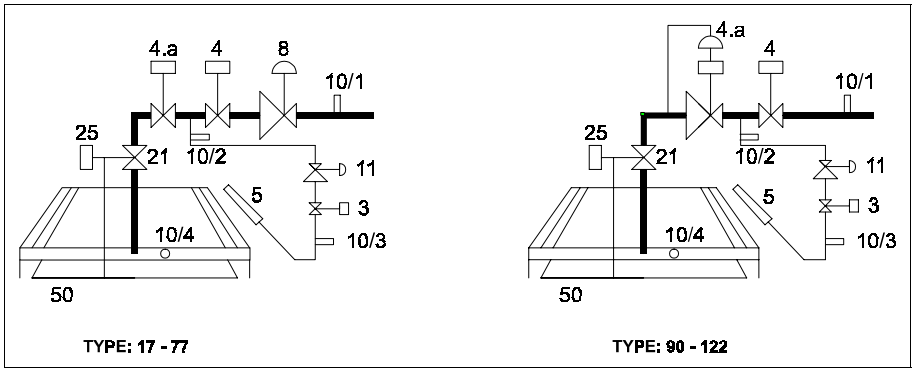


Fig. 30 Gas train

8.6 Component replacement

Electrodes
Remove the burner trolley as described earlier. Remove the insulation covered stainless steel channels and each burner as described at burner bars.
Remove the air guide assembly(s) which are located under the burner bars and ensure the spark electrode is disconnected from the ignition generator. Remove the burner assembly frame complete from its location in the burner trolley.
The ignition and sensing electrodes can now be replaced by removing two security screws and nuts which attach each electrode to the burner assembly frame.
When re-assembling ensure that the electrodes are correctly replaced with the burner bars in position. See that the insulation covered channels are correctly located.
Replace components in the reverse order of removal.
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 - 1.8 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).
Release the fixings securing the top of the gas train cover at the front of the water heater and remove carefully in upward direction.
Ensure that the gas service cock is closed, release the gas union, disconnect the plugs from the front electrical panel and release the quick clamps at either side 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:
Loosen the grub screw securing the keyed shaft of the modulating valve servomotor to its coupling and remove the motor by unscrewing two 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 copper 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 to the left out from its locating slot 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 5 commissioning.

Ignition generator
Release the two fixings securing the top of the gas train cover at the front of the water heater and remove carefully in upward direction.
Disconnect all of the plugs from the front electrical panel and remove the cover of the electrical panel by releasing two screws at each end.
Disconnect the ignition generator electrical connection from within the control panel and release the ignition electrode lead from the generator.
Replace the generator by releasing its screw fitting and reconnect the electrical connections in accordance with the separate supplied wiring diagrams.

Control panel components
Release the two fixing screws at the top of the right hand upper side panel and remove the panel by lifting upwards and off its lower locating pegs.
Refer to fig. 22 for the locations of the various controls.
Replace components by removing electrical connections and screw fixings. It is necessary to drain the water heater when replacing the water flow switch as it incorporates water connections.
The temperature sensing phials for both the control thermostat and the overheat control 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 right hand side panel of the water heater and its fixing screws can be accessed via
the control panel.
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.
Disconnect all pressure and temperature sensors from the flow/return header and electrically disconnect the flow-switch.
Remove the heat exchanger tensioning bars. Carefully remove the water manifold and flow/return header (2P and 3P).

Fin-tube replacement
Remove the unit's 18 O-rings.
From the top of the heat exchanger remove two baffles, one on either side of the damaged finned-tube.
On the side of the unit with the best access, remove the 4 bolts which attach the finned-tube mounting-plate (6) the unit's frame. This will allow partial withdrawal of the finned-tube mounting plate. Insert the 9 special tools into the finned-tubes on this side of the unit.
Gently withdraw the finned-tube mounting plate (6) about 3" and remove the special tool from the damaged fin tube. It should now be possible to remove this finned-tube from within the unit while the remaining tubes remain in position. During this operation the finned-tube mounting plate at the other end of the unit need not be moved.
Fit the replacement finned-tube, the special tool and slide the finned-tube mounting plate back into position and remove the special tools. Refit and secure the two heat exchanger baffles.

Inspection of the headers and the fin-tube mounting plate mating surfaces
Inspect the mating surfaces of the water manifold, flow/return header and the finned-tube mounting plate. These should be clean, smooth and undamaged.

O-ring replacement
Fit new O-rings to all finned-tubes (article No. ARO020).

Fitting and retensioning the water header and flow/return manifold
This is a reversal of the removal procedure.

NOTE It is very important that the tensioning bars are correctly tensioned. This is done by measuring the compression of the tensioning washers. The compression varies depending on unit type. The table and figure on the next page should clarify this.

Washer dimension X	
R2017 - R2034	14,0 mm
R2041 - R2056	21,0 mm
R2066 - R2077	28,5 mm
R2090 - R2122	42,5 mm

Table 15 Springwasher dimension

Upper dimensions are in pressed state wich are appr. 70 % of the unpressed state.

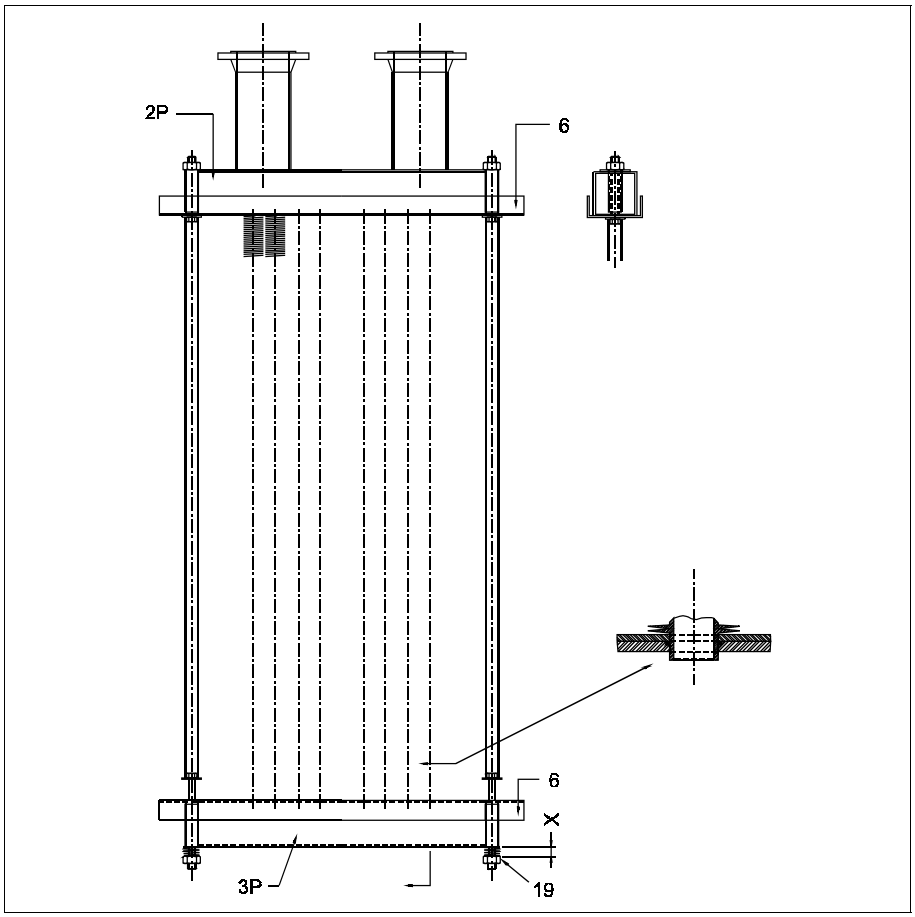


Fig. 31 Fin tube replacing

8.6 Service

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

Andrews Water Heaters
Wednesbury one
Black Country New Road, Wednesbury
West Midlands WS10 7NZ
tel.: 0121 506 7400
fax: 0121 506 7401

9 LIST OF SERVICEABLE PARTS

When ordering parts it is important to specify the model and serial number of the water heater. When ordering under warranty it is also necessary to specify the date of installation and commissioning.

Part	Manufacturer	Article code nr
Main gas valve (multibloc)		
model 2017 & 2022	Inter Albion 1"	RKS200
1st Main gas valve		
Model 2028 - 2034	Dungs MVD 210/5 or	RKS001
	Kromschröder VG25R02ND31	RKS100
Model 2041 - 2077	Dungs MVD 215/5 or	RKS002
	Kromschröder VG40/32	RKS101
Model 2090 - 2122	L&S VGG10/SKP10	RKM001/RMK001
2nd Main gas valve		
Model 2028 - 2034	Dungs MVD 210/5 or	RKS001
	Kromschröder VG25R02ND31	RKS100
Model 2041 - 2077	Dungs MVD 215/5 or	RKS002
	Kromschröder VG40/32	RKS101
Model 2090 - 2122	L&S VGG20/SKP20	RKM010/RMK010
Modulating gas valve		
Model 2017 - 2028	Rmx D 18	2017G1A1
Model 2034 - 2043	Rmx D 22	2034G1A1
Model 2056 - 2077	Rmx D 28	2056G1A1
Model 2090 - 2122	Rmx D 385	2090G1A1
Modulating valve servomotor	Berger/Lahr STM120Q2.47/8	RMS015
Pilot gas valve	Johnson control SM474	RKS025
Ignition transformer	L&S TQG11A27	ETH010
Flame safeguard relay	L&S LFL 1.148	RBA004
Control thermostat		
Type EM	L&S RWF 40	RRW007
Overheat control	L&S RAK 774371	RTR005
Ignition electrode	Rmx	REE001 AS
Flame sensing electrode	Rmx	REE001 BS
Burner bar		
Standard	Rmx	RIB001
Pilot burner assembly	Rmx	2000BIBD
Water flow switch	IT Regelgeräte NL5F-1E	RSS015/RSS010
Temperature gauge	Stork IFC 48-045-KRF	ROT020
Pressure gauge	Stork IM 48-04-KRF	ROM030
“O”-ring for fin tube	Rmx	ARO020
Pump		
model 2017 - 2028	Grundfos UMT 50/30 PN10	
model 2034 - 2077	Grundfos UMT 50/60 PN10	
model 2090 - 2122	Grundfos UMT 50/120 PN10	

SUPPLEMENT

Regulations and standards
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 water heaters 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.

Local water bylaws.