Ultramax Floor Standing Condensing Boiler
Operating & Maintenance Manual
For Models 318 - 1018

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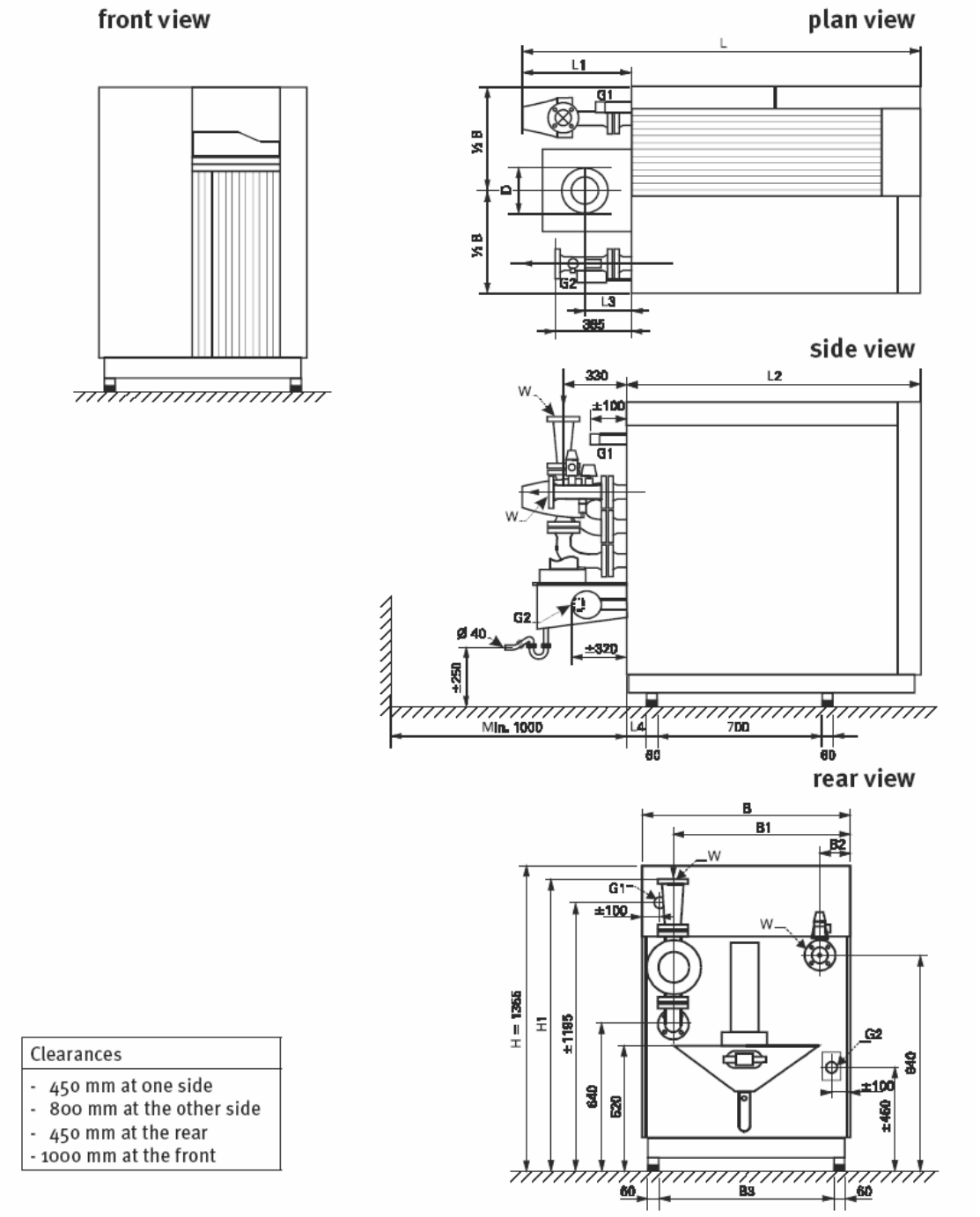
L263

Contents

Ultramax Technical data

Type		318	378	443	508	559	624	730	826	923	1018
Nominal heat output	kW	315	374	438	502	553	613	717	811	906	1000
Nominal heat input (nett.)	kW	333	396	464	532	585	653	764	865	966	1066
Minimum heat output	kW	83	100	112	133	146	187	218	247	276	305
Pilot Burner	kW						30	30	30	30	30
Gas consumption	m3/h	30.5	36.3	42.6	48.8	53.7	59.9	70.1	79.4	88.6	97.8
Nat Gas H (10,9kWh/m3)	kg/h	26.0	30.9	36.2	41.5	45.7	51.0	59.7	67.6	75.5	83.3
Propane (12,8 kWh/kg)											
Gas inlet pressure											
Nat Gas(min.)	mbar	18	18	18	18	18	18	18	18	18	18
Nat Gas(max.)	mbar	100	100	100	100	100	25	25	25	25	25
Propane (min./max.)	mbar	30/50	30/50	30/50	30/50	30/50	100	100	100	100	100
Water capacity	dm3	38	41	44	47	50	53	70	75	80	85
Max. working pressure	bar	6	6	6	6	6	6	6	6	6	6
Gas connection	**G1**	R1½"	-	-	-	-					
	G2	-	Rp1½	Rp2"	Rp2"	Rp2"				DN65	DN65
	G						Rp2"	Rp2"	Rp2"	PN6	PN6
Water connections	**W**	DN65 PN6	DN65 PN6	DN65 PN6	DN65 PN6	DN65 PN6	DN65 PN6	DN80 PN6	DN80 PN6	DN80 PN6	DN80 PN6
Flue connection	**D** mm	250	250	300	300	300	300	350	350	400	400
Safety valve		1"	1"	1¼"	1¼"	1¼"	1¼"	1¼"	1½"	1½"	1½"
Boiler connection		1¼"	1¼"	1½"	1½"	1½"	1½"	1½"	2"	2"	2"
Relief connection											
Standard setting	bar	3	3	3	3	3	3	3	3	3	3
Power supply	V	400	400	400	400	400	400	400	400	400	400
Frequency	Hz	50	50	50	50	50	50	50	50	50	50
Fuse	A	10	10	10	10	10	16	16	20	20	20
Max. electrical power	kW	0.42	0.67	0.71	0.71	0.73	0.90	0.90	1.27	1.27	1.27
consumption unit pump	kW	0.46	0.72	0.72	0.72	1.15	1.15	1.15	1.15	1.50	1.50
maximum total	kW	0.88	1.39	1.43	1.43	1.88	2.05	2.05	2.42	2.77	2.77
Boiler weight, empty, ±5%	kg	525	560	615	645	675	740	840	950	1070	1200
Dimensions height H	mm	1355	1355	1355	1355	1355	1355	1355	1355	1355	1355
width B	mm	830	930	1130	1130	1230	1330	1130	1130	1330	1330
length incl. connections L	mm	1918	1908	1908	1908	1958	2265	2653	2653	2658	2658

Ultramax 318 – 559 Dimensions



Clearances
- 450 mm at one side
- 800 mm at the other side
- 450 mm at the rear
- 1000 mm at the front

Ultramax 318 – 559 Dimensions

Type		318	376	443	508	559
B*	mm	830	930	1130	1130	1230
B1	mm	710	810	960	1010	1110
B2	mm	120	120	170	120	120
B3	mm	646	746	946	946	1046
D	mm	250	250	300	300	300
G1		R 1½"	-	-	-	-
G2		-	Rp 1½"	Rp 2"	Rp 2"	Rp 2"
H1	mm	1115	1205	1205	1205	1120
L	mm	1918	1908	1908	1908	1958
L1	mm	555	545	545	545	595
L2	mm	1362	1362	1362	1362	1362
L3	mm	231	231	231	231	231
L4	mm	108	108	108	108	108
W		DN65 PN6	DN65 PN6	DN65 PN6	DN65 PN6	DN65 PN6

B = Dimensions with external casing (panels) in place

* = To obtain the dimensions without the external casing, subtract 64 mm from dimension eBi.

(Changes may be introduced without notice)

As a result of manufacturing tolerances, there may be small variations in the dimensions.

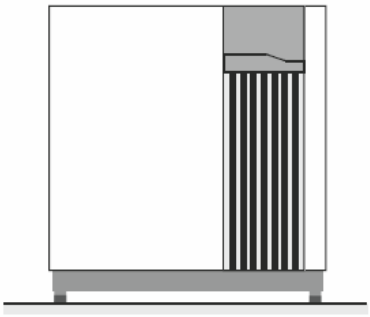
Conditions applicable to above table:

- Nominal capacity measured at: 60 - 80°C.
- Gas consumption at: 1013 mbar, 15°C, dry
- Gas categ o ry: 2_{2H3P}
- Gas pressure: The unit is adjusted during manufacture for a gas supply pressure of 25 mbar.
- Appliance categ o ry: B 23, C53, C33 or C63
- Protection deg r ee: I P20

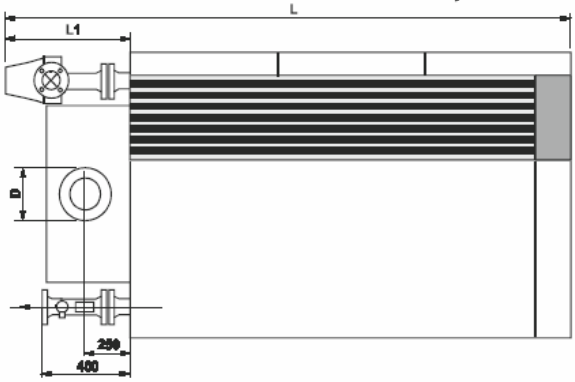
Types R318 to 559 are suitable for nominal distribution pressures of both 20 and 100 mbar for natural gas. For higher gas pressures, a separate gas pressure regulator must be installed in consultation with the local gas supplier. The dynamic supply pressure must never fall below 18 mbar (see para. 5.3.1).

Ultramax 624 – 1018 Dimensions

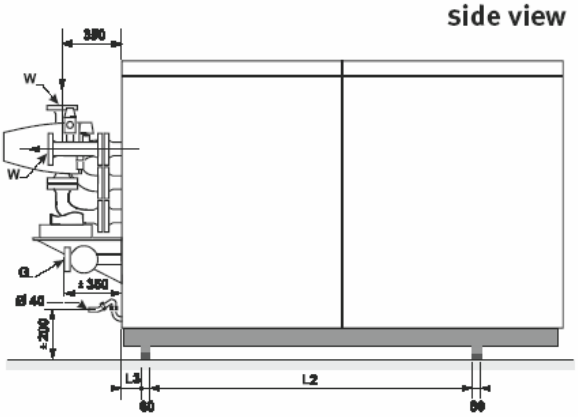
front view



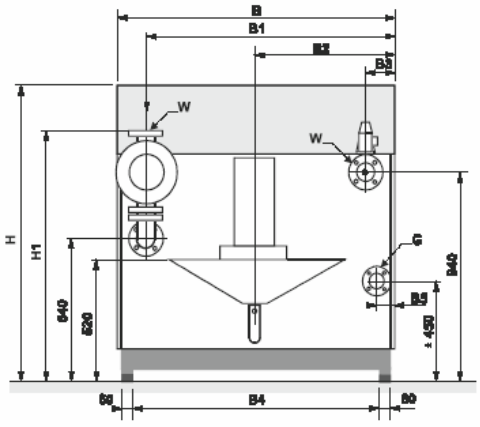
plan view



side view



rear view



Clearances
- 450 mm at one side
- 800 mm at the other side
- 450 mm at the rear
- 1000 mm at the front

Ultramax 624 – 1018 Dimensions

Type		**624**	**730**	**826**	**923**	**1018**
B	mm	1330	1130	1130	1330	1330
B1	mm	1210	1003	1053	1203	1253
B2	mm	665	565	565	665	665
B3	mm	120	127	77	127	77
B4	mm	1146	946	946	1146	1146
B5	mm	65	115	65	115	65
D	mm	300	350	350	400	400
G		Rp2"	Rp2"	Rp2"	DN65 PN6	DN65 PN6
H	mm	1355	1355	1355	1355	1355
H1	mm	1125	1400	1400	1155	1155
L	mm	2265	2653	2653	2658	2658
L1	mm	595	610	610	615	615
L2	mm	700	1166	1166	1166	1166
L3	mm	108	88	88	88	88
W		DN65 PN6	DN80 PN6	DN80 PN6	DN80 PN6	DN80 PN6

(Changes may be introduced without notice)

As a result of manufacturing tolerances, there may be small variations in the dimensions.

Conditions applicable to the above table:

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

1 Introduction

1.1 General

Through their unique construction, the Ultramax range of 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 MHS Boilers Ltd to offer solutions for the most provocative heating demands.

1.2 Supplier

MHS Boilers Ltd are proud to supply and technically support the Ultramax Range of boilers throughout the United Kingdom.

For advice or more information please contact your local sales representative or our head office via 01268 591010.

1.3 This document

This documentation has been written 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.

If additional information is required please contact your local representative or our head office via 01268 591010.

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 the Technical Services Department via 01268 591010.

1.5 General restrictions

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

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

2 Description

2.1 General

The Ultramax series are environmentally friendly modulating gas fired heating boilers that can vary its output from 25% to 100% of its maximum capacity.

The Ultramax series consists of 10 models in a range from 318 to 1018 kW.

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

The R2700/R2800/R2900 series have CE approval for all relevant European countries.

The series are registered under the product identification numbers 0063AQ6600. (318 - 559) & 0063AR3514. (624 - 1018)

The boilers can be supplied either 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 and sends a signal to the frequency converter to maintain the correct heating capacity.

The gas/air mixture so formed is passed through a cooled premix burner and ignited. The premix burner is constructed of finned bimetallic pipes (internally from stainless steel and externally from aluminium) with cast iron water headers.

Heat transfer takes place in two or 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. Both heat exchangers are fitted with cast iron profiled water distribution components (headers) which guarantee an optimum water flow through the appliance.

The burner and the heat exchangers are connected in series.

The boiler pump ensures the correct water flow quantity.

The Ultramax 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.

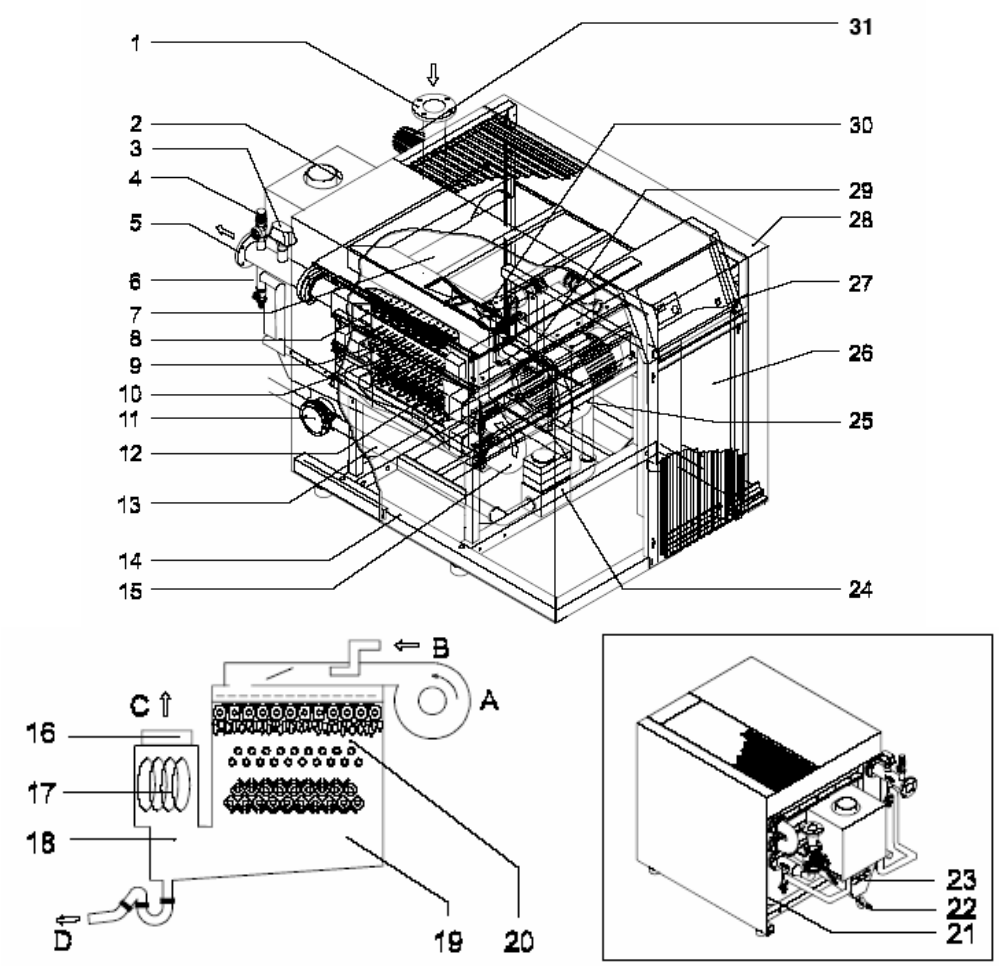
Application possibilities

Because of its construction, the Ultramax 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 (0 – 10 Vdc = +2°C – +90°C), see 5.3.2 connection terminals).

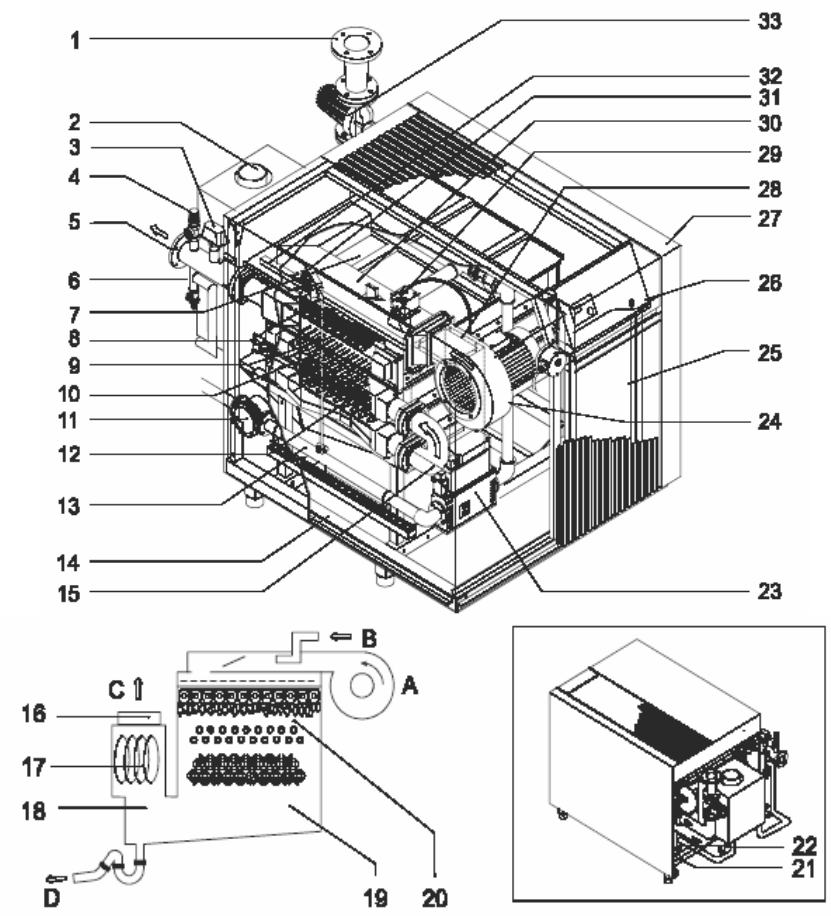
2.2 Ultramax 318-559 Main components

1 Return connection
2 Flue gas discharge attenuator
3 Water flow switch
4 Safety valve
5 Inlet connection
6 Filling / drainage valve
7 Cover
8 Distribution plate
9 Burner
10 First heat exchanger
11 Gas filter
12 Second heat exchanger
13 Gas train
14 Frame
15 Water circulation piping
16 Flue gas discharge
17 Third heat exchanger (Special Order Appliances Only)
18 Condensate collection tank
19 Flue gas collection chamber
20 Combustion chamber
21 Electrical cable duct
22 Condensate discharge
23 Inspection opening
24 Gas valve unit
25 Fan
26 Connection box
27 Control panel
28 Casing
29 Air inlet damper
30 Butterfly valve
31 Mixing chamber
32 Boiler pump
A Air
B Gas
C Flue gas
D Condensate



2.2 Ultramax 623-1018 Main components

1 Return connection
2 Flue gas discharge attenuator
3 Water flow switch
4 Safety valve
5 Flow connection
6 Filling/drainage valve
7 Cover
8 Distribution plate
9 Burner
10 First heat exchanger
11 Gas filter
12 Second heat exchanger
13 Gas train
14 Frame
15 Water circulation piping
16 Flue gas discharge
17 Third heat exchanger (Special Order Appliances Only)
18 Condensate collection tank
19 Flue gas collection chamber
20 Combustion chamber
21 Electrical cable duct
22 Condensate discharge
23 Gas valve unit
24 Fan
25 Connection box
26 Control panel
27 Casing
28 Air inlet damper
29 Main mixing chamber
30 Pilot gas valve
31 Pilot mixing chamber
32 Boiler pump
A Air
B Gas
C Flue gas
D Condensate



2.2.1 Description of principal components

The boiler is constructed from the following principal components:

Fan

This consists of a fan casing, a fan impeller and an electric motor. The fan sucks in combustion air and increases the air pressure.

Air inlet damper

A specially developed air inlet damper ensures a low noise level. As an option, this can be provided with an air filter or with an air inlet opening so that the appliance can function as a room sealed appliance.

Gas train

The principal component of the gas train is the main gas valve/proportional pressure regulator. 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. The unit is fitted with a gas filter as standard.

Mixing chamber

This area is used for the thorough mixing of the gas and the combustion air.

Burner

After the gas/air mixture has been distributed over the burner with the aid of a distribution plate, the mixture is burned on the surface of the burner in such a way that the flame is directed downward. The burner is air and water cooled. The water distribution components are made from cast iron and have a profile that ensures that an optimum distribution and flow are obtained.

Heat exchangers

The primary heat exchanger is constructed from smooth stainless steel tubes. These transfer most of the heat energy to the system water. The secondary heat exchanger, which consists of laser welded stainless steel finned tubes, transfers the remaining heat from the flue gasses to the system water. All the water distribution components are constructed from cast iron and have a profile that ensures that optimum distribution and flow are obtained. The space between the burner and the secondary heat exchanger forms the combustion chamber.

Special order appliances only have a third heat exchanger is attached which consists of one or more stainless steel fin tube(s), switched in series, in form of a spiral. It is arranged on the back of the boiler on the flue gas collection chamber.

The boiler pump ensures the water flow quantity.

The third heat exchanger is switched parallel to the boiler and has a flow of 5 - 10% of the entire water flow.

Water circulation pipes

These pipes connect the burner to the heat exchangers.

Water connections

These consist of a flow connection and a return connection. Both of these connections are

provided with a filling/drain valve. The flow connection is also provided with a safety valve, a flow switch and a temperature sensor.

Boiler pump
The boiler pump is mounted on the return connection to the unit and is 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.

Flue gas collection chamber
The stainless steel flue gas collection chamber is mounted under the heat exchanger. This chamber is provided with a flue gas exhaust connection, a condensate drain connection and an inspection opening.

Frame
The frame is constructed from steel profile sections. Vibration absorption dampers are supplied separately and must be fitted after the unit has been placed in position.

The casing
The casing consists of panels that can be removed easily without the aid of tools.

The electrical section
This includes the control and safety circuits for the unit.

Connection box
The electrical power supply for the boiler, the terminals, the pump connections and the pump relay are mounted in an easily accessible connection box. The supply cables can easily be fed to the connection box via the cable duct inside the boiler.

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 a manual operation mode having been selected, (I or II)
C. In standby mode, when the water temperature falls below the frost protection temperature.
After the boiler has started up, the PID controller sends a signal to the frequency converter. This converter controls the speed of the fan. Depending on the quantity of air moved by the fan, the proportional pressure regulator ensures that the corresponding quantity of gas is added.
In this way the boiler capacity is continually adjusted and the boiler can accurately follow the heating demand. If the boiler is operating at minimum capacity and the temperature of the supply water rises above the desired value, the boiler will be shut down. As soon as the temperature of the supply water falls below the set value, the boiler will be re-started.

2.4 Safety aspects

The boiler contains the following safety components:

- Flame protection with 1x re-start (ionisation)
- Water flow protection
- Maximum water temperature protection
- Gas valve test
- Gas valve leak test (option)
- Minimum air pressure protection
- Boiler pump motor over-heating protection (Clixon).

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

The unit is fitted with a safety valve that opens at 3 bar.

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.

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 appliances are completely assembled, tested and covered in a "heat-shrink" protective covering.

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

For transport purposes, the unit is mounted on wooden blocks, fitted with protective bumpers and covered in a "heat-shrink" protective covering.

4.3 Transport

For transport, consult the technical details for dimensions and weight.

Remove the covering 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 with a minimum fork length of 1 m can be used at the side of the unit.

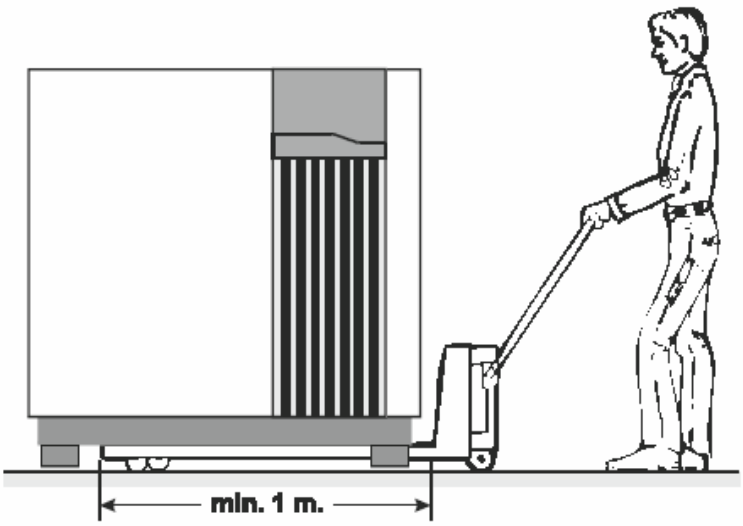


Fig. 6 Moving the appliance

Rollers

After the wooden blocks have been removed, it is possible to move the appliance by rolling it over tubes.

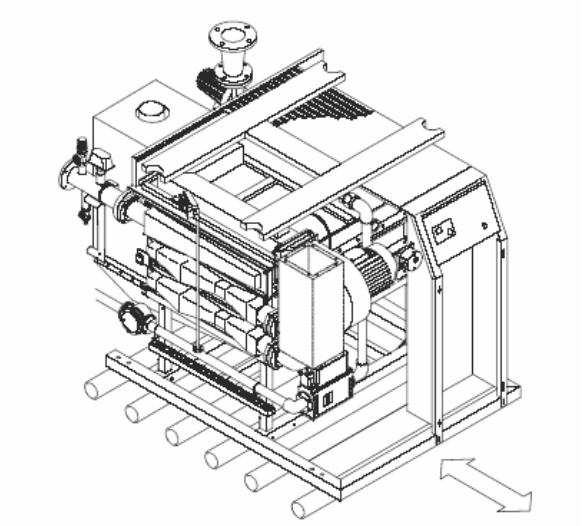


Fig. 7 Moving with the id of rollers

Lifting

The figure below shows how a unit can be safely lifted. To avoid damage to the panels, these should first be removed. The wooden bars between the straps ensure that the unit will not be damaged during lifting.

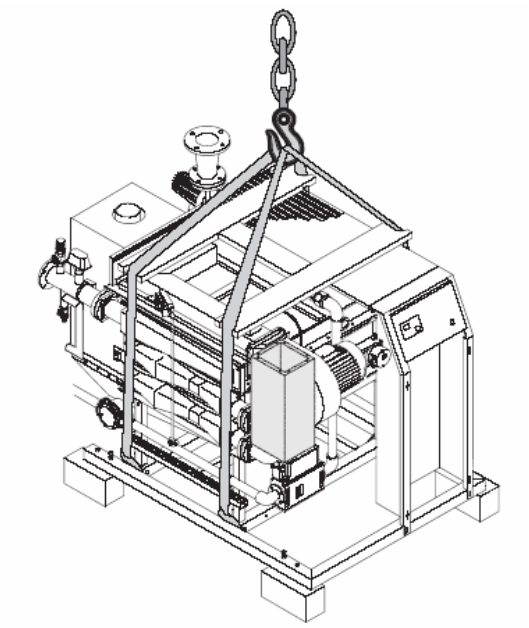


Fig. 8 Lifting

Caution:

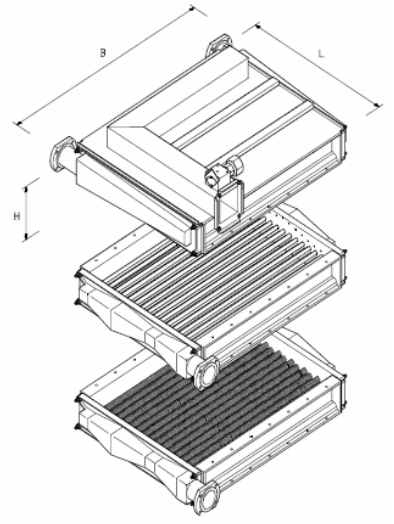
- Ensure that the lifting straps are of the correct quality!
- Never move the units over the heads of persons!

Dismantling and reassembly

When the unit cannot be placed in position because of its dimensions or weight, the boiler may be partially dismantled.

When it is necessary to perform extensive dismantling, we advise you to make early contact with your supplier. The unit can be delivered in parts, each of which has been pre-tested. We strongly advise you to have dismantling and reassembly activities carried out by the MHS Technical Service Department trained staff.

Dimensions and weights of Burner and Heat exchangers

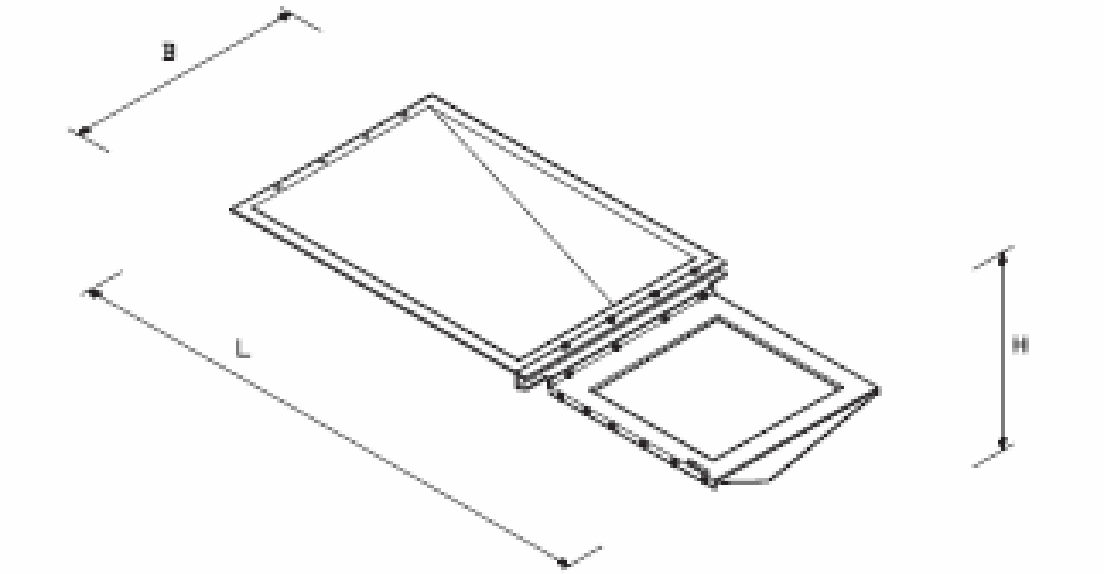


Burner				
Type	Length mm	Breadth mm	Height mm	Weight kg
318	1010	760	400	105
376	1010	860	410	115
443	1010	960	410	120
508	1010	1050	420	130
559	1010	1150	420	135
624	1010	1310	500	140
730	1420	1010	500	210
826	1420	1110	500	215
923	1420	1210	500	220
1018	1420	1310	500	225

Heat Exchanger One				
Type	Length mm	Breadth mm	Height mm	Weight kg
318	1030	760	150	90
376	1030	860	150	95
443	1030	960	150	110
508	1030	1050	150	115
559	1030	1150	150	120
624	1010	1310	160	135
730	1420	1010	160	180
826	1420	1110	160	185
923	1420	1210	160	190
1018	1420	1310	160	195

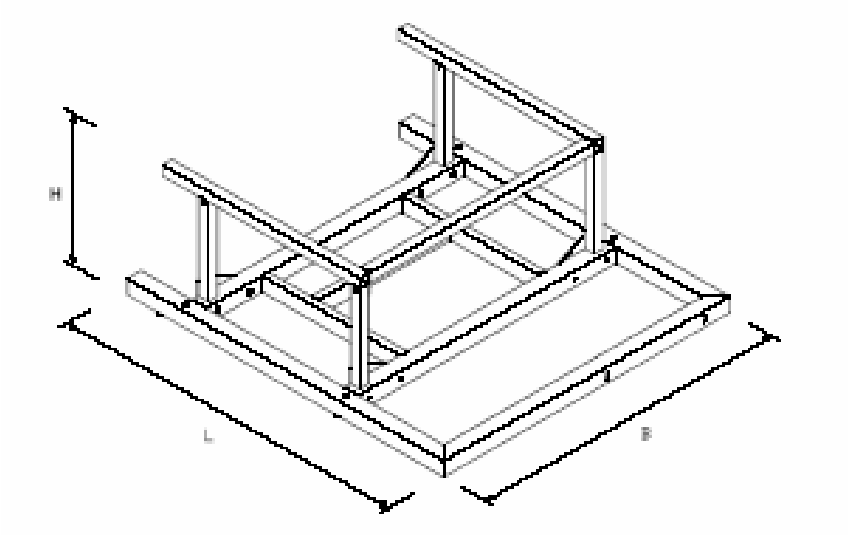
Heat Exchanger Two				
Type	Length mm	Breadth mm	Height mm	Weight kg
318	1030	760	150	100
376	1030	860	150	110
443	1030	960	150	120
508	1030	1050	150	130
559	1030	1150	150	135
624	1010	1310	160	150
730	1420	1010	160	200
826	1420	1110	160	200
923	1420	1210	160	210
1018	1420	1310	160	210

Dimensions and weights of the Condensate Collectors.



Condensate Collector				
Type	Length mm	Breadth mm	Height mm	Weight kg
318	1320	590	800	25
376	1320	690	800	25
443	1320	790	800	25
508	1320	890	800	25
559	1320	990	800	25
624	1450	1070	400	35
730	1950	770	400	35
826	1950	870	400	35
923	1950	970	400	35
1018	1950	1070	400	35

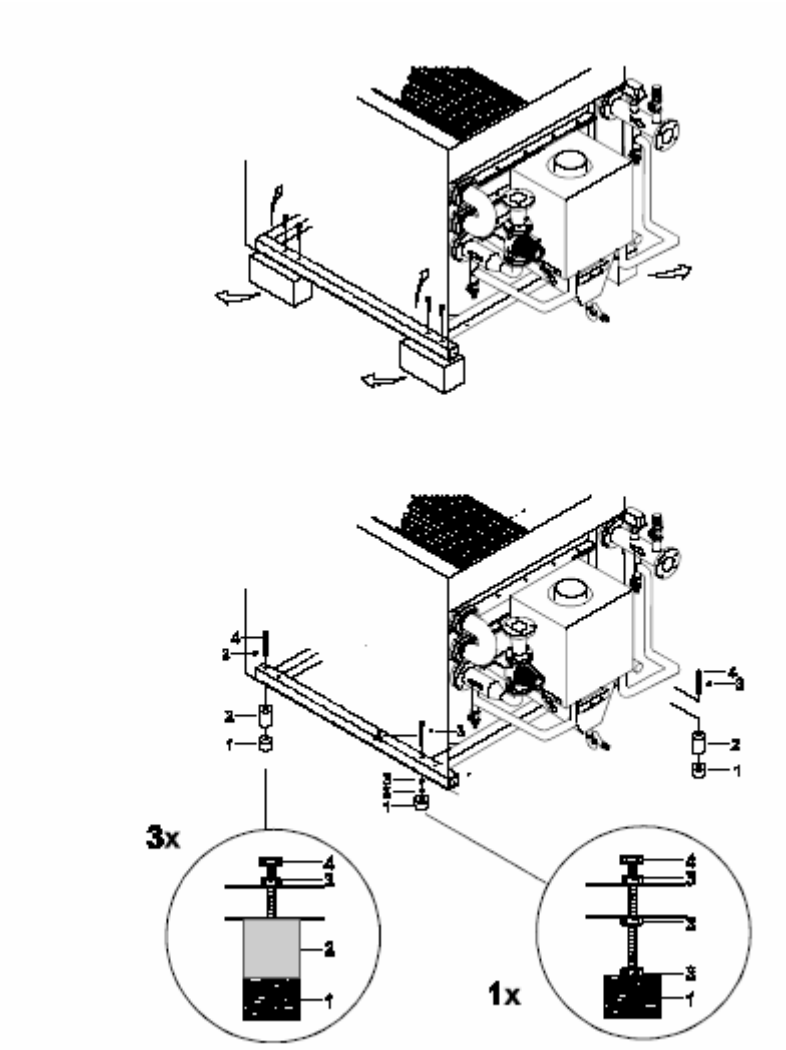
Dimensions and weights of the Frame.



Frame				
Type	Length mm	Breadth mm	Height mm	Weight kg
318	1325	765	460	45
376	1325	865	460	45
443	1325	1065	460	50
508	1325	1065	460	50
559	1325	1165	460	50
624	1630	1266	500	60
730	2004	1066	500	70
826	2004	1066	500	70
923	2004	1266	500	70
1018	2004	1266	500	70

Positioning

Once the unit is in the correct position, the wooden blocks must be removed. The vibration absorption dampers with spacers delivered with the unit must now be mounted as described in the instructions delivered with them (see drawing). Thereafter, the water, gas, chimney, condensate and electrical connections can be completed.



Mounting the vibration dampers

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 Technical Service Department of MHS Boilers Ltd, 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. (Consult BS 6644)

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:

- 450 mm at one side
- 800 mm at the other side
- 450 mm at the rear
- 1000 mm at the front (space for free movement).

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

Hydraulic System Pressure Monitoring

All hydraulic systems connected to the Ultramax range of boilers must incorporate a system water low pressure switch, in accordance with BS6644.

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 20 mbar for natural gas or 37 mbar for propane with the use of a gas pressure regulator if required.
The maximum gas pressure sustainable at the gas valve inlet connection is 100 mbar for models 318 - 559 and 25 mbar for models 624 - 1018
The loss of pressure in the connecting pipes must be such that, at maximum boiler capacity, the pressure must never fall below 20 mbar for natural gas or 37 mbar for propane.

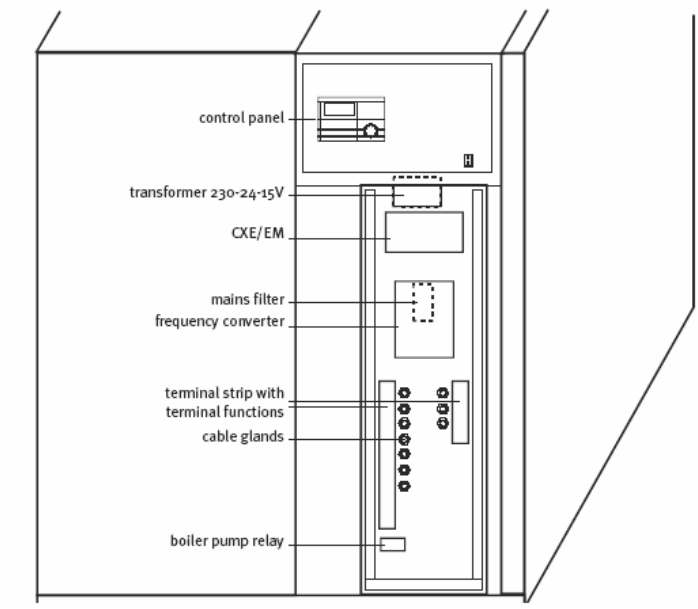
5.3.2 Electrical connection

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 terminals and the boiler pump relay are mounted in a separate connection box behind the front panel.

This front panel can be simply removed by pulling the lower edge of the panel forward.
Behind this panel are two cover plates which can be removed by unscrewing the M5 bolts.
The terminal strip with the connection clamps are mounted behind the lower cover plate.
The cables to be connected (power supply, control) enter the appliance via the rear of the unit, and pass via the cable duct at the inner right hand side to the connection box at the front of the unit.
The connection box is provided with cable glands and connection terminals.
The boiler pump is provided with thermal protection and a pump relay.



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 at the exits from the boiler room. In the event of a calamity, the power supply to the unit can be switched off.
Earth leakage trips can give problems when they are used in combination with frequency converters. In some countries this is actually forbidden.
There are two reasons for this:
a All rectifiers (not only frequency converters) can cause direct currents to flow in the mains power supply and which can reduce the sensitivity of the safety switch
b The asymmetric loading caused by radio interference filters can result in the premature operation of the earth leakage trip, which in turn will result in the unit being 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		Total electrical consumption (max)
	Supply 1 Phase	Power Consumption (max)	Supply ** 3 Phase		Power consumption *** max)
	V	kW	V	kW	kW
318	240	0.42	400	0.46	0.88
376	240	0.67	400	0.72	1.39
443	240	0.71	400	0.72	1.43
508	240	0.71	400	0.72	1.43
559	240	0.73	400	1.15	1.88
624	240	0.90	400	1.15	2.15
730	240	0.90	400	1.15	2.15
826	240	1.27	400	1.15	2.45
923	240	1.27	400	1.50	3.12
1018	240	1.27	400	1.50	3.12

Electro-technical data

* Tolerance on voltage: 230 V +10% /-15% tolerance on frequency: 50 Hz □} 5%

** tolerance on voltage: 400 V +10% /-15%

*** the stated pump power is based on the maximum power consumption in pump speed 3. The pump curves can be used to determine the optimum operating point in relation to pump efficiency and power consumption.

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 (= +2°C – +90°C) signal. Also a domestic hot water priority circuit belongs to the standard equipment.

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
- 2 week programs
- 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 will then be 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

Terminal Description

L1-L2-L3-N-E	Boiler power supply; must be fused at 10 A, 16 A or 20 A dependant upon type of unit.
8 - 9	Domestic hot water primary pump control. This out put provides a voltage (240 V) when the boiler is operational as a result of a domestic hot water heating demand.

10 - 11 Boiler enable (240 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 set ting the boilers to standby during the summer months whilst continuing to provide domestic hot water priority.

12 - 13 Operating signal (240 V, 50 Hz, 1 A, N.O.). 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.

14 - 15 Control voltage for an external gas valve. This output begins to provide 240 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 (240 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**. The calorifier temperature can also be regulated by a sensor (terminals 35-36).

18 - 19 Interlock input (240 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 (240 V). If the connection between these terminals is interrupted the boiler will lockout. Reinstate the connection and press reset.

30 - 31 External sensor* (2-wire 1,01 kΩ PTC). 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* (2-wire 1,01 kΩ PTC). This sensor can measure the temperature of a low velocity header.

35 - 36 Calorifier temperature sensor* (2-wire 1,01 kΩ PTC). After a suitable sensor has been connected it will be automatically recognised when the power supply voltage is switched on. **The terminals 34 - 35 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”.

39 - 40 Output capacity signal*. This signal provides information for a capacity display. 0 – 100% = 0 – 10 VDC. The maximum current is 5 mA.
For higher currents or long connecting wires (›5 m) the use of a signal amplifier is recommended.

41 - 42 SCOM bus connection (use the correct polarity).

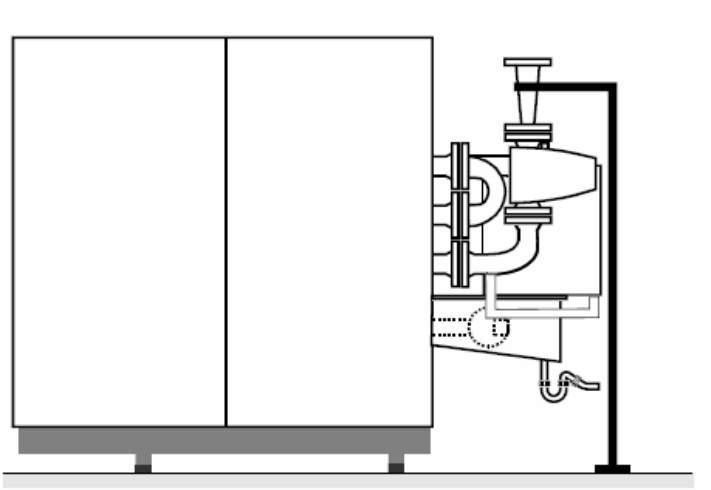
43 - 44 Primary boiler pump control (0 – 10 V = +2°C – +90°C). * the use of screened cables is recommended.

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.

Supports for water connections

It is recommended that the flow and return pipes be properly supported. This will avoid damage through overloading (weight) and simplifies maintenance.



The unit is a constant water flow appliance and is only suitable for use on closed pre-pressurised systems.

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 12) 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** can 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

5.3.4.1 General

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

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 may not result in a pressure drop exceeding 1.0 mbar.

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).

Type	Air supply diameter D (mm)	X (mm)	Y (mm)
318	200	160	220
376	200	160	220
443	250	240	240
508	250	185	240
559	250	185	240
624	250	239.5	359
730	300	239.5	266
826	300	239.5	266
923	355	289.5	266
1018	355	233.5	266

Fig. 18 horizontal air supply

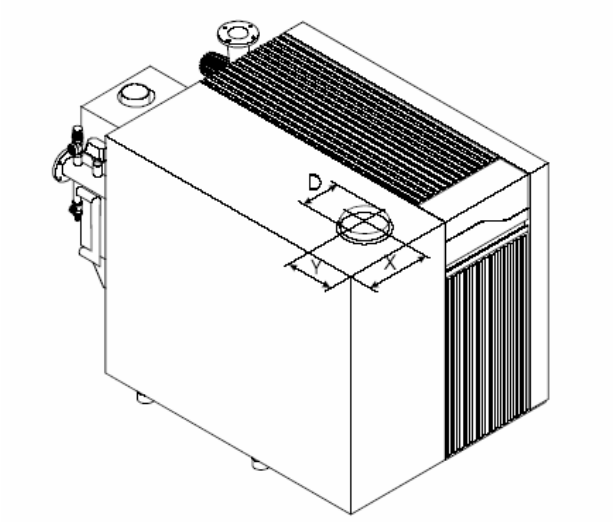


Fig. 19 Air supply connection

The connection to the air supply pipe is always mounted on the top 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 30 cm above the roof and must be fitted with a rain cap.
The flue pipe opening must end at least 100 cm above the roof, assuming the roof to be flat.

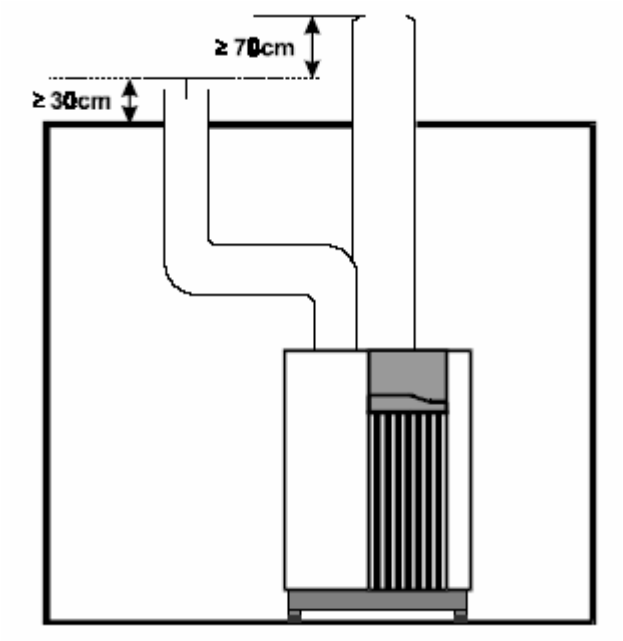


Fig. 20 Heights of air inlet and flue gas discharge

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

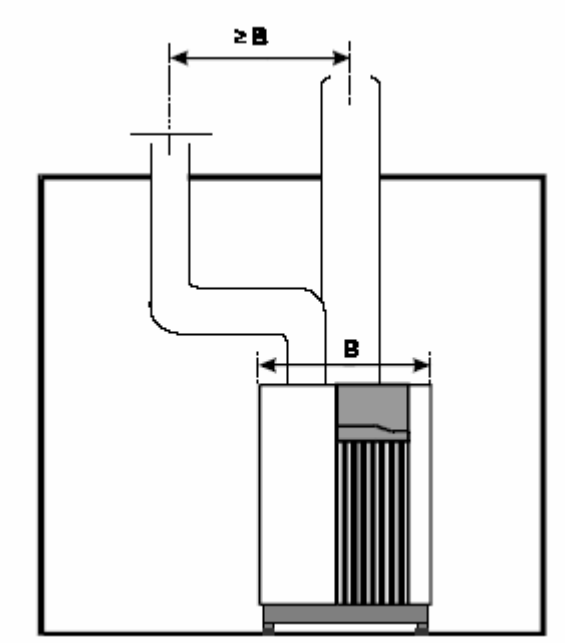


Fig. 21 Distance between air inlet and flue gas outlet

The formation of unwanted condensation must be avoided. In the event that during the heating up

period condensation occurs, the condensate must be able to flow back to the unit. Inspection of the air supply and flue pipe must be possible.
The connection, exit position and height in relation to possible obstacles must comply with the applicable national and local standards and regulations.

5.3.5 The flue system

5.3.5.1 General

The flue pipe connection is at the rear of the appliance and has been designed for direct connection to a corrosion resisting flue pipe.
Condensation forms because of the high boiler efficiency and the considerable degree of cooling of the flue gasses that takes place against the walls of the flue pipe. In order to reduce flue gas condensation as much as possible, the use of a double-walled and insulated flue pipe is recommended.
Aluminium or stainless steel is strongly recommended. Because a slight overpressure exists in the flue pipe during a cold start-up, flue pipes should preferably be constructed from seamless materials.
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 combustion products at low flue gas temperatures will damage the stack.
The following table lists all the flue gas data for all types of boiler.

Type	Flue gas temperature at full capacity (approx.)	Flue gas quantity at full capacity		Maximum permissible chimney resistance
	°C	m3/h	kg/s	mbar
318	140	637	0.156	1.0
376	140	757	0.186	1.0
443	140	858	0.208	1.0
508	140	1018	0.249	1.0
559	140	1118	0.275	1.0
624	155	1287	0.306	1.5
730	155	1505	0.357	1.5
826	155	1703	0.404	1.5
923	155	1901	0.451	1.5
1018	155	2099	0.498	1.5

Table 9 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 mbar (318-559) 1.5 mbar (624-1018) 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 4.7 m/s. For the appliance there will be a maximum overpressure of approximately 1.0 - 1.5 mbar (100 – 150 Pa) for the flue system (see table 10 for lengths).

Owing to their high resistance, bends with an R/D ratio smaller than 1 should be avoided. It may happen that these must be used, in which case the chimney length must be calculated with the aid of table 11. We advise fitting the horizontal pipe section with a fall so that any condensate formed can be drained via the boiler.

The flue system attached to the Ultramax range of boilers must be designed to overcome its own resistance and provide a draught at the appliance flue connection of between 5 to 15 Pa.

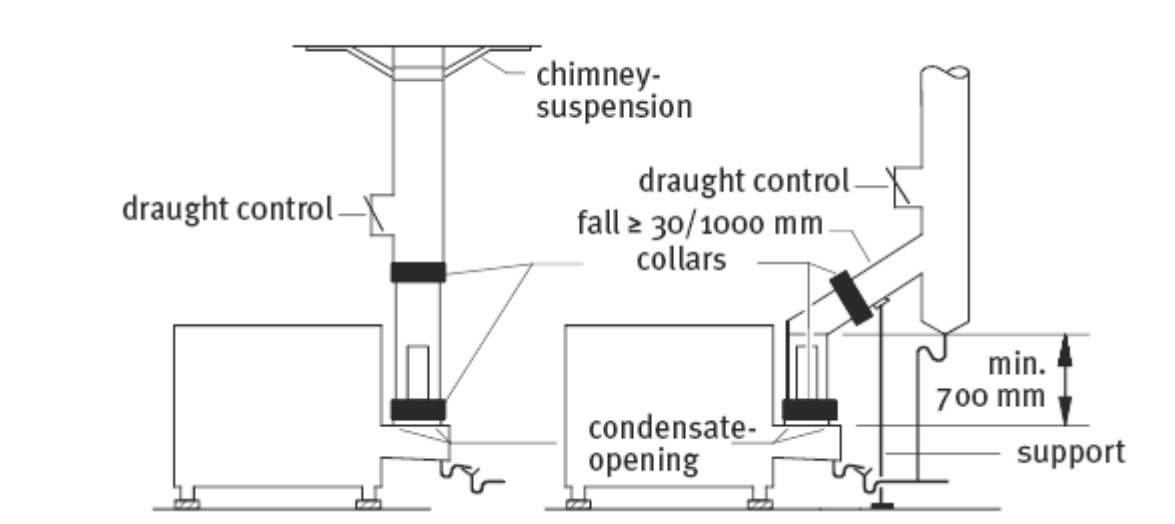


Fig. 22a Chimney connection

The Ultramax boiler must never be connected to a flue systems with a plastic lining (consult the applicable standards and regulations). The maximum flue gas temperature at full capacity and with a water supply temperature of 80°C will not exceed 160°C.

The boilers are equipped with a flue attenuator.

Never connect the flue pipe directly to the flue attenuator.
The flue attenuator must always be free standing. It must never be in contact with the walls of the chimney. The flue pipe connected to the appliance must first rise vertically by 70 cm before either the diameter or the direction is changed.
The openings on the underside of the flue connection ring must never become blocked. The free flow of condensate and any rain water must be guaranteed. The flue connection is at the back of the appliance.
To ensure proper functioning of the appliance, it is recommended that a draught stabiliser be mounted in the flue system.

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

Calculation of the length
The lengths given in the following table are only intended for the further calculation of the total length. The maximum vertical length may not exceed the flue length as indicated in table 10.

Maximum permitted flue system length in metres of smooth pipe. Standard flues only.

Type	Length of flue system in m							
	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter	Diameter
	120 mm	150 mm	180 mm	200 mm	250 mm	300 mm	350 mm	400 mm
318	**	**	**	32	109*	-	-	-
376	**	**	**	21	76*	-	-	-
443	**	**	**	**	53	141*	-	-
508	**	**	**	**	38	105*	-	-
559	**	**	**	**	31	86*	-	-
624	**	**	**	**	**	115*	235	-
730	**	**	**	**	**	80	175*	-
826	**	**	**	**	**	**	135*	265
923	**	**	**	**	**	**	110	200*
1018	**	**	**	**	**	**	100	175*

Table 10 Length of flue system

The flue system lengths have been rounded down.

* Chimney diameter at the appliance

** Not applicable

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 10.
Conversion for other types of accessories with different (resistance coefficient) values can be simply accomplished by comparing with the stated losses at ζ =1.

Type	Diameter in mm	Z= 1	Elbow 90° R/D = 1	Elbow 90° right angle	Elbow 45° ζ= 0,5	90° Tee ζ= 2
318	250*	6.2	3.1	8.1	3.1	12.4
	200	4.5	2.2	5.8	2.2	8.9
376	250*	6.1	3.1	8.0	3.1	12.3
	200	4.1	2.1	5.4	2.1	8.3
443	300*	7.0	3.5	9.2	3.5	14.1
	250	5.5	2.8	7.2	2.8	11.0
508	300*	7.4	3.7	9.6	3.7	14.8
	250	5.5	2.8	7.2	2.8	11.1
559	300*	7.3	3.6	9.5	3.6	14.6
	250	5.5	2.7	7.1	2.7	10.9
624	300*	10	5	13	5	20
	350	11	5	14	5	21
730	300*	9	5	12	5	19
	350	11	6	14	6	22
826	350*	11	5	14	5	22
	400	12	6	14	5	22
923	350*	11	6	14	6	22
	400	12	6	15	6	24
1018	350*	12	6	16	6	24
	400	13	6	16	6	25

Table 11 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. 23). 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.

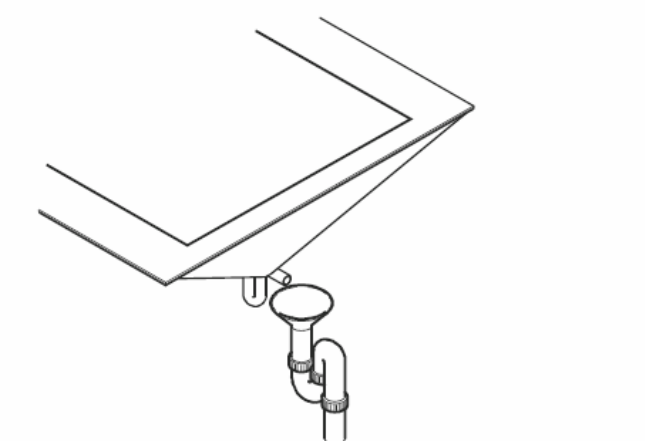


Fig. 23 Condensate discharge

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 Ultramax units are low water content boilers for which the water flow rates must be within minimum and maximum values. (Δt 15^0C - 25^0C)

Table 12 - 14 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 20 K		Pump data				
	Nominal flow rate	Boiler-resis tance	Grundfos pump type	Pump speed	Head at Qnom.	Available head at Qnom.	Max.* power consumption
	m3/h	kPa	UPS		kPa	kPa	W
318	13.55	25	40-120F	3	55	30	460
376	16.08	30	50-120F	3	76	46	720
443	18.27	22	50-120F	3	70	48	720
508	21.59	27	50-120F	3	59	32	720
559	23.78	32	65-120F	3	83	51	1150
624	26.36	37	UPS 65-120F	3	80	43	1.15
730	30.83	25	UPS 65-120F	3	72	47	1.15
826	34.87	30	UPS 65-120F	3	60	30	1.15
923	38.96	35	UPS 80-120F	3	75	40	1.50
1018	43.00	40	UPS 80-120F	3	68	28	1.50

Table 12 Water flow rate and pump data

* 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.

The primary pump has been sized to have an optimum duty when ΔT = 20 K. When running at ΔT's less than 20 K 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 12). 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.

5.4.2.2 Pump characteristics

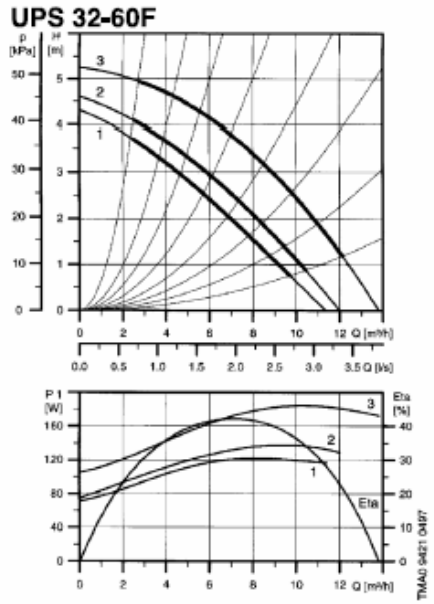


Fig. 24 Pump char. UPS 32-60F

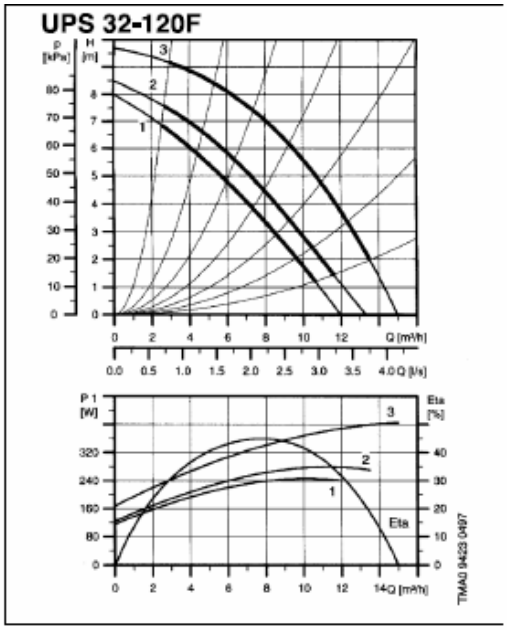


Fig. 25 Pump char. UPS 32-120F

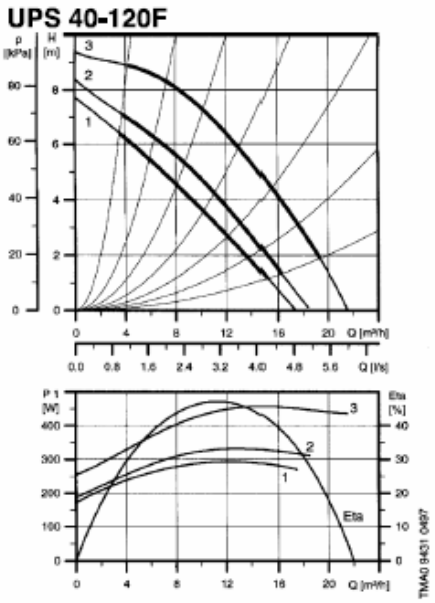


Fig. 26 Pump char. UPS 40-120F

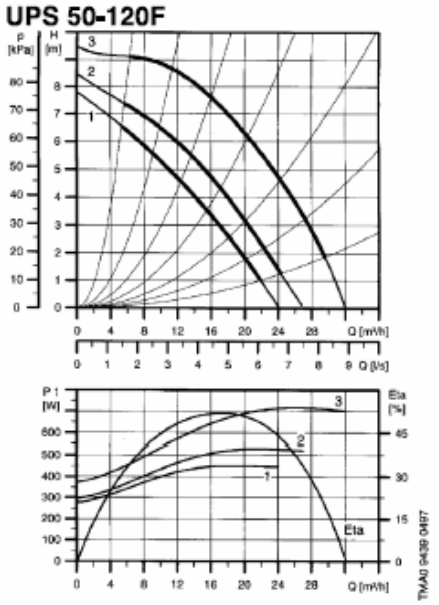


Fig. 27 Pump char. UPS 50-120F

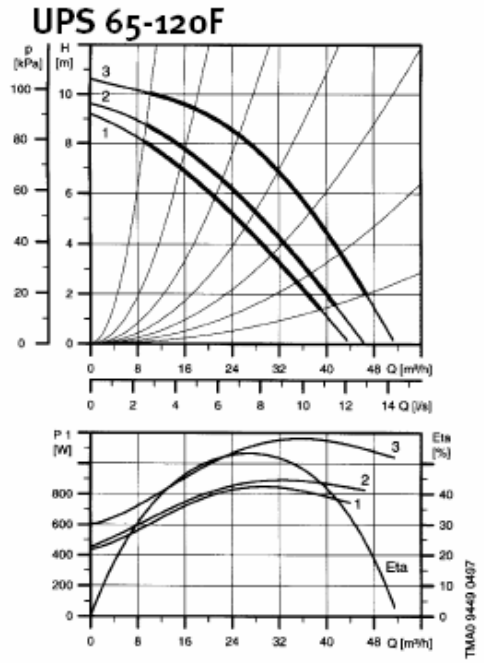


Fig. 24 Pump char. UPS 65-120F

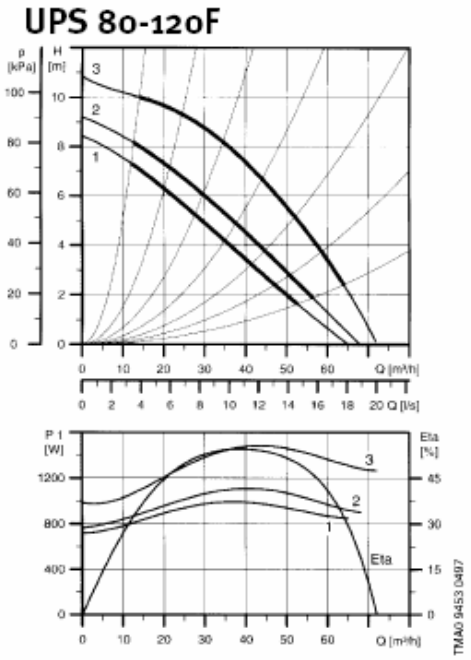


Fig. 25 Pump char. UPS 80-120F

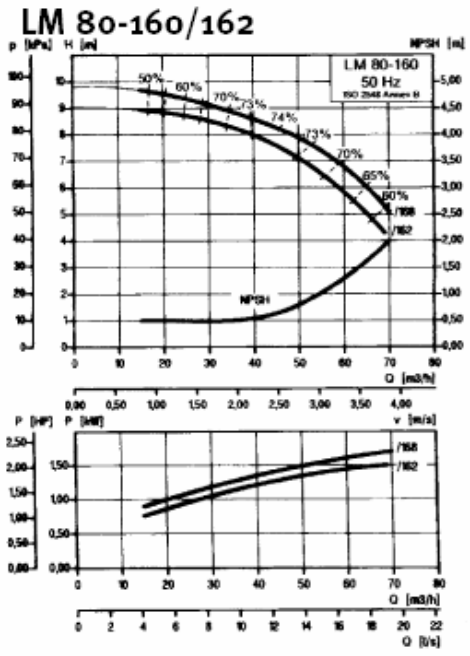


Fig. 26 Pump char. LM 80-160/162

Type	Pump speed	Pmax W	Pmin W	I A 3x400 V	cos φ
UPS 40-120F					
318	2	330	190	0.56	0.85
UPS 50-120F					
376 – 508	2	530	300	0.94	0.81
UPS 65-120F					
559	2	900	460	1.45	0.90
UPS 65-120F					
624 – 826	2	900	460	1.45	0.90
UPS 80-120F					
923 - 1018	2	1100	760	1.80	0.88

Table 13 Electrical data for pumps

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

For Ultramax units connected in cascade, a delayed motorised shut-off valve can be used if it is controlled by the boiler using terminals 14 + 15 or alternatively, a 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 protection. This shuts the appliance down in the event that the flow of water through the appliance falls below the minimum required value. This protection is implemented by means of a water flow switch.

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	ΔT K
›1.5	90	20
›1	80	20

Table 14 minimum operating pressures

5.4.3.2 Boiler expansion tank

It is possible 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

All appliances are fitted with a safety valve that opens at 3 bar. As an option, safety valves can be supplied with settings between 3 and 6 bar with increments of 1 bar.

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

Very soft less than 50 ppm

Soft approx. 50 - 160 ppm

Moderately hard approx. 160 - 250 ppm

Hard and very hard over 250 ppm

The system must contain soft to moderately hard water with a water hardness not exceeding 250 ppm with a supply temperature of 80°C and ΔT = 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.

It is imperative that the system is treated with suitable corrosion and scale inhibitors. The concentration of the dosage must be monitored and maintained on a regular basis. Failure to comply with these requirements will render the appliance warranty null and void.

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.

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:

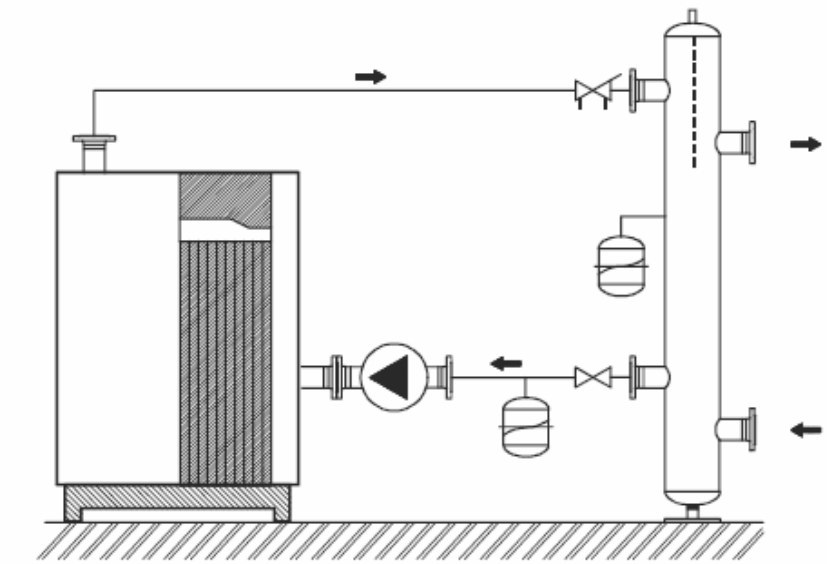
$$\varnothing = \sqrt{\frac{\frac{Q}{3600} \times 1.28}{v}}$$

Where: $\varnothing$ = the diameter of the low velocity header in m

Q = the water flow rate in m3/h of the boiler circuit or the secondary circuit, whichever is the greater.

v = the speed in m/s.

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



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.

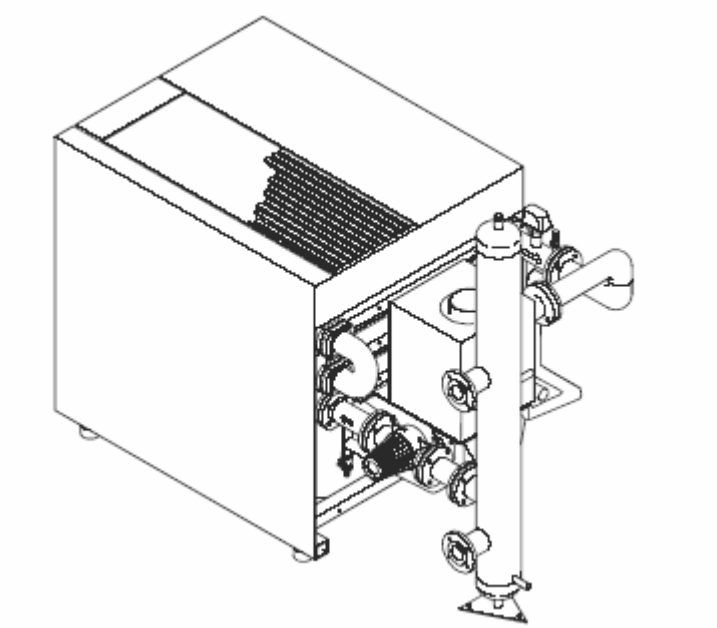
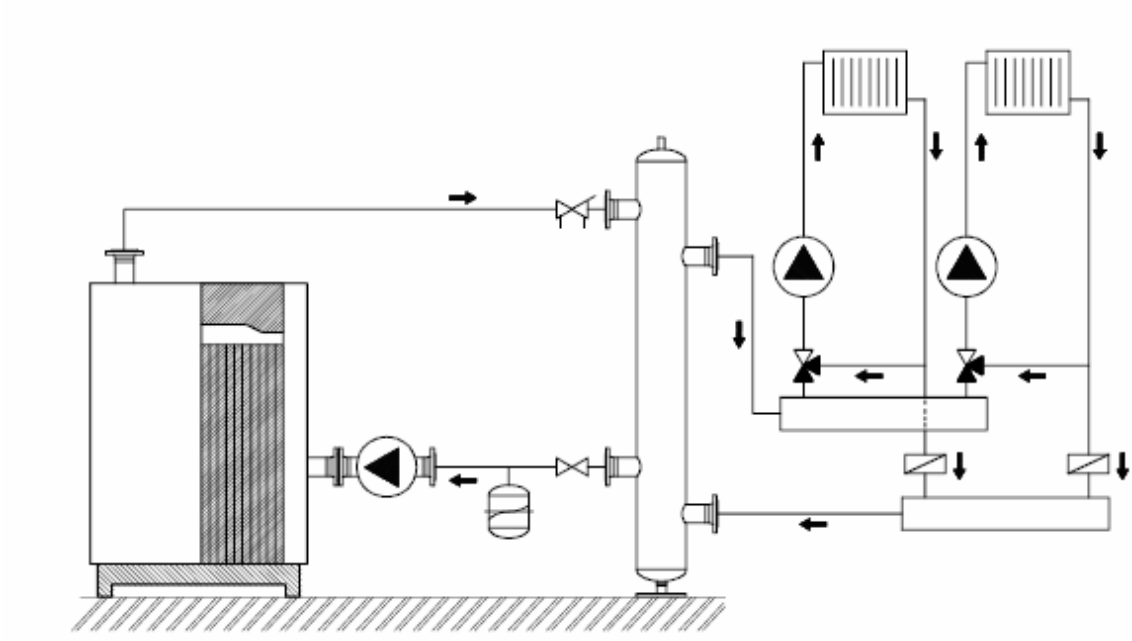


Fig. 28 Boiler with vertically mounted low velocity header arranged with right hand connections



Low velocity header with multiple heating circuits in a mixing control arrangements without a main pump

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.

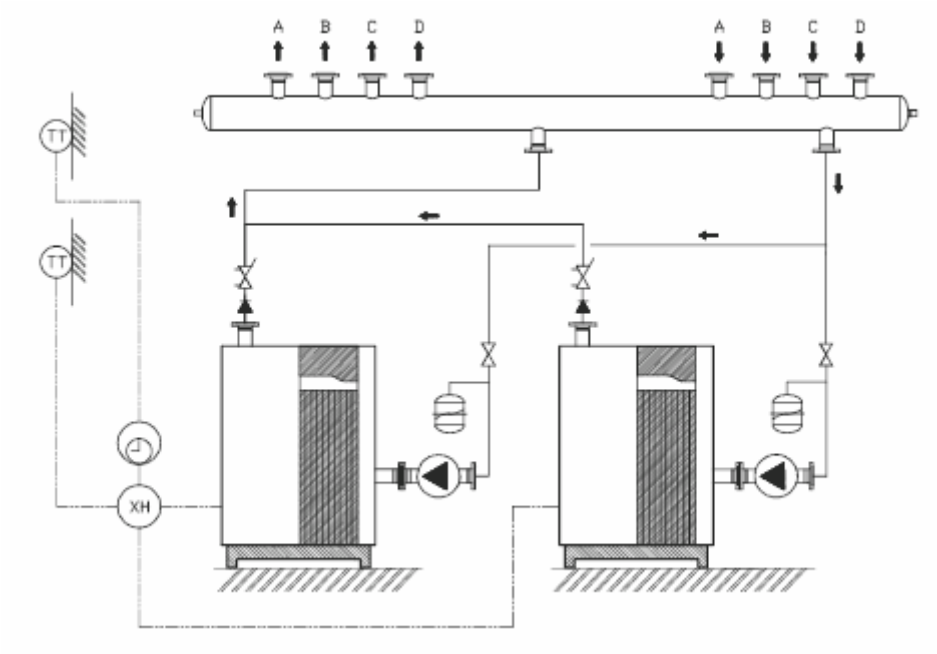


Fig. 29 Installation with multiple appliances

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 (see 5.4.2.4).

Installations with multiple appliances without non-return valves

The total resistance of the system (boiler, isolating valves and pipework) will be much greater than the resistance of the low velocity header. The baffles “X” (see fig. 30) prevent undesirable circulation through the non-operating boiler.

When two appliances are switched in cascade, it is advisable to employ this system. When appliances are controlled by a building 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.

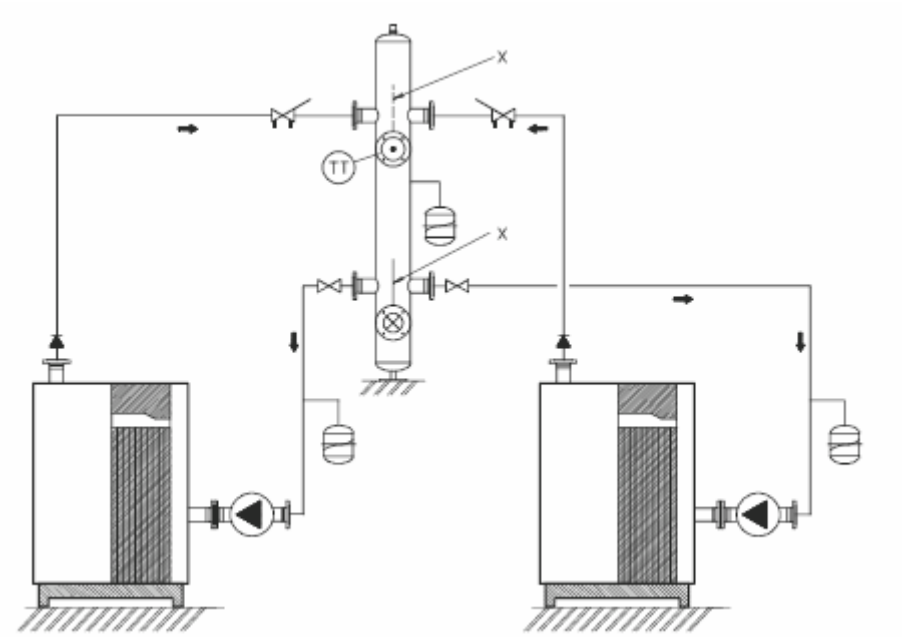


Fig. 30 Installation with more than one appliance, without non-return valves and making use of a low velocity header for two boilers

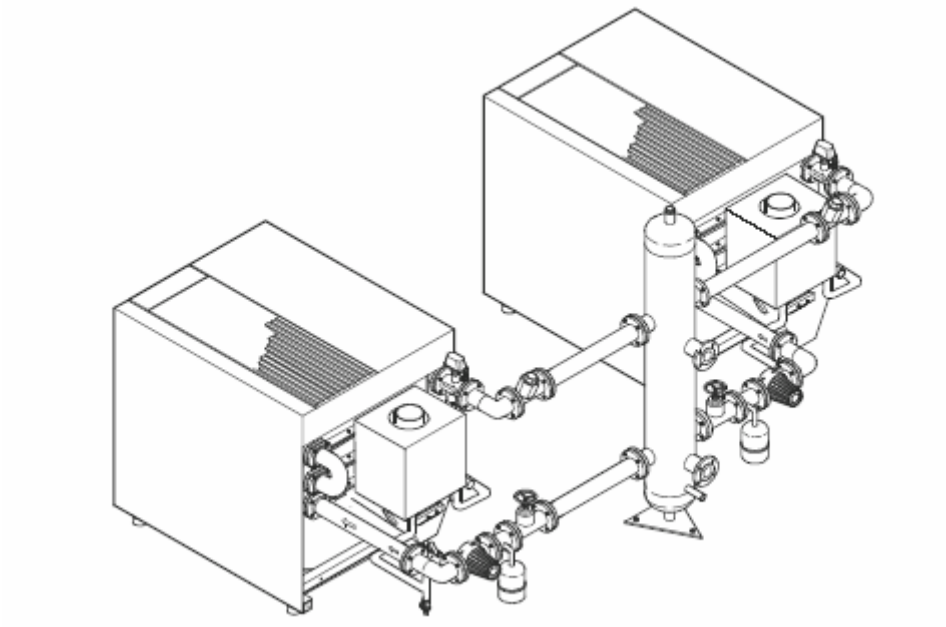


Fig. 31 Low velocity header for two boilers

6 Operating instructions

6 .1 Function

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

6.1 Function

When a heating demand is received and before the boiler starts up, the appliance must be prepurged. Gas and air are optimally mixed in the mixing chamber. The fan supplies air for combustion, the quantity being regulated by the frequency controlled fan speed. A proportional controller determines (also by means of regulation) the required quantity of gas. 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.

Frequency Inverter Lenze

The Frequency inverter is used by the boiler control system to control the burner fan speed and thus the heat output of the boiler.
The operating state is displayed by the 2 LEDs on the front of the unit.

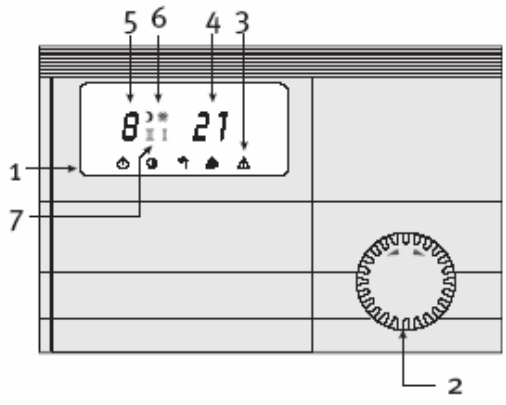
LED display		**Operating state**
Green	Red	
On	Off	Frequency regulator enabled
On	On	Mains connection and automatic start
Flashing	Off	Frequency regulator inhibited
Off	Flashing every second	Fault indication
Off	Flashing every 0,4 second	Under voltage
Off	Off	Mains voltage too low

6 .2 Regulation

Depending on the heating demand, the unit will be started up and shut down between 0% and 25% capacity and will be continuously modulated between 25% and 100% capacity.

6.3 Control module

Lid closed



Lid open

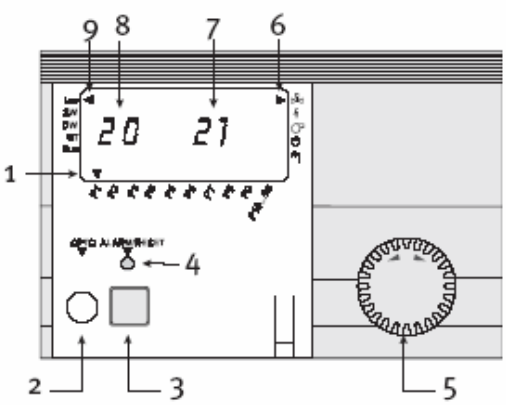


Fig. 16 Controle module

1 Function
- standby
- automatic operation
- summer operation
- service operation

2 Function selector

3 fault indication ⚠

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
service,	low capacity the boiler will run at low capacity (adjusted by [P17])
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 set point 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 / setting boiler capacity
P10 only for MHS trained service engineers.

Summary of input and output indications (cover open)

Input indications: -

- Flame Ionisation detected

SW Water flow switch in operating position
DW Air Pressure Switch 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.

Commissioning of the unit by MHS Boilers Ltd will not only ensure optimum operation of the unit but will enhance the warranty enjoyed by the unit.

7.2 Commissioning

Water and the hydraulic system

The system water circulating around the boiler must be treated with a suitable / proprietary scale and corrosion inhibitor.

Failure to comply with these requirements will invalidate the appliance warranty.

The total hardness of the system water must be below. **250 ppm**.

In addition to the introduction and repeated monitoring of the scale and corrosion inhibitor the Chloride concentration of the system water must **never exceed 200 mg/l**.

Failure to comply with this requirement will invalidate the appliance warranty.

Check the pressure of the system water. This must have at least the minimum value given in table 14(Operating pressures).

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

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.
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. The flue must be connected to outer white flexible seal and not the inner vertical extension.

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.

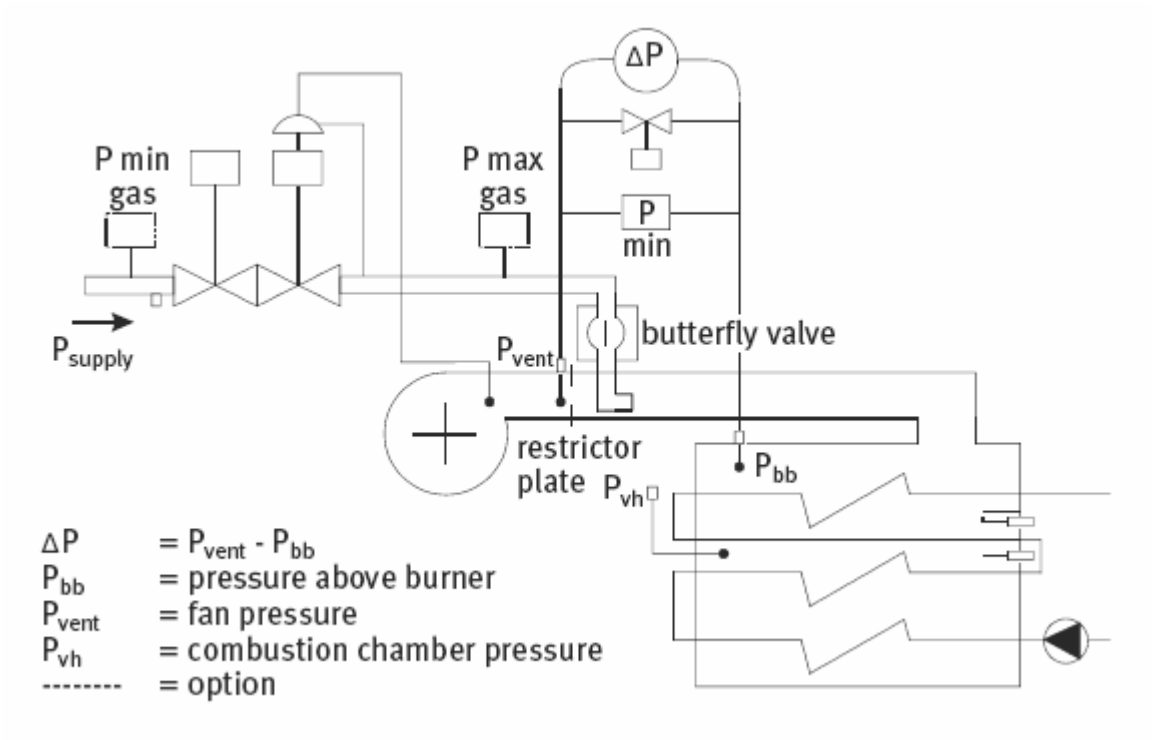
Check the operation of the appliance at full capacity

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 using the butterfly valve on the mixing chamber, The V-adjust screw on the gas valve, should not normally require adjusting.

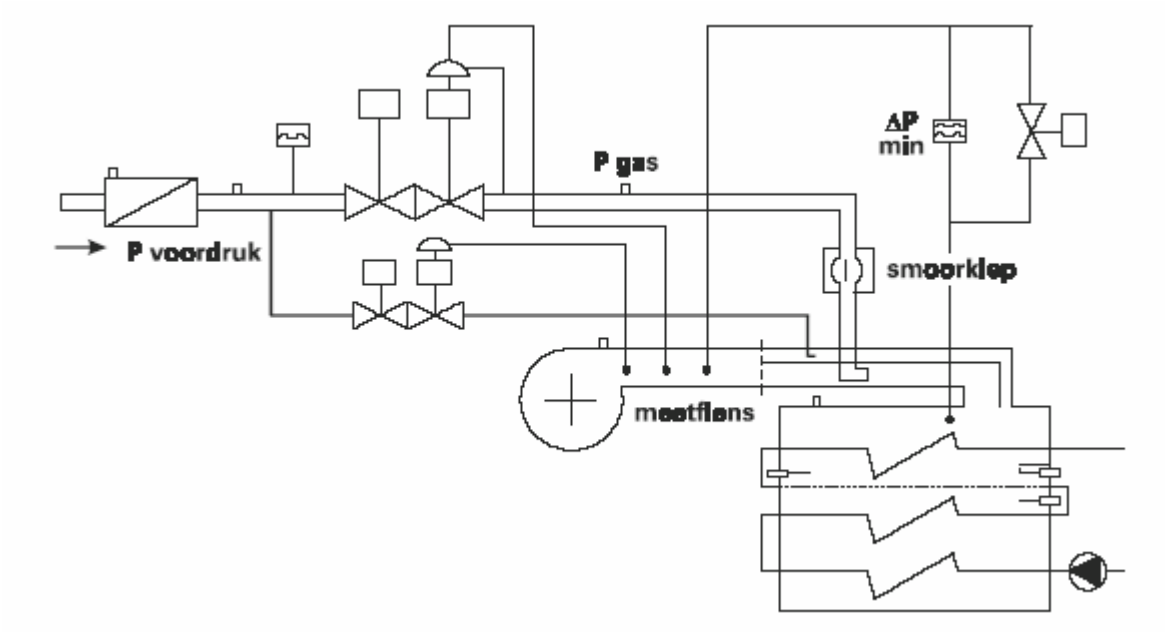
Guide valves V: Kromschroder gasvalves 1.2 - 1.5 Dungs gas valves 0.94

Natural Gas		
Pilot burner CO_2 (Types 624–1018)	[%]	10.0 ± 0.2
Pilot burner CO (Types 624–1018)	[ppm]	≤ 1000
Main burner CO_2	[%]	10.0 ± 0.2
Main burner CO	[ppm]	≤30
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 318–559)	[mbar]	8.5 ± 1
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 624–1018)	[mbar]	9.0 ± 1
Propane		
Pilot burner CO_2 (Types 624–1018)	[%]	11.0 ± 0.2
Pilot burner CO (Types 624–1018)	[ppm]	≤ 1000
Main burner CO_2	[%]	11.0 ± 0.2
Main burner CO	[ppm]	≤ 30
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 318–559)	[mbar]	8.5 ± 1
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 624–1018)	[mbar]	9.0 ± 1

Table 15 Settings at full capacity



Burner pressure measurement Type 318 - 559



Burner pressure measurement Types 624 - 1018

Measure the gas pressure at the supply side of the gas valve. This must be at least 18 mbar (for natural gas) 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. Check the temperature difference (ΔT) between the flow and return to the appliance at the water side. ΔT must be at full capacity 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 only using the N-adjust screw on the gas valve.

Natural Gas		
Pilot burner CO_2 (Types 624–1018)	[%]	10.2 ± 0.2
Pilot burner CO (Types 624–1018)	[ppm]	≤ 1000
Main burner CO_2	[%]	9.2 ± 0.2
Main burner CO	[ppm]	≤ 30
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 318–559)	[mbar]	0.8 ± 0.1
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 624–1018)	[mbar]	0.7 ± 0.1
Propane		
Pilot burner CO_2 (Types 624–1018)	[%]	11.2 ± 0.2
Pilot burner CO (Types 624–1018)	[ppm]	≤ 1000
Main burner CO_2	[%]	11.0 ± 0.2
Main burner CO	[ppm]	≤ 30
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 318–559)	[mbar]	0.8 ± 0.1
Burner pressure $p_{fan} - p_{above\ burner}$ (Types 624–1018)	[mbar]	0.7 ± 0.1

Table 16 Settings at minimum capacity

Setting air pressure switch: 0,4 +} 0,05 mbar

Check the function ΔP_{min} pressure switch by carefully placing a board (for example, a piece of strong cardboard) in front of the supply opening to the fan and slowly slide the board so as to close off the opening until the boiler shuts down.

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 air inlet damper
- Clean the fan blades
- Clean the flue gas collection chamber
- Clean the condensate trap and the drainage pipe from the appliance
- Clean the gas filter
- 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 from both front and rear via a sight glass.
- Test the unit at the flue gas side for CO_2 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: Scale and corrosion inhibitor concentration, 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 rear 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.

-In order to clean the air inlet damper this must first be re moved. Clean it with a vacuum cleaner.

- 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 collection tank. Unscrew the trap and clean it.

-A gas filter is fitted at the start of the gas train.

This filter can be cleaned as follows:

1 Close the gas valve on the boiler

2 Unscrew the six bolts securing the cover to the gas filter

3 Carefully remove the filter element

4 Clean the filter element by shaking it. When it is heavily polluted, the filter element must be renewed.

5 Re-assemble the filter

6 Check for leaks (soap solution).
- 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

Only in exceptional circumstances (In relation to severely contaminated supply air) the burner and the heat exchangers can be cleaned internally with suitable media. This must only be undertaken by qualified MHS engineers. Failure to comply with this will invalidate all appliance warranties.

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.

Kromschröder gas combination block

1 Close the gas supply valve to the boiler
2 Release the gas train by unscrewing the top bracket from the mixing system
3 Unscrew the four bolts securing the input flange
4 Remove the filter from the combination block
5 Remove any dirt by tapping the filter
6 Re-assemble the filter in the reverse order
7 Check for leaks (soap solution).

Dungs gas combination block

1 Close the gas supply valve to the boiler
2 Unscrew the bolts from the input and output flange, while supporting the gas valve
3 Carefully remove the gas valve from between de flanges
4 Clean the sieve
5 Re-assemble the gas valve
6 Check for leaks (soap solution).

8.6 Ionisation measurement

In order to carry out an ionisation measurement, a micro-ammeter with a measuring range of 0 - 200 μA DC must be connected in the ionisation circuit. In this way the ionisation protection function can be checked. The nominal ionisation current is between 6 and 25 μA.
The minimum ionisation current is 2.8 μA.

8.7 Replacing the frequency Inverter

Each boiler is factory tested and adjusted to run at the desired maximum output. The frequency set in code CO11 allows the boiler to modulate up to but not higher than this maximum output and is specific to the boiler.

If the frequency Inverter has to be replaced then it must be pre programmed with this setting at the factory.

ALWAYS QUOTE THE BOILER SERIAL NUMBER to enable this to be done.

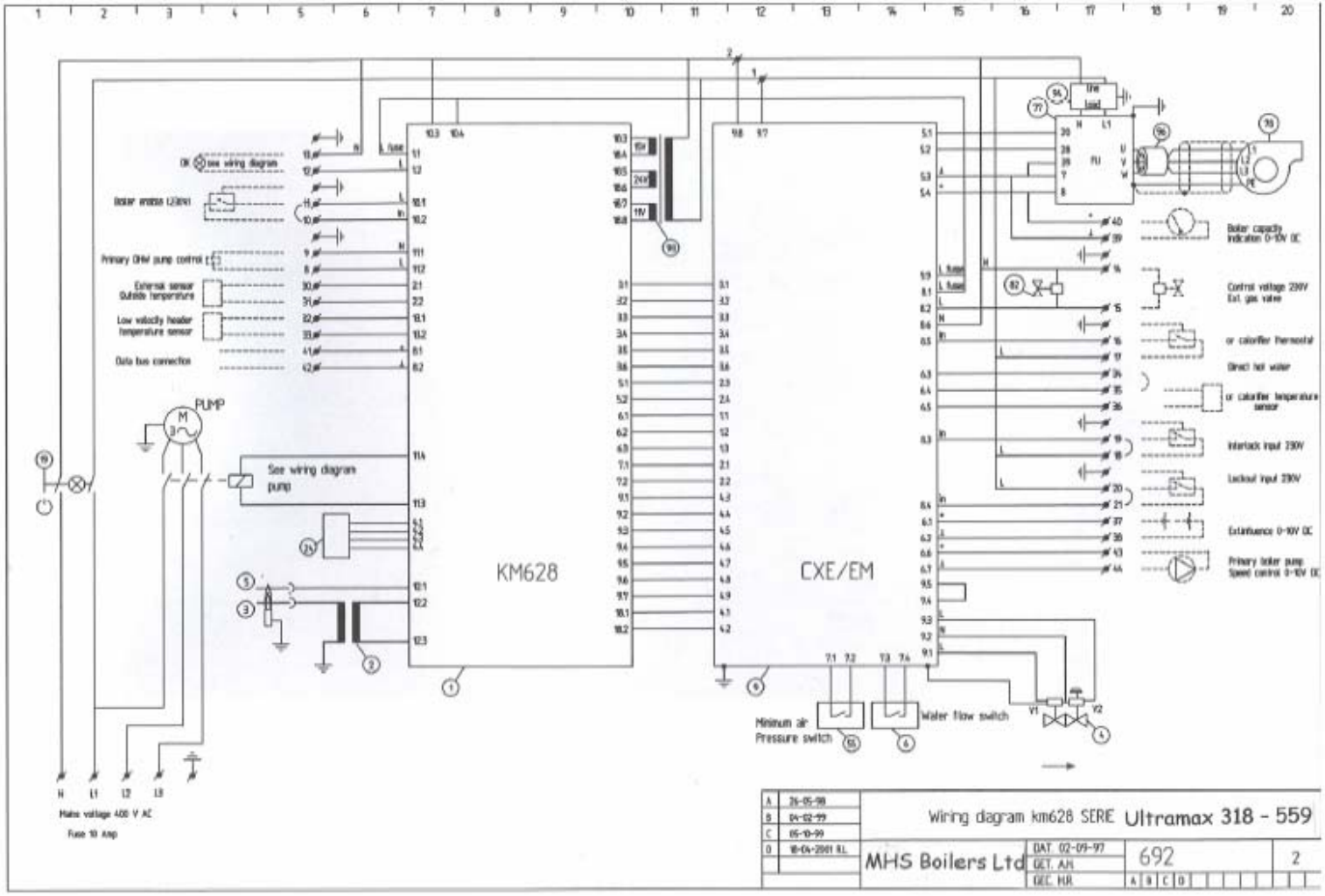
Factory set parameters Frequency Inverter

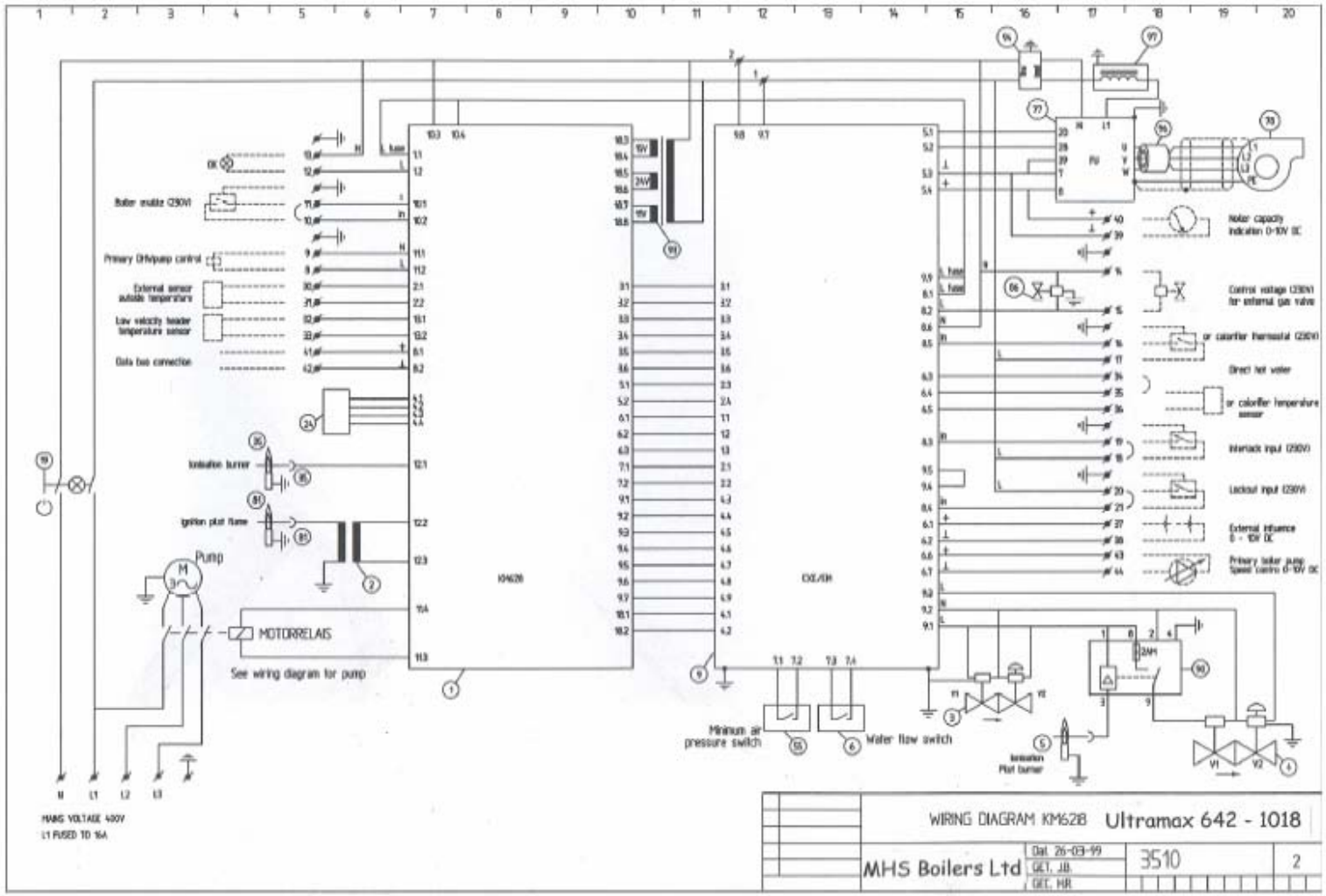
CO11	Max. field frequency	Boiler specific
CO12	Acceleration time	15 sec.
CO13	Deceleration time	15 sec.
CO14	Control mode	1 (quadratic)
CO15	V/f rated frequency	70 Hz

8 .8 Service

For service and maintenance the Technical Service Department of MHS Boilers Ltd can be contacted on 01268 546700.

Notes


KM628
CXE/EM
PUMP
See wiring diagram (pump)
Mains voltage 400 V AC
Fuse 10 Amp
Minimum air Pressure switch
Water flow switch
Boiler capacity indication 0-10V DC
Control voltage 230V Ext. gas valve
or calorifier thermostat
Direct hot water
or calorifier temperature sensor
Interlock input 230V
Lockout input 230V
Extaffluence 0-10V DC
Primary boiler pump Speed control 0-10V DC
Wiring diagram km628 SERE Ultramax 318 - 559
MHS Boilers Ltd
DAT. 02-09-97
DET. A.H.
DEC. H.R.
692
2


Boiler enable (230V)
Primary Diff/pump control
External sensor outside temperature
Low velocity header temperature sensor
Data bus connection
Ignition
Ignition plat flame
Pump
MOTORRELAIS
See wiring diagram for pump
KM628
EXL/EH
Minimum air pressure switch
Water flow switch
Ignition Plat burner
Rotor capacity indication 0-10V DC
Control voltage (230V) for external gas valve
or calorifier thermostat (230V)
Direct hot water
or calorifier temperature sensor
Interlock input (230V)
Lockout input (230V)
External influence 0 - 10V DC
Primary boiler pump Speed control 0-10V DC
MAINS VOLTAGE 400V
L1 FUSED TO 16A
WIRING DIAGRAM KM628 Ultramax 642 - 1018
MHS Boilers Ltd
Dat. 26-03-99
GET. JB.
GET. MR.
3510
2