Operation and Installation manual
for authorized technicians only

MHS BOILERS

Ultramax R600

03/2008 Art. No DOC0960 GB

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Safety

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General regulations
This documentation contains important information, which is a base for safe and reliable installation, commissioning and operation of the Ultramax R600 boiler. All activities described in this document may only be excecuted by authorized companies.

Changes to this document may be effected without prior notice. We accept no obligation to adapt previously delivered products to incorporate such changes.

Only original spare parts may be used when replacing components on the boiler, otherwise warranty will be void.

Application
The Ultramax R600 boiler may be used for heating and hot water production purposes only. The boiler should be connected to closed systems with a maximum temperature of 100ºC (high limit temperature), maximum setpoint temperature is 90ºC.

Norms and regulations
When installing and operating the boiler, all applicable norms (european and local) should be fulfilled:

- Local building regulations for installing combustion air and flue gas systems;
- Regulation for connecting the boiler to the electrical appliance;
- Regulations for connecting the boiler to the local gas network;
- Norms and regulations according to safety equipment for heating systems;
- Any additional local laws/regulations with regard to installing and operating heating systems.

The Ultramax R600 boiler is CE approved and applies to the following European standards:

- 92 / 42 / EEC
  Boiler efficiency directive
- 90 / 396 / EEC
  Gas appliance directive
- 73 / 23 / EEC
  Low voltage directive
- 89 / 336 / EEC
  EMC directive
- EN 656
  Gas-fired central heating boilers – Type B boilers of nominal heat input exceeding 70 kW but not exceeding 300 kW
- EN 15420
  Gas-fired central heating boilers - Type C boilers of nominal heat input exceeding 70 kW, but not exceeding 1000 kW
- EN 15417
  Gas-fired central heating boilers - Specific requirements for condensing boilers with a nominal heat input greater than 70 kW but not exceeding 1000 kW
- EN 13836
  Gas fired central heating boilers - Type B boilers of nominal heat input exceeding 300 kW, but not exceeding 1000 kW
- EN 15502-1
  Gas-fired central heating boilers - Part 1: General requirements and tests
- EN 55014-1
  Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission
- EN 55014-2
  Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard
- EN 61000-3-2
  Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current 16 A per phase)
- EN 61000-3-3
  Electromagnetic compatibility (EMC) - Part 3-3: Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current 16 A per phase and not subject to conditional connection
- EN 60335-1
  Household and similar electrical appliances - Safety - Part 1: General requirements
- EN 50165
  Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections

Additional national standards

Germany:
- RAL - UZ 61 / DIN 4702-8

Switzerland:
- SVGW

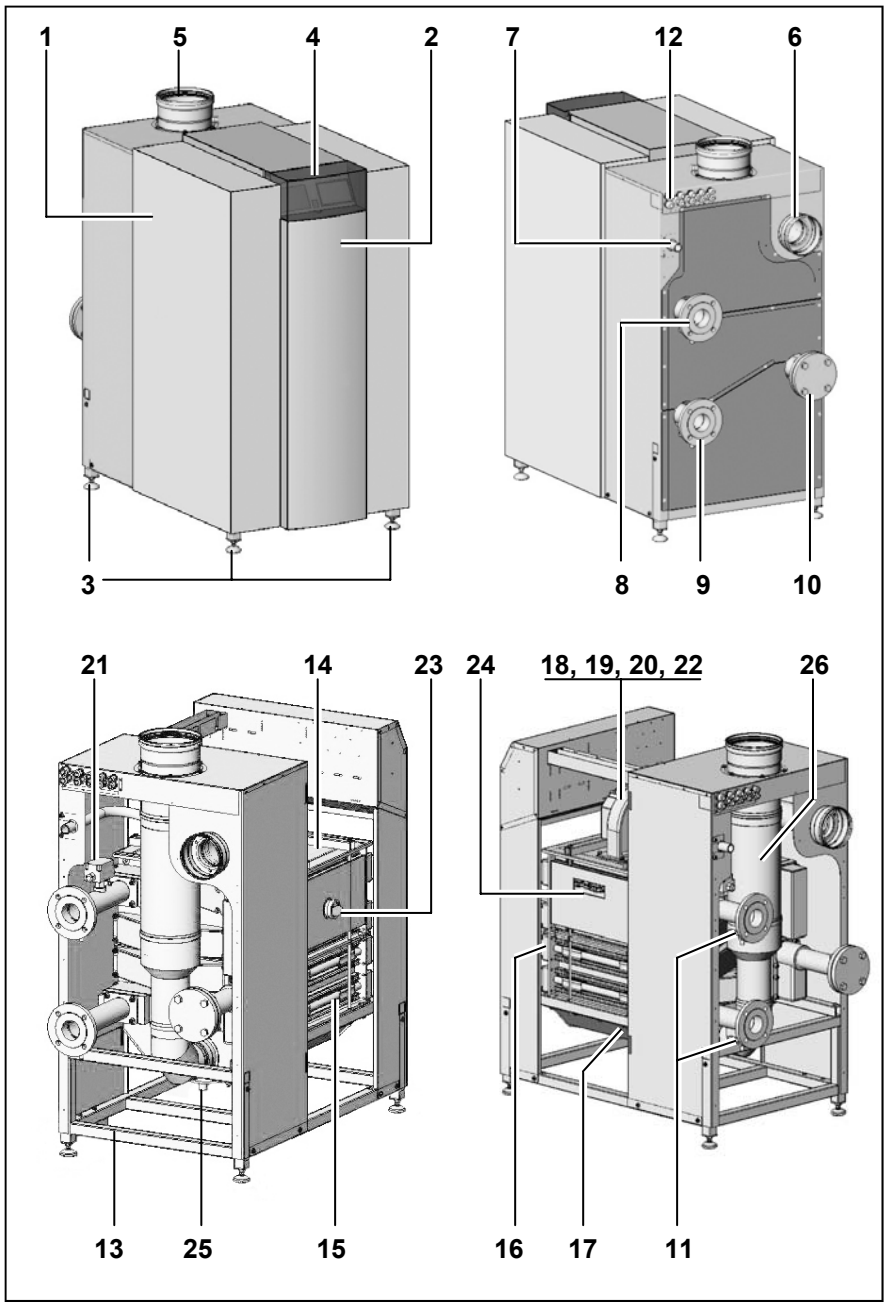
Austria:
- ÖVGW

Netherlands:
- NOx staatsblad 344 (1994)
- GASKEUR BASIS
- GASKEUR SV
- GASKEUR HR107

Belgium:
- HR TOP

Construction

Layout of boiler
Operating principle



Layout of boiler
The Ultramax R600 boiler consists of the following main components:

1 Casing
2 Front panel
3 Adjustable feet
4 Control panel (below cover)
5 Flue gas connection
6 Air intake connection
7 Gas connection
8 Flow water connection
9 Return water connection
10 2nd (hot) return water connection (for split system use)
11 Filling/draining valve
12 Electrical input connections
13 Frame
14 Burner/1st heat exchanger assembly
15 2nd/3rd heat exchanger assembly
16 Water headers
17 Condensate receptacle
18 Whirlwind gas/air mixing system
19 Fan
20 Gas valve
21 Water flow switch
22 Gas pressure switch
23 Inspection opening
24 Ignition and ionisation electrodes
25 Syphon
26 Removable flue gas adapter

Operating principle
The Ultramax R600 is a fully modulating boiler. The control unit of the boiler adapts the modulation ratio automatically to the heat demand requested by the system. This is done by control ling the speed of the fan. As a result, the Whirlwind mixing system will adapt the gas ratio to the chosen fan speed, in order to maintain the best possible combustion figures and therewith the best efficiency. The flue gases created by the combustion are transported downwards through the boiler and leave at the back side into the chimney connection.

The return water from the system enters the boiler in the lower section, where is the lowest flue gas temperature in the boiler. In this section condensation takes place. The water is being transported upwards through the boiler, in order to leave the boiler at the top (burner) section. The cross flow working principle (water up, flue gas down) ensures the most efficient combustion results.

The KM628 control unit can control the boiler operation based on:

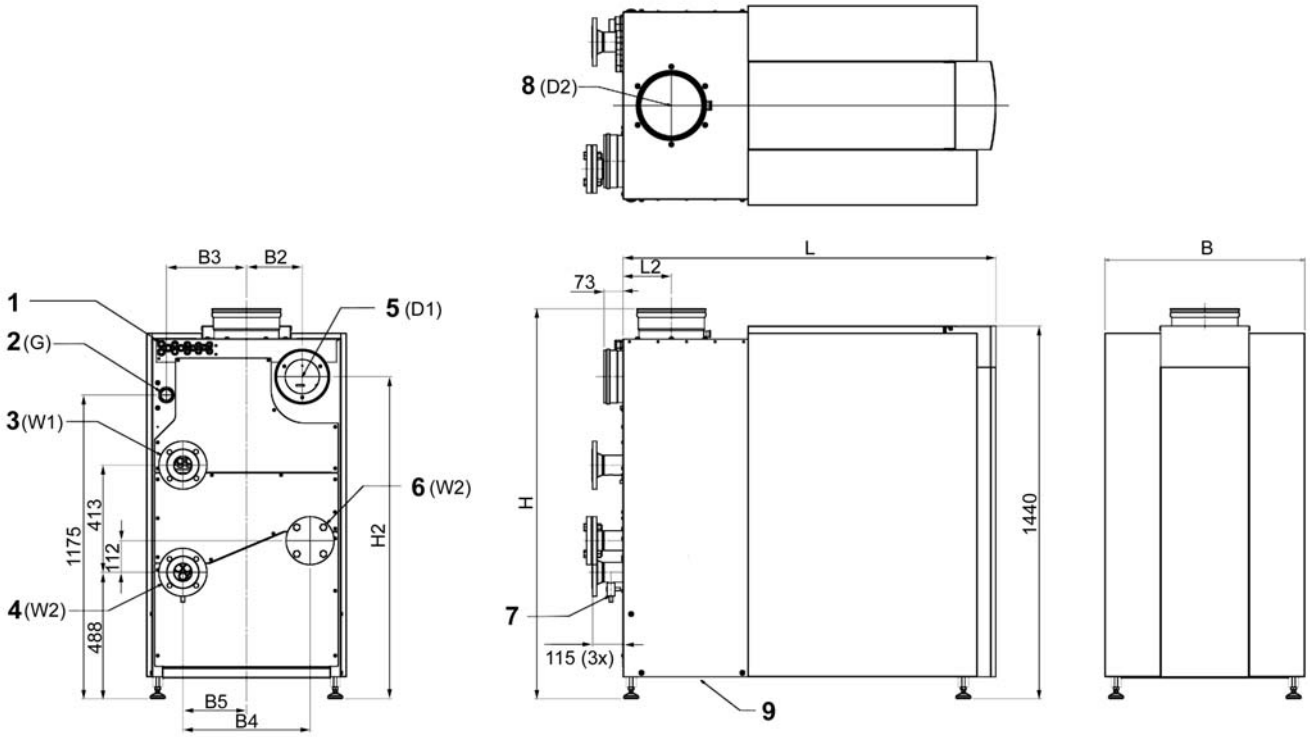
- fixed temperature (stand alone operation);
- weather compensated operation (with optional controller);
- with 0-10V external influence (temperature or capacity) from a building management system.

Technical data

		R601	R602	R603	R604	R605	R606	R607
Nominal heat output at 80-60ºC max/min*	kW	142.1/23.3	190.1/39.5	237.2/39.5	285.2/39.5	380.2/76.6	475.3/76.6	539.0/76.6
Nominal heat output at 75-60ºC max/min*	kW	142.2/23.5	190.3/39.5	237.4/39.5	285.5/39.5	380.6/76.6	475.8/76.6	539.6/76.6
Nominal heat output at 40/30ºC max/min*	kW	150.7/26.7	201.6/45.2	251.4/45.1	302.3/45.2	403.1/87.7	503.9/87.7	571.5/87.7
Nominal heat input Hi max/min*	kW	145.0/24.5	194.0/41.5	242.0/41.5	291.0/41.5	388.0/80.5	485.0/80.5	550.0/80.5
Efficiency at 80/60ºC	%	98.0						
Efficiency at 40/30ºC	%	103.9						
Annual efficiency (NNG 75/60ºC)	%	106.8						
Annual efficiency (NNG 40/30ºC)	%	110.4						
Standstill losses (T_{water} = 70ºC)	%	0.21	0.18	0.17	0.16	0.15	0.14	0.13
Max. condensate flow	l/h	11	15	19	22	30	37	42
Gas consumption H-gas max/min (10,9 kWh/m^3)	m^3/h	13.3/2.3	17.8/3.8	22.2/3.8	26.7/3.8	35.6/7.4	44.5/7.4	50.5/7.4
Gas consumption L-gas max/min (8,34 kWh/m^3)	m^3/h	17.4/2.9	23.2/5.0	29.0/5.0	34.9/5.0	46.5/9.7	58.2/9.7	66.0/9.7
Gas consumption LL-gas max/min (8,34 kWh/m^3)	m^3/h	17.4/2.9	23.2/5.8	29.0/5.8	34.9/5.8	46.5/11.2	58.2/11.2	66.0/11.2
Gas consumption LPG. max/min (12,8 kWh/kg)	kg/h	11.3/1.9	15.2/3.2	18.9/3.2	22.7/3.2	30.3/6.3	37.9/6.3	43.0/6.3
Gas pressure H-gas	mbar	20						
Gas pressure L/LL-gas	mbar	25						
Gas pressure LPG	mbar	30/50						
Maximum gas pressure	mbar	100						
Flue gas temperature at 80/60ºC max/min	ºC	78/61						
Flue gas temperature at 40/30ºC max/min	ºC	56/30						
Flue gas quantity max/min*	m^3/h	238/40	318/69	397/69	477/69	636/134	795/134	901/134
CO_2 level natural gas H/E/L/LL max/min	%	10.2/9.4						
CO_2 level liguid gas P max/min	%	11.9/10.0						
NOx level max/min	mg/kWh	35/15						
CO level max/min	mg/kWh	14/8						
Max. permissible flue resistance max/min	Pa	160/10	160/10	200/10	200/10	200/10	250/10	250/10
Water volume	l	27	31	35	61	68	75	82
Water pressure max/min	bar	8/1						
Max. water temperature (High limit thermostat)	ºC	100						
Maximum temperature setpoint	ºC	90						
Nominal water flow at dT=20K	m^3/h	6.1	8.1	10.2	12.2	16.3	20.4	23.1
Hydraulic resistance at nominal water flow	kPa	10	18	28	15	27	42	55
Electrical connection	V	230/400						
Frequency	Hz	50						
Mains connection fuse	A	10						
IP class	-	IP20						
Power consumption boiler max/min (excl. pump)	W	158/43	200/35	230/35	260/35	470/61	650/61	770/61
Power consumption 3-step pump (optional)	W	170/90	190/120	380/210	380/210	530/300	720/380	1150/600
Power consumption speed controlled pump (opt)	W	180/10	180/10	435/25	435/25	450/25	800/35	800/35
Power consumption bypass pump (optional)	W	55/35	85/65	170/90	170/90	190/120	460/225	470/280
Weight (empty)	kg	295	345	400	465	535	590	650
Noise level at 1 meter distance	dB(A)	59						
Ionisation current minimum	µA	6						
PH value condensate	-	3.2						
CE certification code	-	CE-0063BS3840						
Water connections	-	R2"			DN65 PN16			
Gas connection	-	R3/4"	R1"	R1"	R1"	R1.1/2"	R1.1/2"	R1.1/2"
Flue gas connection	mm	150	150	200	200	250	250	250
Air intake connection (for room sealed use)	mm	130	150	150	150	200	200	200
Condensate connection	mm	22	22	22	22	22	22	22

* min load on gasses H/L/LPG. For type R602-R607 on gasses LL-Gas min value is 15% higher.

Technical data



Dimension		R601	R602	R603	R604	R605	R606	R607
L	mm	1105	1260	1470	1220	1435	1585	1735
L2	mm	127.5	127.5	137.5	137.5	187.5	187.5	187.5
H	mm	1480	1480	1500	1500	1500	1500	1500
H2	mm	1120	1130	1130	1150	1245	1245	1245
B	mm	670	670	670	770	770	770	770
B2	mm	225	235	235	235	215	215	215
B3	mm	260	260	260	310	310	310	310
B4	mm	260	260	260	490	490	490	490
B5	mm	130	130	130	245	245	245	245
D1	mm (Diam.)	130	150	150	150	200	200	200
D2	mm (Diam.)	150	150	200	200	250	250	250
W1	R" / DN	R2"	R2"	R2"	DN65 PN16			
W2	R" / DN	R2"	R2"	R2"	DN65 PN16			
G	R	R 3/4"	R 1"	R 1"	R 1"	R 1 1/2"		

1 Electrical connections
2 Gas supply
3 Water supply
4 Water return (Cold)
5 Air Intake
6 Water 2nd return (Hot)
7 Boiler water drain valve 1/2"
8 Flue gas Outlet
9 Condensate drain
flexible hose 25mm diam.

Extent of delivery

Standard boiler
Accessories

Standard boiler
A boiler delivery package contains the following components:

Component	Pcs.	Package
Boiler fully assembled and tested	1	Mounted on wooden blocks with wooden border, sealed in PE foil
Adjustable feet	4	Mounted on frame of the boiler
Syphon for condensate connection	1	Cardboard box on top of heatexchanger (under casing)
Conversion kit for natural gas L and propane incl. instruction	1	Cardboard box on top of heatexchanger (under casing)
Operation and Installation manual	1	Map attached to back panel of the boiler
Spare parts list	1	Map attached to back panel of the boiler
Wiring diagram	1	Map attached to back panel of the boiler
Integrated additional system controller , incl. all necessary sensors and sockets (optional)	1	Integrated in electronic switchboard of the boiler. Sensors and sockets in cardboard box on top of the heatexchanger (under casing).

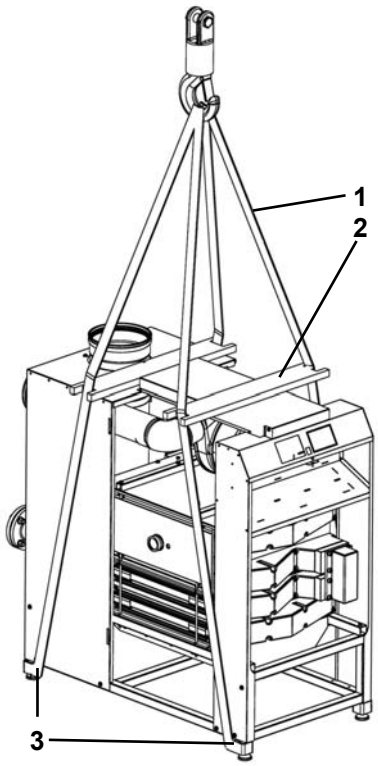
Accessories
Additional to the boiler, the following accessories can be ordered:

- Standard 3-step pump incl. connection kit;
- Speed controlled pump incl. connection kit;
- Safety valve, manometer and deaerator (3,4,5 or 6 bar) incl. connection kit;
- 2x max. water pressure switch and 1 external high limit thermostat incl. connection kit;
- Gas filter incl. connection kit;
- Max. gas pressure switch;
- External high limit thermostat incl. connection kit;
- Gas valve leakage tester (not possible for R601);
- Controlled bypass (incl. pump) incl. connection kit;
- Electronic kit for possibility to connect room fan and/or external gas valve;
- Plate heat exchanger (dT=10K/15K or dT=20K) incl. connection kit;
- Low velocity header, suitable for dT=10K/15K and dT=20K incl. connection kit;
- Duo header for connecting 2 boilers in cascade (excl. connection kit);
- Weather compensated controller, also suitable as room unit (incl. all necassary sensors and sockets).;
- Additional heating zone controller, when controlling more than 2 zones (incl. wall hung box, all necessary sensors and sockets and connection material for bus communication).

The above accessories are specially designed for the Ultramax R600 boiler and therewith easy to install (plug and play). By choosing a combination of the kits mentioned above, you can create your own complete system solution. Ask your supplier for more detailed information.

Installation

Boiler transport



1 Hoisting belt (4x)
2 Wooden retaining beam (2x)
3 Hoisting belt position (4x)

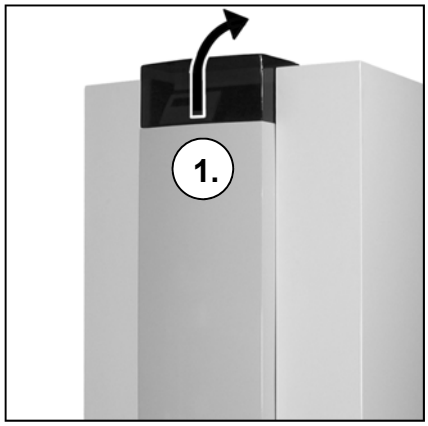
Boiler transport
The Ultramax R600 boiler will be supplied as a complete unit being fully assembled and pre-tested. The maximum width is 670mm for models R601-R603 and 770mm for models R604-R607, which makes it possible to transport all models through a normal door in one piece. The boiler can be transported with a pallet truck, entering either from the front or from the side. Whenever necessary, the boiler can be dismantled into smaller parts for easier transport inside the building. The table below shows the main dismantled parts with their weight and dimensions.

When the boiler has to be transported with a crane, it is necessary to remove the casing before connecting the boiler to the crane. Always connect the crane to the frame of the boiler by using straps.

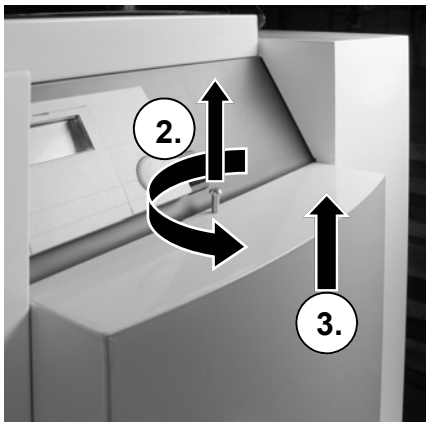
Component		R601	R602	R603	R604	R605	R606	R607
Burner/1st heat exchanger assembly	Weight [kg]	86	100	112	135	158	181	198
	Length [mm]	735	885	1035	735	885	1035	1185
	Width [mm]	400	400	400	680	680	680	680
	Height [mm]	321	321	321	321	321	321	321
2nd/3rd heat exchanger assembly	Weight [kg]	90	103	116	150	170	198	219
	Length [mm]	735	885	1035	735	885	1035	1185
	Width [mm]	400	400	400	680	680	680	680
	Height [mm]	244	244	244	244	244	244	244
Condensate receptacle	Weight [kg]	7	9	10	11	12	13	15
	Length [mm]	589	739	889	589	739	889	1039
	Width [mm]	385	385	385	665	665	665	665
	Height [mm]	225	225	225	225	225	225	225
Frame	Weight [kg]	15	16	17	17	18	19	21
	Length [mm]	990	1140	1350	1100	1320	1470	1620
	Width [mm]	624	624	624	724	724	724	724
	Height [mm]	335	335	335	335	335	335	335
Front U-frame with electronic board	Weight [kg]	11	11	11	12	12	12	12
	Length [mm]	628	628	628	728	728	728	728
	Width [mm]	1304	1304	1304	1304	1304	1304	1304
	Height [mm]	202	202	202	202	202	202	202

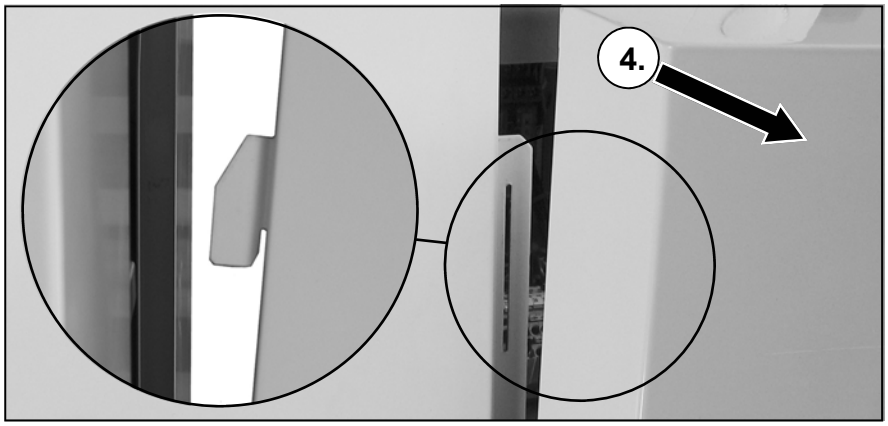
Installation

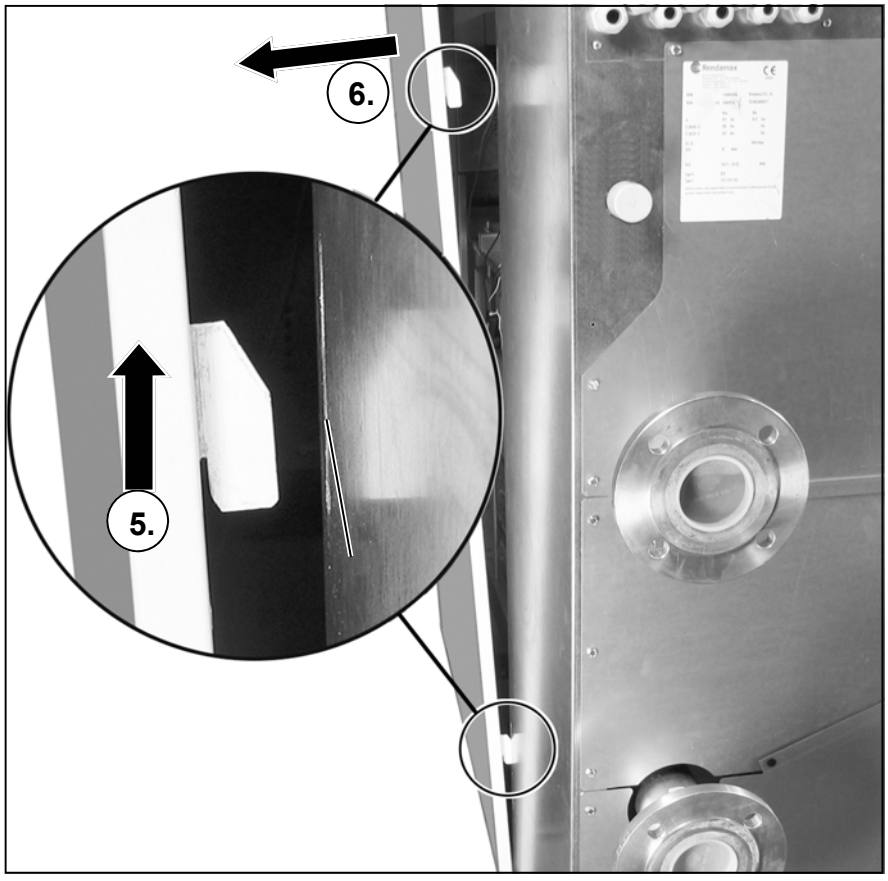
Removing the casing



Boiler transport
Remove the casing before transporting the boiler, in order to avoid damage to the casing parts during transportation. Removing the casing is done as follows:

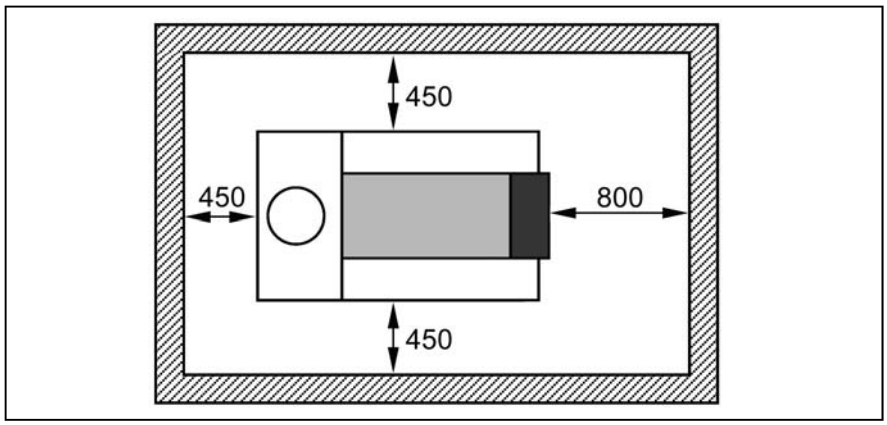


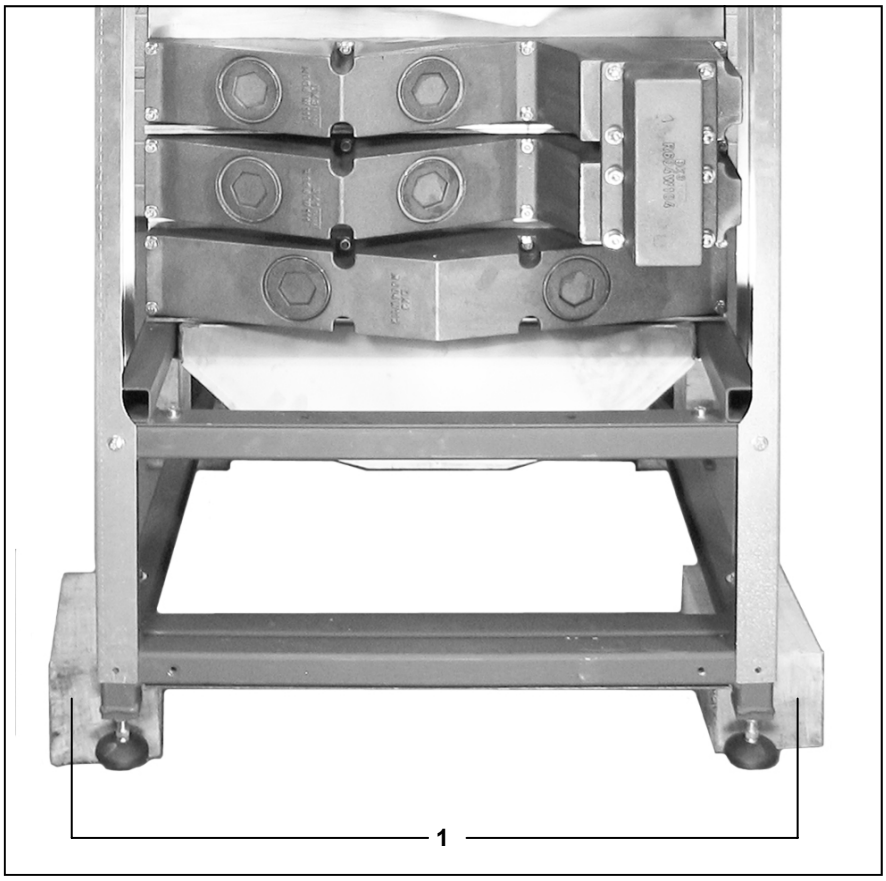




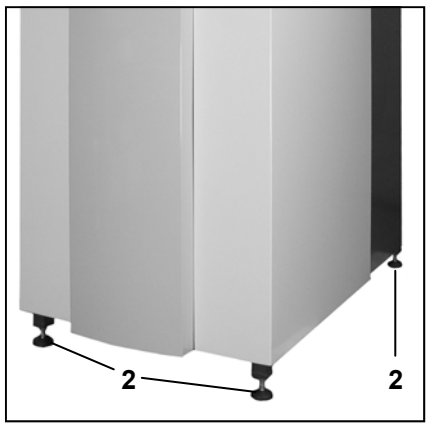
Installation

Boiler installation



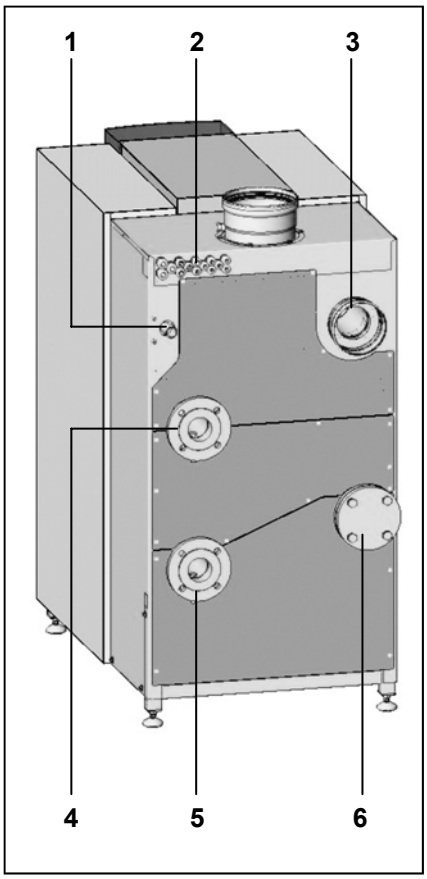


Boiler installation
The boiler should be positioned in a frost-proof boiler room. If the boiler room is on the roof, the boiler itself may never be the highest point of the installation.
When positioning the boiler, please note the recommended minimum clearance in the picture. When the boiler is positioned with less free space, maintenance activities will be more difficult.
Once the boiler is in the correct position, the wooden blocks (1) should be removed and the adjustable feet (2) (with vibration absorption dampers) should be adjusted to the right height.
Water and gas connections should be done after mounting the feet, as they affect the exact height of all connections.



Installation

Connecting the boiler



Connecting the boiler
This chapter will explain how to make all connections to the boiler with regard to:

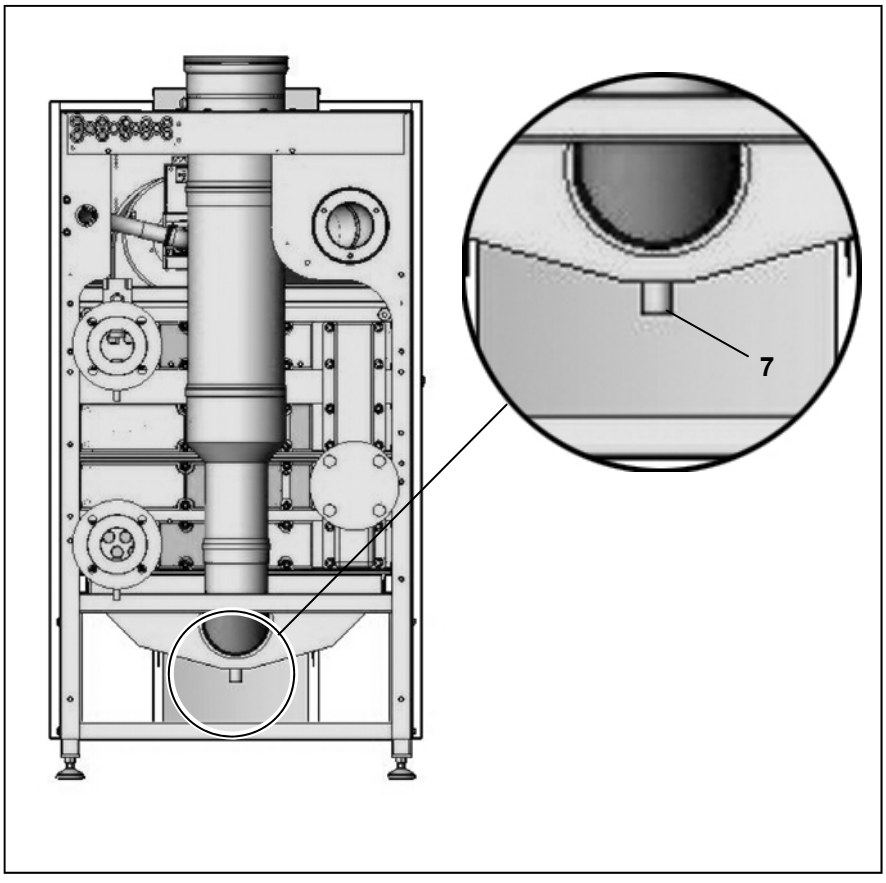
- Hydraulic connections
- Condensate drain connection
- Gas connection
- Flue gas connection
- Air intake connection
- Electrical connection

The boiler should always be connected in such a way, that the system applies to all relevant standards and regulations (European, national and local). It's the responsibility of the installer to ensure that all standards and regulations are respected.

Hydraulic connections
The boiler should always be connected in such a way, that water flow through the boiler can be ensured at all times. Connect the flow (4) and return (5) connection of the system tension free to the boiler connections. If the boiler is used in a system with two return circuits, the common return becomes the low temperature return, the 2nd return connection (6) is the high temperature return (remove cap/flange before connecting).

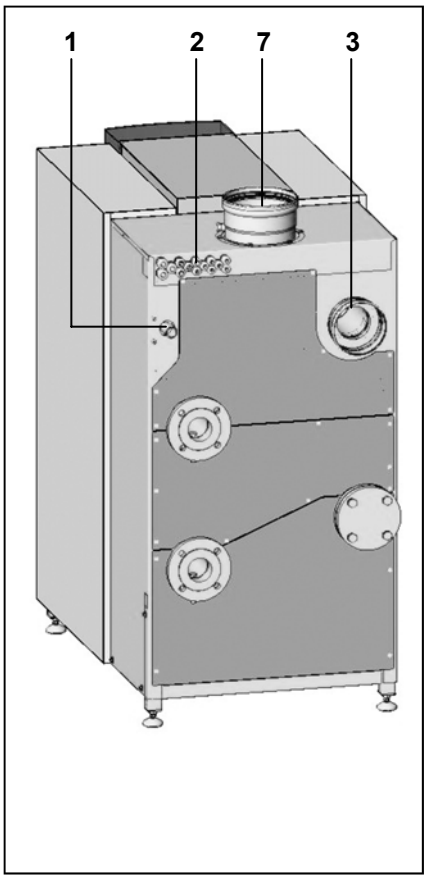
The (optional) accessory kit with safety valve, manometer and deaerator should be mounted on the flow connection (4) of the boiler, before connecting to the system.

The (optional) pump kit should be mounted directly to the return connection (5) of the boiler, before connecting to the system.



Condensate connection (7)
After filling with water, the syphon (included in delivery) should be installed to the connection at the bottom of the condensate receptacle. Lead the hose under the frame at the back of the boiler and connect it to the draining system in the boiler room. The connection to the draining system should always be done with an open connection, in order to avoid a flooding of the boiler in case of a blocked drain.

Connecting the boiler



Gas connection (1)
The gas connection must be made by an authorized installer in accordance with the applicable national and local standards and regulations.

Connect the gas line from the system tension free to the gas connection (1) of the boiler. A gas cock should be mounted directly behind the boiler.

A gas filter can be mounted directly on the gas connection of the boiler.

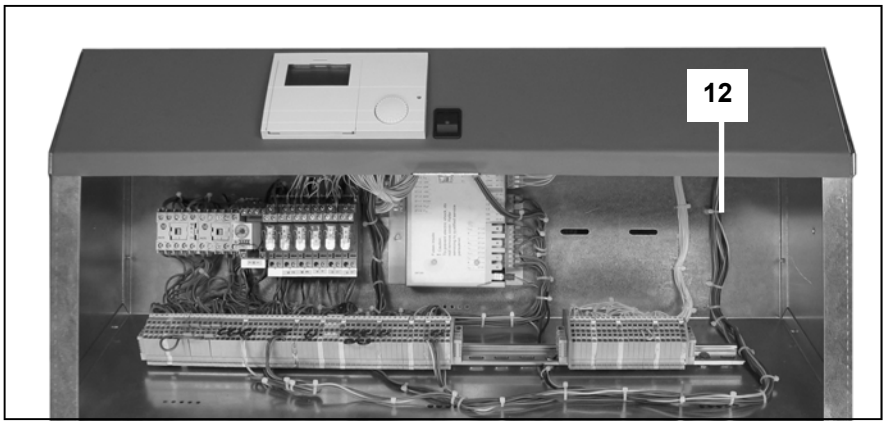
Flue gas connection (7)
Regulations for the construction of flue gas systems are very different for each country. It should be ensured that all national regulations with regard to flue gas systems are respected.

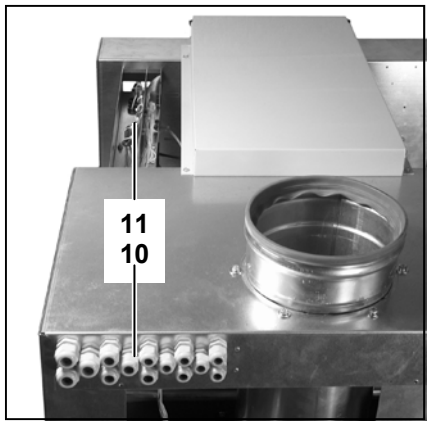
Connect the flue gas system to the flue gas connection (7) of the boiler, use fluegas systems with seamless connections only. It's not necessary to make a separate condensate drain for the flue gas system, as the condensate will be drained via the syphon of the boiler. Please note the following issues:

- It's recommended to use stainless steel or PPS fluegas systems
- The diameter of the flue gas system must be chosen by calculation according to the national regulations
- Construct the flue gas system as short as possible (for maximum length see planner documentation)
- Construct horizonal ways with a minimum angle of 3º

Air intake connection (3)
The air intake can be connected in case of room sealed installation. The diameter should be calculated according to the national regulations, together with the flue gas system. The total resistance of both systems should never overcome the maximum permissible resistance of the fan inside the boiler (see also chapter: Technical data).

When the boiler is installed in a non room sealed situation, a vertical air intake with an air entry above boiler level should be connected to the boiler.





Electrical connection
The electrical connection must be made by an authorized installer in accordance with the applicable national and local standards and regulations.

For the power supply it's necessary to use a mains isolator switch with a contact opening of at least 3 mm within the boiler room. This switch can be used to switch off the power supply for maintenance purposes.

Insert all cables through the cable glands at the back of the boiler (10) and guide them through the cable tray (11) into the electrical panel at the front of the boiler (12).

Connect all wires to the terminals according to the wiring diagram of the boiler (enclosed in map attached to back panel of the boiler).

Commissioning

Water and hydraulic system

Commissioning of the boiler should be carried out by authorized personnel only. Failure to respect this condition makes the guarantee void. A protocol of the commissioning should be filled out (see end of this chapter for example of commissioning protocol).

This chapter explains the commissioning of the boiler with the standard boiler controller. When an additional system controller is installed, please refer to its manual for commissioning the controller.

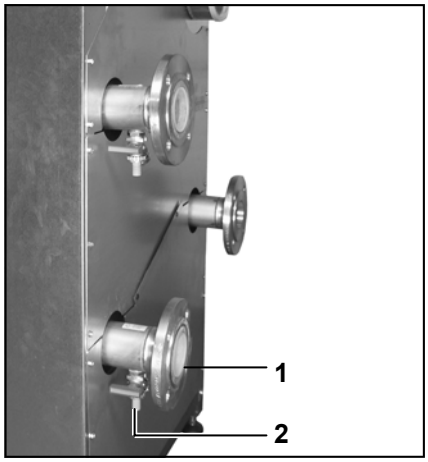
Boiler output [kW]	Max. sum of alkaline earths [mol/m^3]	Max. total hardness [dºH]
50 - 200	2.0	11.2
200 - 600	1.5	8.4

Water quality
The system should be filled with water with a PH value between 8,0 and 9,5. The chloride value of the water should not exceed 50 mg/l. Entry of oxygene by diffusion should be prevented at all times. Damage to the heat exchanger because of oxygene diffusion will not be taken under warranty.

In installations with higher water volumes, it's necessary to respect the maximum filling and additional volumes with corresponding hardness values as stated in the german VDI2035 standard. In the table you can find the nominal values for filling and additional water for the Ultramax 600 according to the the VDI2035.

Concentrate $Ca(HCO_3)_2$		Capacity of installation Q (kW)						
		150	200	250	300	400	500	600
mol/m^3	dºH	Maximum water (re)fill volume V_{max} [m^3]						
≤0.5	≤2.8	-	-	-	-	-	-	-
1.0	5.6	-	-	-	-	-	-	-
1.5	8.4	3	4	5	6	8	10	12
2.0	11.2	3	4	5	6	6.3	7.8	9.4
2.5	14.0	1.9	2.5	3.1	3.8	5.0	6.3	7.5
≥3.0	≥16.8	1.6	2.1	2.6	3.1	4.2	5.2	6.3

The table at the left gives an indication of the relation between the water quality and the maximum water filling volume during the lifetime of the boiler. Consult the original text of the VDI2035 for more detailed information.



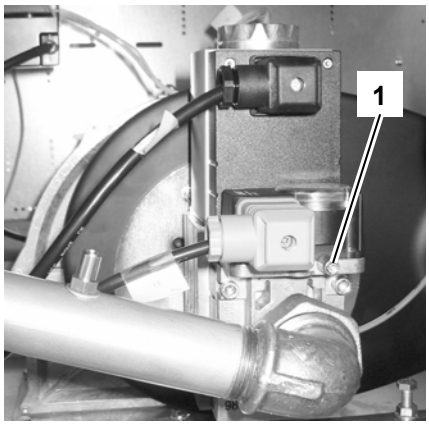
Water pressure
Open the valves to the system. Check the water pressure in the system. If the water pressure is too low (see table below), increase the pressure up to at least the minimum required water pressure in the table.
Filling can be done via the fill and drain valve (2) on the return connection (1) of the boiler.

Minimum operating pressure [bar]	Flow temperature [ºC]
> 1.5	90
> 1.0	80

Hydraulic system
Check if the boiler is hydraulically connected to the system in such way, that water flow can be secured at all times during burner operation. The water flow is supervised by the water flow switch in the boiler and a lack of flow will lead to a direct burner stop and lockout of the boiler.

Commissioning

Gas supply
Condensate connection
Flue and air intake connections



Gas supply
Check the gas supply connection to the boiler for tightness. If any leakage is found, reseal the leakage before starting the boiler!

Remove any air between the gas valve and the gas line. This can be done at the test point (1) at the gas pressure switch. Don't forget to close the test point afterwards!

Check the gas type and values with the local gas company, in order to know for which gas type the boiler should be commissioned.
Consult the conversion kit instruction if the boiler is to be installed with natural gas L or LPG.

Condensate connection
Remove the syphon (2) from the condensate connection. Fill it with water and place it back in the original position. Make sure the syphon is filled before starting the boiler, in order to prevent flue gases discharging through the condensate connection!

Flue and air intake connections
Check whether the flue and air intake systems are made according to the national and local regulations. Installations which don't comply with the regulations, are not allowed to be commissioned.

Make sure that all connections are free.

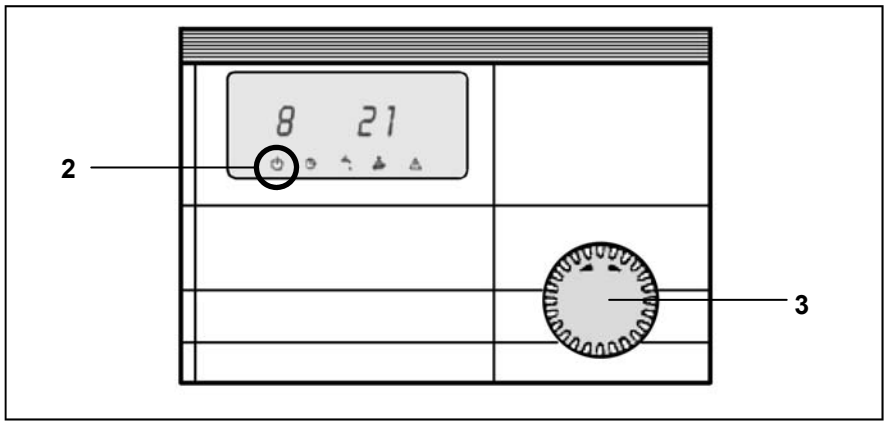
The size of flue gas and air intake connections may not be reduced.

Commissioning

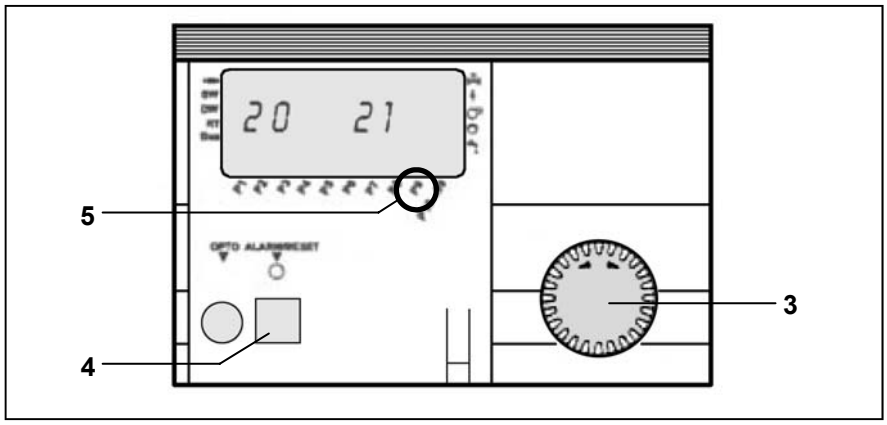
Prepare boiler for first startup

Prepare boiler for first startup

- Open gas connection;
- Switch on mains isolator switch for power supply to the boiler;
- Switch on boiler with on/off switch (1)



- Make sure the boiler remains in standby operation ⏻ (2) use rotational switch (3);
- Check the pump operation: make sure that the direction of the rotation is correct;
- Remove any air from the pump by removing the end cap of the pump motor housing.

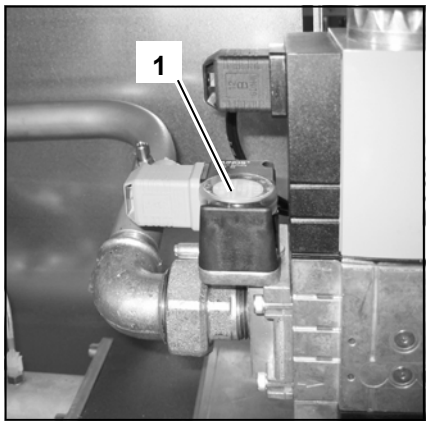


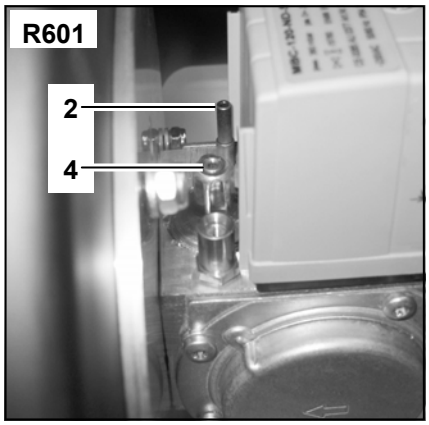
It's recommended to keep the boiler at 50% load for a while after the first startup, as this is the easiest base for starting the combustion analysis. This can be assured as follows:

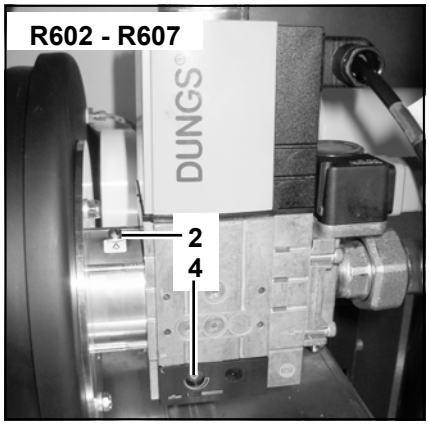
- Open the lid of the boiler controller;
- Use rotational switch (3) for going to parameter P9 in the menu;
- Change P9 (5) into 50% (push programming button (4), change value with rotational switch (3), push programming button (4) to confirm);
- Close the lid of the boiler controller.

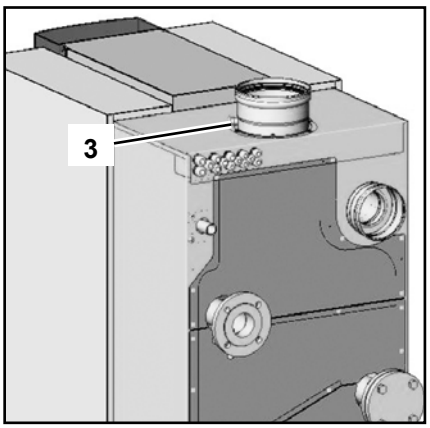
Commissioning

Combustion analysis









Combustion check at full load
Start the boiler at service mode for full load operation (🔧II). When you have reduced P9 to 50% (see previous chapter), the boiler will operate at 50% load. Allow the boiler to stabilise the combustion for 3 minutes. Then increase P9 step by step up to 100%. Check the gas pressure on the inlet of the gas valve while increasing the boiler load: the gas pressure should never go below the minumum required value ➔ see technical data. Set the minimum gas pressure switch (1) at 50% of the required gas pressure.

Check the combustion settings via the test point in the chimney connection(3). If necessary, correct the settings with the flat adjustment screw on the outlet of the gas valve (2).

Combustion check at minimum load
Switch the boiler to service mode for minimum load operation (🔧I). Check the combustion settings the same way as described for full load. If necessary, correct the settings with the allen key adjustment screw on either side of the gas valve (4).

Combustion check at 50% load
An additional reference check of combustion values at 50% load is recommended in order to check if the gas valve is set in such way, that the modulating behaviour is normal. The CO_2 value should be in between the settings of full load and minumum load. CO value should be equal to full load and minimum load values.

Make sure parameter P9 is set back to 100 and switch the boiler to automatic operation (🕘) after the combustion test is finished.

Combustion settings for natural gas G20 / G25		
		R601-R607
$CO_{2,\ max}$	%	10.2 ± 0.2
CO_{max}	ppm	< 30

Combustion settings for LPG G31		
Convert boiler before operation (see coversion kit instruction)		
		R601-R607
$CO_{2,\ max}$	%	11.9 ± 0.2
CO_{max}	ppm	< 30

Combustion settings for natural gas G20 / G25		
		R601-R607
$CO_{2,\ min}$	%	9.4 ± 0.2
CO_{min}	ppm	< 30

Combustion settings for LPG G31		
Convert boiler before operation (see coversion kit instruction)		
		R601-R607
$CO_{2,\ min}$	%	10.0 ± 0.2
CO_{min}	ppm	< 30

Commissioning

Check water flow

Check water flow
The water flow through the boiler can be checked with two different methods shown below.

∆T measurement
Check the temperature difference over the boiler (∆T flow-return) when the boiler is running on 100% load. The nominal ∆T is 20K and must be at least between 15K and 25K for secure boiler operation. An indication of the actual flow rate can be found with the following calculation (see table below for nominal data):

$q_{actual} = (\Delta T_{nominal} / \Delta T_{measured}) * q_{nominal}$ [m^3/h]

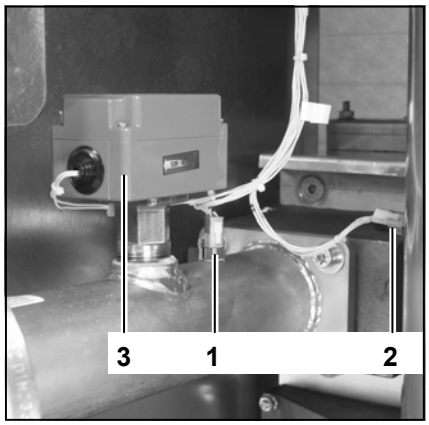
∆p measurement
Check the pressure difference over the boiler (∆p flow-return) when the boiler pump is running (burner on is not required). The nominal ∆p for each boiler type can be found in the table below, actual ∆p must be within: $0.35*\Delta p_{nom} \leq \Delta P \leq 1.75*\Delta p_{nom}$. An indication of the actual flow rate can be found with the following calculation (see table below for nominal data):

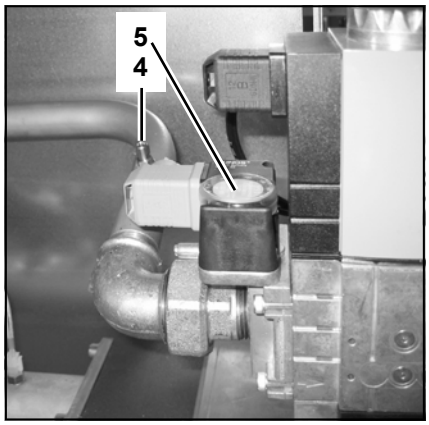
$q_{actual} = \sqrt{(\Delta p_{measured} / \Delta p_{nominal})} * q_{nominal}$ [m^3/h]

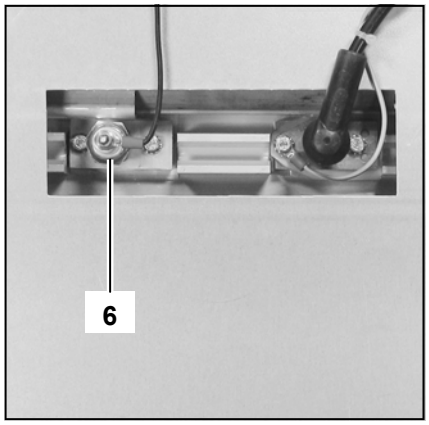
Water flow data								
		R601	R602	R603	R604	R605	R606	R607
Nominal flow rate	[m^3/h]	6.1	8.1	10.2	12.2	16.3	20.4	23.1
∆T at nominal flow rate	[°C]	20						
∆p at nominal flow rate	[kPa]	10	18	28	15	27	42	55

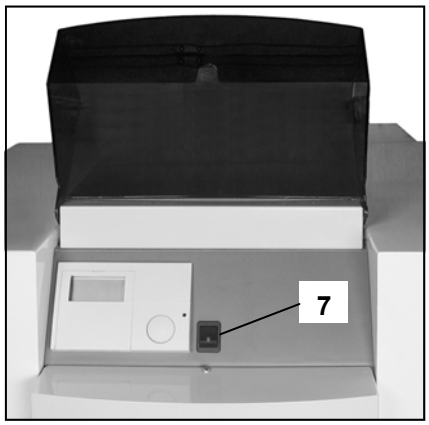
Commissioning

Check functionality of safety devices
Gas tightness check
Boiler shut down









Check functionality of safety devices
All safety devices have to be checked on good functioning. Safety devices on a standard boiler are a water flow temperature sensor, fluegas temperature sensor, water flow switch minumum gas pressure switch and ionisation electrode. These devices can be checked as described below.

Water flow temperature sensor (1)
Disconnect the plug from the sensor while the boiler is switched on. This should result in a lockout no. 12.
The lockout should disappear as soon as the plug is placed back in position, the boiler will restart.

Flue gas temperature sensor (2)
Disconnect the plug from the sensor while the boiler is switched on. This should result in a lockout no. 13.
The lockout should disappear as soon as the plug is placed back in position, the boiler will restart.

Water flow switch (3)
Close (slowly!) the valve in the flow connection to the system while the boiler is running on minimum load. When the valve is almost closed and the water flow is insufficient, the water flow switch will switch off and the boiler will go in lockout 40. Open the valve. A manual reset is necessary.

Minimum gas pressure switch (5)
Close the gas cock when the boiler is in standby position (⏻). Open the test point on the gas line (4) while measuring the gas pressure on the test point of the gas pressure switch (5).
The boiler will go in lockout no. 2 when the switch off setting is achieved. Close both test points and open the gas cock.

Ionisation electrode (6)
Remove electrical connection from the ionisation electrode while the boiler is running, the boiler will go in lockout no.5. The boiler will try to restart. With the electrical connection removed, the restart will result in lockout no. 4. When the connection is already mounted, the restart will be successful.

Measuring the ionisation current can be done by mounting a multi-meter (set to µA) in between the ionisation electrode and its electrical connection. The ionisation current should always be above 1.2 µA, in normal conditions it will be 6 µA and above.

Gas tightness check
Check the gas tightness of all sealed connections with an approved soap or electronic gas analyzer, for example:
- Test points
- Bolt connections
- Gaskets of mixing system, etc.

Boiler shut down
When the boiler will not be used for longer periods, shut down the boiler by following procedure:
- Switch the boiler in standby operation (⏻)
- Switch off the boiler with the on/off switch (7)
- Disable power supply to the boiler by deactivating the mains isolator switch in the boiler room
- Close the gas supply to the boiler.

Commissioning

Commissioning protocol

Commissioning Protocol Ultramax R600				
Project				
Boiler type		Project		
Serial number		Address		
Year		City		
Nominal load (Hi)	[kW]	Date		
Nominal output (Hi)	[kW]	Engineer		
System				
Water pressure	[bar]	Installation:	Roof top	☐
Water pH	[-]		Ground floor	☐
Water hardness	[dºH]		Basement	☐
Water chloride	[mg/l]		Other:	☐
Water ΔT full load	[ºC]	Hydraulics:	Low velocity header	☐
Water Δp_{boiler}	[kPa]		Plated heat exchanger	☐
Water flow	[m^3/h]		Bypass boiler	☐
Pump setting	[-]		Other:	☐
Safety devices				
High limit setting	[ºC]	Water flow sensor checked		☐
Temp. limiter setting	[ºC]	Fluegas sensor checked		☐
Min. gas pressure switch setting	[mbar]	Water flow switch checked		☐
Ignition time burner	[sec]			

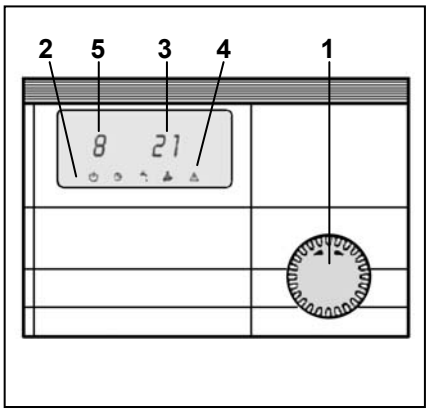
Combustion analysis			
	100% load	**50% load**	**Min. load**
Gas consumption	[m^3/h]	[m^3/h]	[m^3/h]
Gas pressure	[mbar]	[mbar]	[mbar]
CO_2	[%]	[%]	[%]
O_2	[%]	[%]	[%]
CO	[ppm]	[ppm]	[ppm]
NOx	[ppm]	[ppm]	[ppm]
$T_{atmospheric}$	[ºC]	[ºC]	[ºC]
$T_{fluegas}$	[ºC]	[ºC]	[ºC]
$T_{water,\ flow}$	[ºC]	[ºC]	[ºC]
$T_{water,\ return}$	[ºC]	[ºC]	[ºC]
Ionisation current	[µA]	[µA]	[µA]
p_{fan}	[mbar]	[mbar]	[mbar]
$p_{top\ panel}$	[mbar]	[mbar]	[mbar]
$p_{combustion\ chamber}$	[mbar]	[mbar]	[mbar]

Parameter settings			
P1 Setpoint temperature heating	[ºC]	P12 Boiler hysteresis	[ºC]
P2 Setpoint temperature DHW	[ºC]	P17 Fan speed min. load	[%]
P11 Maximum boiler setpoint	[ºC]	P19 Fan speed 100% load	[%]
Remarks			

Operating instructions

Main menu (operating mode)
Parameter menu (information/programming mode)

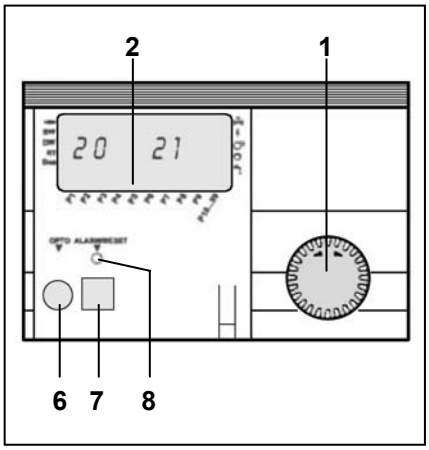
The boiler controller has two menus: the main menu (operating mode) when the lid is closed, and the parameter menu (information/programming mode) when the lid is open. Both menus and possibilities are explained in the next paragraphs.



Main menu (operating mode) ➔ lid closed
With the lid closed and by using the rotational switch (1) clockwise or anticlockwise the boilers' operating mode (2) can be set. The available modes are:

- Standby mode (only frost protection)
- Automatic operation mode (heating and DHW)
- Summer mode (only DHW, no heating)
- Service mode minimum load
- Service mode full load (limited by P9)

Besides the operating mode, the display also shows the actual water flow temperature (3) and, in case of a lockout, a warning triangle (4) combined with a lockout code (5). The explanation of the lockout codes can be found in chapter "Lockouts".



Parameter menu (information/programming mode) ➔ lid open
With the lid open and by using the rotational switch (1) clockwise or anticlockwise it's possible to read/change certain values/parameters from the boiler controller. An arrow at the bottom of the display (2) indicates which parameter has been selected. The available values/parameters are:

P1	Actual / setpoint water flow temperature [ºC]
P2	Actual / setpoint DHW temperature [ºC]
P3	Actual temperature/capacity setpoint for boiler [ºC]*
P4	--
P5	Actual outside temperature [ºC] (if sensor is connected)
P6	Actual fluegas temperature [ºC]
P7	--
P8	Actual low velocity header temperature [ºC] (if sensor is connected)
P9	Actual / Limit boiler output [%]
P10	Password for advanced settings

* P3 shows the actual temperature setpoint of the boiler, either coming from P1/P2 or from an additional (weather compensated) controller or building management system (2-10V). When the boiler capacity is controlled via a cascade manager or building management system (2-10V), P3 shows the actual capacity setpoint of the boiler.

Behind the lid you find an optical I/O connection (6), a reset/programming button (7) and an alarm/programming LED (8). Besides the parameter values/ settings, the display also shows additional information with regard to input and output indications to and from the boiler:

Output indications

- Power to main gas valve
- Power to ignition transformer
- Fan control signal
- Power to primary boiler pump
- Power to DHW pump/diverter valve

Input indications

	Flame ionisation detected
SW	Water flow switch active
DW	--
RT	Boiler enabled**
Bus	Bus communication active

**The boiler enable signal is equipped with a jumper in the standard delivery and therefore the boiler will normally be enabled. If a building management system is connected to provide the enable signal to the boiler (jumper should be removed), check the building management system if the boiler remains disabled.

Changing parameter values
For changing any parameters, in the example parameter P2 (DHW setpoint), the following procedure should be carried through:

- Open the lid (the arrow at the bottom of the display indicates parameter P1)
- Turn the rotational switch clockwise until the arrow indicates parameter P2
- Press the reset/programming button to select (the LED lights up)
- Turn the rotational switch until the desired DHW setpoint value has been reached
- Press the reset/programming button to confirm (the LED goes out)
- Close the lid.

The new value is now activated. All parameters can be changed by following the same procedure as described above.

Maintenance

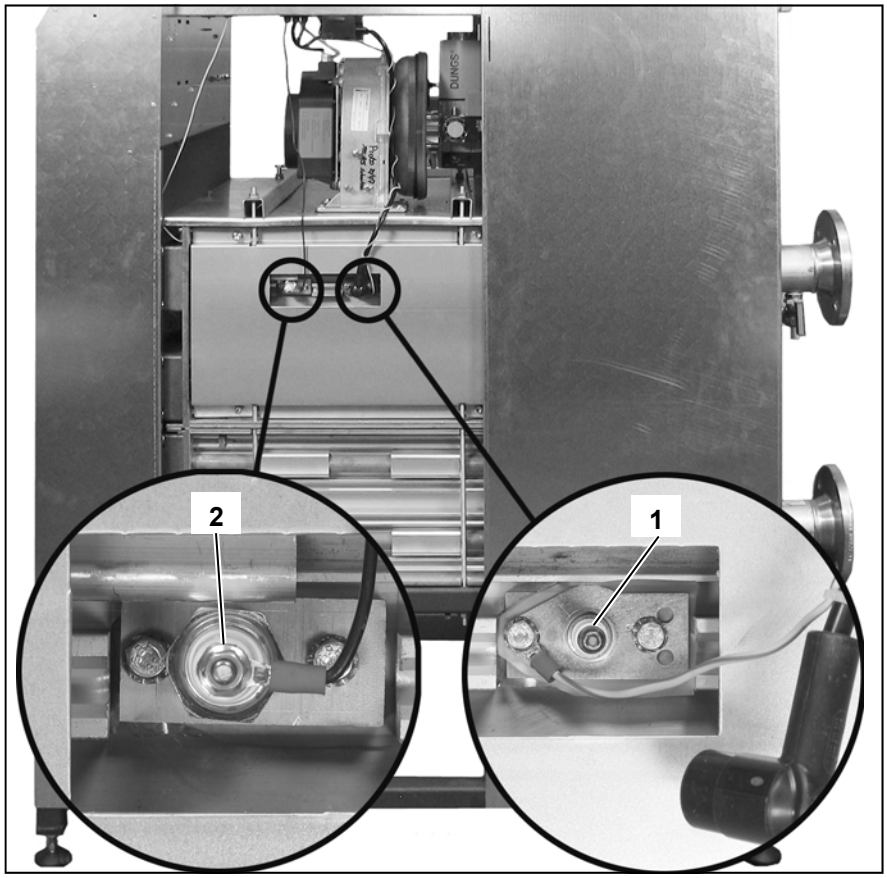
Checklist
Replacing the electrodes

Maintenance of the boiler should be carried out by authorized personnel only.

In order to ensure continued good and safe operation of the boiler, it should be inspected at least once per year. A maintenance protocol should be filled out (see end of this chapter for example of maintenance protocol).

Checklist
The following activities must be carried out, see following paragraphs for an extensive description of the main activities:

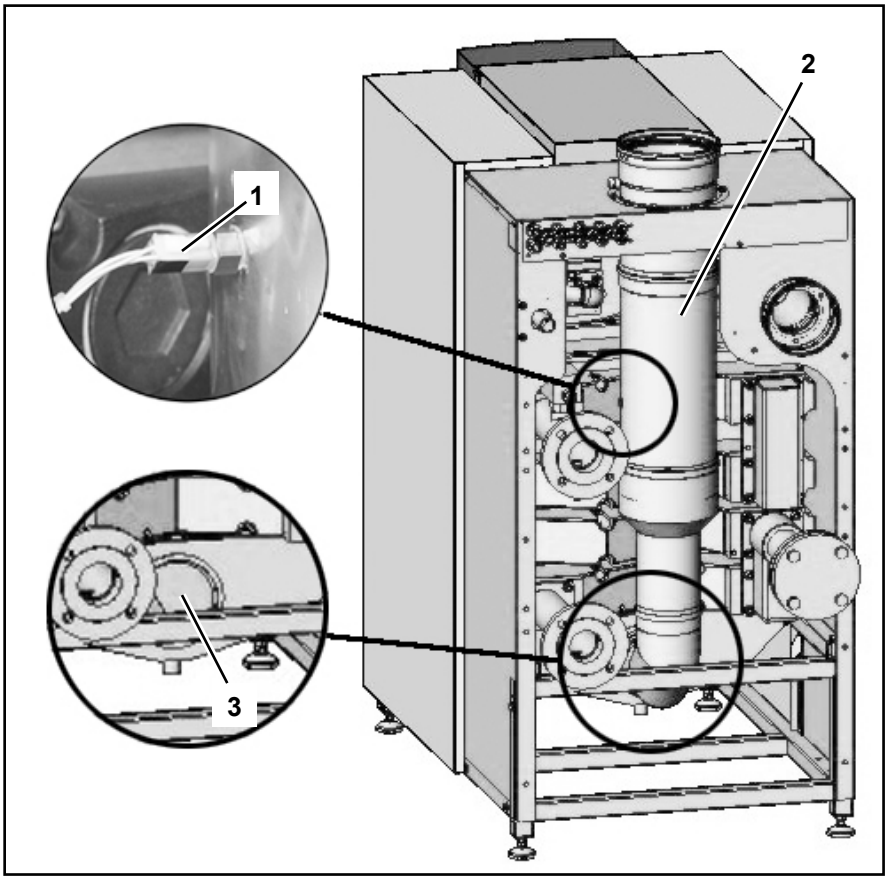
- Replace the ignition and ionisation electrodes;
- Clean the condensate receptacle;
- Clean and refill the syphon;
- Inspect the combustion chamber, clean if necessary;
- Check the water pressure of the system;
- Check the water quality of the system water as well as supply water;
- Check the water flow rate through the boiler;
- Check/correct the combustion values at full and mimimum load with a combustion analyzer;
- Check the gas pressure to the boiler;
- Check the tightness of all sealed connections and test points;
- Check the functionality of all safety devices;
- Fill out a maintenance protocol.



Replacing the electrodes
The electrodes are positioned on the right hand side of the boiler. Replace the ignition elektrode (1) and ionisation eclectrode (2) as shown on the picture.

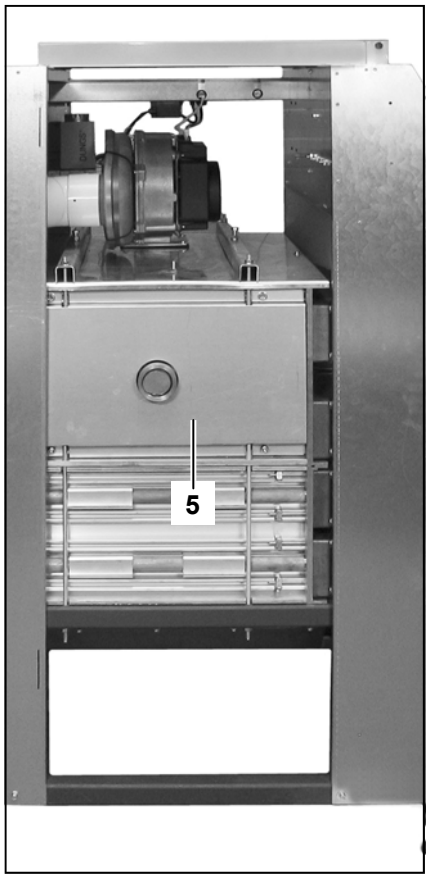
Maintenance

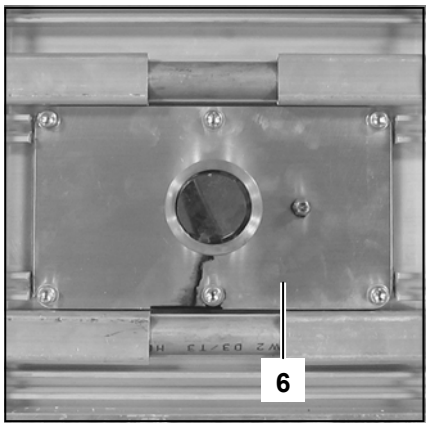
Cleaning the condensate receptacle
Cleaning and refilling the syphon
Inspection of combustion chamber

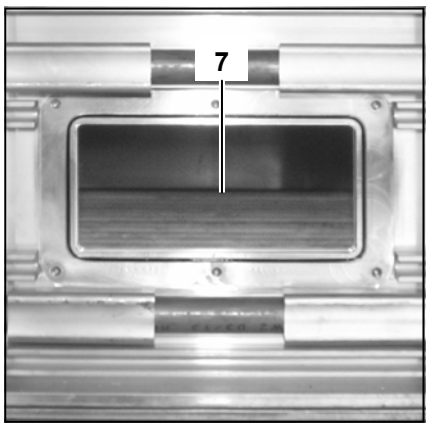


Cleaning the condensate receptacle

- Disconnect the plug of the fluegas temperature sensor (1);
- Remove the internal fluegas pipe (2) of the boiler in order to create access to the condensate receptacle;
- Clean the receptacle (3);
- Mount the fluegas pipe back in position when the cleaning is finished;
- Connect the plug of the fluegas temperature sensor.







Cleaning and refilling the syphon

- Remove the syphon (4) from the condensate connection;
- Clean and fill it with fresh water;
- Mount the syphon back in the original position.

Inspection of combustion chamber

The inspection opening is positioned on the left hand side of the boiler.

- Remove the radiation panel (5) from the heat exchanger;
- Remove the cover (6) from the inspection opening;
- Inspect the combustion chamber (7), clean if necessary;
- Mount the cover and radiation panel back in original position.

Maintenance

Water pressure and quality
Check if the water pressure and quality meet the requirements. Consult the chapter “commissioning: water and hydraulic system” for more detailed information.

Water flow rate
Check if the water flow rate through the boiler is within the limits. Consult the chapter “commissioning: check water flow” for more detailed information.

Combustion analysis
Check the combustion at full load and minumum load, correct the settings if necessary. An additional reference check at 50% load is recommended. Consult the chapter “commissioning: combustion analysis” for more detailed information.

Gas pressure
Check the dynamic pressure of the gas supply to the boiler, when the boiler is running at full load. In case of a boiler cascade, all boilers should be running at full load. See technical data for required values.

Gas tightness check
Check the tightness of all sealed connections with an approved soap or electronic analyzer, for example:

- Test points;
- Bolt connections;
- Gaskets of mixing system, etc.

Safety devices
Check the functionality and the settings of all safety devices connected. Consult the chapter “commissioning: Check functionality of safety devices” for more detailed information.

Maintenance Protocol

Maintenance Protocol Ultramax R600			
Project			
Boiler type		Project	
Serial number		Address	
Year		City	
Nominal load (Hi)	[kW]	Date	
Nominal output (Hi)	[kW]	Engineer	
System			
Water pressure	[bar]		
Water pH	[-]		
Water hardness	[dºH]		
Water chloride	[mg/l]		
Water ΔT full load	[ºC]		
Water Δp_{boiler}	[kPa]		
Water flow	[m^3/h]		
Pump setting	[-]		
Safety devices			
High limit setting	[ºC]	Water flow sensor checked	☐
Temp. limiter setting	[ºC]	Fluegas sensor checked	☐
Min. gas pressure switch setting	[mbar]	Water flow switch checked	☐
Ignition time burner	[sec]		

Combustion analysis			
	100% load	**50% load**	**Min. load**
Gas consumption	[m^3/h]	[m^3/h]	[m^3/h]
Gas pressure	[mbar]	[mbar]	[mbar]
CO_2	[%]	[%]	[%]
O_2	[%]	[%]	[%]
CO	[ppm]	[ppm]	[ppm]
NOx	[ppm]	[ppm]	[ppm]
$T_{atmospheric}$	[ºC]	[ºC]	[ºC]
$T_{fluegas}$	[ºC]	[ºC]	[ºC]
$T_{water, flow}$	[ºC]	[ºC]	[ºC]
$T_{water, return}$	[ºC]	[ºC]	[ºC]
Ionisation current	[µA]	[µA]	[µA]
p_{fan}	[mbar]	[mbar]	[mbar]
$p_{top\ panel}$	[mbar]	[mbar]	[mbar]
$p_{combustion\ chamber}$	[mbar]	[mbar]	[mbar]

Parameter settings			
P1 Setpoint temperature heating	[ºC]	P12 Boiler hysteresis	[ºC]
P2 Setpoint temperature DHW	[ºC]	P17 Fan speed min. load	[%]
P11 Maximum boiler setpoint	[ºC]	P19 Fan speed 100% load	[%]

Remarks

Lockouts

In case of a lockout, a warning triangle (⚠) and a flashing error code appears on the display. The cause of a fault should first be determined and eliminated before the boiler is being reset. In case the lockout appears more than twice within 6 minutes or maintains for longer than 6 minutes, the error code is added with a "3". The table below shows all possible lockouts and an indication of possible cause.

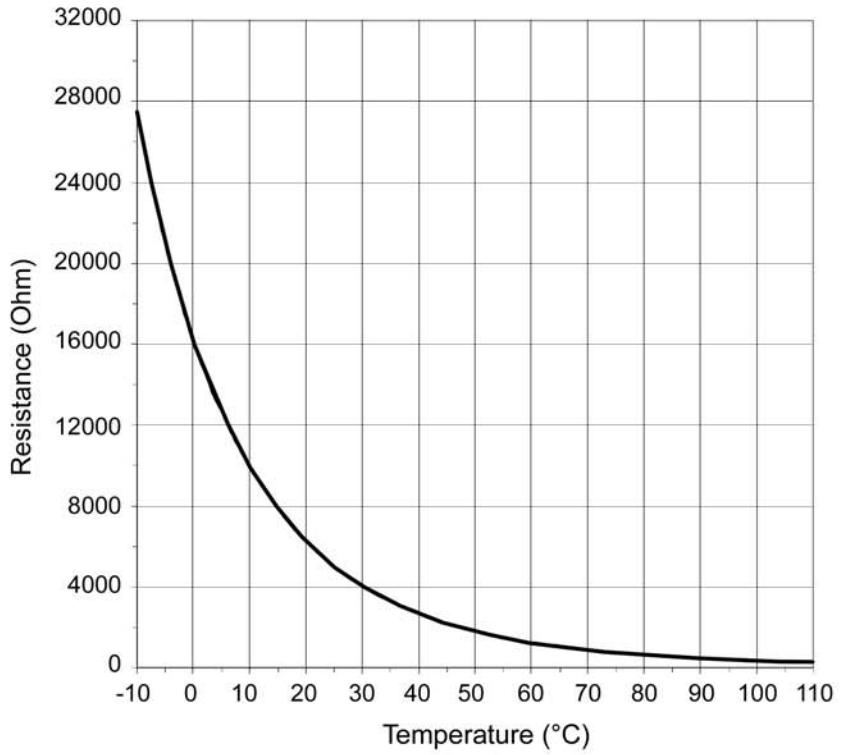
No.	Error type	Explanation	Possible solution
1	Lockout	Water flow temperature has exceeded the high limit temperature setting (100ºC).	Check if boiler is in automatic mode (K), Check if water flow through the boiler is sufficient, check if (P11+P12) < High limit setting (V9).
2	Interlock	Gas pressure has dropped below minimum value of minimum gas pressure switch or additional safety device connected to the interlock input has been interrupted (during startup).	Check gas supply pressure / check function of additional safety device on interlock input.
3	Interlock	Gas pressure has dropped below minimum value of minimum gas pressure switch or additional safety device connected to the interlock input has been interrupted (during operation).	Check gas supply pressure / check function of additional safety device on interlock input.
4	Lockout	No flame ionisation signal detected during burner start.	Check phase/neutral of power supply (phase sensitivity!), check gas supply, check ignition spark, increase gas valve setting min. load (alan key screw).
5	Lockout	Flame ionisation signal lost during operation.	Check gas supply pressure during operation, check gas valve setting via combustion analysis.
6	Interlock	Water flow temperature has exceeded the temperature limiter setting (97ºC).	Check if boiler is in automatic mode (🕘), check if water flow through the boiler is sufficient, check if (P11+P12) < Temp. limiter setting (V10).
7	Lockout	Fluegas temperature has exceeded the high limit temperature setting (100ºC).	Check if water pressure is sufficient, check if water flow through the boiler is sufficient, check if heat exchanger is clean (fluegas and water side).
11	Lockout	Flame ionisation signal detected before burner start.	Check ionisation electrode, measure ionisation current when boiler is off, check wiring between ionisation electrode and boiler controller.
12	Interlock	Water flow temperature sensor is defective	Check resistance of sensor (see chapter "sensor values"), check wiring between water flow temperature sensor and boiler controller.
13	Interlock	Fluegas temperature sensor is defective	Check resistance of sensor (see chapter "sensor values"), check wiring between fluegas temperature sensor and boiler controller.
14	Interlock	DHW temperature sensor (optional) is defective	Check resistance of sensor (see chapter "sensor values"), check wiring between DHW temperature sensor and boiler controller.
15	Interlock	Outside temperature sensor (optional) is defective	Check resistance of sensor (see chapter "sensor values"), check wiring between outside temperature sensor and boiler controller.
18	Interlock	Header temperature sensor (optional) is defective	Check resistance of sensor (see chapter "sensor values"), check wiring between header temperature sensor and boiler controller.

Lockouts

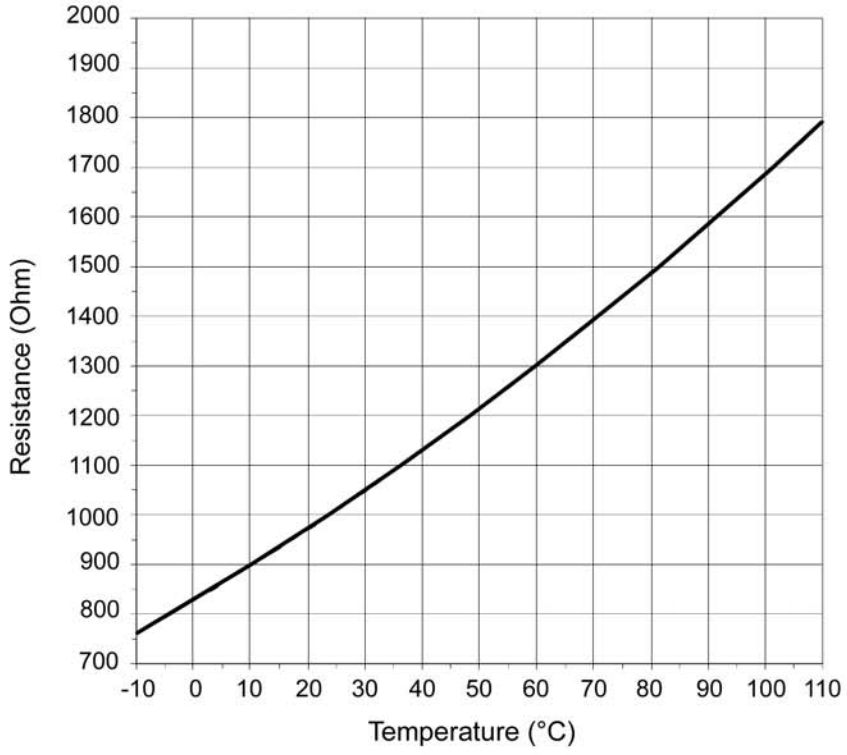
No.	Error type	Explanation	Possible solution
20	Lockout	Error gas valve V1, flame ionisation signal detected longer than 5 seconds after burner stop.	Check closing position of valve V1 within gas combi valve, replace gas valve.
21	Lockout	Error gas valve V2, flame ionisation signal detected longer than 5 seconds after burner stop.	Check closing position of valve V2 within gas combi valve, replace gas valve.
24	Lockout	Fan did not reach speed setpoint during prepurge.	Check fan speed and feedback settings within boiler controller, check wiring between fan and boiler controller, check fan electronics.
25	Lockout	Fan did not reach speed setpoint for ignition.	Check fan speed and feedback settings within boiler controller, check wiring between fan and boiler controller, check fan electronics.
26	Lockout	Fan did not reach switch off position (fan speed > 300 rpm).	Check chimney draught, check fan speed and feedback settings within boiler controller, check wiring between fan and boiler controller, check fan electronics.
30	Lockout	CRC error in control system parameters (P11-P40).	Check parameter settings of P11-P40, change value of one parameter within P11-P40 (lockout disappears), change all parameters back to original settings.
31	Lockout	CRC error in boiler safety parameters (V1-V16).	Check parameter settings of V1-V16, change value of one parameter within V1-V16 (lockout disappears), change all parameters back to original settings.
32	Interlock	Power supply voltage to boiler controller is too low.	Check fuse of boiler controller, check power supply to boiler controller.
40	Lockout	Water flow switch has been interrupted when pump being enabled.	Check pump operation, check water flow through the boiler, check functionality of water flow switch.
x.y.	Lockout	(all lockout codes which are not listed above) Internal lockout of boiler controller.	Press reset. Change boiler controller when lockout can not be reset or occurs more frequently.

Sensor values

Water flow and fluegas temperature sensor (5kΩ NTC)



DHW, outside and header temperature sensor (1kΩ PTC)



The diagrams show the sensor values for all boiler sensors and optional sensors available in accessory kits. The diagrams contain average values, as all sensors are liable to tolerances.

When measuring the resistance values, the boiler should always be switched off. Measure close to the sensor, in order to avoid value deviations.

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Declaration of Conformity

Rendamax BV, Hamstraat 76, 6465 AG Kerkrade (NL),
declares that the product

Ultramax R600

is in conformity with the following standards:

EN 298
EN 50165
EN 55014-1 / -2
EN 60 335-2

and in accordance with the guidelines of directives:

92 / 42 / EEC (boiler efficiency directive)
90 / 396 / EEC (gas appliance directive)
73 / 23 / EEC (low voltage directive)
89 / 336 / EEC (EMC directive)

This product is designated with CE nr.:

CE – 0063BS3840

Kerkrade, 29-08-2007

ing. G.A.A. Jacobs
Plant Manager

Notes

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MHS BOILERS

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