

Technical documentation

R300

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R300 Technical data

Type		R301	R302	R303	R304	R305	R306	R307
Nominal heat output	kW	70	86	114	139	185	230	274
Nominal heat input (nett. CV)	kW	74	91	121	147	194	243	289
Minimum heat input	kW	16	20	23	29	39	49	58
Gas consumption								
natural gas H (10.9 kWh/m ³)	m ³ /h	6.79	8.35	11.10	13.49	17.80	22.29	26.51
propane (12.8 kWh/kg)	kg/h	5.78	7.11	9.45	11.48	15.16	18.98	22.58
Gas inlet pressure								
natural gas (min.)	mbar	17	17	17	17	17	17	17
natural gas (max.)	mbar	50	50	50	50	50	50	50
propane (min./max.)	mbar	30/50	30/50	30/50	30/50	30/50	30/50	30/50
Water capacity	dm ³	13	15	17	19	36	39	42
Max. working pressure	bar	6	6	6	6	6	6	6
Flue connection	D	mm	100	100	130	150	180	200
Air supply	D1	mm	100	100	125	125	150	180
Gas connection	G		R 3/4"	R 3/4"	R 3/4"	R 3/4"	R 1"	R 1 1/2"
Water connections	W		R 1 1/2"	R 1 1/2"	R 1 1/2"	R 1 1/2"	R 2"	R 2"
Power supply	V	230 1N~	230 1N~	230 1N~	230 1N~	230 1N~	230 1N~	230 1N~
Frequency	Hz	50	50	50	50	50	50	50
Fuse	A	10	10	10	10	10	10	10
Max. electrical power consumption	unit	W	128	128	391	391	397	397
pump (option) maximum		W	245	245	245	245	380	380
total		W	373	373	636	636	777	777
Boiler weight, empty, ± 5 %	kg	120	140	160	180	250	270	290

Table 1 Technical data R300

Dimensions R300

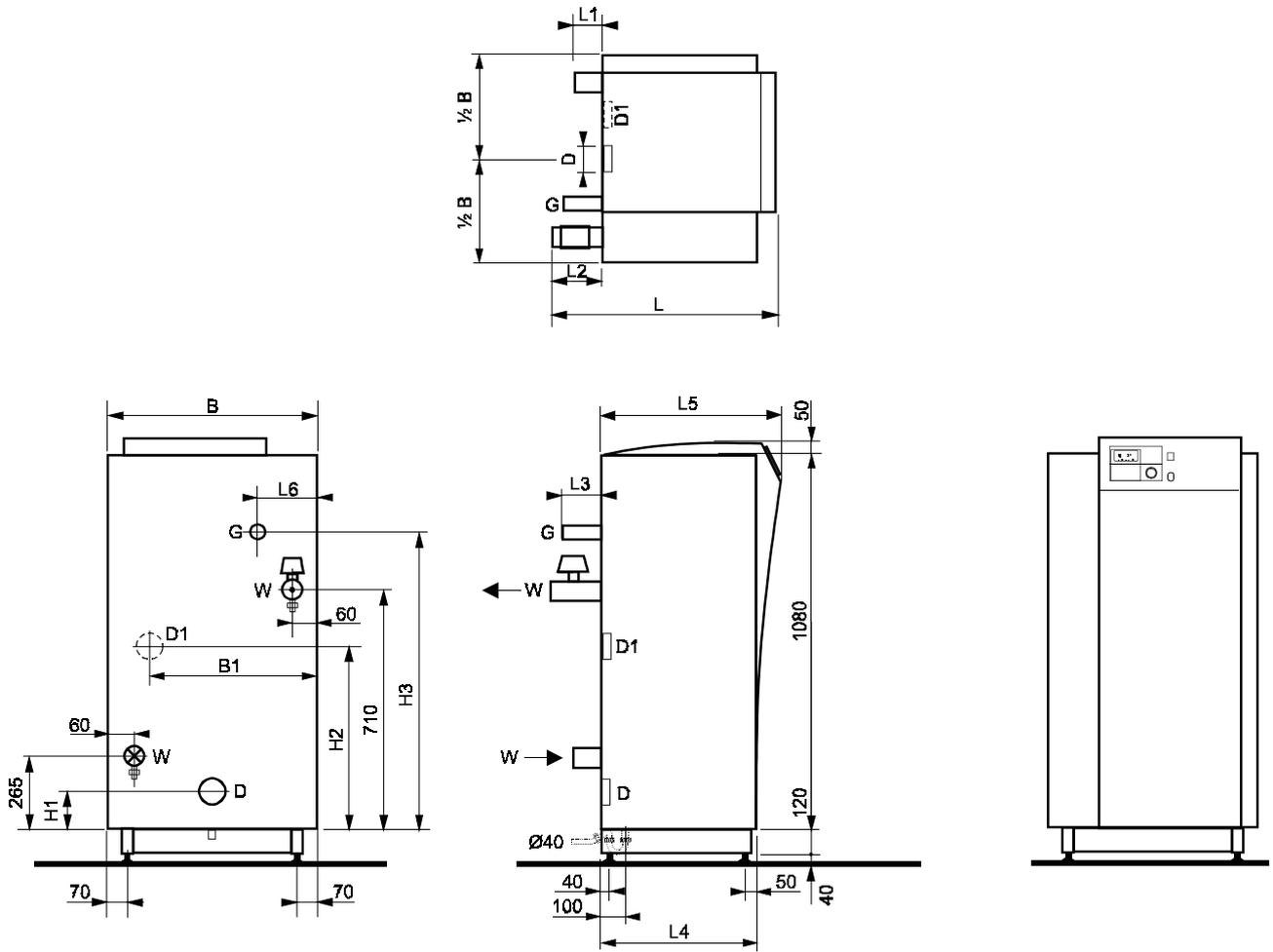


Fig. 1 Dimensional sketch R300

Type		R301	R302	R303	R304	R305	R306	R307
B	mm	500	600	700	800	600	700	800
B1	mm	360	420	490	560	470	550	600
D	mm	100	100	130	150	180	200	200
D1	mm	100	100	125	125	150	180	180
G		R 3/4"	R 3/4"	R 3/4"	R 3/4"	R 1"	R 1 1/2"	R 1 1/2"
H1	mm	160	160	170	176	197	197	197
H2	mm	497	488	501	486	556	549	537
H3	mm	943	943	921	921	921	921	921
L	mm	685	685	685	685	895	895	895
L1	mm	50	50	50	50	85	85	85
L2	mm	160	160	160	160	160	160	160
L3	mm	80	80	90	90	100	100	100
L4	mm	445	445	445	445	655	655	655
L5	mm	525	525	525	525	735	735	735
L6	mm	95	95	135	120	130	120	120
W		R 1 1/2"	R 1 1/2"	R 1 1/2"	R 1 1/2"	R 2"	R 2"	R 2"

Table 2 Dimensions R300

Conditions applicable to table 1:

- Nominal capacity measured at: 60 - 80°C.
- Gas consumption at: 1013 mbar, 15°C, dry
- Gas category: II_{2H3P}
- Appliance category: B23, C53, C33 or C63
- Protection degree: IP20

1 Introduction

1.1 General

Founded in 1968 Rendamax B.V., from her dutch basis, has evolved a worldwide reputation in research and development. production and marketing of gas fired high performance heating equipment of professional use in the range from 45 to 1200 kW.

Through their unique construction, these central heating units 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.

Active and market required research enables Rendamax to offer solutions for the most provocative heating demands.

1.2 Supplier

Rendamax heating boilers are sold throughout the United Kingdom by your supplier (see cover). For advice or more information with regard to our products contact your supplier.

1.3 This document

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 cover) 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 6.

1.4 Service

For commissioning and assistance in maintenance matters, please contact your supplier's service department.

1.5 *General restrictions*

The application, installation and maintenance of Rendamax 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 Rendamax B.V. in relation to its products are based on careful investigation. Nevertheless, neither Rendamax B.V. nor any other organisation connected with Rendamax B.V. accepts any liability for application, installation or exploitation that occurs outside its sphere of influence.

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

2 *Description*

2.1 *General*

The R300 series are environmentally friendly modulating gas fired heating boilers with variable outputs from 20% to 100% of maximum capacity.

The R300 series consists of 7 types in a range from 70 to 274 kW.

The units have an extremely low emission of NO_x and CO, so that this boiler satisfies the most stringent European requirements.



The R300 series have CE approval for all relevant European countries. The series are registered under the product identification number 0063BL3354.

The boilers are standard supplied as a standard (category B23) or a room sealed (categories C53, C33 or C63) appliance.

Working principle and construction

Air is blown into the appliance, as required, by a speed-controlled fan and thoroughly mixed with gas in the correct proportions.

A temperature controller compares the desired water temperature with the temperature of the water flow. If required, the controller will vary the load and the fan will emit a speed feedback signal to maintain the correct heating capacity.

The gas/air mixture so formed is passed through the cooled premix burner and ignited. The premix burner is constructed of finned bimetallic pipes (inside stainless steel, outside aluminium) and cast iron water headers.

Heat transfer takes place in three heat exchangers. The first heat exchanger is constructed from smooth stainless steel pipes, while the second heat exchanger is fitted with laser-welded, stainless steel finned pipes. The third heat exchanger is fitted with smooth stainless steel pipes.

All heat exchangers are fitted with cast iron water headers (stainless steel for water heater) which guarantee an optimum water flow through the appliance.

The burner and the heat exchangers are connected in series.

The R300 units have a small water capacity so that it can rapidly adjust to changing conditions. It can be installed without any restrictions to the return water temperature. The necessary water flow rate is ensured by the standard pump delivered with the appliance.

Application possibilities

Because of its construction, the R300 unit is suitable for use in heating systems:

- With a constant supply temperature
- With a weather dependent heating demand
- With low temperature condenser systems
- With optimised condensation
- With control by means of building optimizer/compensator system ($2 - 10 \text{ Vdc} = +10^\circ\text{C} - +90^\circ\text{C}$), see 5.3.2 connection terminals).

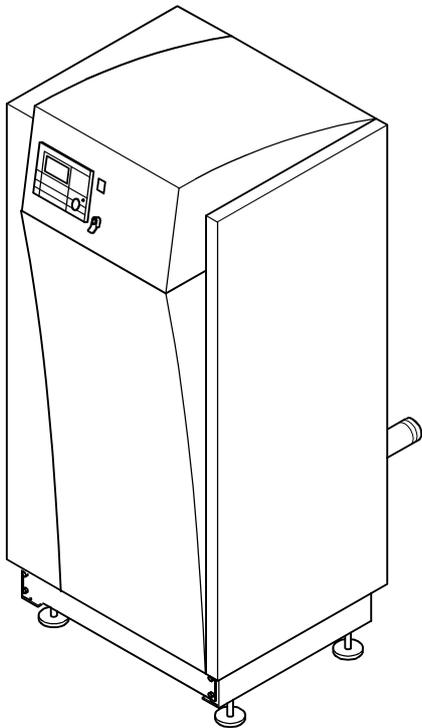


Fig. 2 The R300 model

2.2 Main components

- | | | | |
|----|------------------------------------|----|------------------------|
| 1 | Casing | 17 | Frame |
| 2 | Air pressure switch | 18 | Filling/drainage valve |
| 3 | Control panel | 19 | Return connection |
| 4 | Burner | 20 | Water flow switch |
| 5 | Combustion chamber | 21 | Water headers |
| 6 | First heat exchanger | 22 | Ignition transformer |
| 7 | Second heat exchanger | 23 | Connecting terminals |
| 8 | Third heat exchanger | 24 | Distribution plate |
| 9 | Condensate receptacle | 25 | Gas valve unit |
| 10 | Flue attenuator | 26 | Fan |
| 11 | Condensate discharge trap (V-bend) | 27 | Gasfilter (option) |
| 12 | Flue gas discharge | 28 | Air supply |
| 13 | Flow connection | A | Air |
| 14 | Safety valve (option) | B | Gas |
| 15 | Gas connection | C | Flue gas |
| 16 | Adjusting feet | D | Condensate |

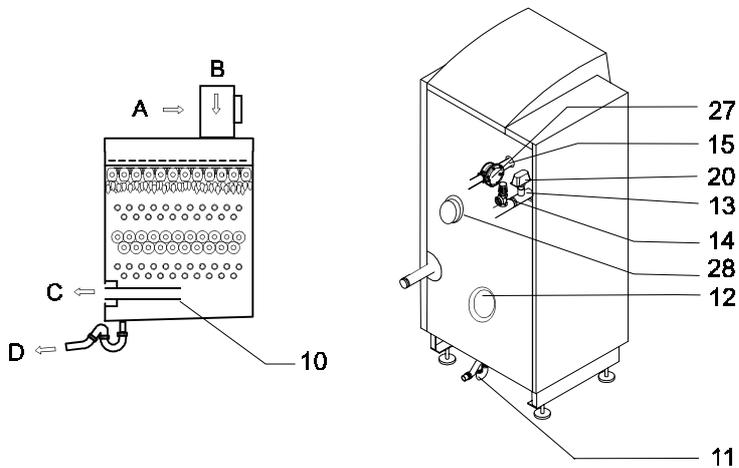
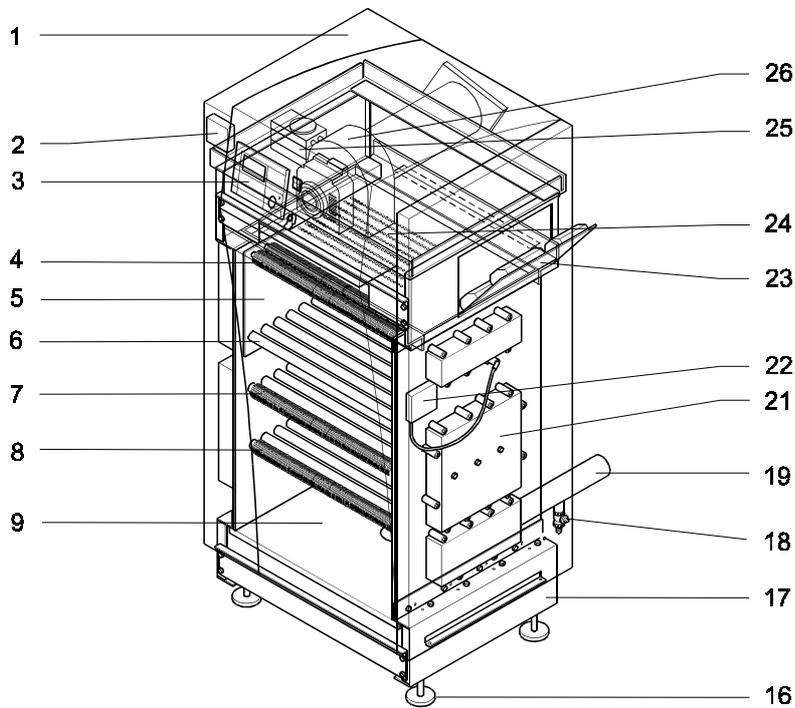


Fig. 3 General survey

2.2.1 *Description of principal components*

The boiler is constructed from the following principal components:

Fan [26]

The DC fan, which is equipped with a speed feedback, draws in the combustion air and increases the air pressure. The speed feedback signal is relayed to the regulator, which adjusts the speed if need be.

Gas train

The principal component of the gas train is the main gas valve [25]. The quantity of gas is adjusted in proportion to the quantity of air being supplied. The quantity of air depends on the speed of the fan. As an option, the unit can be equipped with a gas filter [27].

Burner [4]

After the gas/air mixture has been distributed over the burner using a distribution plate, the mixture is burnt on the burner surface such that the flame is directed downward. The burner is both air and water-cooled. The water headers are constructed of cast iron (stainless steel for water heater), and ensure a two-pass flow through the burner.

Heat exchangers [6, 7 and 8]

The first heat exchanger is constructed of smooth stainless steel pipes and transfers most of the combustion energy to the system water. The second heat exchanger is constructed of laser-welded, stainless steel finned pipes. The third heat exchanger is constructed of smooth stainless steel pipes. The second and third heat exchanger transfer the heat from the combustion gasses to the system water. All water headers are constructed of cast iron (stainless steel for water heaters), and ensure a five-pass or three-pass flow through the heat exchangers (depending on the type). The space between the burner and the first heat exchanger constitutes the combustion chamber.

Water headers [21]

The water headers are part of the burner and the heat exchangers.

Water connections

These consist of a flow connection [13] and a return connection [19]. Both of these connections are provided with a filling/drain valve [18]. The flow switch [20] is fitted on the flow line.

Boiler pump (optional)

The boiler pump must be mounted on the return connection to the unit and can be directly connected electrically to the appropriate terminals in the connection box. The capacity and the working head of the pump is sufficient to overcome both the resistance of the boiler and some system resistance. As an option, the pump is supplied as a separate item with the boiler.

Condensate receptacle [9]

A condensate receptacle is fitted underneath the last heat exchanger. This receptacle is equipped with a condensate and flue gas outlet.

Frame [17]

The frame is constructed from steel profile sections and is fitted with vibration absorbing adjusting feet [16].

Casing [1]

The casing consists of easy-to-remove panels. Once the cover has been opened (using tools), all other panels can be removed without using tools.

The electrical section

This includes the control and safety circuits for the unit.

Connecting terminals [23]

The boiler power supply, the connecting terminals, the pump connection and the pump relay are all fitted on top of the boiler. The terminal strip is located under the cover, on the right hand side.

2.3 Boiler control

The principle employed for the Boiler Management Unit is as follows: The boiler begins operating on receipt of a heating demand. This heating demand is generated either:

- A if the measured supply temperature is lower than the desired temperature
- B as a result of “service operation” mode having been selected (⚙ I or ⚙ II)
- C in standby mode, when the water temperature falls below the frost protection temperature.

After the unit has started up, the PID controller sends a signal to the fan, thus controlling the fan speed. Depending on the quantity of air displaced by the fan, the proportional pressure regulator will add the corresponding quantity of gas. In this way, the boiler power is continuously modulated, enabling the boiler to accurately follow the demand for heat. The fan is equipped with a speed feedback, enabling an even more accurate control behaviour.

Once the supply water temperature exceeds the desired value, the unit will shut down. As soon as the supply water temperature falls below the set value, the boiler restarts.

2.4 Safety aspects

The boiler contains the following safety components:

- Flame protection (1x re-start)
- Water flow protection
- Maximum water temperature protection
- Gas valve test
- Fan protection
- Overload and underload protection.

If one of these components operates, this results in a lockout fault. Lockout faults can only be cancelled by resetting the unit.

3 Safety

Installation instructions

Read through these instructions carefully before starting the installation.

The appliance must be installed by a recognised installer in accordance with the applicable national and local regulations.

The installation may only be used for heating systems up to a maximum water temperature of 90°C.

It is expressly stated that these installation instructions must be seen as a supplement to the above mentioned standards and regulations and that these standards and regulations must take precedence over any information included in this technical manual.

Pictograms used in this manual



An instruction that is essential for the correct functioning of the installation.



If these operations, procedures, etc., are not accurately followed this can result in serious damage to the installation, personal injury or environmental damage.



Danger of electric shock.



Useful information.

Maintenance

Work on the electrical installation may only be carried out by an authorised installer in accordance with the applicable electrical regulations.

Work on the gas and hydraulic installations may only be undertaken by properly trained personnel in accordance with the safety regulations for gas installations.



Keep unauthorised persons away from the installation. Do not place any objects on the unit. Remain out of the area of the hot water connection and the chimney to avoid burns.

Before starting any maintenance or service activities, disconnect the electrical power supply and close the gas supply valve.

After completing any maintenance or service activity, check the whole installation.



As a supplement to the information provided in this technical manual, all applicable safety regulations must be consulted to avoid accidents.

All panels forming part of the casing must be mounted. Panels may only be removed for maintenance or service purposes. After performing maintenance or service activities, ensure that all panels are replaced.



Safety provisions

The installation may never be switched on if any of the panels have been removed or if any of the safety devices have been disabled.



Instruction and warning stickers

None of the instruction and warning stickers attached to the installation may be removed or covered and during the whole of the lifetime of the installation they must remain legible. Replace any damaged or unreadable instruction and warning stickers immediately.

Modification

Modifications to the installation may only be carried out with the written approval of the manufacturer.

Danger of explosion

When activities are being undertaken in the boiler room, always follow the applicable instructions “Working in an area where there is a danger of explosion”.

Installation

The appliance must be installed by an authorised installer in accordance with the applicable national and local specifications and regulations. Carefully follow all the safety instructions.

Operation

In the event of a gas leak, switch off the unit and close the gas supply valve. Open doors and windows and warn the appropriate authorities.

When the installation is re-commissioned, always follow the instructions for use.

Technical specifications

The specifications listed in this technical manual cannot be ignored.

4 Delivery and transport

4.1 Delivery

The unit comes standard fully assembled, tested and packaged.
After delivery and removal of the protective covering, check the appliance for damage.
Check that the equipment delivered is in accordance with the order and the delivery note.
On delivery, check the data plate for the correct boiler type and gas supply pressure.

4.2 Packaging

The unit is supplied in cardboard packaging on a pallet.
For transport, consult the technical details for dimensions and weight.

4.3 Transport



Remove the packaging preferably after transportation and positioning in the boiler room or remove the panels before transporting the appliance. This is to prevent damage to the casing panels.

Moving the appliance

A pallet truck or fork lift truck used at the front or side of the unit.

Standard door width

The dimensions of the unit are such that after removing the pallet, all types will fit through a standard width door opening of 80 cm (remove the outside panels of type R307).

Positioning

Once the boiler has been installed, it can be adjusted horizontally using the adjusting feet.
Subsequently, the water, gas, condensate and electrical connections can be made.

Protection against frost



If the unit is out of use during the winter months there is a danger of freezing. Drain the water from the installation using the filling/drainage valves.

5 Installation

5.1 Regulations

The appliance must be installed by a recognised installer in accordance with the applicable national and local specifications and regulations.

Commissioning should be carried out by the service department of your supplier, who can also determine the composition and quality of the system water.

5.2 Boiler room

5.2.1 General

- The construction of the unit ensures that losses through radiation can be neglected
- Because of the low noise level, additional sound insulation of the boiler room is unnecessary
- Because of the position of the electrical components, a plinth is not required
- The unit is so constructed that the space required for it is small
- The range of applications for the boiler is that much greater because of the possibility to install it as a room sealed appliance (see Section 5.3.4)

5.2.2 Set up

In order to avoid any difficulties, the following rules apply to the boiler room:

- a Install the appliance in a frost-proof room
- b Pay particular attention to the positioning of the appliance to ensure protection from freezing and/or high temperatures
- c Ensure that the boiler room is sufficiently large, so that there is sufficient space on all sides of the unit to permit maintenance and possible replacement of components to be carried out.

The recommended minimum free space is:

- 250 mm at both sides
- 1000 mm at the front (space for free movement).

If you do not observe the recommended space requirements, future maintenance might be more difficult.

Installation on a roof

When the appliance is installed on a roof or when the boiler room is the highest point in the system, the following protective measures are important:



The unit itself may NEVER be the highest point of the installation; in other words, the flow and return pipes from the boiler (as seen from the boiler) must first run upward before running down to the boiler.

Despite the fact that every unit is provided with water flow protection, local authorities often require low water level protection to be fitted. When multiple units are installed, it is only necessary to fit one additional protective device.

5.2.3 Ventilation

The ventilation of the boiler room must satisfy the applicable national and local standards and regulations.



With regard to ventilation, pay particular attention to the following points:

- a Observe the applicable national and local standards and regulations for the dimensions of the openings and the protection for any mechanical ventilation
- b Ensure that the air inlet openings are transversely placed in two opposite walls
- c Fit inlet gratings with a large width and a small height

- d Ensure that the correct amount of high level ventilation exists
- e If the air supply is inadequate, it may be necessary to fit a mechanical means of providing adequate ventilation.

5.3 Connections

5.3.1 Gas connection

The gas connection must be made by a recognised installer in accordance with the applicable national and local standards and regulations.

The gas connection is made at the rear of the boiler.

The pressure of the gas supplied to the unit must be reduced to 50 mbar for natural or for propane with the use of a gas pressure regulator.

The loss of pressure in the connecting pipes must be such that, at maximum boiler capacity, the pressure must never fall below 17 mbar for natural gas or 30 mbar for propane.

5.3.2 Electrical connection

The electrical connections and provisions must comply with the applicable national and local standards and regulations.

The units are wired in accordance with the electrical diagram supplied with the appliance.



The electrical connections, the handling brackets and the boiler pump relay are located underneath the cover, on the right-hand side of the boiler. You can unlock the cover using a 4 mm socket wrench.

You must connect the unit using an all-pole main switch with a contact opening of at least 3 mm. The cables to be connected (power supply, control) enter the appliance via the rear of the unit, using cable glands.

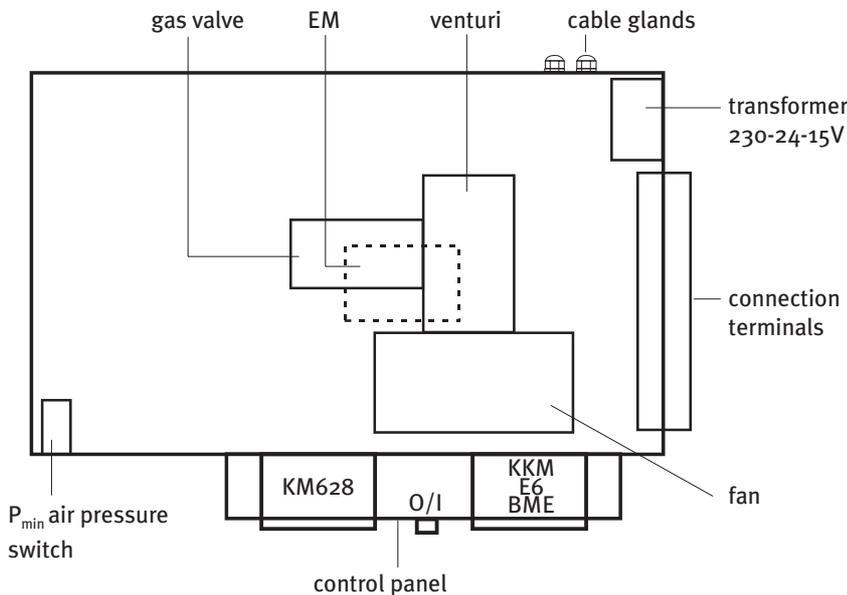


Fig.4 Connection box

The appliance can be switched on and off with the switch on the control panel. The power supply voltage cannot be removed from the boiler pump relay in this way.

The installer must fit a mains isolator switch in the power supply to the unit **within the boiler room**. This can be used to switch off the power to the unit for maintenance purposes or in the event of a problem.



In accordance with the applicable standards and regulations, an **emergency shut-off** must be fitted **outside the boiler room**. In the event of a calamity, the power supply to the unit can be switched off.



In order to prevent malfunctions occurring as a result of inductive or high frequency signals, or static electricity, screened cables must be employed for all low voltage and control signals between the boiler and externally connected units. The screening must be earthed at both ends of the cable.

Electro-technical data

Type	Fan, control and safety components		Pump (option)		Total electrical power consumption (max)
	Supply* 1N~	Power consumption (max)	Supply* 1N~	Power consumption ** (max)	
	V	W	V	W	W
R301	230	128	230	245	373
R302	230	128	230	245	373
R303	230	391	230	245	636
R304	230	391	230	245	636
R305***	230	397	230	380	777
R306***	230	397	230	380	777
R307***	230	397	230	380	777

Table 3 Electrotechnical data

- * tolerance on voltage: 230 V +10 % /-15 % tolerance on frequency: 50 Hz ± 5 %
- ** the stated pump power is based on the maximum power consumption in pump speed 3
- *** 3-phase pump available as an option.

For additional energy savings an optional speed controlled pump is available for the series R300. For details of this, consult your supplier.

Control and options

The appliances are fitted with a proportional regulation system. This can be made temperature dependent with the aid of a 0 – 10 VDC (= -10°C – +90°C) signal. In addition, the boiler regulating system can be extended by fitting one of the three options described below:

BME option

This is a weather-compensated regulator with the following possibilities:

- Three on/off periods per day with three different temperatures
- Night-time temperature reduction
- Domestic hot water priority with time programming
- Anti-legionella provision
- Optimum start
- Room-temperature sensor (can be switched off)
- Two-wire communication bus connection
- Multi-language display
- External control.

E6 option

This is a regulator with which two secondary groups can be weather-dependently controlled. In addition, domestic hot water temperature can also be regulated. All the settings can be adjusted independently for each group. This E6 regulator can be further extended with an optimizing controller for each group (BM). The boiler is then directly weather-dependently controlled.

KKM option

This is a boiler cascade manager permitting up to eight boilers to be switched in cascade. The KKM also has the same possibilities as the E6 option.

Connection terminals

The operation of the appliance can be influenced by externally generated signals applied to the appropriate terminals.

Terminal	Description
L1 - N - PE	Boiler power supply; must be fused at 10 A.
8 - 9	Domestic hot water primary pump control. This output provides a voltage (230 V) when the boiler is operational as a result of a domestic hot water heating demand.
10 - 11	Boiler enable (230 V). When these terminals are connected the primary pump will be started and the boiler will be enabled. When there is an open circuit between them the boiler will be shut down. The pump will also stop after the set run on time. These terminals can be used, among other things, for setting the boilers to standby during the summer months whilst continuing to provide domestic hot water priority.
12 - 13	Operating signal. The operating signal falls off if a fault has occurred more than 2 times within 6 minutes (the fault code will appear in the display with a "3") or if a fault is longer than 6 minutes active (230 V, 50 Hz, 1 A, N.O.).
14 - 15	Control voltage for an external gas valve. This output begins to provide 230 V before the boiler starts up; the voltage ceases after the boiler shuts down. This output can be used to open hydraulic valves or to operate boiler room ventilation.
16 - 17	Calorifier thermostat (230 V). When these terminals are interconnected the boiler will try to provide the set flow temperature programmed for the boiler. This input only functions if terminals 34 - 35 are interconnected.
18 - 19	Interlock input (230 V). If the connection between these terminals is interrupted, the boiler will be deactivated and wait until the connection is restored (after 6 minutes or if the same fault has occurred three times within 6 minutes, this input will be interlocked).
20 - 21	Lockout input (230 V). If the connection between these terminals is broken the boiler will enter the fault mode. Reinstatement the connection and press the reset push-button.
30 - 31	External sensor*. After a suitable sensor has been connected it will be automatically recognised when the power supply is switched on.
32 - 33	Low velocity header sensor*. This sensor can measure the temperature of a low velocity header.
35 - 36	Calorifier temperature sensor*. After a suitable sensor has been connected it will be automatically recognised when the power supply voltage is switched on. The terminals 35 - 36 must not be interconnected. The purpose of this function, in comparison with the calorifier thermostat, is to make possible a night time temperature reduction and an anti-legionella switching (only with BME, E6 or KKM).
37 - 38	External influence (2 – 10 VDC = +10°C – +90°C)*. At voltages below 2 V the boiler will switch to "constant supply temperature operation".
41 - 42	SCOM bus connection (make sure to use the correct polarity).
43 - 44	Prim. boiler pump control (0 – 10 VDC).

* In order to avoid faults caused by inductive currents, static electricity or high frequency signals, the use of screened cables is necessary.

5.3.3 Water connections

The appliance must be installed by a recognised installer in accordance with the applicable national and local specifications and regulations. The flow and return connections are made at the rear of the unit.

Water connection supports

We recommend that the supply and return pipes be properly supported using brackets to prevent mechanically overloading the lines and to simplify maintenance.

The unit is a constant water flow appliance and is suitable for use in both open vented (non-pressurised) systems and sealed (pressurised) systems provided the minimum pressure requirements, as per table 10, are met. The unit is fitted with a boiler pump as standard and which guarantees the required water circulation through the boiler. The capacity and working head of the pump is sufficient to overcome both the resistance of the boiler and some resistance offered by the system.



The boiler pump is however not a system pump

If the resistance of the system exceeds the available working head, the boiler will be shut down by the flow switch. In order to prevent this happening, the length and diameter of the primary pipework between the boiler and the low velocity header must be chosen such that the remaining working head of the pump (see table 8) will not be exceeded.

It is recommended that manually operated valves be fitted between the water connections and the installation.



In order to limit the losses occurring in a non-operational boiler, a **motorised valve** is sometimes fitted in the flow or the return pipe or a mechanical non-return valve is used for this purpose. Standby losses can be reduced even further by shutting down the boiler via the “boiler enable” terminals. A properly dimensioned low velocity header ensures that the natural flow through the boiler can be neglected.

5.3.4 Combustion air supply

The unit will standard be supplied as a room sealed appliance. This simplifies the possibilities for installation within the building.

5.3.4.1 General

Guide lines and installation instructions

The flue gas discharge and the air supply systems must be installed by a recognised installer in accordance with the applicable national and local specifications and regulations.

The total resistance of the air supply and the flue should not result in a pressure drop exceeding 1.8 mbar (types 1 and 2) or 1.0 mbar (types 3 to 7).

If the unit is used as a room sealed appliance, open Tees or draught stabiliser are not permitted.

5.3.4.2 Air supply pipe

The air supply pipe may be single-walled and constructed of:

- plastic
- thin-walled aluminium
- flexible aluminium (take account of the resistance)
- stainless steel.

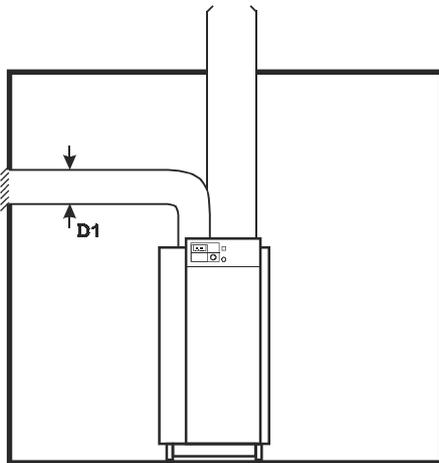


Fig. 5 horizontal air supply

Type	Air supply diameter D1 (mm)
R301	100
R302	100
R303	125
R304	125
R305	150
R306	180
R307	180

Table 4 Air supply connection

The connection to the air supply pipe is always mounted on the back of the unit.

Multiple units may not be connected to the same air supply or flue pipe.

To prevent snow entering, the air supply pipe must extend at least 300 mm above the roof and must be fitted with a rain cap.

The flue pipe opening must end at least 1000 mm above the roof, assuming the roof to be flat.

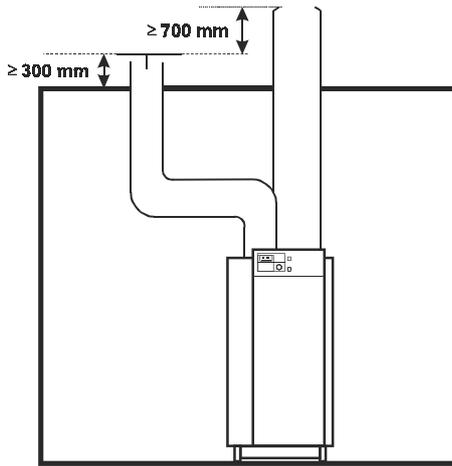


Fig. 6 Heights of air inlet and flue gas discharge

The relative horizontal difference between the flue pipe and the air supply pipe must not be less than the width of the unit.

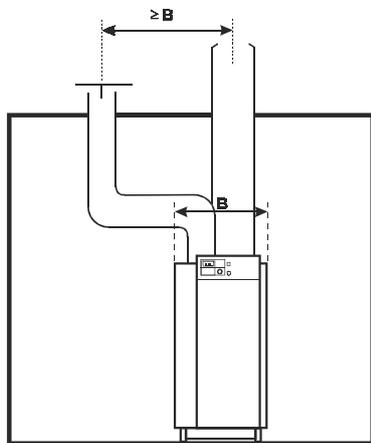


Fig. 7 Distance between air inlet and flue gas outlet

To prevent undesirable condensate from forming, we strongly recommend that you insulate the air-supply duct on the outside to make it vapour tight.

5.3.5 The Flue system

5.3.5.1 General

The flue system must be installed by a recognised installer in accordance with the applicable national and local specifications and regulations. The flue pipe connection is at the back of the appliance and has been designed for direct connection to a corrosion resisting flue pipe.

When the boiler functions as a high capacity boiler, the high efficiency can lead to the formation of condensation in the chimney.



The condensate drain must never become blocked!

Direct connection to brick built stacks is not permitted because the combustion efficiency of the boiler is > 83%.

The following table lists all the flue gas data for all types.

Type	Flue gas temperature at full capacity (approx.)	Flue gas quantity at full capacity		Maximum permissible chimney resistance
	°C	m ³ /h	kg/s	mbar
R301	≈ 135	130	0.033	1.8
R302	≈ 135	161	0.040	1.8
R303	≈ 135	214	0.053	1.0
R304	≈ 135	261	0.065	1.0
R305	≈ 135	345	0.086	1.0
R306	≈ 135	430	0.106	1.0
R307	≈ 135	513	0.127	1.0

Table 5 Flue gas data
 Capacity 100%
 Flow temperature 80°C
 Return temperature 60°C.

5.3.5.2 Chimney Chimney length

Because the appliance is fitted with a “premix burner” with a fan, an over-pressure is built up in the unit. This overpressure is sufficient to overcome the resistance of the cooled burner, heat exchangers, air intake and chimney up to a maximum of 1.8 mbar (types 1 and 2) or 1.0 mbar (types 3 to 7) external to the boiler.

The back-pressure outside the unit depends on:

- a The resistance of the flue pipe
- b The degree of cooling of the burner system
- c The resistance of the discharge system.

The degree of cooling of the flue gasses depends on:

- a the insulation value of the chimney
- b the local ambient temperature
- c the discharge system.

The flue connection diameters of the units have been chosen such that the speed of the flue gas will always be approximately 5 m/s. For the appliance there will be a maximum overpressure of approximately 1.8 mbar (types 1 and 2) or 1.0 mbar (types 3 to 7) for the flue system.



Owing to their high resistance, bends with an R/D ratio smaller than 1 should be avoided.

Calculation of the diameter and length

For calculating and checking the internal diameter of a flue system with mechanical discharge, refer to the applicable national and local regulations and specifications.

Type	Length of flue system in m					
	Diameter 80 mm	Diameter 100 mm	Diameter 130 mm	Diameter 150 mm	Diameter 180 mm	Diameter 200 mm
R301	9	68*	> 256			
R302		38*	200			
R303		5	36*	117		
R304			39	83*		
R305				42	61*	
R306					61	89*
R307						97*

Table 6 Length of flue system
The flue system lengths have been rounded down.
* Chimney diameter at the appliance.

These lengths are valid for boilers as open appliance.
For room sealed appliances these lengths are valid for the air supply and flue together.

Losses in the chimney related to various chimney sections expressed in metres of straight pipe.
The total loss must be subtracted from the maximum permitted chimney length given in table 6.

Type	Diameter in mm	Elbow 90° R/D = 0.5	Elbow 90° R/D = 1	Elbow 45° R/D = 0.5	90° Tee
R301	80	4.0		1.2	4.0
	100*	4.9		1.4	4.9
	130	3.2	3.2	1.6	6.2
R302	100*	4.9		1.4	4.9
	130	3.2	3.2	1.6	6.2
R303	100	4.9		1.4	4.9
	130*	3.2	3.2	1.6	6.2
	150		3.6	1.8	7.5
R304	130	3.2	3.2	1.6	6.2
	150*		3.6	1.8	7.5
R305	150		3.6	1.8	7.5
	180*		4.6	2.3	9.0
R306	180		4.6	2.3	9.0
	200*		4.8	2.6	10.1
R307	180		4.6	2.3	9.0
	200*		4.8	2.6	10.1

Table 7 Chimney losses in metres of straight pipe
* Connection at boiler.

5.3.6 Condensate discharge

Condensate that forms in the appliance must be discharged to a drain.



If there is no direct connection to a drain present, a water collection tank with a pump and a level switch may be used, so that the condensate can be pumped into a drain. The discharge of condensate into roof guttering is not permitted.

The appliance is fitted with a water trap which prevents flue gasses from entering the boiler room.

The connection to the drain must be arranged such that there is an open connection under the condensate discharge point on the appliance (see fig. 8). In addition, the discharge pipe must be fitted with a trap (U-bend) in accordance with the applicable regulations. Ensure that the distance between the condensate discharge point of the boiler trap and the drainage pipe is at least 5 mm. This provides the required open connection and simplifies any subsequent maintenance activities and inspections.

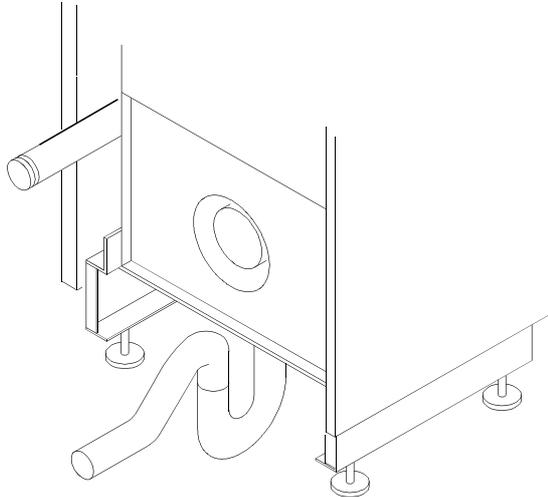


Fig. 8 Condensate discharge

5.4 *Hydraulic system*

5.4.1 *General*

Although it is not the intention to provide a complete handbook covering the most divergent hydraulic systems, the data is more extensive than would generally be provided in the case of conventional central heating boilers.

The R300 unit is a low water content boiler for which the water flow rates must be within minimum and maximum values.

Table 8 lists the required relationship between the three parameters Q (water flow), P (pressure) and t (temperature) at maximum capacity. Because of the high flow rate, the appliance is less sensitive to water hardness. Therefore, the water hardness may not exceed 250 ppm with a supply temperature of 80°C (see 5.4.5 Water quality).

5.4.2 *Water flow*

5.4.2.1 *Flow rate and resistance*

The rate of water flow through the appliance must never fall below the required minimum (otherwise the water flow switch will be activated and the appliance will be shut down). The use of valves, non-return valves, systems in which several appliances are connected to a common transport system, etc., must not interfere with the required water circulation.

Type	ΔT 22 K		Pump data				
	Nominal flow rate	Boiler-resistance	Grundfos pump type	Pump speed	Head at Qnom.	Available head at Qnom.	Max.* power consumption
	m ³ /h	kPa	UPS		kPa	kPa	W
R301	2.72	17.0	25-80	3	66	49.0	245
R302	3.51	23.5	25-80	3	58	34.5	245
R303	4.52	30.0	32-80	3	52	22.0	245
R304	5.48	30.0	32-80	3	45	15.0	245
R305**	7.25	20.0	32-120F	3	75	55.0	380
R306**	9.05	23.0	32-120F	3	65	42.0	380
R307**	10.85	32.0	32-120F	3	52	20.0	380

Table 8 Water flow rate and pump data R300

- * The maximum power consumption of the pump is given for pump speed 3. The optimum operating point in relation to efficiency and minimum power consumption can be determined from the related pump curve
- ** 3-phase pump available as an option.

The optional primary pump has been sized to have an optimum duty when $\Delta T = 22$ K. When running at ΔT 's less than this the pump size should be checked to ensure suitability. The water flow rate can be adjusted with the aid of the built-in 3-speed pump control. The water flow rate can be measured by making a ΔP measurement via the filling and drainage valve in the supply and return pipe of the unit. The measured head can be compared with the boiler resistance (table 8). At full capacity the water flow rate can be very accurately compared with the ΔT , measured across the flow and return of the boiler.

The unit has a standard pump control. When the boiler is enabled, the pump is switched on. When the enable signal is removed, the pump will continue to run for several minutes. This run on time is adjustable. The standard time is two minutes.

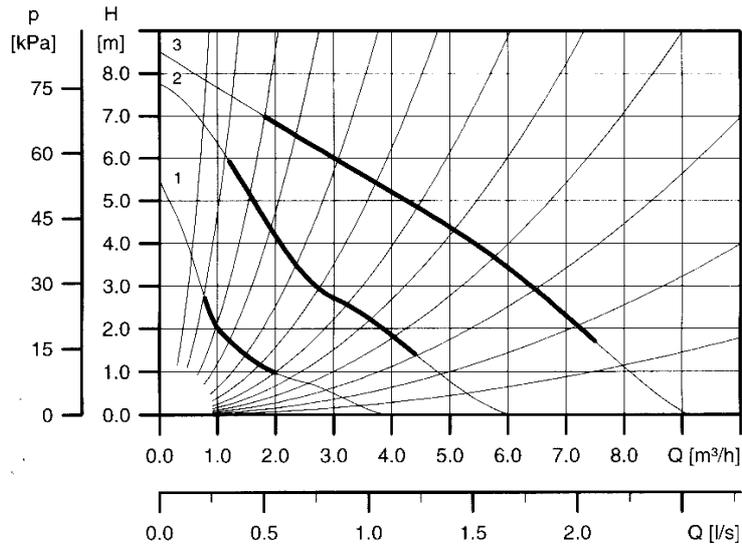
When the system includes air heaters (ventilation, air treatment), it is usually desirable to have a small ΔT over these components. Because of this, the quantity of water flowing through the total secondary circuit is usually greater than that flowing through the boiler units.



The low velocity header must be dimensioned such that the **water speed does not exceed 0.5 m/s**. In this case the diameter of the header must be calculated for the water volume flowing through the secondary circuit. When the water volume flowing through the secondary circuit is greater than that flowing through the primary circuit, a mixed temperature will exist which is lower than the desired temperature of the supply from the appliance. The regulation system reacts to this and opens the control devices (valves, etc.). Usually the supply temperature from the boiler(s) must be adjusted to obtain the desired temperature in the connected circuits.

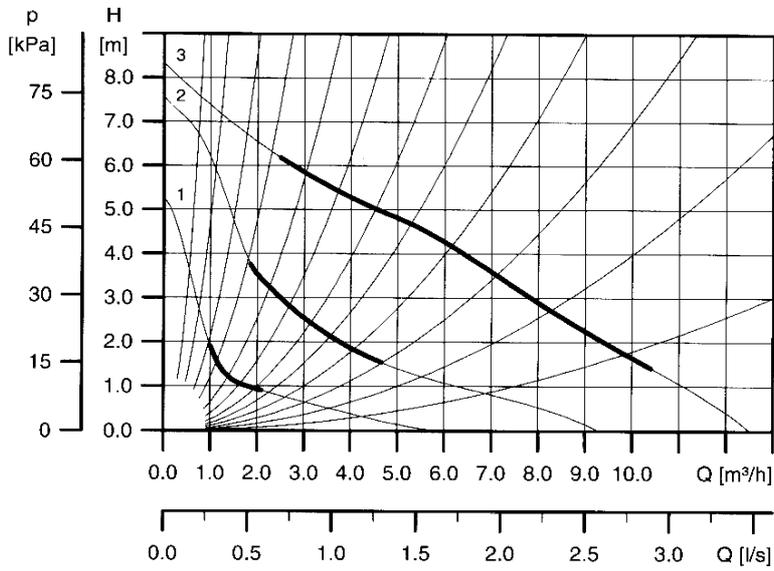
For additional energy savings an optional speed controlled pump is available for the R300 series. For details of this, consult your supplier.

5.4.2.2 Pump characteristics



TM00 9754 0397

Fig. 9 Pump characteristic UPS 25-80



TM00 9753 0397

Fig. 10 Pump characteristic UPS 32-80

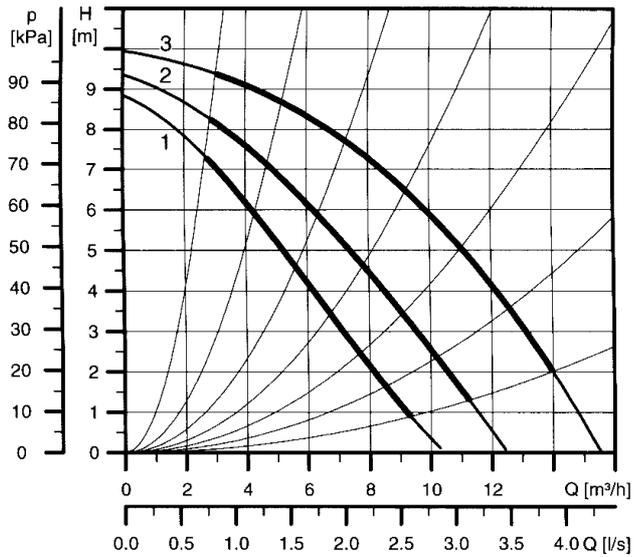


Fig. 11 Pump characteristic UPS 32-120F

Type	Pump speed	Pmax W	I 1 x 230 V A
UPS 25-80 R301 - R302	1	140	0.63
	2	210	0.92
	3	245	1.04
UPS 32-80 R303 - R304	1	145	1.05
	2	220	0.95
	3	245	1.05
UPS 32-120F* R305 - R307	1	320	1.55
	2	340	1.65
	3	380	1.75

Table 9a Electrical pump data

* 3-phase pump optionally available for types 5 - 7.

Type	Pump speed	Pmax W	I 1 x 230 V A
UPS 32-80B R301 - R304	1	145	1.05
	2	220	0.95
	3	245	1.05
UPS 32-120FB* R305 - R307	1	320	1.55
	2	340	1.65
	3	380	1.75

Table 9b Electrical pump data bronze version for water heater

* 3-phase pump optionally available for types 5 - 7.

5.4.2.3 Isolating valves

It is recommended that manual valves be fitted between the flow and return connections and the installation.

5.4.2.4 Valves

Mechanical non-return valve can be used. This is required so as to avoid short-circuiting the appliance on the water side.

5.4.2.5 **Water flow protection**

The unit is provided with water flow switch. This shuts the appliance down in the event that the flow of water through the appliance falls below the minimum required value.

5.4.3 **Water pressure**

5.4.3.1 **Operating pressure**

At a maximum supply temperature of 90°C and a minimum water flow rate such as occurs at a ΔT of 20 K, the minimum operating pressure must be greater than 1.5 bar.



The operating pressure must be measured with the pump switched off. If a lower pressure is desired, the maximum supply temperature must be adjusted accordingly.

Minimum operating pressure in bar	Flow temperature °C
> 1.5	90
> 1	80

Table 10 minimum operating pressures at nominal flow rate

5.4.3.2 **Boiler expansion tank**

It is advisable to fit an expansion tank in the return pipe between pump and the boiler isolating valve.

5.4.3.3 **System expansion tank**

The size of the expansion tank is determined by the quantity of water in the system. Our advice is to fit the system expansion tank at the neutral point (centrally) of the low velocity header.

5.4.3.4 **Water pressure protection**

As an option, a 3 bar pressure relief valve can be supplied (separately). Pressure relief valves adjusted between 3 and 6 bar, with increments of 1 bar, can also be supplied if necessary.

5.4.4 **Water temperature**

The maximum permissible temperature of the water flow can be set at 90°C. If the high limit thermostat functions at 100°C, the appliance shuts down and locks out and does not restart automatically when the temperature falls below the high limit temperature setting.

5.4.5 **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 general, 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.

Before the water is topped up, the hardness and the chloride content of the water must be determined.

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 low velocity header is employed, the air separator should be fitted above the header.



The chloride concentration must not exceed 200 mg/l. If this level is exceeded, the cause must be located. Compare the chloride concentration of the additional water with that of the system water. If this concentration is higher, this indicates evaporation if no chloride containing materials have been added. If chloride is present in high concentrations the water will be more aggressive (due to, among other things, incorrectly regeneration of the water softener). The system must then be flushed out and re-filled with low chloride content water.

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 the supplier. The supplier can provide advice on filter systems and other requirements. (Water analysis forms can be obtained from the supplier).

5.4.6 **Examples of hydraulic systems**

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:

$$\varnothing = \sqrt{\frac{Q}{3600} \times 1.28 \over v}$$

Where: \varnothing = the diameter of the low velocity header in mm
 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.

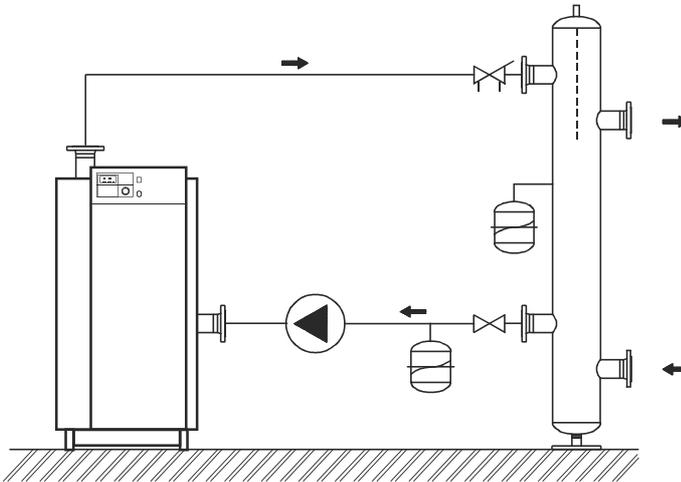


Fig. 12 Installation with a low velocity header, isolating valves and expansion tanks

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

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 dimensioned 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 volume of the water 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.

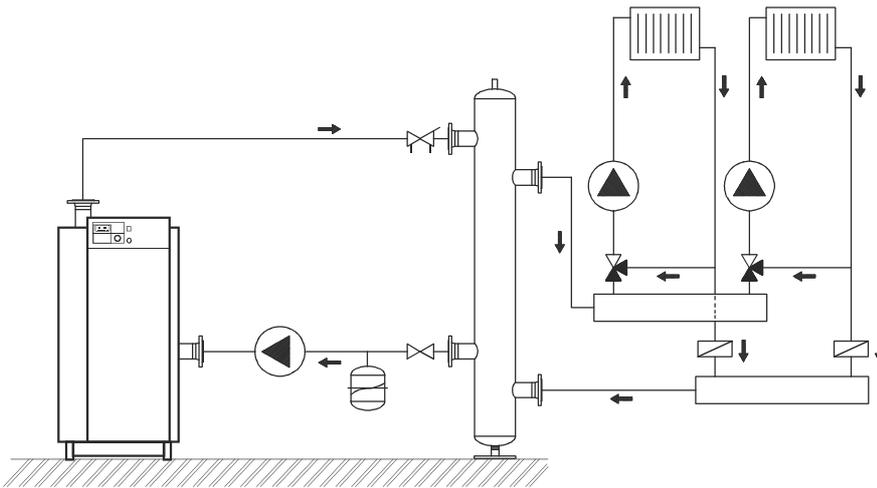


Fig. 13 Boiler with vertically mounted low velocity header arranged with right hand connections

Installations with weather dependent regulation and hot water priority switching

The small water capacity of the boiler and the fast, accurate boiler temperature regulation make the R300 unit ideal for use as a boiler with hot water priority switching.

The boiler uses a simple temperature regulator without room-temperature compensation. In order to determine the supply water temperature and to compare this with the set heating curve using an external temperature sensor, it is necessary to keep the boiler pump operating continuously.

Switching the secondary pumps on and off without the use of a building optimising system results in the temperature swings being too large and a boiler and pump that are switched too frequently. This increases the chances of wear and faults occurring. In addition, it is likely that the operating efficiency will be reduced.

Generally the hot water storage capacity is determined by peak usage and operating cycle. In order to avoid shuttling between central heating and hot water regulation and to keep the boiler operating at high capacity, we advise the following:

- Minimum hot water storage capacity: 300 l/100 kW
- Maximum storage tank heating time: 20 minutes.

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.

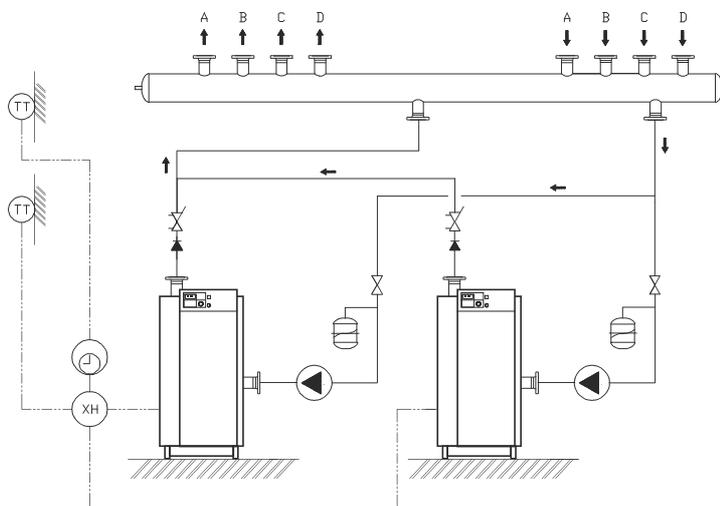


Fig. 14 Installation with multiple appliances

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.

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

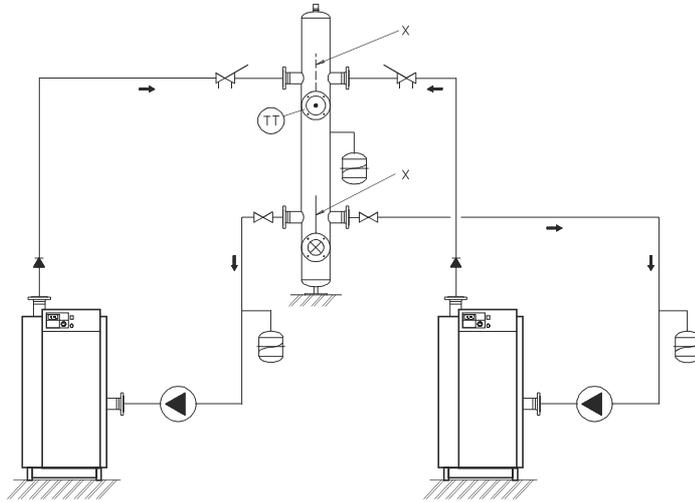


Fig. 15 Installation with more than one appliance

6 Operating instructions

6.1 Function

When a heating demand is received and before the boiler starts up, the appliance must be pre-purged.

The fan supplies combustion air and has a modulating control. A zero controller in the gas valve determines the required quantity of gas. Gas and air are optimally mixed. Thereafter, the gas air mixture is ignited on the main burner. The fan also ensures that the resulting flue gasses are subsequently removed. The removal system for these gasses performs an essential function for the proper operation of the appliance.

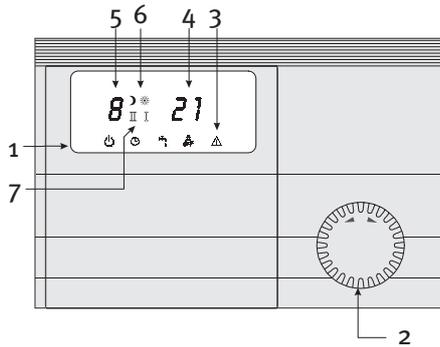
The unit has no limits for return water temperature. If this temperature is low, condensation will be formed which will then be removed via the drainage system.

6.2 Regulation

Depending on the heating demand, the unit will be started up and shut down between 0% and 20% capacity and will be continuously modulated between 20% and 100% capacity.

6.3 Control module

Lid closed



Lid open

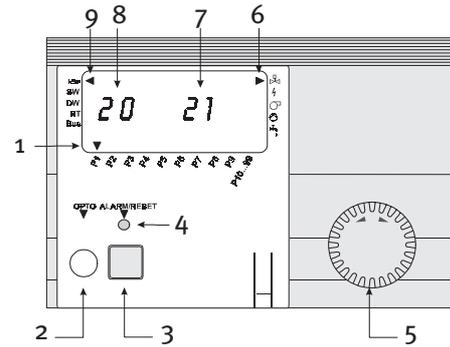


Fig. 16 Control module

- 1 function
 - ⏻ standby
 - ⌚ automatic operation
 - ☀ summer operation
 - ⚙ service operation
- 2 function selector
- 3 fault indication Δ
- 4 supply temperature
- 5 malfunction code (flashing)
- 6 operation mode
 - ☾ night time reduction (no heating demand)
 - ☀ heating mode (heating demand)
 - ☀ (flashing) burning

- 1 parameter indication
 - P1 current/setting boiler supply temp.
 - P2 current/setting domestic hot water temperature
 - *P3 desired temperature
 - P5 current external temperature
 - P8 current low velocity header temp.
 - P9 current/maximum boiler capacity
 - P10 password entry for factory settings
- 2 optical I/O
- 3 reset/programming push-button
- 4 alarm LED
- 5 parameter/value selector
- 6 output status
- 7 current/desired parameter value
- 8 fault/parameter indication
- 9 input status

* P3 set load (in combination with KKM)

Operating mode (cover closed)

With the cover closed and by using the rotational switch (pos. No. 2) clockwise or anti-clockwise the boilers' operating mode can be set.

The operating modes are:-

- | | |
|-----------------------------|---|
| ⏻ standby | the boiler switched off but frost protection is active |
| ⌚ automatic | the boiler can operate in heating or hot water mode |
| ☀ summer mode | the boiler will only react to a hot water demand |
| ⚙ I service, low capacity | the boiler will run at low capacity (adjusted by [P17]) |
| ⚙ II service, high capacity | the boiler will run at full capacity (adjusted by [P19]). |

Information mode

With the cover open and by turning the rotational switch (Pos. No 5) clockwise or anti-clockwise it is possible to read out certain information from the boiler management unit.

There are 10 possibilities. An arrow at the bottom of the LCD display will indicate which parameter has been selected. The following parameters are readable:-

Parameter

- P1 actual/setting flow temperature
- P2 actual/setting direct hot water temperature (if used)

- P3 setpoint temperature (* P3 set load in comb. with KKM)
- P5 actual outside temperature (if used)
- P8 temperature at the low velocity header (if used)
- P9 actual boiler capacity
- P10 only for trained service engineers.

Summary of input and output indications (cover open)

Input indications: -

-  Flame Ionisation detected
- SW** Water flow switch in operating position
- DW** APS in operating position
- RT** Boiler enabled by BMS
- Bus** Data-bus detected.

Output indications: -

-  Power to Main Gas Valve
-  Power to Ignitor
-  Control signal to fan
-  Power to Primary Boiler Pump
-  Power to Primary DHW Pump.

Setting the flow temperature for Central Heating (cover open)

Only applicable to boilers **without** weather compensated flow temperature or a 0 - 10 Volt control signal.

- Open the lid (the arrow at the bottom of the LCD display indicates parameter P1)
- Push the Reset/Programming key (pos. 3), the LED will light, turn the rotary switch (pos. 5) until the desired water flow temperature has been reached
- Push the Reset/Programming key, the LED will go out
- Close the cover.

Setting the flow temperature for Domestic Hot Water (cover open)

- Open the lid
- Turn the rotational switch (pos.5) clockwise until the arrow at the bottom of the LCD display indicates parameter P2
- Press the Reset/Programming key (pos.3), the LED will light, turn the rotary switch until the desired Domestic Hot Water flow temperature has been reached
- Push the Reset/Programming key, the LED will go out
- Close the cover.

6.4 Fault indications

A fault always results in a flashing  symbol and a fault code appearing in the display. When a fault occurs, the cause must always be found and corrected before the related protective function is reset. The operating signal (terminals 12 - 13) falls off if a fault has occurred more than 2 times within 6 minutes (the fault code will appear in the display with a "3") or if a fault is longer than 6 minutes active. The boiler can be nevertheless in operation.

- 1 The high limit thermostat has operated. The boiler temperature has exceeded 100°C. Press the reset button.
- 2/3 The interlocking input has been interrupted. Correct the external error and press reset.
- 4 Flame signal fault. No flame detected at burner start. One restart possible. Correct fault and press reset.
- 5 Flames go out during operation. If this fault occurs 3 times within 6 minutes, the fault becomes interlocking. Correct the fault and press reset.

- 6 Temperature protection has operated. The boiler temp. has exceeded the setting. Press reset.
- 7 The lockout input has been interrupted. Correct the external fault and press reset.
- 11 Error in flame signal. A flame has been detected during start-up. Correct the fault and press reset.
- 12 Flow temperature sensor is faulty. Correct fault.
- 13 Wiring of the CXE/EM extension module is defective. Correct fault.
- 14 Hot water temp. sensor is defective. Correct fault.
- 15 External temp. sensor is defective. Correct fault.
- 18 Header temp. sensor is defective. Correct fault.
- 20 Error in the control of gas valve 1. After burner has stopped a flame has been detected for a period of 5 seconds. This in spite of the fact that valve has been sent a close signal. Correct fault.
- 21 Error in the control of gas valve 2. After burner has stopped a flame has been detected for a period of 5 seconds. This in spite of the fact that valve has been sent a close signal. Correct fault.
- 22 Air flow too low. The air pressure switch has not operated during pre-purge. Correct fault and press reset.
- 23 The air pressure switch has not switched off. Press reset.
- 24 The fan does not reach the set speed during pre-ventilating. Correct fault.
- 25 The fan does not reach the set speed during ignition. Correct fault.
- 26 The fan does not come to a standstill. Correct fault.
- 27 The air pressure switch switched off during operation.
- 30 CRC error in EEprom data group "Boiler". Press reset.
- 31 CRC error in EEprom data group "Burner". Press reset.
- 32 Fault in 24 V circuit. Correct fault.
- 40 Error detected in the position of the flow switch. Correct fault.
- X.Y. An internal fault has been detected during the self-test. Press reset.

6.5 Start-up

- 1 Open the gas valve
- 2 Switch on the appliance using the on/off switch on the control panel
- 3 Select the function "automatic operation ☺" using the function selector. (See also the operating instructions on the boiler).

6.6 Shut-down

The unit can be shut down in three different ways:

- A The boiler continues to supply domestic hot water. Select the ☺ function with the function switch
- B The boiler is not operating and will only start up for automatic frost protection. Select the ☹ function using the function selector
- C Shut down the boiler:
 - 1 Switch off the boiler using the on/off switch on the control panel
 - 2 Close the gas valve.

6.7 Warnings

The unit must be installed by a recognised installer. The operating instructions must be strictly observed.

If the source of the fault cannot be found, the service organisation must be contacted. Never repair the appliance yourself.

The condensate drain may never be modified or closed off. When a boiler is completely shut down in the winter period, there is a danger of freezing. Drain the water out with the aid of the filling/

drainage valve. The user must never make any modifications to the appliance or the discharge system.

Annual checking and good maintenance are necessary in order to guarantee optimum performance.

7 Commissioning

7.1 General

Commissioning must be carried out by skilled personnel. Failure to observe this condition will invalidate the guarantee.

7.2 Commissioning

Water and the hydraulic system

Take a sample of the water from the filling/drainage valve on the boiler and a sample of the make-up water. Determine the water hardness using the titration method. The water hardness must be **less than 250 ppm**. If the measured hardness is too high, the water must be softened.



Determine the concentration of chloride in the system water. This may **never exceed 200 mg/l**. If this concentration is exceeded, the system must be flushed through and re-filled with low chloride water.

Check the pressure of the system water. This must have at least the minimum value given in table 10 (Operating pressures).

Check that there is a by-pass or a low velocity header fitted in the hydraulic system. This is a requirement.

Check and bleed the pump

Switch on the power supply to the boiler at the on/off switch and check the direction of rotation of the boiler pump after removing the end cap from the pump motor housing. If the direction of rotation is incorrect, two of the three phase connections must be swapped (only 400 V).

Before the appliance is started up, any air present must be bled out of the pump by removing the end cap from the pump motor housing. This must be repeated after the appliance has been in operation for a short time.

Check the chimney

Check the chimney. Ensure that the connection between the appliance and the chimney is such that gasses cannot escape. If necessary, apply an appropriate sealing tape.

Bleed the gas pipework

Open the gas valve. Check that the gas piping is gas-tight. Remove any air between the gas valve and the appliance.

Check the operation of the appliance at full capacity

Start up the appliance. Allow the appliance to operate at full capacity and to stabilise (approximately 3 minutes). At full capacity, the following settings must be checked and corrected if necessary.

Settings at full capacity

Guide value CO ₂	9.8 - 10.2%	for natural gas	G20, G25
	11.6 - 12.0%	for propane	G31
	13.6 - 14.0%	for butane	G30

Guide value CO	≤ 15 ppm	for natural gas	G20, G25
	≤ 25 ppm	for propane	G31
	≤ 200 ppm	for butane	G30

Burner pressure = pressure above burner – fan pressure			
$P_{bb} - P_{vent}$	type R301 - R302	1.5 ± 0.5 mbar	
$P_{vent} - P_{bb}$	type R303 - R307	1.0 ± 0.5 mbar	

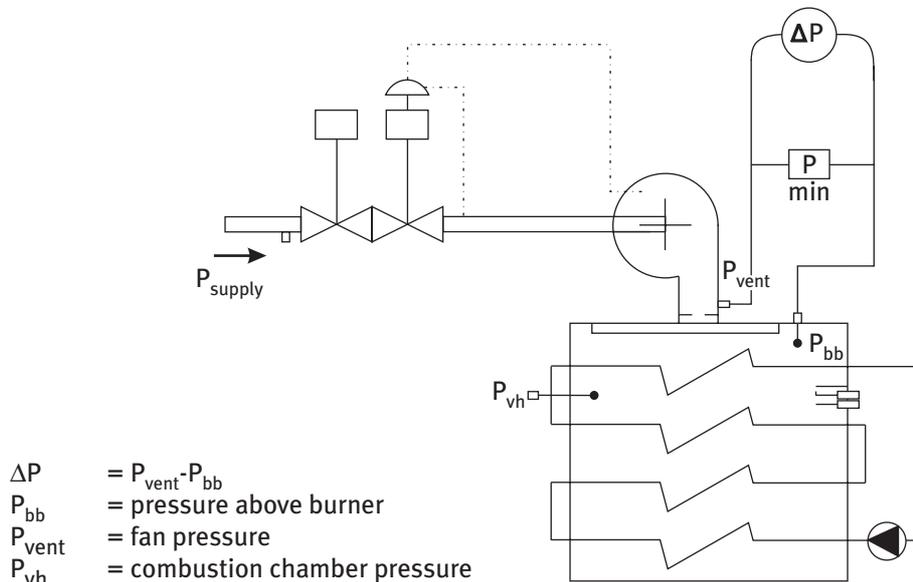


Fig. 17 Burner pressure measurement

Measure the dynamic gas pressure at the supply side of the gas valve. This must be at least 17 mbar for natural gas (30 mbar for propane or butane) with the boiler operating at full capacity. When multiple appliances are installed in the boiler room, this pressure must be measured with all the appliances operating at full capacity.

The heat input will be 10% higher in case of butane

Check the temperature difference (ΔT) between the flow and return to the appliance at the water side. ΔT must be between 15 and 25 K at full capacity.

Check the appliance at minimum capacity

Adjust the appliance to operate at minimum capacity. At minimum capacity the following settings must be checked and corrected if necessary:

Settings at minimum capacity

Guide value CO ₂	9.0 - 9.4%	for natural gas	G20, G25
	10.8 - 11.2%	for propane	G31
	12.8 - 13.2%	for butane	G30

Guide value CO	≤ 15 ppm	for natural gas	G20, G25
	≤ 25 ppm	for propane	G31
	≤ 180 ppm	for butane	G30

Burner pressure = pressure above burner - fan pressure			
$P_{bb} - P_{vent}$	type 1 - 7	0.1 ± 0.05 mbar	

Adjusting the gas valve R301 - R307

Two screws are located at the gas valve which can be used to adjust the gas volume (CO₂ value). Run the boiler at full load and check the CO₂ value. Adjust if necessary using the flat screw (types 1 and 2) or the inbus screw (types 3 to 7). Run the boiler at minimum load and check the CO₂ value. Adjust if necessary using the torcx screw.

Adjusting the air-pressure switch R301 - R307

The air-pressure switch is set at 80% of the fan speed when pre-ventilating.

For example:

Pre-ventilating takes place at 80 rps.

The air-pressure switch is set to $0.8 \times 80 = 64$ rps.

The actual switching moment can be read on the display.

If the appliance is checked in the manner indicated, and corrected as necessary, the following pressures, at full capacity, must be recorded for reference on the commissioning report note:

P_{vent}

P_{bb}

$P_{vent} - P_{bb}$ (measure separately!)

P_{vh}

ΔT .

8 Maintenance

8.1 Safety

During maintenance activities, always wear suitable clothing and shoes. Consider your own safety, particularly in respect of jewellery and loose clothing.

8.2 General

In order to ensure continued good and safe operation of the appliance, this must be inspected at least once per year.

The following activities must be carried out (for an extensive description of these activities, see 8.3):

- Renew the ignition and ionisation electrodes
- Clean the fan blades
- Clean the condensate receptacle
- Clean the condensate trap and the drainage pipe from the appliance
- Inspect all pressure measurement pipes and nipples
- After removing the panels from the left hand side of the appliance, ignition and burning can be observed via a sight glass
- Test the unit at the flue gas side for CO₂ and CO and correct these at both full and minimum capacity if necessary
- Check all the safety functions, and make any necessary adjustments
- Measure the water temperature difference ΔT as a measure of the flow rate
- Check the water pressure
- Check the water quality: hardness and chloride content
- Record all data
- Clean the outside of all the panels and ensure that these all have a smart appearance.

8.3 Procedure

- a) Disconnect the power supply
 - b) Close the gas supply valve
- The ignition and ionisation electrodes are fitted at the right side of the appliance
 - Remove the spark plug caps from the ignition and ionisation electrodes and inspect them for possible damage, such as indications of burning or pollution (renew the spark plug caps if damaged).

In order to carry out the following activities, the panels must first be removed.

- For appliances installed in a dusty environment, the fan blades may become dirty. This will result in the air supply being reduced and the fan becoming unbalanced. Clean the fan blades with a brush. All loose dirt can be removed in this way
- A trap is fitted under the condensate plate. Unscrew the trap and clean it
- Inspect all the pressure measurement pipes. Ensure that these are securely fastened and tighten the connection nuts if necessary
- Inspect the screws in the measuring nipples; renew the measuring nipples if they have become damaged
- In order to measure gas and air pressures and to perform measurements at the flue gas side, calibrated test equipment must be employed
- All test data must be recorded on the applicable test forms.

8.4 Cleaning the burner and heat exchangers

The burner and the heat exchangers can be cleaned internally with suitable media. For advice concerning suitable media, consult the service department of your supplier.

8.5 Cleaning the filter/screen in the gas combination block

In order to clean the filter/screen in the gas combination block, this must first be removed.

8.6 Ionisation measurement

In order to carry out an ionisation measurement, a micro-ammeter with a measuring range of 0 - 200 μ A DC must be connected in the ionisation circuit. In this way the ionisation protection function can be checked. The nominal ionisation current is between 10 and 25 μ A.
The minimum ionisation current is 2.8 μ A.

8.7 Service

For service and maintenance the service department of your supplier is always available.

9 Conversion formulae and factors

Formulae

$$\text{CO}_2 = \frac{20.9 - \text{measured O}_2}{20.9} \times 11.7$$

$$\text{O}_2 = 20.9 - \frac{\text{measured CO}_2 \times 20.9}{11.7}$$

11.7% CO₂ is the maximum CO₂ percentage that is generated by stoichiometric burning of G20 natural gas (H-gas).

Excess air N:

$$N = \frac{20.9}{20.9 - \text{measured O}_2} \times 0.914 \quad \text{or}$$

$$N = 1 + \left(\frac{11.7}{\text{CO}_2 \text{ measured}} - 1 \right) \times 0.914$$

Conversion factors

For NO_x (N=1):

$$1 \text{ ppm} = 2.05 \text{ mg/m}^3 = 1.759 \text{ mg/kWh} = 0.498 \text{ mg/MJ}$$

For CO (N=1):

$$1 \text{ ppm} = 1.24 \text{ mg/m}^3 = 1.064 \text{ mg/kWh} = 0.298 \text{ mg/MJ}$$

Example:

Measured values for an environmentally friendly unit:

NO_x = 15 ppm

CO₂ = 10%

What is the value for NO_x according to the most usual standard in mg/kWh for N=1?

$$\text{O}_2 = 20.9 - \frac{10 \times 20.9}{11.7} = 3\%$$

$$N = \frac{20.9}{20.9 - 3} = 1.17$$

$$\begin{aligned} \text{NO}_x \text{ (for } N = 1) &= \\ 15.0 \times 1.17 &= 17.6 \text{ ppm} \\ 17.6 \times 1.759 &= 30.9 \text{ mg/kWh} \end{aligned}$$

W	kcal/h	Btu/h
1	0.86	3.41
1.163	1	3.97
0.293	0.252	1

Table 11 Conversion factors

$$1 \text{ kcal} = 4.187 \text{ kJ}$$

$$1 \text{ kWh} = 3.6 \text{ MJ}$$

Efficiency at the flue gas side

The difference between upper and lower calorific values is the heat of evaporation of the combustion formed water. At 298.15 K (25°C) this amounts to 2442.5 kJ/kg (583.38 kcal/kg).

For non condensing boilers:

$$\eta_b = 90 - \left(\frac{0.339}{\text{CO}_2} + 0.008 \right) \times \Delta T$$

$$\eta_o = 100 - \left(\frac{0.377}{\text{CO}_2} \times 0.009 \right) \times \Delta T$$

For condensing boilers:

As a result of condensation, the efficiency at the lower value increases.

$$\eta_b = 90 - \left(\frac{0.339}{\text{CO}_2} + 0.008 \right) \times \Delta T + A (7.5 + 0.006 \Delta T)$$

$$\eta_o/\eta_b = 1.11$$

ΔT = Difference in temperature between the flue gasses and the environmental temperature

η_b = Fuel efficiency at the upper calorific value

η_o = Fuel efficiency at the lower calorific value

CO_2 = The volume of CO_2 in the flue gas (%)

O_2 = The volume of O_2 in the flue gas (%)

A = The quantity of condensed water in the appliance per m^3 gas in $\text{kg} (\text{kg}/\text{m}^3_{\text{gas}})$.

	meg/l	°dH	°f	°e	mg CaCO_3/l
meg/l	1	2.8	5	3.51	50
°dH	0.37	1	1.78	1.25	17.8
°f	0.2	0.56	1	0.7	10
°e	0.285	0.8	1.43	1	14.3
mg CaCO_3/l	0.02	0.056	0.1	1.54	1

Table 12 Conversion of degrees of hardness

1 degree English hardness (°e)	= 65 mg $\text{CaCO}_3/\text{imp. gallon}$
1 Grain/US Gallon	= 0.958 °dH
1 milligram equivalent per l (mval/l)	= 2.8 °dH
1 ppm (parts per million) CaCO_3	= 1 mg CaCO_3/l

For information:

The public water supply in general has a pH value of approximately 7 - 8. The temporary hardness will be 60 to 80% of the total hardness, which can vary considerably from one place to another.

Technical documentation

R300 Bypass

R300 Bypass technical data

Type		R301	R302	R303	R304	R305	R306	R307
Nominal heat output	kW	70	86	114	139	185	230	274
Nominal heat input (nett. CV)	kW	74	91	121	147	194	243	289
Minimum heat input	kW	16	20	23	29	39	49	58
Gas consumption								
natural gas H (10,9 kWh/m ³)	m ³ /h	6.79	8.35	11.10	13.49	17.80	22.29	26.51
propane (12,8 kWh/kg)	kg/h	5.78	7.11	9.45	11.48	15.16	18.98	22.58
Gas inlet pressure								
natural gas (min.)	mbar	17	17	17	17	17	17	17
natural gas (max.)	mbar	50	50	50	50	50	50	50
propane (min./max.)	mbar	30/50	30/50	30/50	30/50	30/50	30/50	30/50
Water capacity	dm ³	13	15	17	19	31	34	37
Max. working pressure	bar	6	6	6	6	6	6	6
Flue connection	D mm	100	100	130	150	180	200	200
Air supply	D1 mm	100	100	125	125	150	180	180
Gas connection	G	R 3/4"	R 3/4"	R 3/4"	R 3/4"	R 1"	R 1 1/2"	R 1 1/2"
Water connections	W	R 1 1/2"	R 1 1/2"	R 1 1/2"	R 1 1/2"	R 2"	R 2"	R 2"
Safety valve	boiler connection	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"
(option)	relief connection	3/4"	3/4"	3/4"	3/4"	3/4"	1 1/4"	1 1/4"
	standard setting	3	3	3	3	3	3	3
Power supply	V	230 1N~	230 1N~	230 1N~	230 1N~	230 1N~	230 1N~	230 1N~
Frequency	Hz	50	50	50	50	50	50	50
Fuse	A	10	10	10	10	10	10	10
Max. electrical power consumption								
unit	W	128	128	391	391	397	397	397
pump	W	60	90	90	90	90	245	245
total	W	188	218	481	481	487	642	642
Boiler weight, empty, ±5%	kg	160	175	190	205	260	280	300

Table 3 Technical Data R300 Bypass

Type		R301	R302	R303	R304	R305	R306	R307
B	mm	500	600	700	800	600	700	800
B1	mm	360	420	490	560	470	550	600
D	mm	100	100	130	150	180	200	200
D1	mm	100	100	125	125	150	180	180
G		R ^{3/4} "	R ^{3/4} "	R ^{3/4} "	R ^{3/4} "	R1"	R1 ^{1/2} "	R1 ^{1/2} "
H1	mm	160	160	170	176	197	197	197
H2	mm	497	488	501	486	556	549	537
H3	mm	943	943	921	921	921	921	921
L	mm	760	760	760	760	975	975	975
L1	mm	50	50	50	50	85	85	85
L2	mm	235	235	235	235	240	240	240
L3	mm	80	80	90	90	100	100	100
L4	mm	445	445	445	445	655	655	655
L5	mm	525	525	525	525	735	735	735
L6	mm	95	95	135	120	130	120	120
W		R1 ^{1/2} "	R1 ^{1/2} "	R1 ^{1/2} "	R1 ^{1/2} "	R2"	R2"	R2"

Table 4 Dimensions R300 Bypass

Conditions applicable table 1:

- Nominal capacity measured at: 60 - 80°C.
- Gas consumption at: 1013 mbar, 15°C, dry air.
- Gas category: II_{2H3P}
- Appliance category: B23, C53, C33 of C63
- Protection degree: IP20

1 Description

1.1 General

In case the water volume flow over the unit is too low (high ΔT) this bypass directly returns flow water to the secondary heat exchanger and thereby guarantees the minimum required flow in the unit.

The pump installed in the bypass supplies the required head and capacity for the burner, 1st heat exchanger and the 2nd heat exchanger and overcomes the resistance of these three parts. With a high water flow (low ΔT) the pump only supplies little of it's capacity as the volume flow complies with the minimum required flow quantity. However a low water volume flow (high ΔT) forces the pump to supply such a force that the minimum required flow over the unit is guaranteed.

The Rendamax unit equipped with a bypass and bypass pump supplies no remaining head for the heating circuits. Further the bypass pump does not replace the system pumps and should not be used for that purpose. The pump has to be switched in position 3 for all unit types.

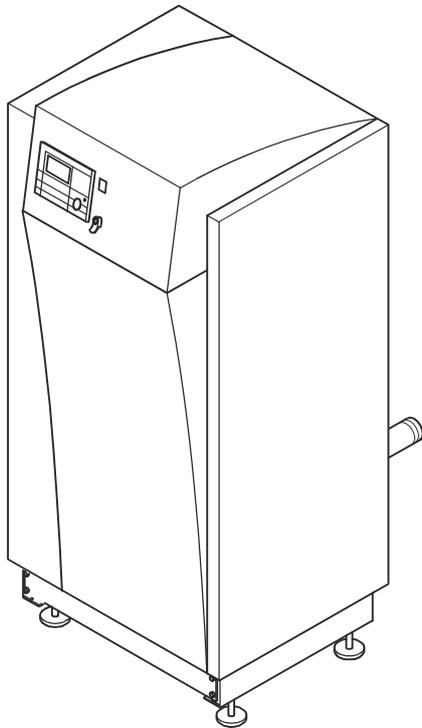


Fig. 2 The Rendamax R300

1.2 Main components

- | | |
|---------------------------------------|---------------------------|
| 1 Casing | 18 Filling/drainage valve |
| 2 Air pressure switch | 19 Return connection |
| 3 Control panel | 20 Water flow switch |
| 4 Burner | 21 Water headers |
| 5 Combustion chamber | 22 Ignition transformer |
| 6 First heat exchanger | 23 Connecting terminals |
| 7 Second heat exchanger | 24 Distribution plate |
| 8 Third heat exchanger | 25 Gas valve unit |
| 9 Condensate receptacle | 26 Fan |
| 10 Flue attenuator | 27 Gasfilter (option) |
| 11 Condensate discharge trap (V-bend) | 28 Pump |
| 12 Flue gas discharge | 29 Bypass-pipe |
| 13 Flow connection | 30 Air supply |
| 14 Safety valve (option) | A Air |
| 15 Gas connection | B Gas |
| 16 Adjusting feet | C Flue gas |
| 17 Frame | D Condensate |

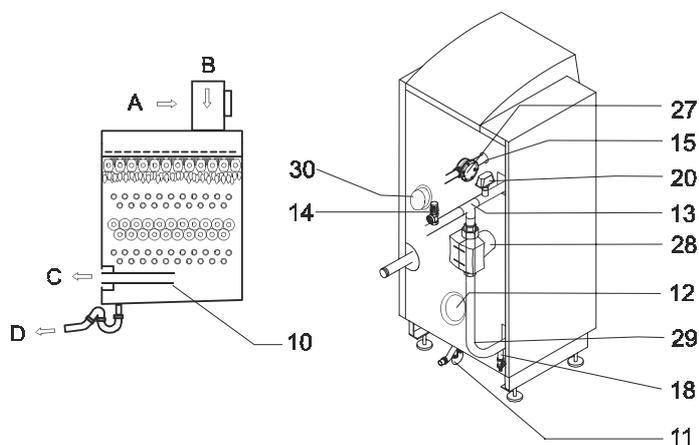
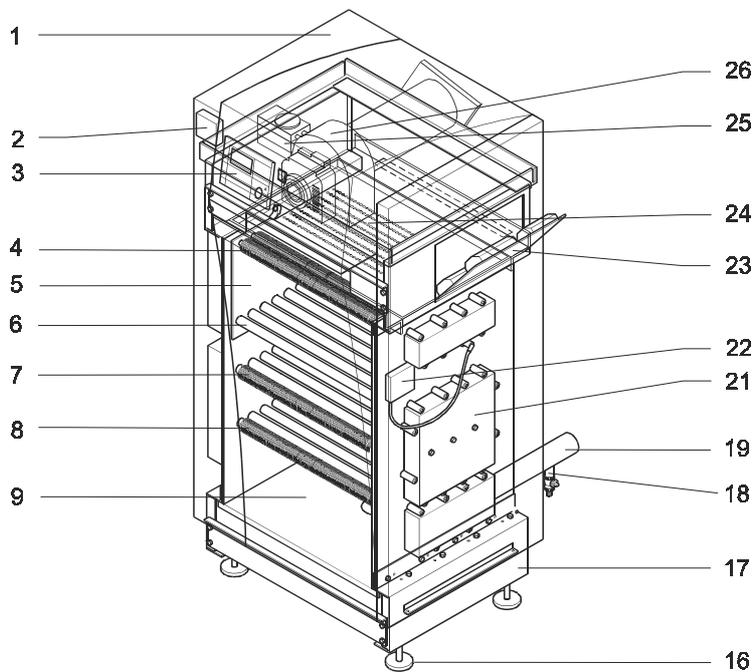


Fig. 3 General survey

1.2.1 *Description of principal components*

The boiler is constructed from the following principal components:

Fan [26]

The DC fan, which is equipped with a speed feedback, draws in the combustion air and increases the air pressure. The speed feedback signal is relayed to the regulator, which adjusts the speed if need be.

Gas train

The principal component of the gas train is the main gas valve [25]. The quantity of gas is adjusted in proportion to the quantity of air being supplied. The quantity of air depends on the speed of the fan. As an option, the unit can be equipped with a gas filter [27].

Burner [4]

After the gas/air mixture has been distributed over the burner using a distribution plate, the mixture is burnt on the burner surface such that the flame is directed downward. The burner is both air and water-cooled. The water headers are constructed of cast iron, and ensure a two-pass flow through the burner.

Heat exchangers [6, 7 and 8]

The first heat exchanger is constructed of smooth stainless steel pipes and transfers most of the combustion energy to the system water. The second heat exchanger is constructed of laser-welded, stainless steel finned pipes. The third heat exchanger is constructed of smooth stainless steel pipes. The second and third heat exchanger transfer the heat from the combustion gasses to the system water. All water headers are made of cast iron, and ensure a five-pass or three-pass flow through the heat exchangers (depending on the type). The space between the burner and the first heat exchanger constitute the combustion chamber.

Water headers [21]

The water headers are part of the burner and the heat exchangers.

Water connections

These consist of a flow connection [13] and a return connection [19]. Both of these connections are provided with a filling/drain valve [18]. The flow switch [20] is fitted on the flow line.

Boiler Pump [28]

The pump installed in the bypass supplies the required head and capacity for the burner, 1st heat exchanger and 2nd heat exchanger and overcomes the resistance of these three parts.

Condensate receptacle [9]

A condensate receptacle is fitted underneath the last heat exchanger. This receptacle is equipped with a condensate and flue gas outler.

Frame [17]

The frame is constructed from steel profile sections and is fitted with vibration absorbing adjusting feet [16].

Casing [1]

The casing consists of easy-to-remove panels. Once the cover has been opened (using tools), all other panels can be removed without using tools.

The electrical section

This includes the control and safety circuits for the unit.

Connecting terminals

The boiler supply, the connecting terminals, the pump connection and the pump relay are all fitted on top of the boiler. The terminal strip is located under the cover, on the right hand side.

2 Installation

2.1 Connections

2.1.1 Electrical connection

Electro-technical data

Type	Fan, control and safety components		Pump		Total electrical power consumption (max)
	Supply* 1N~	Power consumption (max)	Supply* 1N~	Power consumption (max)	
	V	W	V	W	
R301	230	128	230	60	188
R302	230	128	230	90	218
R303	230	391	230	90	481
R304	230	391	230	90	481
R305	230	397	230	90	487
R306	230	397	230	245	642
R307	230	397	230	245	642

Table 5 Electrotechnical data

* tolerance on voltage 230 V +10% /-15%

tolerance on frequency 50 Hz \pm 5%

** the stated pump power is based on the maximum power consumption in pump speed 3.

2.1.2 Water connections

The pump installed in the bypass supplies the required head and capacity for the burner, 1st heat exchanger and 2nd heat exchanger and overcomes the resistance of these three parts.

The pump does not replace the system pumps!

2.1.3 Condensate discharge

The appliance is fitted with a water trap which prevents flue gasses from entering the boiler room. Ensure that the distance between the condensate discharge point of the boiler trap and the drainage pipe is at least 5 mm.

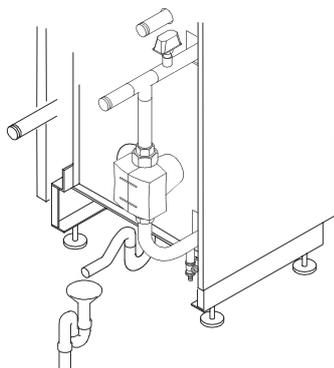


Fig. 4 Condensate discharge

2.2 Hydraulic system

2.2.1 General

Although it is not the intention to provide a complete handbook covering the most divergent hydraulic systems, the data is more extensive than would generally be provided in the case of conventional central heating boilers.

2.2.2 Water flow

Table 6 lists the required relationship between the three parameters Q (water flow), P (pressure) and t (temperature) at maximum capacity. Because of the high flow rate, the appliance is less sensitive to water hardness. Therefore, the water hardness may not exceed 250 ppm with a supply temperature of 80 °C.

2.2.2.1 Flow rate and resistance

Type	Dt 22 K		Pump data		
	Nominal flow rate	Boiler-resistance	Grundfos pump type	Pump speed	Max. power consumption
	m ³ /h	kPa	UPS		W
R301	2.72	17.0	32-40	3	60
R302	3.51	23.5	32-60	3	90
R303	4.52	30.0	32-60	3	90
R304	5.48	30.0	32-60	3	90
R305	7.25	20.0	32-60	3	90
R306	9.05	23.0	32-80	3	245
R307	10.85	32.0	32-80	3	245

Table 6 Water flow rate and pump data R300

* The maximum power consumption of the pump is given for pump speed 3.

The pump has to be switched in position 3 for all unit types.

The unit has a standard pump control. When the boiler is enabled, the pump is switched on. When the enable signal is removed, the pump will continue to run for several minutes. This run is on time adjustable. The standard time is two seconds.

2.2.2.2 Pump characteristics

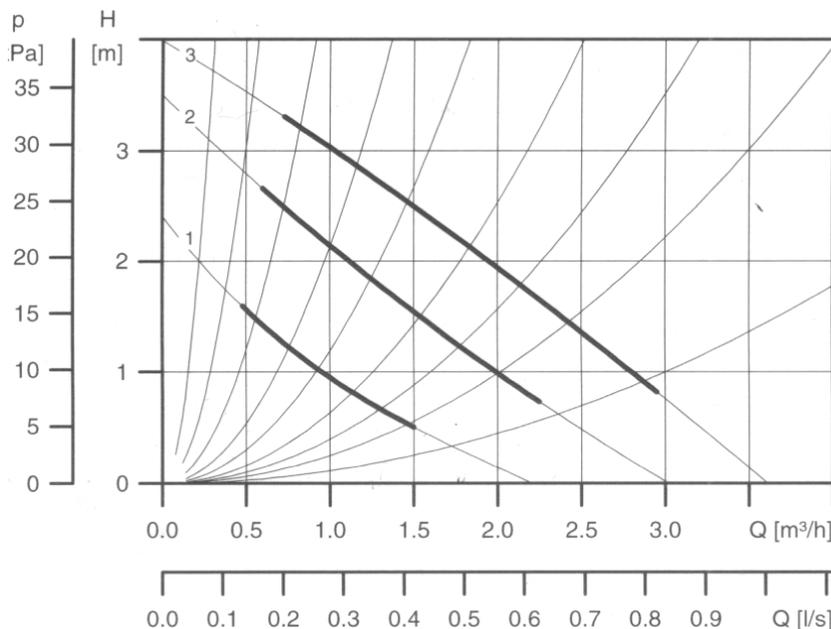
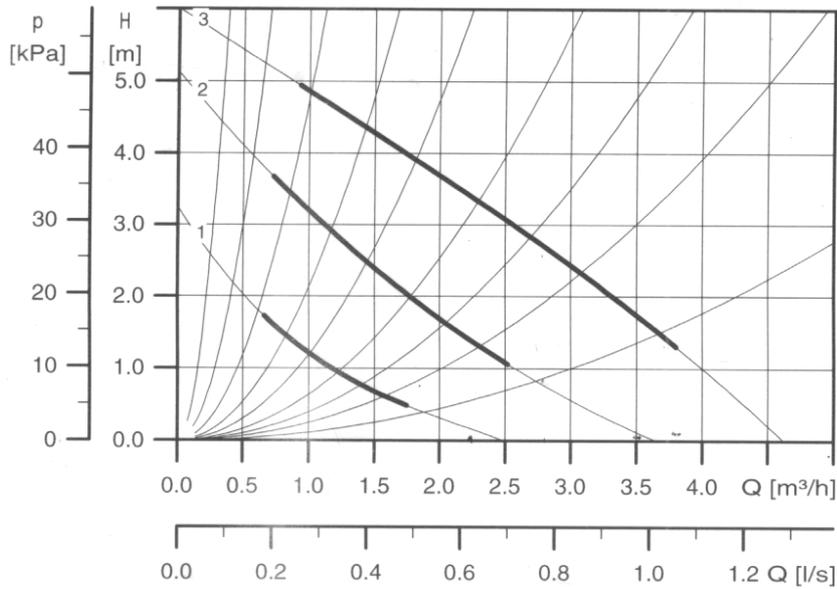


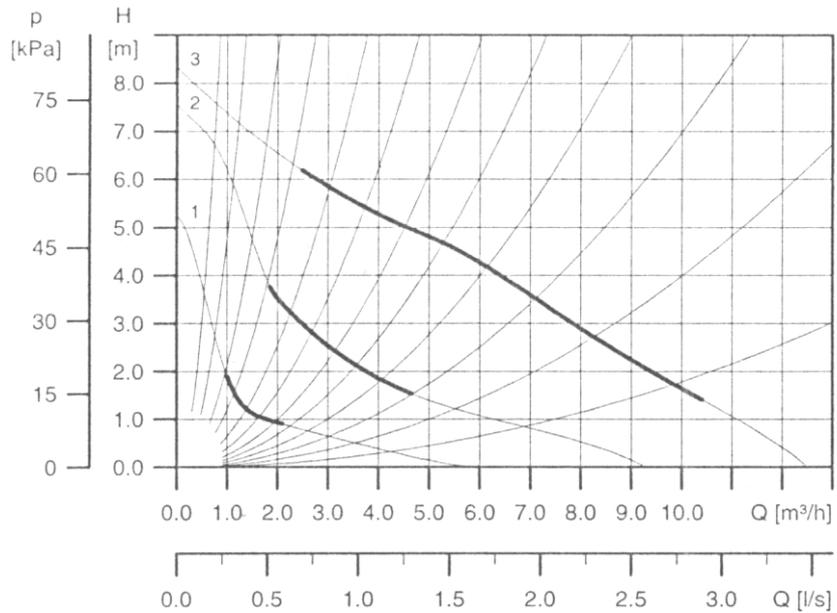
Fig. 5 Pump characteristic UPS 32-40

TM00 9749 0397



TM00 9751 0397

Fig. 6 Pump characteristics UPS 32-60



TM00 9753 0397

Fig. 7 Pump characteristics UPS 32-80

Type	Pump speed	Pmax W	I 1 x 230 V A
UPS 32-40 R301	3	60	0,26
UPS 32-60 R302 - R305	3	90	0,40
UPS 32-80 R306 - R307	3	245	1,05

Table 7 Electrical pump data

2.3 Examples of hydraulic Systems

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

Figure 9 shows an example of an R300 unit with a bypass in a system with one heating circuit only. As the bypass pump returns only a little quantity of flow water to the unit in case of a ΔT of 20°C the boiler resistance is hardly any higher then with a conventional unit without a bypass. The choice of a system pump can be made according to the known boiler resistances.

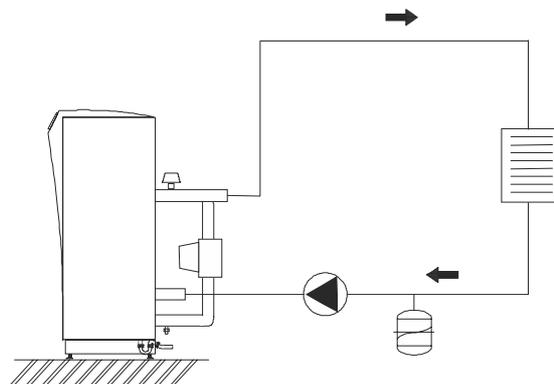


Fig. 8 R300 Bypass - one heating circuit

An example of a system with more heating circuits is shown in figure 10. In this case the application of an open header is not necessary, because it's replaced by the bypass. Using a closed header is to be advised. Application of a pump between the unit and the header is not necessary a system pumps supply the required water flow through the unit.

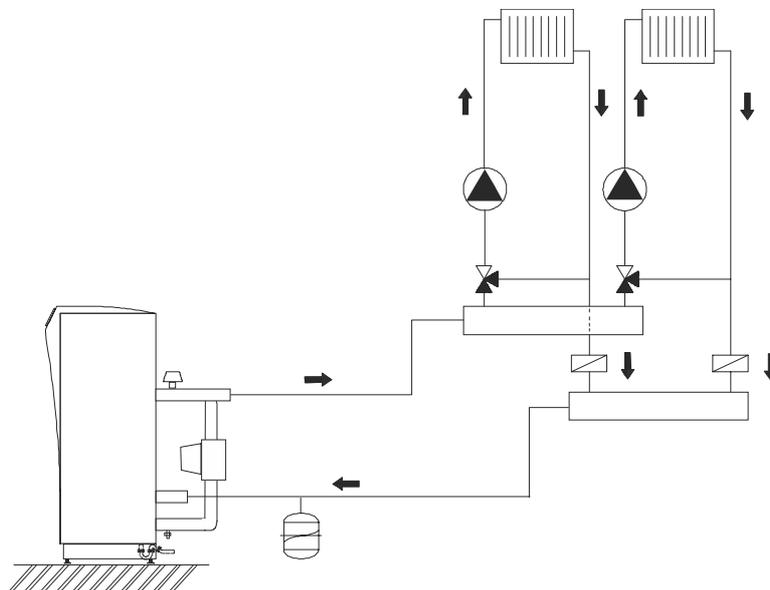


Fig. 10 R300 Bypass - heating groups

