

TTW

FLOOR STANDING GAS FIRED CONDENSING CIRCULATING TYPE WATER HEATER

Installation, Commissioning, User and
Maintenance instructions



MODELS

TTW410

TTW580

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1.0 INTRODUCTION

- The Lochinvar TTW is a floor standing gas-fired condensing water heater. The equipment comprises of two stainless steel radial burner assemblies and a heat exchanger that permits fully condensing operation.
- The burners are initiated by cascaded electronic ignition sequence controls that incorporate spark ignition and flame rectification devices for supervision of the flame.
- The output from the water heater is regulated by two variable speed combustion fans and gas/air ratio controls to maintain correct combustion at all levels of modulation. This configuration allows modulation down to 12.5% of the rated output.
- For the correct operation of the water heater, it is essential that a suitably sized pump is utilised to maintain a constant water flow rate through the heat exchanger.
- This equipment is intended for use on Group H Natural Gas (2nd Family) and LPG propane (3rd Family). The information relating to propane firing is to be found in **Section 20.3**. This equipment **MUST NOT** use gas other than that for which it has been designed and adjusted.
- This equipment must be installed by a competent person, registered with a H.S.E. approved body. All installations must conform to the relevant Gas Safety and Building Regulations. Health & Safety requirements must also be taken into account when installing any equipment. Failure to comply with the above may lead to prosecution.
- If the equipment is to be connected to an unvented (pressurised) system, care must be taken to ensure all extra safety requirements are satisfied should a high or low-pressure condition occur in the system.
- The equipment is designed for direct connection to a flue system.

1.1 ANCILLARY OPTIONS:

Matched primary pump	See Technical product submittal
Twin pipe balanced flue assemblies	Refer to TT Flueing Specification Document*.
Conventional flue assembly	Refer to TT Flueing Specification Document*.

* Visit www.lochinvar.ltd.uk for additional technical documentation

2.0 SAFETY GUIDELINES



READ AND UNDERSTAND THE INSTRUCTIONS

Read and fully understand all instructions before attempting to operate maintain or install the unit.

Keep these instructions near the water heater for quick reference.

This equipment must be installed by a competent person, registered with the H.S.E. approved body. All installations must conform to the relevant Gas Safety and Building Regulations. Health & Safety requirements must also be taken into account when installing any equipment. Failure to comply with the above may lead to prosecution

Without written approval of the manufacturer the internals of the water heater may not be changed. When changes are executed without approval, the water heater certification becomes invalid.

Commissioning, maintenance and repair must be done by a skilled installer/engineer, according to all applicable standards and regulations.

2.1 GENERAL DESCRIPTION OF SAFETY SYMBOLS USED



BANNED

A black symbol inside a red circle with a red diagonal indicates an action that should not be performed



WARNING

A black symbol added to a yellow triangle with black edges indicates danger



ACTION REQUIRED

A white symbol inserted in a blue circle indicates an action that must be taken to avoid risk



ELECTRICAL HAZARD

Observe all signs placed next to the pictogram. The symbol indicates components of the unit and actions described in this manual that could create an electrical hazard.



HOT SURFACES

The symbol indicates those components with a high surface temperature that could create a risk.



This symbol shows essential information which is not safety related



Recover or recycle material

2.2 WHAT TO DO IF YOU SMELL GAS



Warning if you smell gas

- No naked flames, no smoking!
- Avoid causing sparks, do not switch on or off electrical equipment or lights
- Open windows and doors
- Shut off the main gas supply
- Warn occupants and leave the building
- After leaving the building alert the local gas supply company
- Do not re-enter the building until it is safe to do so



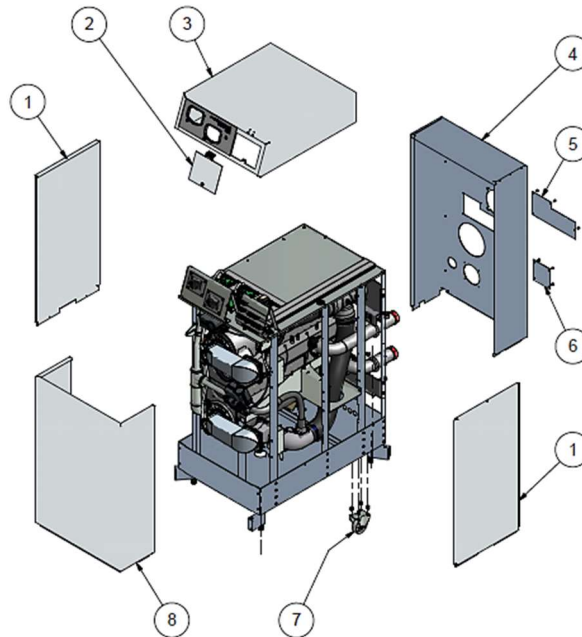
Lochinvar Limited is not liable for any damage caused by inaccurately following these installation instructions. Only original parts may be used when carrying out any repair or service work.



This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

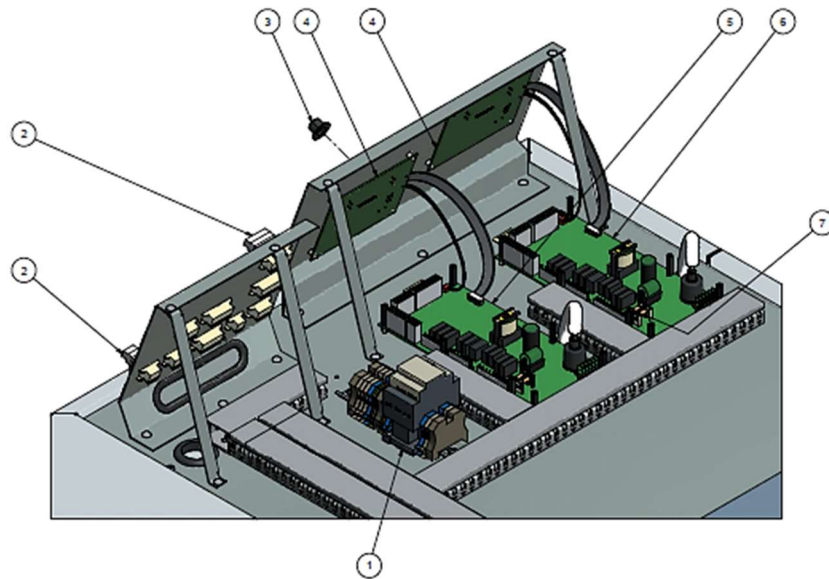
3.0 PRINCIPLE PARTS

3.1 CASING



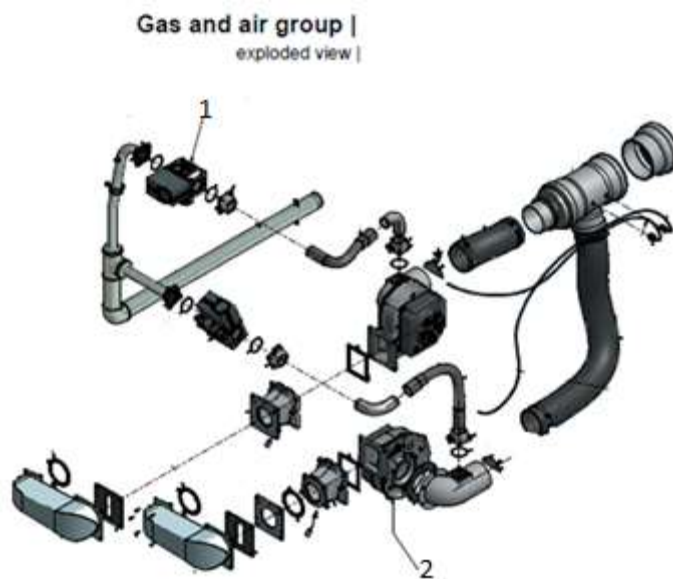
No	Item No	Description
1	E01-000-124	SIDE PANEL
2	S01-000-337	ELECTRICAL COVER
3	S01-000-380	TOP COVER
4	E01-002-114	REAR COVER
5	E01-002-128	COVER UPPER LIMIT SWITCH
6	E01-002-129	COVER LOWER LIMIT SWITCH
7	S04-000-307	WHEEL ASSEMBLY
8	E01-000-215	FRONT PANEL

3.2 ELECTRICAL



No	Item No	Description
1	E04-016-425	RELAY LC1D09
2	E04-016-291	CONNECTOR PLUG 2 POLE
2	E04-016-292	CONNECTOR PLUG 3 POLE
2	E04-016-293	CONNECTOR PLUG 4 POLE
2	E04-016-295	CONNECTOR PLUG 6 POLE
3	E05-001-062	RUBBER PLUG 15mm
4	S04-000-310	REPLACEMENT KIT DISPLAY
5		WATER HEATER CONTROL SLAVE-STATE TYPE AND SERIAL NO
6		WATER HEATER CONTROL MASTER-STATE TYPE AND SERIAL NO
7	S04-016-582	FUSE SET x10

3.3 GAS TRAIN AND AIR INLET



No	Item No	Description
1	S04-000-199	GAS VALVE
2	S04-000-200	COMBUSTION FAN

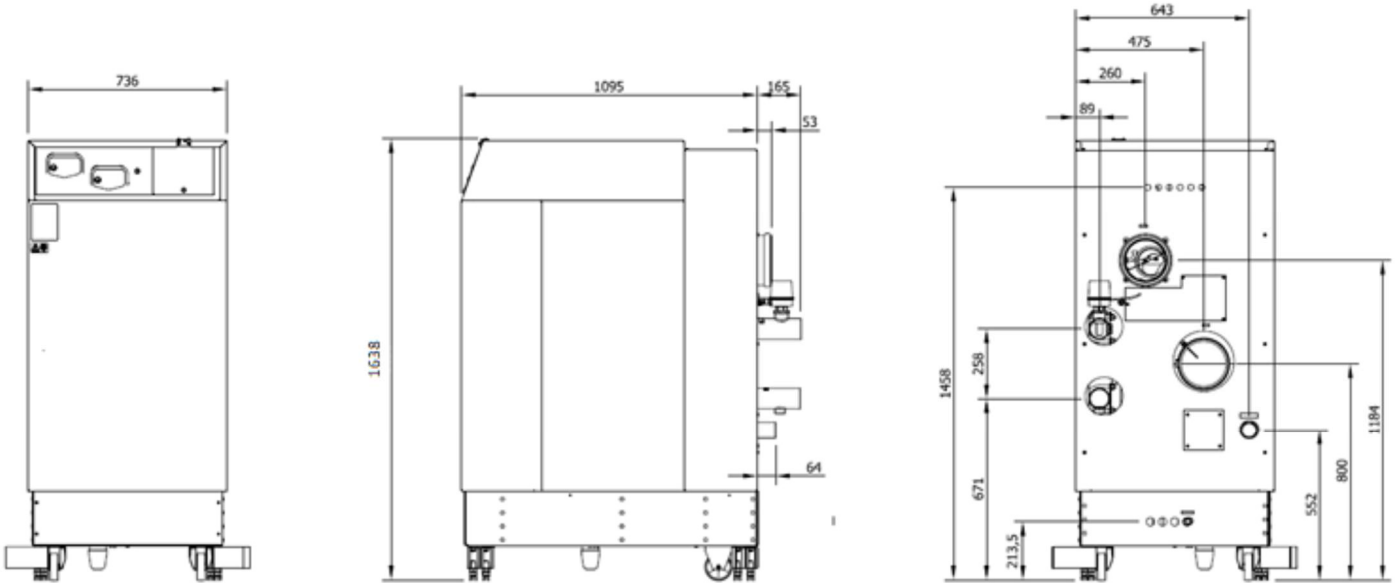
4.0 TECHNICAL DATA

Model Number		TTW410	TTW580
GENERAL DATA			
Product I.D. Number		CE 0063BS3806	
Classification		II2H3B/P	
Input (gross) min-max	kW	55.4 - 444	75.5 - 611
Input (net) min-max	kW	50 - 400	68 - 550
Recovery Rate (44° ΔT)	l/hr	8168	11263
Recovery Rate (50° ΔT)	l/hr	7188	9912
Heat generator seasonal efficiency	%	95.4	95.9
Shipping Weight	kg	400	450
NO _x	mg/kWh	44	41
NO _x Class		6	
GAS DATA G20			
Nominal gas inlet pressure	mbar	20	
Maximum gas inlet pressure	mbar	25	
Minimum gas inlet pressure	mbar	17.5	
Gas flow rate – m ³ /hr	m ³ /hr	5.3 - 42.3	7.2 - 58.2
Flue gas mass rate (@ 9.0% CO ₂)	g/s	24 - 208	28 - 260
Gas inlet connection size	" BSP	2	2
GAS DATA G31			
Nominal gas inlet pressure	mbar	37	
Maximum gas inlet pressure	mbar	45	
Minimum gas inlet pressure	mbar	27	
Gas flow rate – m ³ /hr	m ³ /hr	16.8	23
Flue gas mass rate (@ 9.0% CO ₂)	g/sec	193	265
Gas inlet connection size	" BSP	2	2
ELECTRICAL DATA			
Power consumption	W	752	829
Power supply		Single phase 230v/50Hz	
Protection class		IPX0B	
WATER DATA			
Water content	litres	30	43
Water connections (F & R)	" BSP	2 ½	
Max. water pressure	bar	8	
Min. water pressure	bar	1	
Maximum water temperature	°C	70	

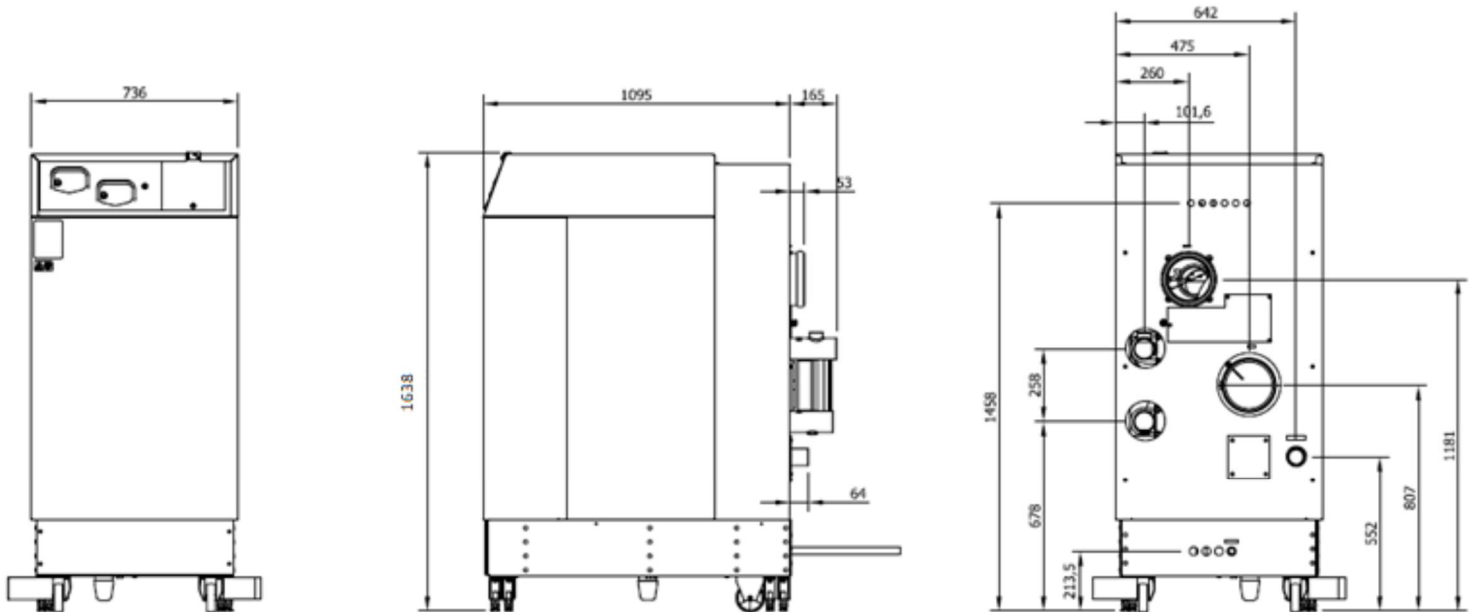
4.1.1 TECHNICAL DATA

5.0 DIMENSIONS AND CLEARANCE

5.1 DIMENSIONS



5.1.1 DIMENSIONS TTW410



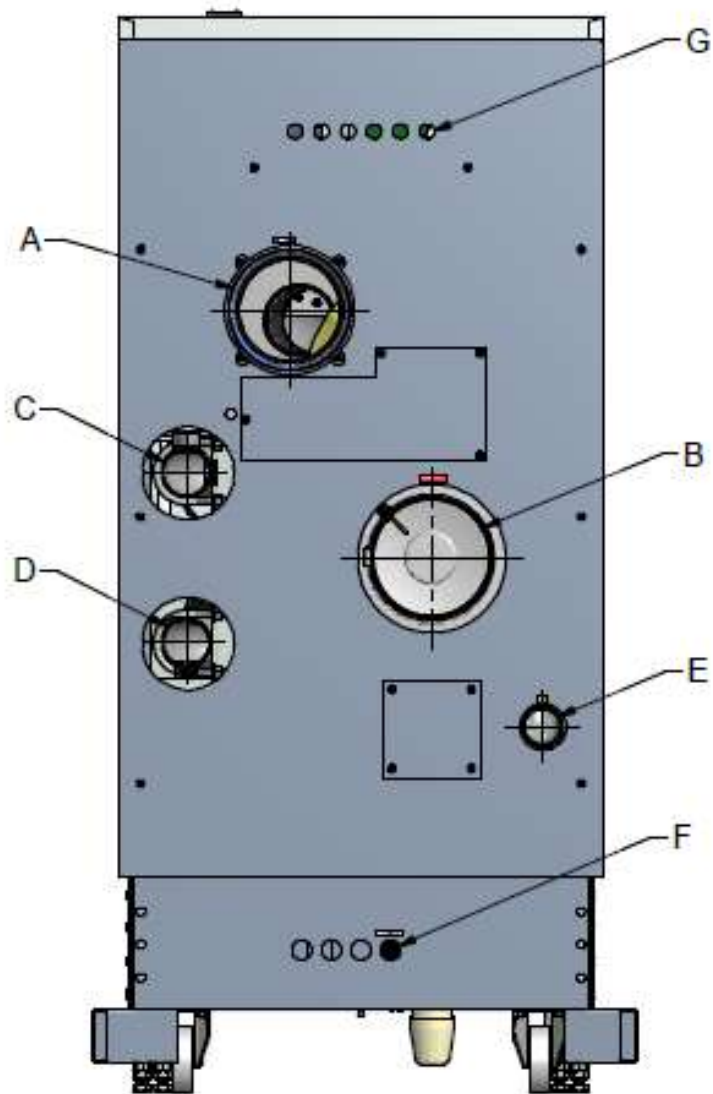
5.1.2 DIMENSIONS TTW580

- Minimum Side Clearance of 500mm (Advised 1000mm)
- Minimum Front Clearance of 800mm
- Minimum Rear Clearance of 500mm

5.1.3 MINIMUM CLEARANCES

5.2 WATER HEATER CONNECTIONS

Rear view



5.2.1 WATER HEATER CONNECTIONS

Connection	Function	Diameter (inch/mm)
A	combustion air inlet	Ø 180 mm
B	flue outlet	Ø 180 mm
C	water flow (outlet)	R 2½ "
D	water return (inlet)	R 2½ "
E	gas connection	R 2 "
F	condensate discharge hose	Ø 25 mm outer diameter
G	cable input	Ø 22.5 mm

5.2.2 CONNECTIONS AND CONNECTION SIZES

5.3 CONDENSATE DRAIN CONNECTION

The condensate drain is placed at the centre and at the bottom of the water heater and has a ¼ inch hose discharge. Connect this flexible hose to a suitable drain point.

Use only plastic parts with the condensate drain.

Blockage of this drain may damage the water heater. The drain connection is correct when the condensate can be seen flowing away.



Any damage caused by incorrectly installing the condensate drain will NOT be covered by warranty.

There should be an open connection of the condensate hose into the drain. A possible under pressure in the drainage system must never be allowed to cause drain water to pull into the water heater.



When mounting the bottom part of the siphon, before commissioning the water heater and/or after maintenance, the siphon must ALWAYS be completely filled with water.

This is a safety measure: the water in the siphon keeps the flue gases from entering the plant room by leaving the heat exchanger via the condensate drain.

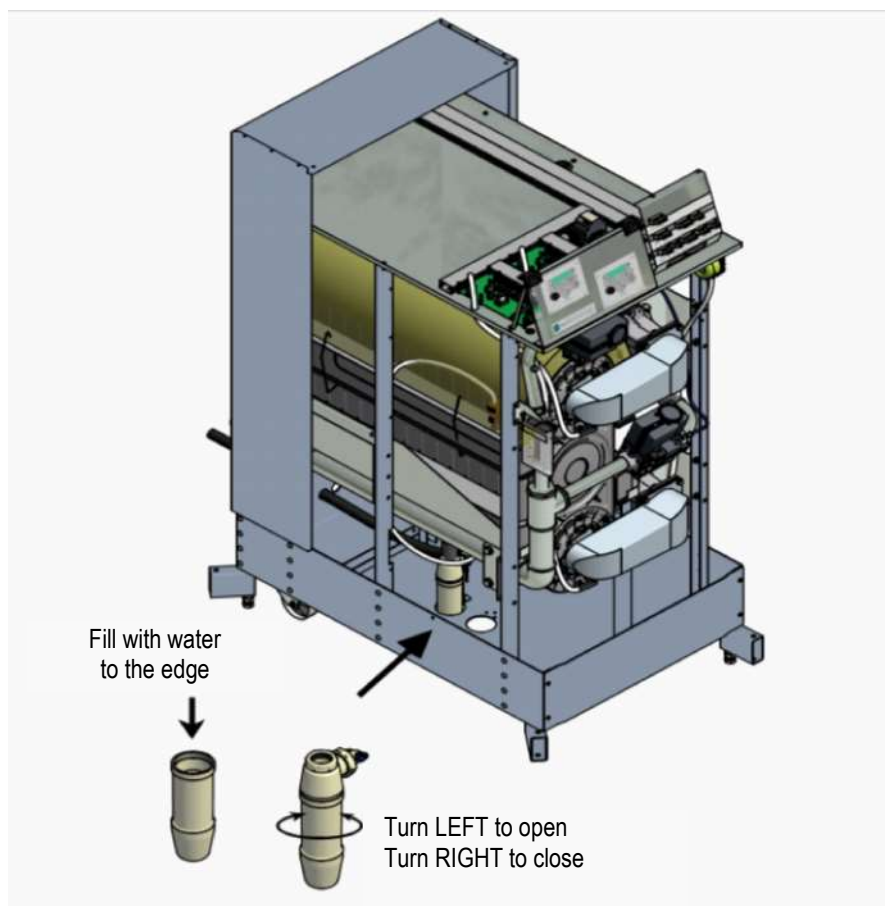


FIGURE 3.2 CONDENSATION SIPHON

6.0 GENERAL REQUIREMENTS

The Lochinvar TTW comes with the following documents and accessories:

- An installation, commissioning and maintenance instruction guide for the installer.
- 3 spare fuses and 3 spare nuts for the installation of the burner plate (this is attached to the front of the gas valve).
- Spare flue gas plugs
- One gas conversion sticker
- One Torx key T40
- One allen key no. 3
- Bottom part of Siphon



Lochinvar will supply a suitable shunt pump with every TTW water heater, this must be installed with the TTW to maintain the correct flow

On delivery, immediately check that the water heater is complete and without any defects. Report any damage immediately to Lochinvar Limited.

The Lochinvar TTW has been designed to operate trouble free for many years. These instructions should be followed closely to obtain the maximum usage and efficiency of the equipment. **PLEASE** read the instructions fully before installing or using the appliance.

NOTES

- 1 All water heaters are supplied as twin pipe model.
- 2 Using propane, butane and B/P, maximum fan speed needs to be reduced (parameter P4BD)
- 3 Below a table is given in which the min. and max. gas supply pressures are listed according to EN437:

	p nominal [mbar]	p min [mbar]	p max [mbar]
G20	20	17	25
G31	30	25	35
	37	25	45
G30	50	43	57

- 4 Emissions measured during unit certification.
- 5 Maximum combined resistance of flue gas and air supply piping at high fire.
- 6 230 Vac is necessary for the water heater to function. If a 400 Vac water heater pump is applied, 400 Vac must be connected to the appliance so the power supply for the pump can be delivered by the system. (An optional safety switch for the pump motor must be added externally).

6.1 RELATED DOCUMENTS

It is law that all gas appliances are installed by competent persons, in accordance with The Gas Safety (Installation and Use) Regulations 1998. Failure to install appliances correctly could lead to prosecution. It is in your own interest, and that of safety, to ensure that this law is complied with.

The installation of the equipment **MUST** be in accordance with the relevant requirements of the Gas Safety Regulations, Building Regulations, I.E.E. Regulations and the bylaws of the local water undertaking. The installation should also be in accordance with any relevant requirements of the local gas distributor and local authority.

In addition the installation should follow the relevant guidance offered in the following documents. It is not practical to list all relevant information but emphasis is placed on the following documents, as failure to comply with the guidance given will almost certainly result in an unsatisfactory installation:

Regulation	Description
BS EN 1858: 2008 + A1: 2011	Chimneys, Components. Concrete flue blocks.
BS 5440-1: 2008	Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases). Specification for installation of gas appliances to chimneys and for maintenance of chimneys.
BS 5440-2: 2009	Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases). Specification for installation and maintenance of ventilation for gas appliances.
BS 6644: 2011	Specification for Installation of gas-fired hot water Heaters of rated inputs between 70 kW (net) and 1.8 MW (net) (2nd and 3rd family gases).
BS EN 806 1-5	Specifications for installations inside buildings conveying water for human consumption.
BS 7671 :2008 + A3:2015	Code of practice for low temperature hot water systems of output greater than 45 kW.
BS 7074: 1989 Parts 1 and 2	Application, selection and installation of expansion vessels and ancillary equipment for sealed systems.
BS 7671: 2008 + A1: 2011	Requirements for electrical installations, I.E.E. wiring regulations seventeenth edition.
BS 7671: Amendment 2: August 2013	
BS EN 12828:2012+A1:2014	Heating systems in buildings. Design for water-based heating systems.
CP 342 (Part 2 1974):	Code of practice for centralised hot water supply-buildings other than dwellings. Institute of Gas Engineers and Managers (IGEM) Publications
IGE/UP/1 - Edition 2:	Installation pipework on industrial and commercial premises.
IGE/UP/2 – Edition 3	Gas installation pipework, boosters and compressors on industrial and commercial premises.
IGE/UP/4 - Edition 4	Commissioning of gas-fired plant on industrial and commercial premises.
IGE/UP/10 - Edition 4	Installation of flued gas appliances in industrial and commercial premises.

Gas Safety (Installation and Use) Regulations 1998 (England, Scotland & Wales)

CIBSE: Guide parts A, B and C

H.S.E. guidance Automatically controlled steam and hot water heaters **note PM5:**

Third edition of the 1956 Clean Air Act Memorandum on Chimney Heights



Manufacturer's notes must not be taken in any way as overriding statutory obligations.

7.0 WATER QUALITY

7.1 WATER CHEMISTRY

Water supply quality may adversely affect the efficiency performance and longevity of Water Heaters and Hot Water systems. Hard water may cause the formation of limescale that will reduce operating efficiency and may cause early product failure. Please note the following: -

- Maximum allowed water hardness is 205 PPM or 205 mg/L CaCO₃ (= 11.5°dH)
- TDS (total dissolved solids) may not exceed 350 PPM
- Water hardness and TDS together may not exceed 350 PPM
- The pH value of the water may not be under 6.5 and not above 7.5 (measured cold)
- If TDS alone or the combined value is higher than the abovementioned, the water should be heated by means of an indirect water-heating appliance.
- Minimum water hardness = 80 PPM or 80 mg/L CaCO₃ (= 4.5°dH)
- Minimum TDS = 100 PPM
- Water that is under these minimum values normally has a pH value, which is aggressive and corrosive.



If these values are exceeded a water treatment specialist should be consulted. Water Softeners and Water Conditioners may be considered, but whichever method is selected, it should be suitable for installation with Direct Gas-fired Water Heaters. A maintenance regime will also be required for such systems



The formation of limescale or other solids can cause a blockage within the heat exchanger, which in turn may cause premature failure. Such instances are not regarded as defects in manufacture and will not be covered under the product warranty

8.0 LOCATION

8.1 PLANT ROOM REQUIREMENTS

The Lochinvar TTW condensing water heater can only be installed in a room that complies with the appropriate ventilation requirements.

The Lochinvar TTW can be used as a type C₁₃, C₃₃, C₄₃, C₅₃, or C₈₃ appliance. Due to its room sealed design, ventilation allowances for combustion air are not necessary; ventilation for cooling purposes however, must be fitted. For further guidance, please refer to **Section 9: AIR SUPPLY** or to **BS6644**.

The Lochinvar TTW can also be used as a type B₂₃ appliance. If such a configuration is to be used, then appropriate ventilation for cooling and combustion must be provided. For further details, please refer to **Section 9: AIR SUPPLY** or to **BS6644**.

8.2 GENERAL REQUIREMENTS

Corrosion of the heat exchanger and vent system may occur if air for combustion contains certain chemical vapours. Such corrosion may result in poor combustion and create a risk of asphyxiation. Aerosol propellants, cleaning solvents, refrigerator and air conditioning refrigerants, swimming pool chemicals, calcium and sodium chloride, waxes and process chemicals are corrosive. Products of this sort should not be stored near the water heater or outside by the air intake (if applicable). The fitting of this equipment in a situation where aerosols or other chemicals may be entrained into the combustion air will invalidate the warranty.

The equipment must be installed on a level, non-combustible surface that is capable of adequately supporting its weight (when filled with water) and any ancillary equipment. The operation of the equipment must not cause the temperature of any combustible material in the vicinity of the equipment and its flue to exceed 65°C. If such a situation is unavoidable, appropriate insulation should be provided.



Locate the equipment so that if the appliance or any connecting pipework should leak, water damage will not occur. When such locations cannot be avoided, it is recommended that a suitable drain pan be installed under the equipment. The pan should be adequately drained but must not restrict the combustion or ventilation airflow.

8.3 UNPACKING AND LEVELLING THE WATER HEATER

The water heater is mounted on a pallet with a wooden support frame around it. The water heater is wrapped in shrink wrap before the wooden support frame is mounted. After the frame is placed the whole pallet, water heater and frame package is shrink wrapped again. Only remove the outer packaging once the water heater has been positioned as close as possible to the place where it will be installed. After removing the wrapping and frame the water heater can be taken off the pallet using a fork-lift truck or suitable lifting device. The water heater is fixed to the pallet with screws; make sure these are removed before attempting to lift the water heater from the pallet. Once the water heater is in its final position, the inner packaging can be removed.

The water heater will now be stood on 4 adjustment bolts; ensure the water heater is level in both directions by using these 4 bolts. There are also four legs under the appliance that can be turned outward if a positive fixing to the floor structure is required.

8.4 CLEARANCES

The location chosen for the equipment must permit the provision for a satisfactory flue system and, where necessary, an adequate air supply. The location must also provide adequate space for servicing and air circulation around each unit. This includes any electrical trunking laid across the floor and to the appliance.

See 5.1.3 for dimensions/clearances. Further details regarding locations are given in **BS6644**.

9.0 GAS SUPPLY

The Lochinvar TTW is suitable for use on second and third family gasses 2H - G20 - 20mbar and 3P - G31 - 37mbar. Details relating to Natural Gas (2H) appear below; for details relating to Propane (3P) please refer to **Section 17.1.4 GAS TYPE SELECTION**.

9.1 SERVICE PIPES

The local gas distributor must be consulted at the installation planning stage in order to establish the availability of an adequate supply of gas. An existing service pipe must not be used without prior consultation with the local gas distributor.

9.2 METERS

The local gas distributor contractor will connect a new gas meter to the service pipe. An existing gas meter should be checked, preferably by the gas distributor, to ensure that it is adequate to deal with the rate of gas supply required.

9.3 GAS SUPPLY PIPES

Supply pipes must be fitted in accordance with **IGE/UP/2**. Pipework from the meter to the equipment must be of adequate size. The complete installation must be purged and tested as described in **IGE/UP/1**. Refer to **Section 17.1.4 GAS TYPE SELECTION** for information on LPG installation guidance.

9.4 BOOSTED SUPPLIES

Where it is necessary to employ a gas pressure booster, the controls must include a low-pressure cut-off switch at the booster inlet. The local gas distributor must be consulted before a gas pressure booster is fitted. For details of how to connect a low-pressure cut-off switch, please refer to **Section 15.0: ELECTRICAL INSTALLATION**.

9.5 PLANT-ROOM CONTROL VALVE

A manual valve for plant-room isolation must be fitted in the gas supply line. It must be clearly identified and readily accessible for operation, preferably by an exit.

9.6 EQUIPMENT GAS SYSTEM LEAK CHECK



An approved isolating valve and union should be installed for each unit in a convenient and safe position and be clearly marked.

Ensure that the manual gas service valve is in the OFF position. Although the equipment receives a gas leak check and gas train component integrity check prior to leaving the factory, transit and installation may cause disturbance to unions, fittings and components. During commissioning, a further test for tightness should be carried out on the equipment gas pipework and components.



Care must be taken not to allow leak detection fluid on or near any electrical parts or connections.

10.0 FLUE SYSTEM

All versions of the TTW Condensing water heater can be installed as either type B23 (fan assisted open flue) C53 (room sealed) C63 (Flue not supplied by the appliance manufacturer) appliances. Only B23,C53 Flue systems are covered in any detail within this document, further information can be found in the TTW Flue assemblies and ancillaries guide available at www.lochinvar.ltd.uk See the relevant section for details of each flue type and requirements.

10.1 FLUE SYSTEM GENERAL REQUIREMENTS



Install the horizontal flue components with an angle of 3° back in the direction of the water heater (roughly equal to five centimetres for every linear meter). Failure to install the flue correctly will result in a build-up of condense within the flue pipework that will cause early component failure.



When using a wall terminal, there is the possible risk of ice building-up on surrounding parts/structures, because the condensate will freeze. This risk should be taken into account during the design phase of the heating installation.



TTW Water heaters will produce large condense clouds especially during cold weather, consideration must be taken as to whether this will cause a nuisance to neighbouring properties and if so alternative flue arrangements used.



TTW Water heaters can operate with very low flue temperatures; as such the flue system used must be suitable for use with condensing appliances made from either Polypropylene or stainless steel and have a temperature class of T120.



Aluminium flue pipe must not be used on this appliance as it may lead to premature failure of the heat exchanger and will invalidate the warranty.



Before installation of any flue system read the installation manual carefully for both the appliance and flue system to be used. Information on the flue system Supplied by Lochinvar can be found within this manual.

MODEL NUMBER	TTW410	TTW580
FLUE DATA		
Appliance category	B23, C13, C33, C43, C53, C83	
Nominal flue diameter – mm	180	180
Maximum flue gas temp. – °C	90	90

10.2 FLUE TERMINAL POSITION

Any flue termination must be in such a position as will not cause a hazard to the health of persons who may be nearby or a nuisance to other persons beyond the curtilage. The flue terminal must be positioned externally such as to allow the dispersal of products of combustion and air intake. The terminal should be installed in a location where it will not easily flood or be blocked by snow. Under certain operating and weather conditions, the TTW may generate a plume at the terminal. Consideration should be given to the nuisance this may cause and the terminal should be sited accordingly.

The flue terminal position is very important and must be in accordance with the recommendations found in **BS6644** or **IGE/UP/10**. Once the terminal position has been determined the appropriate local authority should be advised of the proposed installation. It is important that the appropriate local authority is consulted at an early stage in the design in order to establish that the proposed flue discharge positions are acceptable and will not cause significant local exceedances of air quality objectives.

Where agreement is reached with the local authority, this should be recorded in a reproducible format as competent people involved at the latter stages of the project (i.e. the commissioning engineer) will ask for proof before allowing products of combustion to be discharged in an apparently non-compliant position.

10.3 FLUE GAS AND AIR SUPPLY SYSTEM

The overall resistance of the air supply and exhaust ducts must not create a pressure drop exceeding 200 Pa. The output of the water heater is influenced by the resistance of the air supply and discharge system therefore all flue gas and air supply systems must be carefully considered or referred to a specialist flue design company.

Details of air inlet and exhaust locations and sizes can be found in **4.0 TECHNICAL DATA**.

10.4 APPROVED FLUE SYSTEM

When used as a type C appliance, the approved, purpose designed adaptive flue system should be used. For further details, please contact Lochinvar Limited.

When used as a Type B appliance, a suitable flue system constructed of Stainless Steel or Polypropylene with a temperature rating in excess of 120°C should be used.

10.5 INSTALLATION PRECAUTIONS



The water heater must not be operated unless the complete flue system is installed. This includes the water heater connections, flue pipes, air ducts (if required) and terminals.



Due to the condensing nature of the water heater, long external runs should be avoided to prevent the condensate freezing within the flue system.

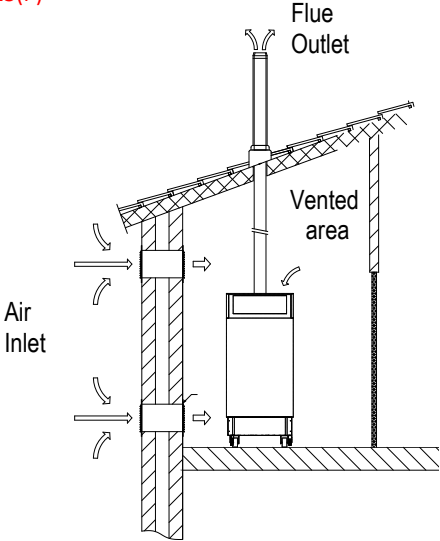
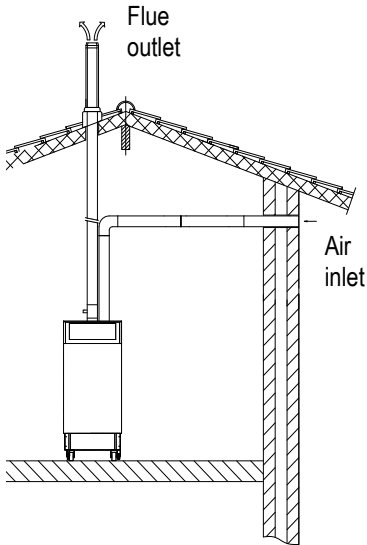


During assembly, precaution should be taken to ensure that any sealing ring is seated correctly

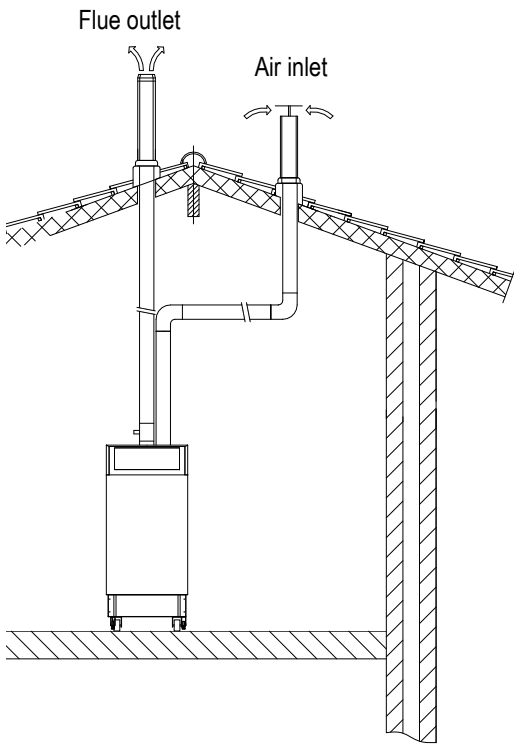


Due to the close tolerances in the flue system, it may be necessary to use a twisting action to fit the joints together. No lubrication other than water should be used.

10.6 WATER HEATER CATEGORIES - TYPES OF FLUE GAS SYSTEMS.

Type according EN 15502-2-1: 2012	Performance	Description
<p>B23(P)</p>  <p>The diagram shows a water heater installed in a room. A vertical flue pipe extends from the top of the heater through the roof, ending in a roof terminal. On the left wall, there are two air inlets with arrows pointing into the room. Above the heater, a 'Vented area' is indicated between the heater and the roof structure.</p>	<p>Open Air supply from room</p>	<ul style="list-style-type: none"> * Roof terminal * Without draught diverter * Water heater room air supply. * P = overpressure systems <p>Be aware: The installation room has to have sufficient air supply vents. These vents must be open and may not be closed or blocked. Requirements at NEN 3028 paragraph 6.5</p> <p>Use table 10.11 to select the correct flue items.</p>
<p>C53</p>  <p>The diagram shows a water heater with a separate air supply duct and a separate flue gas discharge duct. The air supply duct is connected to an 'Air inlet' on the wall. The flue gas discharge duct is connected to a 'Flue outlet' through the roof. The ducts are shown as separate lines from the heater to the outside.</p>	<p>Closed Air supply from outside</p>	<ul style="list-style-type: none"> *Separate air supply duct *Separate flue gas discharge duct. * Air supply inlet and flue gas outlet at different air pressure zones. But not at opposite walls. <p>Use table 10.9 to select the correct flue items</p>

C63



Closed
Air supply from
outside

* Appliance sold without flue/air-inlet ducts
* The flue gas parts are not part of the water heater. The water heater is intended to be connected to a separately approved and marketed system for the supply of combustion air and discharge of combustion products. Condensate is allowed to go to the water heater.
* Air supply inlet and flue gas outlet not at opposite walls

* Technical data:

nominal $T_{\text{flue gas}}$	85°C
nominal Q_{fluegas}	see 2.2 ¹⁾
maximum T_{fluegas}	95°C
min. load T_{fluegas}	35°C
min. load Q_{fluegas}	see 2.2 ¹⁾
nominal % CO_2	see 2.2 ¹⁾
max. allowed draft	70Pa
max. pressure drop inlet-outlet	200Pa
max $T_{\text{air supply}}$	40°C
max recirculation	10%

1) table technical specifications

See chapter: Accessories
- Fluegas and air supply parts

10.7 TYPE C₆₃ CERTIFIED

In general, water heaters are certified with their own flue gas material. For type B23(P), C13, C33, C43, C53 and C83 systems, only use flue gas and air supply parts approved for use with the appliance.

If a heater is C63 certified, no specific type flue gas material has been certified in combination with the water heater. In this case the flue gas and air supply parts should comply with the applicable European standards (EN14989).

So, for type C63 systems flue gas and air supply parts from other suppliers can be used. It must be able to handle the condensate forming (W) and transport, overpressure (P1) and must have a minimum temperature class of T120. Also, it has to meet the requirements in the following chapters "air supply" and "flue terminal".

CE string flue gas material	European standard	Temperature class	Pressure class	Resistance to condensate	Corrosion resistance class	Metal: liner specifications	Soot fire resis- tance class	Distance to combustible material	Plastics: location	Plastics: fire behaviour	Plastics: enclosure
min. req. PP	EN 14471	T120	P1	W	1		O	30	I of E	C/E	L
min. req. SS	EN 1856-1	T120	P1	W	1	L20040	O	40			

A few examples of flue gas material suitable for TTB water heaters:

CE String for Plastic PPs: EN14471 T120 P1 W 2 O(30) I C/E L

CE String for Stainless Steel: EN1856-1 T250 P1 W V2-L50040 O (50)

When selecting flue gas systems, be aware that the minimum requirements are met. So only select flue gas materials having the same or better properties than this table.



Never use aluminium containing flue gas pipes in these water heaters.

Connecting diameters and tolerances:

mat		d _{nom}	D _{outside}	L _{insert}		d _{inside}	L _{insert}	d _{wall thickness}
RVS		180	180 ± 0.3	50 ± 1		181.2 ± 0.3	50 + 0 / -2	0.6 ± 10%
RVS		200	200 ± 0.3	50 ± 1		201.2 ± 0.3	50 + 0 / -2	0.6 ± 10%
PP		200	200 + 1/ -0.6	50 + 20 / -2		202 + 0.6 / -1	50 + 20/ -2	≥ 3.5

Multiple water heaters can be connected to a common duct. These flue gas systems for multiple water heater installations must always be engineered as zero or negative pressure systems; so as to prevent the risk of recirculation of the flue gases. Consult the flue gas supplier for detailed information and engineering.

If the combustion air is taken from the water heater room, the inlet air must be clean and free of water. Always use a wire mesh to prevent debris being drawn into the air inlet

10.8 TTW AIR INLET / FLUE GAS OUTLET CALCULATION EXAMPLES

The load of the water heater is influenced by the resistance of the air supply and the discharge system. The diameter and length of both air supply and flue gas pipes needs to be designed accurately to decrease the possible power loss of the water heater.

Calculation examples

In the following, two calculation examples are given for determining the maximum length of the flue gas and air supply pipes.

A: Twin pipe system with separate pipes for flue gas and air supply.

Air supply roof mounted.

B: Single pipe system for flue gas outlet only.

Air supply from water heater room.

10.9 TYPE C₅₃(TWIN PIPE) FLUE SYSTEMS

Flue system specifications

- MANUFACTURER MUELINK AND GROL (M&G)
- TEMPERATURE CLASS T120
- FLUE GAS MATERIAL PP

Each Twin-Pipe starter assembly includes the items shown in the tables below

TWIN-PIPE FLUE ASSEMBLY MODELS TTW410,TTW580

COMPONENTS REQUIRED TO START INSTALLATION

VERTICAL FLUE

M70439	VERTICAL TERMINAL Ø200mm	1
LE400092	INCREASER Ø180mm TO Ø200mm FOR AIR INLET ONLY	1
LE400093	ECCENTRIC INCREASER Ø180mm - Ø200mm FOR EXHAUST	1
LE400096	VERTICAL TERMINAL Ø200mm (AIR INLET) - PP	1

Additional Flue Ancillary Items

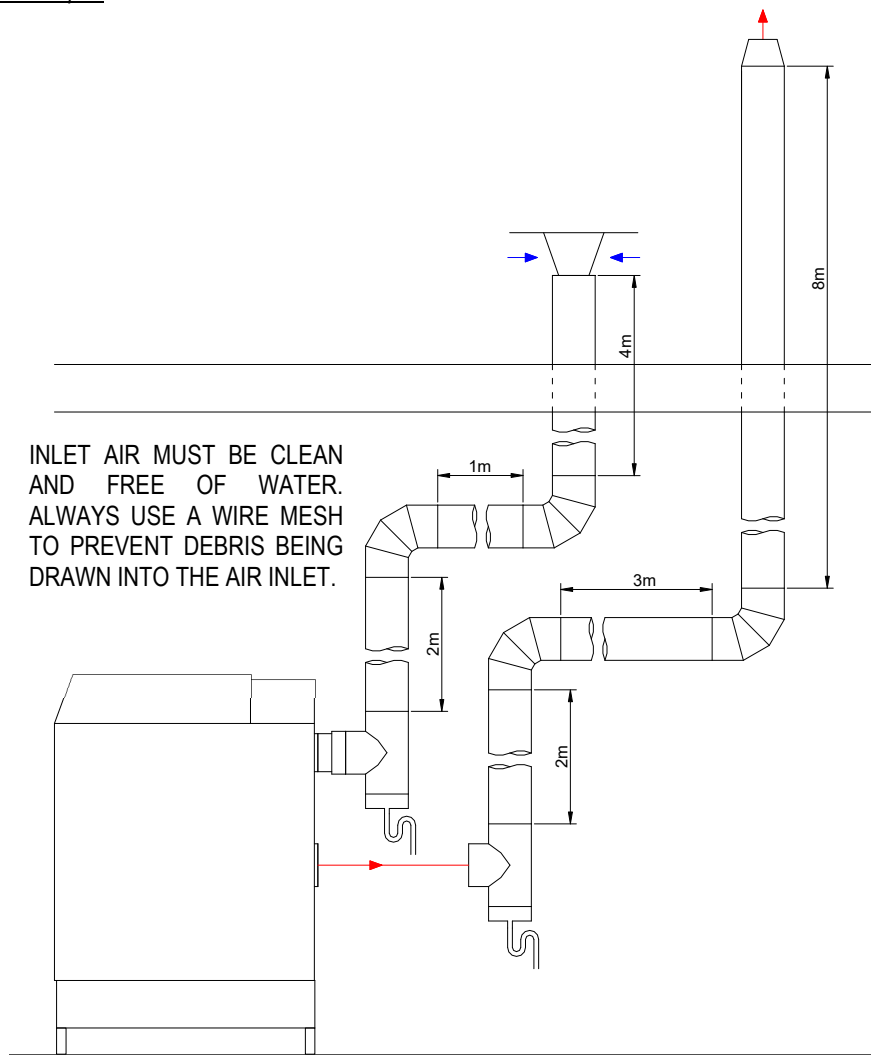
Item No.	Description	Dimensions
LV310696	EXTENSION Ø200mm PP	500mm
M70402	EXTENSION Ø200mm PP	1000mm
M70404	EXTENSION Ø200mm PP	2000mm
M70411	ELBOW 90° Ø200mm PP	n/a
M70412	BEND 45° Ø200mm PP	n/a
LV310677	T PIECE WITH CONDENSATE CONNECTOR Ø200mm PP	n/a
M87198	WALL CLAMP Ø200mm	n/a



Do not reduce the pipe diameter relative to the water heater connection

10.9.1 EXAMPLE A: TWIN PIPE SYSTEM

Calculation example:



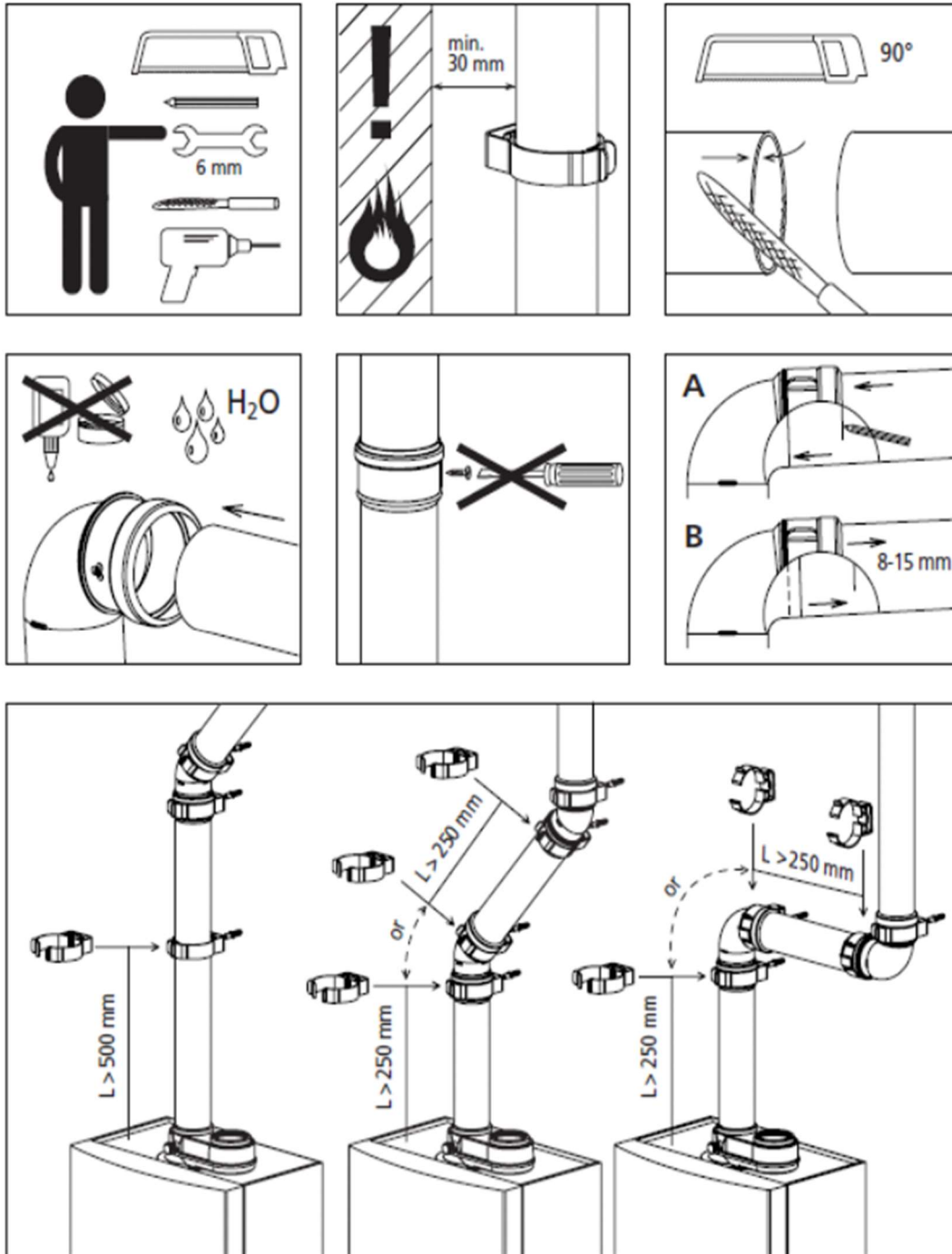
Water heater type:		TTW410			
Flue gas	Diameter: 200 mm.		Number	Pa	Pa total
	Straight tube m ¹	total	13	1,8	23,4
	T-piece	outlet	1	16,7	16,7
	Bend	90°	2	6,5	13
	Flue outlet	Zeta=0,05	1	0,9	0,9
Total resistance flue gas outlet:					54,0
Air supply	Diameter: 200 mm.		Number	Pa	Pa total
	Straight tube m ¹	total	7	1,3	9,1
	T-piece	inlet	1	17,5	17,5
	Bend	90°	2	4,9	9,8
	Air inlet	Zeta=1,0	1	14,0	14,0
Total resistance air supply:					50,4
Total resistance flue gas outlet and air supply:					104,4 Pa

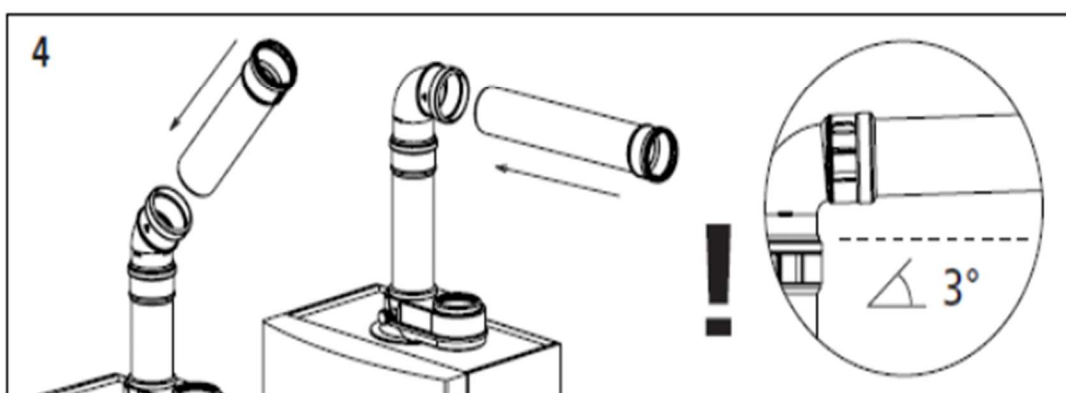
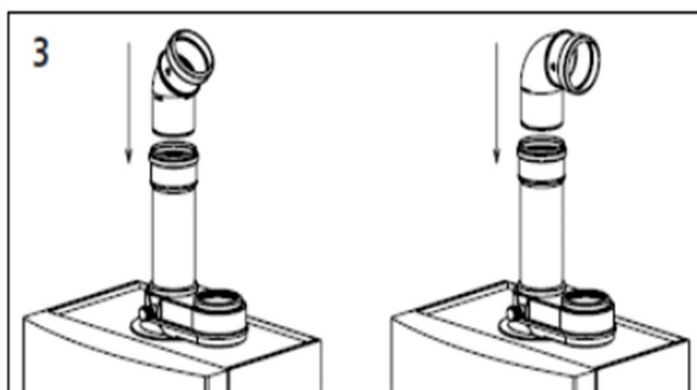
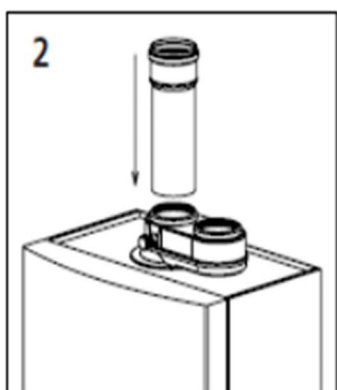
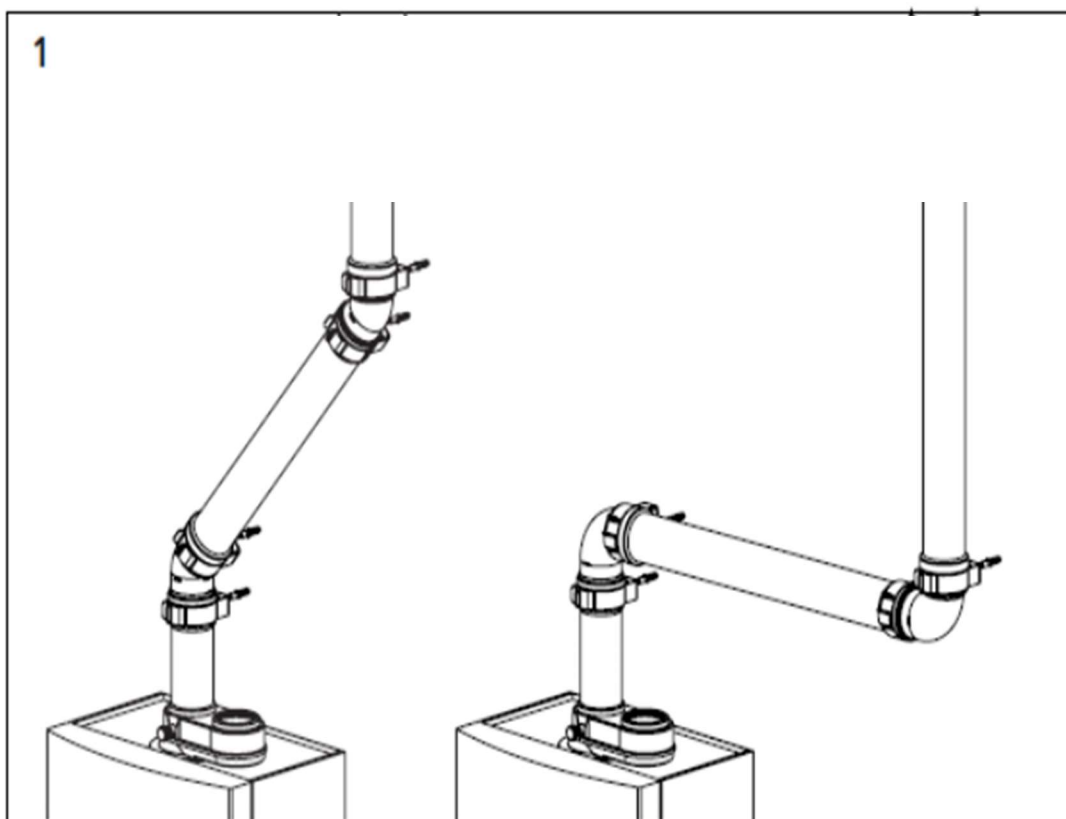
The total resistance is less than 200 Pa, so this is acceptable.

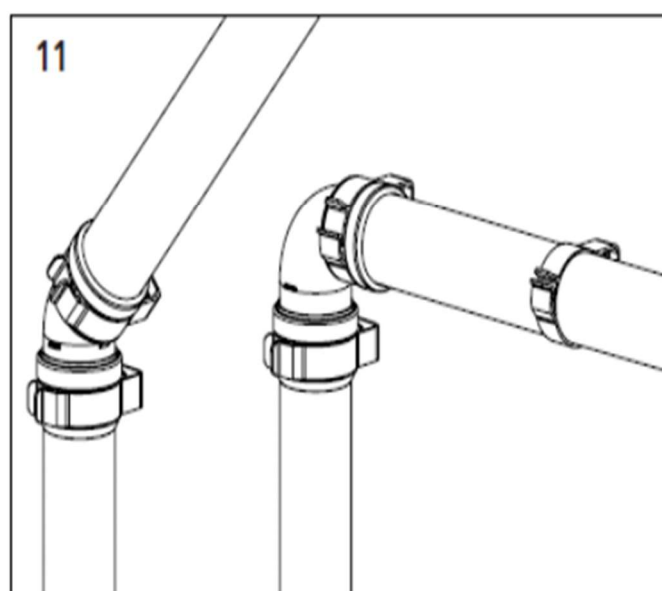
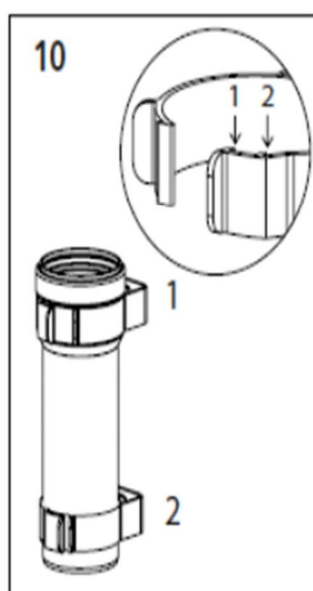
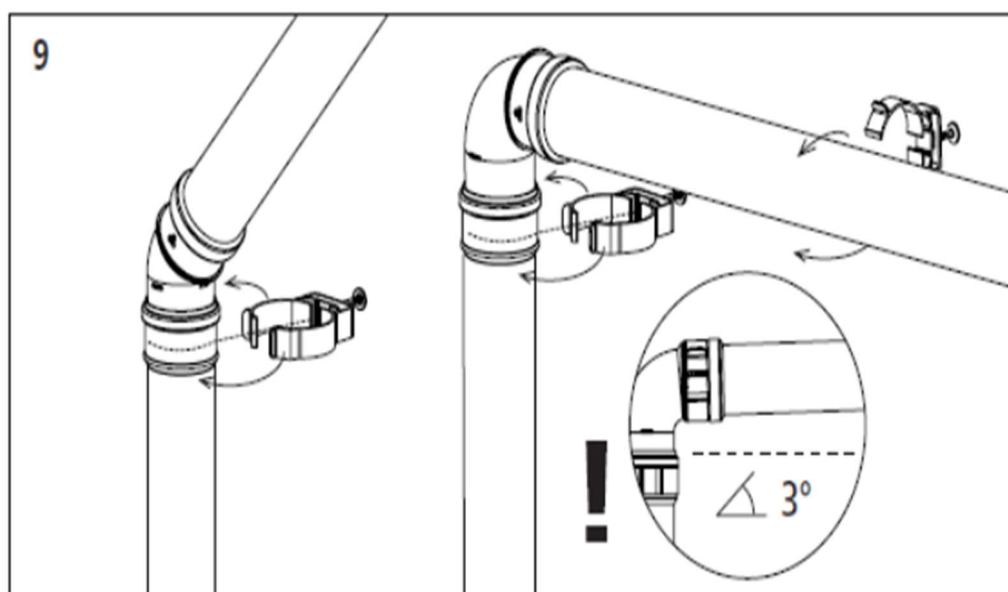
10.10 GENERAL TWIN-PIPE INSTALLATION GUIDELINES



The images shown below may not represent the equipment supplied, images and instructions are for general guidance only







10.11 TYPE B₂₃ (CONVENTIONAL FLUE WITH FAN ASSISTANCE)

When the water heater is installed as a Type B₂₃ appliance, the flue system should be installed in accordance with the flue manufacturer's specific instructions

CONVENTIONAL FLUE ASSEMBLY MODELS TTW410, TTW580

COMPONENTS REQUIRED TO START INSTALLATION

Item No.	Description	Dimensions
M70439B	VERTICAL TERMINAL Ø200mm	1
LE400093B	ECCENTRIC INCREASER Ø180mm - Ø200mm FOR EXHAUST	1
LM900205A	AIR INLET SCREEN Ø160mm SS	1

Additional Flue Ancillary Items

Item No.	Description	Dimensions
LV310696	EXTENSION Ø200mm PP	500mm
M70402	EXTENSION Ø200mm PP	1000mm
M70404	EXTENSION Ø200mm PP	2000mm
M70411	ELBOW 90° Ø200mm PP	n/a
M70412	BEND 45° Ø200mm PP	n/a
LV310677	T PIECE WITH CONDENSATE CONNECTOR Ø200mm PP	n/a
M87198	WALL CLAMP Ø200mm	n/a

When using flue pipe supplied by Lochinvar the guidance given in **section 10.10** is also applicable for B₂₃ systems.

Installation of air inlet screen



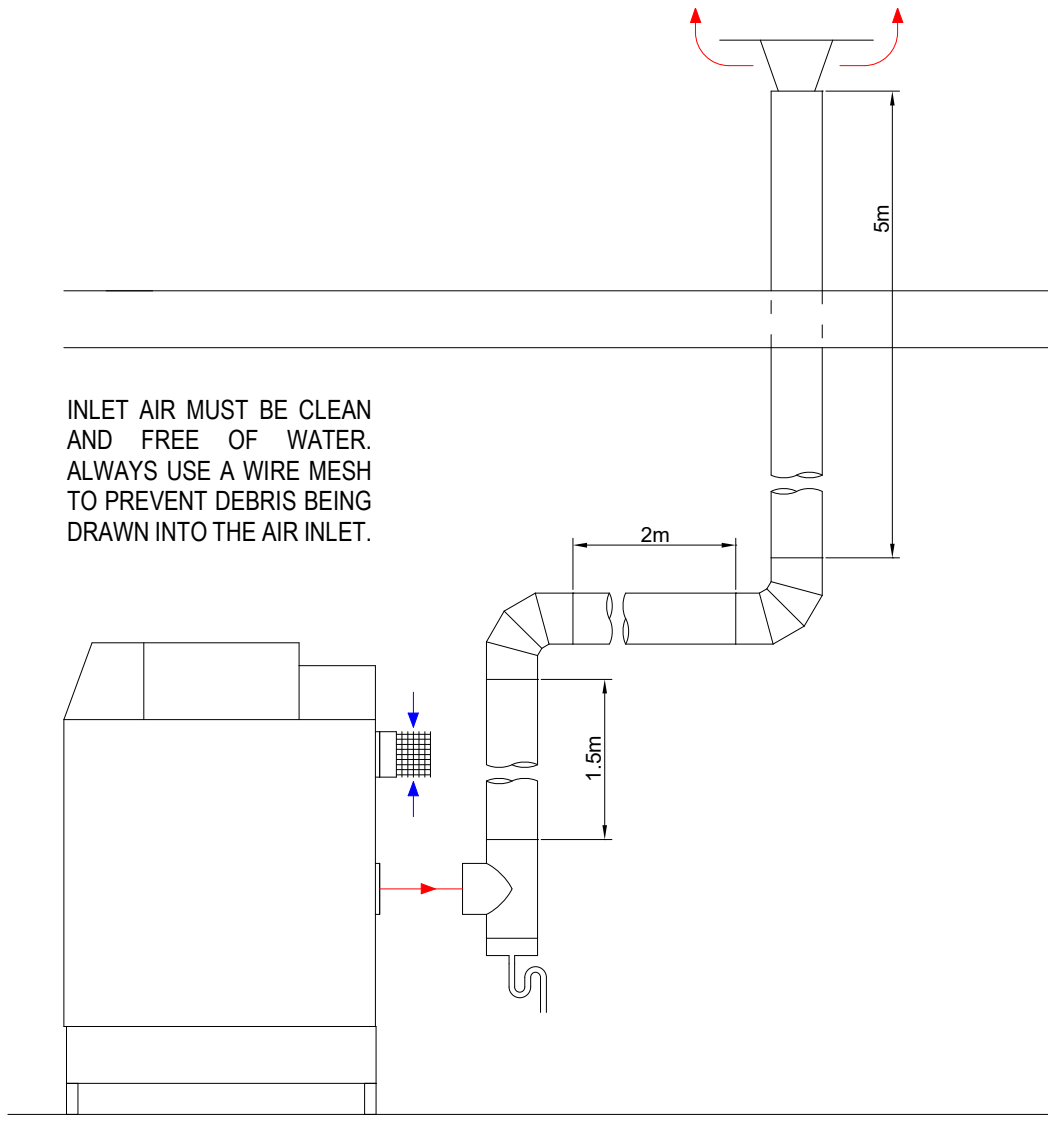
Remove existing 160-180mm increaser by pulling towards you, the increaser extends from the back of the water heater as shown and is not fixed into position but will require some manipulation to loosen before removal. Take 160mm air inlet screen and install as shown below.

Do not use any tool that could damage the water heater.



10.11.1 EXAMPLE B: SINGLE PIPE SYSTEM FOR FLUE GAS OUTLET ONLY

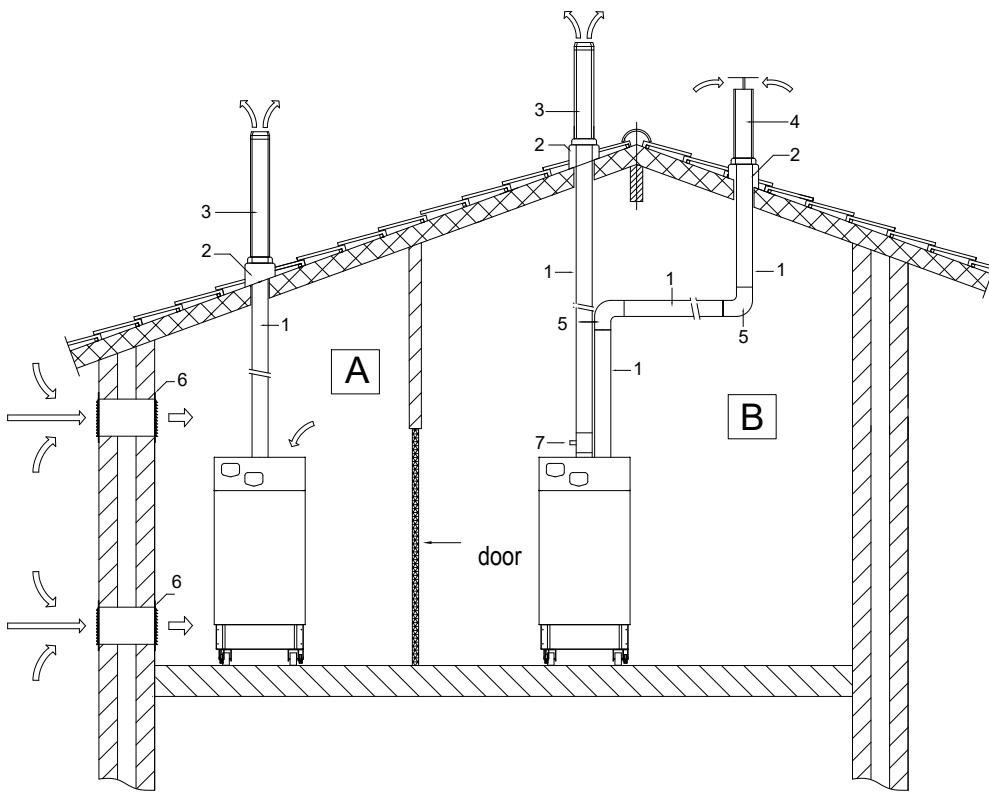
Calculation example:



Water heater type:		TTW410			
Flue gas	Diameter: 180 mm.		Number	Pa	Pa total
		Straight tube	m ¹ total	8,5	3,0	25,5
	T-piece	outlet	1	25,5	25,5
	Bend	90°	2	9,9	19,8
	Flue outlet	Zeta=1,0	1	28,3	28,3
Total resistance flue gas outlet:					99,1
Air supply	Diameter: 180 mm.		Number	Pa	Pa total
	Air inlet	Zeta=1,3	1	27,7	27,7
Total resistance air supply:					27,7
Total resistance flue gas outlet and air supply:					126,8 Pa

The total resistance is less than 200 Pa, so this is acceptable.

10.12 SEPARATE AIR SUPPLY AND FLUE TERMINAL FOR A PITCHED ROOF



- 1 connection tube
- 2 pitched roof adhesive flashing
- 3 flue gas roof terminal
- 4 air inlet roof duct
- 5 90° bend
- 6 ventilation grill

10.13 COMMON FLUE SYSTEMS

The Lochinvar TTW can be installed on to a common flue system if required. The common flue system should be sized to operate under a negative pressure of -0.03 to -0.10 mbar throughout the modulation range of the appliance.



If a positive pressure common flue system is to be used, a proprietary recirculation prevention device must be installed at the flue spigot of each water heater to prevent products of combustion from re-entering the plant room.

10.14 CONDENSATE DRAIN

If the length of the flue system exceeds 6 metres, an additional condensate drain should be fitted. The discharge pipework should include a suitable water trap to prevent products of combustion from entering the plant room or drainage system.

11.0 AIR SUPPLY

If combustion air is drawn from outside the building, the water heater will operate as a room-sealed (Type C) appliance. If combustion air is drawn in from the plant room the water heater will operate as a conventionally flued (Type B) appliance.

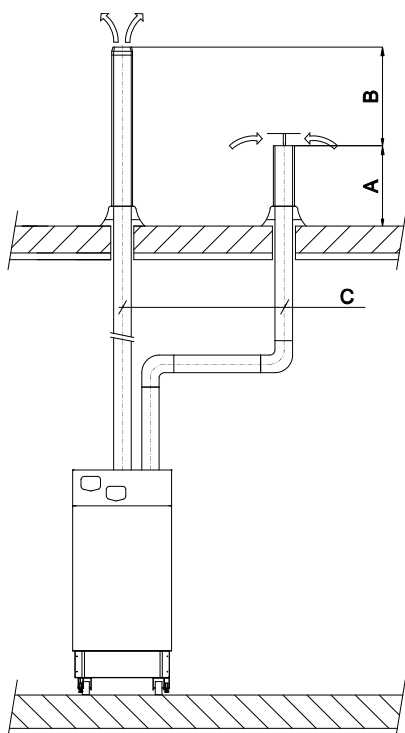
The following information is based on single water heater installations only. If more than one water heater is being used, **BS6644** should be consulted to calculate the necessary requirements.

11.1 AIR SUPPLY THROUGH HUMID AREAS

When the supply duct is installed in a water heater room with humid air (for example: greenhouses), a double wall supply duct or an insulated duct should be considered to prevent condensation on the outside of the duct. It is not possible to insulate the internal air pipes of the water heater. Make sure that no condensate can be formed on the internal air canals.

The air supply duct must be protected against rain, when it is installed on top of the roof.

11.2 PIPE HEIGHTS AND MUTUAL DISTANCES ON A FLAT ROOF.



Height A

This is the height of the air inlet that must have a cap to prevent rainwater entering the system.

When in- and outlet are mounted on a flat roof, the inlet should be at least 60 cm above the roof surface and at least 30 cm above the maximum snow level.

Example 1:

When the maximum snow level on the roof surface is 45 cm then height A should be $45 + 30 = 75$ cm. This is more than 60 cm so this height should be 75 cm.

Example 2:

When the maximum snow level on the roof surface is 15 cm then height A should be at least $15 + 30 = 45$ cm. This is less than 60 cm, so the height should be 60 cm.

Height difference B

This should be at least 70 cm: the flue gas outlet should be at least 70 cm higher than the air inlet and should be equipped with a conical outlet.

A single flue outlet on a flat roof should stick out at least 100 cm from the roof surface.

Distance C – mutual horizontal distance at roof level

This should be at least 70 cm.

11.3 COMBUSTION VENTILATION

Depending upon installation location, ventilation must comply with the requirements of BS6644 and/or IGEM UP10.



The tables below are for guidance only and should be cross-referenced with the latest editions of the documents shown above.

When used as a Type C appliance, ventilation for combustion is not necessary as the combustion air is ducted directly from outside. When used as a Type B appliance, the combustion air requirements are as follows:

Model	Input Gross kW	Input Nett kW	PLANT ROOM		ENCLOSURE	
			HIGH (CM ²)	LOW (CM ²)	HIGH (CM ²)	LOW (CM ²)
TTW410	444	400	800	1600	2000	4000
TTW580	611	550	1100	2200	2750	5500

TABLE 9.1 TYPE B COMBUSTION AND COOLING VENTILATION REQUIREMENTS TTW410 – TTW580

When used as a type B appliance, provision for cooling ventilation is included in the combustion ventilation allowance.

11.4 COOLING VENTILATION

When used as a type C appliance, cooling ventilation should be provided as follows:

Model	Input Gross kW	Input Nett kW	ENCLOSURE/COMPARTMENT (DIRECT TO OUTSIDE)		ENCLOSURE/COMPARTMENT (TO INTERNAL SPACE)	
			HIGH (CM ²)	LOW (CM ²)	HIGH (CM ²)	LOW (CM ²)
			TTW410	444	400	2000	2000	4000	4000
TTW580	611	550	2750	2750	5500	5500

TABLE 9.2 TYPE C COOLING VENTILATION REQUIREMENTS TTW410-TTW580



An enclosure is defined as a space in which an appliance(s) is installed which is not large enough to enter to perform work tasks other than maintenance via external access.

12.0 WATER CONNECTIONS

12.1 GENERAL

TTW water heaters require a minimum flow rate and must also be installed with separate storage vessels. Suitably sized pumps and separate storage vessels are available from Lochinvar Limited as ancillary options.



To preserve the warranty on the appliance Lochinvar Limited insists on the use of glanded pumps.

Recommended pipework layouts are available for different water heater and storage vessel combinations. Please refer to www.lochinvar.ltd.uk for details.

The requirements of minimum water flow are given in **Table 10.3**. Recommendations for the water circulation system are given in **BS6644** and **CP 342**. The following notes are of particular importance.

1. When the unit is being utilised as a direct-fired water heater it is designed for use with a direct type storage vessel. Contact Lochinvar Ltd for help in sizing the storage vessel
2. Circulating pipework not forming part of the useful heating surface should be insulated. Cisterns, expansion vessels and pipework situated in areas exposed to freezing conditions should also be insulated.
3. Drain valves must be located in accessible positions that will permit draining of the entire system including the unit and the storage vessel.
4. Tapping sizes for connection to the water system are detailed in **Table 2.1**.
5. Ideally, individual valves should be fitted to each unit to enable isolation from the system. The arrangement must comply with the requirements of **BS6644**.

12.2 UNVENTED SYSTEM ARRANGEMENT



It is strongly recommended that unvented hot water systems be installed by an approved installer.

If the Lochinvar TTW water heater is to be used in an unvented arrangement, the system should follow the guidance given in **BS6700** and must comply with **Building Regulations 1992: Part G3, in England and Wales, P5 in Northern Ireland and P3 in Scotland**. A kit of components that have been suitably sized for the unvented operation of the appliance is available from Lochinvar Limited. For further information, please see our unvented/boosted systems guide, available on our website.

The maximum working pressure of the water heater is 8.0 bar.

12.2.1 EXPANSION VESSEL SIZING

The following information is based on:

Working pressure of 3bar

Pressure relief valve setting of 6 bar

$$V V = \frac{S V}{e} * e$$

Expansion vessel efficiency =0.45

Where:

V V = Vessel Volume

S V = System Volume

e = Coefficient of Expansion (See **Table 10.1**)

FLOW TEMP. °C	35	40	45	50	55	60	65	70
e	0.006	0.008	0.010	0.012	0.015	0.017	0.020	0.023

12.2.2 COEFFICIENT OF EXPANSION OF WATER AT 3.5 BAR INLET PRESSURE

12.3 CIRCULATING PUMPS

In order to ensure the correct flow rates through the water heater, the unit requires a bronze glanded pump sized to overcome the resistance of the TTW water heater and any primary pipework loop. Lochinvar will supply a suitable bronze glanded shunt pump with every TTW water heater sized to overcome the resistance of the TTW water heater **plus an allowance for the pipework loop between the water heater and storage vessel:**



The installer must check that the supplied pump is suitable for use with the installation checking the total pipework resistance before installation of the pump. If in doubt, please contact Lochinvar Technical support before proceeding with any installation.

The specification of this type of pump ensures that the bronze body and associated parts in contact with water are suitable for use with potable water. A glanded construction is required to ensure that any scale or deposits within the system does not build up within the pump and cause a resistance that can lead to a loss of water flow. Glandless (canned rotor pumps) must not be used with TTW water heaters due to the fact scale can quickly build up on the rotor in hard water areas causing early and sudden failure not only of the pump but of the TTW water heater as well.

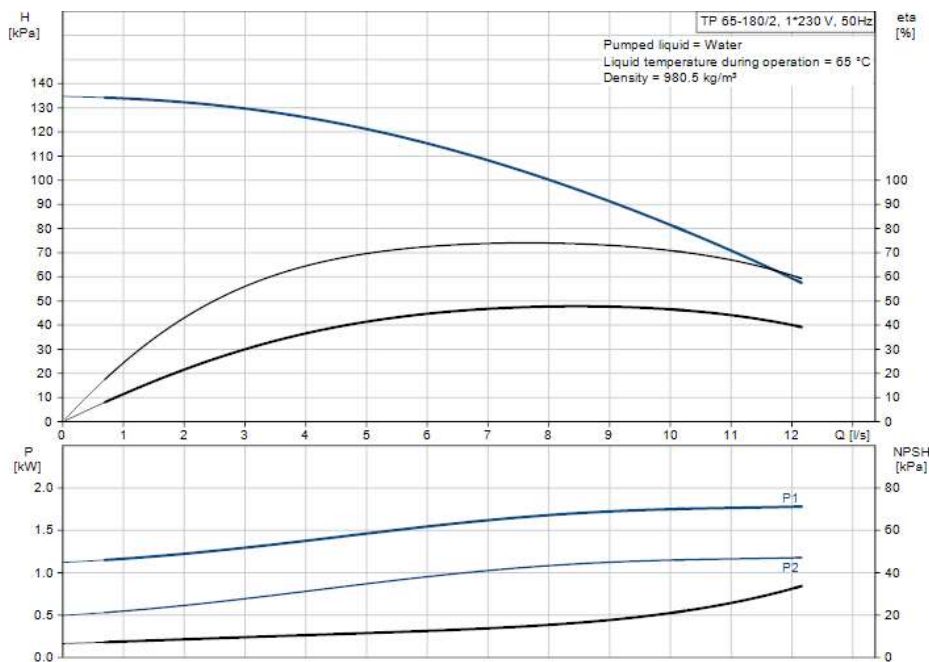


The use of glandless (canned rotor pumps) will invalidate the warranty of the TTW water heater

MATCHED PRIMARY CIRCULATION PUMP	PART NUMBER
Pump for model TTW410	LM900378A
Pump for model TTW580	LM900378A

12.4 PRIMARY PIPEWORK LOOP SIZING

		TTW410	TTW580
Minimum Water Flow	L/sec	5.61	7.48
Pressure Loss – Heat Exchanger	kPa	52	52
Pressure Loss – Internal Piping	kPa	0.78	0.78
Pressure Loss – Water Flow Switch	kPa	9.8	9.8
Pressure Loss – Total (Appliance)	kPa	63.5	63.5



12.4.1 PRESSURE DROP CHART FOR STANDARD PUMP LM900378A



The pipework header between the TTW water heater(s) and LST(s) buffer vessels must be sized as per the guidance given in this section. Failure to use the correct pipework header size will cause operational problems and potential early failure of the water heater: this will not be covered under the water heater warranty.
If the installation is outside the scope of this guidance, please contact Lochinvar Technical support before proceeding with the installation.

12.4.2 CIRCULATION REQUIREMENTS

Using the example schematics shown in section 12.4.3 and assuming the TTW water heaters are TTW410 in both cases the primary pipework header would be sized as:

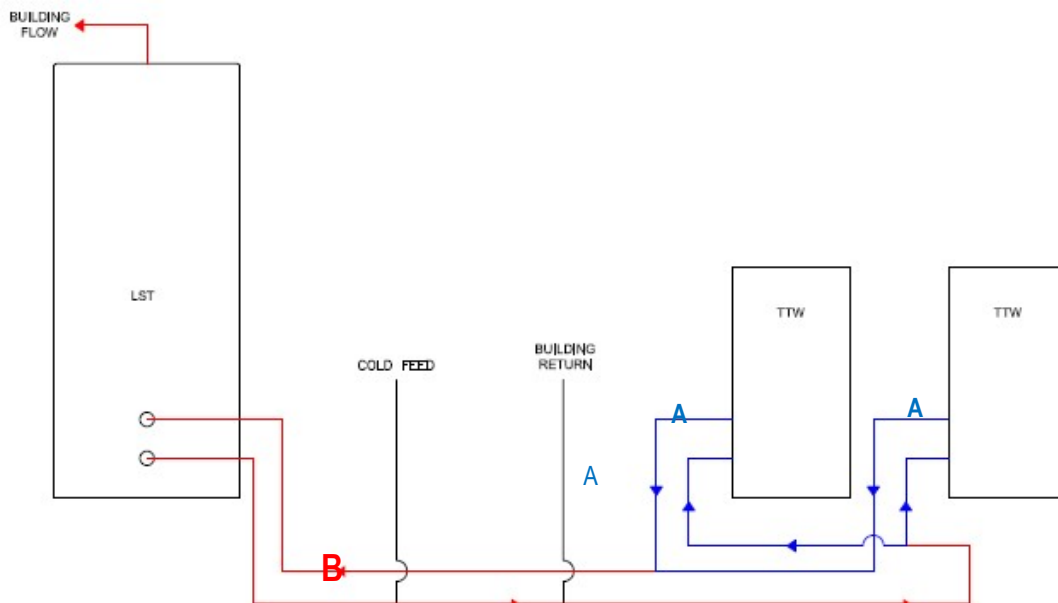
Single unit = as there is only one TTW water heater there is no common header so all pipework should be sized as per A blue at 76mm

Two units = the common header shown in red should be sized according to the table B-red at 108mm with the pipework between each water heater and the header sized as per A-blue at 76mm.

Model	Quantity	A-Blue	B-Red
TTW410	1	76mm	76mm
TTW410	2	76mm	108mm
TTW410	3	76mm	108mm
TTW410	4	76mm	*
TTW580	1	76mm	76mm
TTW580	2	76mm	108mm
TTW580	3	76mm	*
TTW580	4	76mm	*

* n/a contact Lochinvar Technical support for assistance

12.4.3 PIPEWORK HEADER SIZES FOR COMMON INSTALLATIONS



12.4.4 PIPEWORK SCHEMATICS



For applications outside the parameters shown, please contact Lochinvar for further guidance before proceeding with any installation.

12.5 PRESSURE RELIEF VALVE

The Lochinvar TTW has no internal pressure relief valve. A pressure relief valve must be fitted in between the water heater and any isolation valve. When multiple water heaters are installed, each water heater must have its own pressure relief valve. It is recommended that the pressure relief valve is fitted in the T-piece supplied with the water heater.

The lift pressure and size of the relief valve should be in accordance with **BS6644**

12.6 ANTI-GRAVITY LOOP

If the water heater is positioned at the highest point of the installation, the flow and return pipework must rise 500mm above the top of the heat exchanger; this will ensure water remains within the heat exchanger in the event of water loss within the system. This will not be required if the DHW buffer vessel is fitted alongside the water heater and is taller than an automatic air vent should be installed in the top of the anti-gravity loop to ensure all airlocks in the system can be cleared.

12.7 AUTOMATIC AIR VENT

There is an automatic air vent mounted on the water heater to remove air from the water circuit. This automatic air vent is only for releasing air trapped in the heat exchanger of the water heater. One or more external automatic air vent(s) and air separators should be mounted in the heating system to bleed air trapped in the heating circuit.

12.8 FROST PROTECTION

The Lochinvar TTW has a built-in frost protection, automatically activating the primary pump when the water heater return water temperature drops below 5°C. When the water heater water temperature drops to 3°C, the burner is also ignited. The pump and/or burner will shut down as soon as the return temperature has reached 10°C. The above-mentioned temperatures relate to the temperature measured with the inlet sensor of the water heater.



This Frost Protection provision is for the water heater only and does not protect the whole system.

12.9 SYSTEM FLUSHING

The whole installation should always be thoroughly flushed before installing the water heater to remove any debris that may have accumulated.

13.0 CONTROL OPTIONS/INSTALLATION

13.1 VESSEL TEMPERATURE SENSOR SINGLE WATER HEATER INSTALLATION

TTW requires a flow temperature sensor that needs to be fitted between the cold feed/building return and the storage vessel, this should be located as close as possible to the storage vessel on the return pipework to the water heater(s) – see below drawings. This sensor is an ancillary item and should be ordered at the same time as the water heater. If cascading the water heaters then only a single sensor is required, this sensor connects back to the lead water heater. If not cascading the water heaters then each water heater will require a sensor – see section 14.0 Schematics.

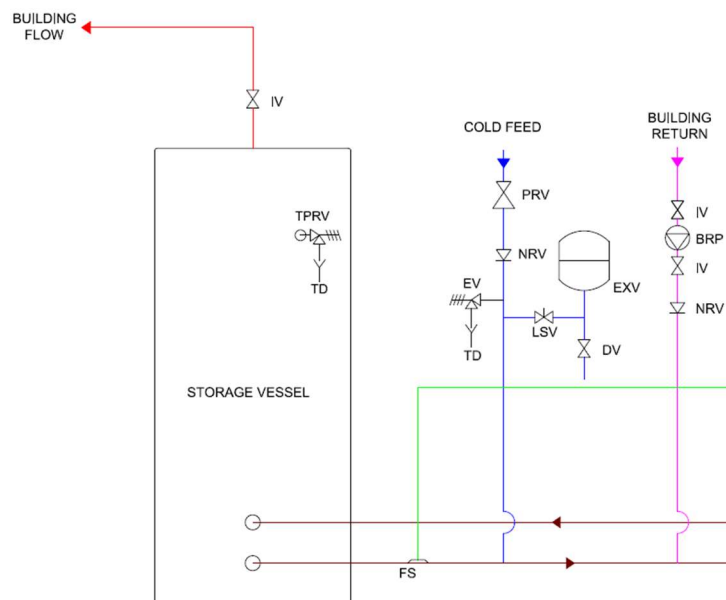
The part number for the sensor is **LE04016304**



Flow Temperature Sensor



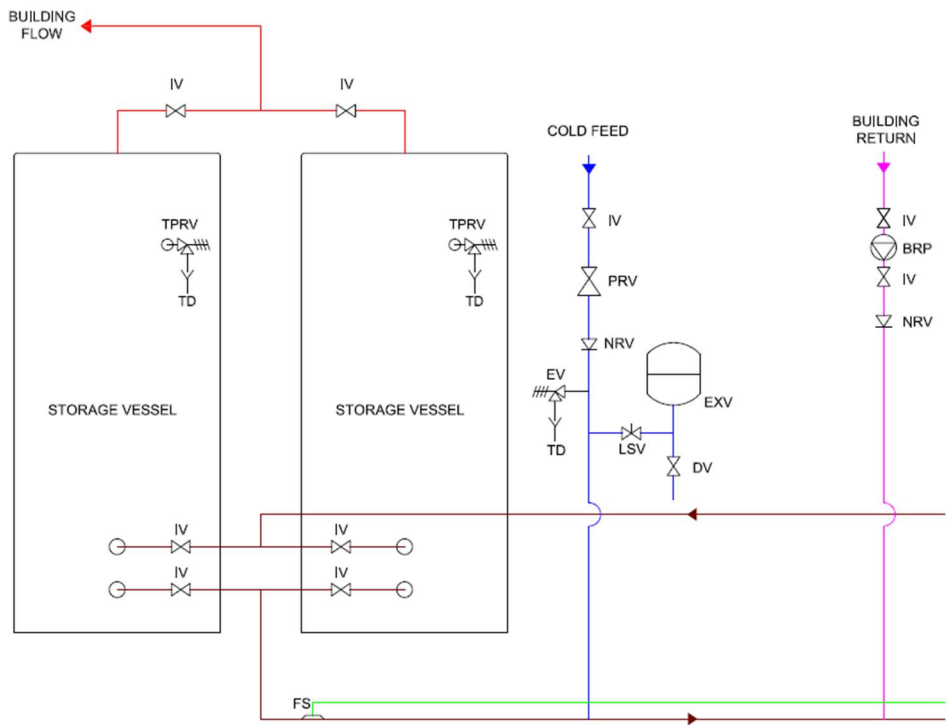
Flow Temperature Sensor on pipework



13.1 LOCATION OF FLOW TEMPERATURE SENSOR (FS) ON A SINGLE VESSEL INSTALLATION



On systems with multiple storage vessels it is recommend that the water heaters only read the temperature of a single vessel, the vessels should be balanced so they are all the same temperature.



13.2 LOCATION OF FLOW TEMPERATURE SENSOR (FS) ON A MULTIPLE VESSEL INSTALLATION

13.3 SENSOR WIRING

For guidance on installing the wiring for the temperature sensor, please refer to section 15.0

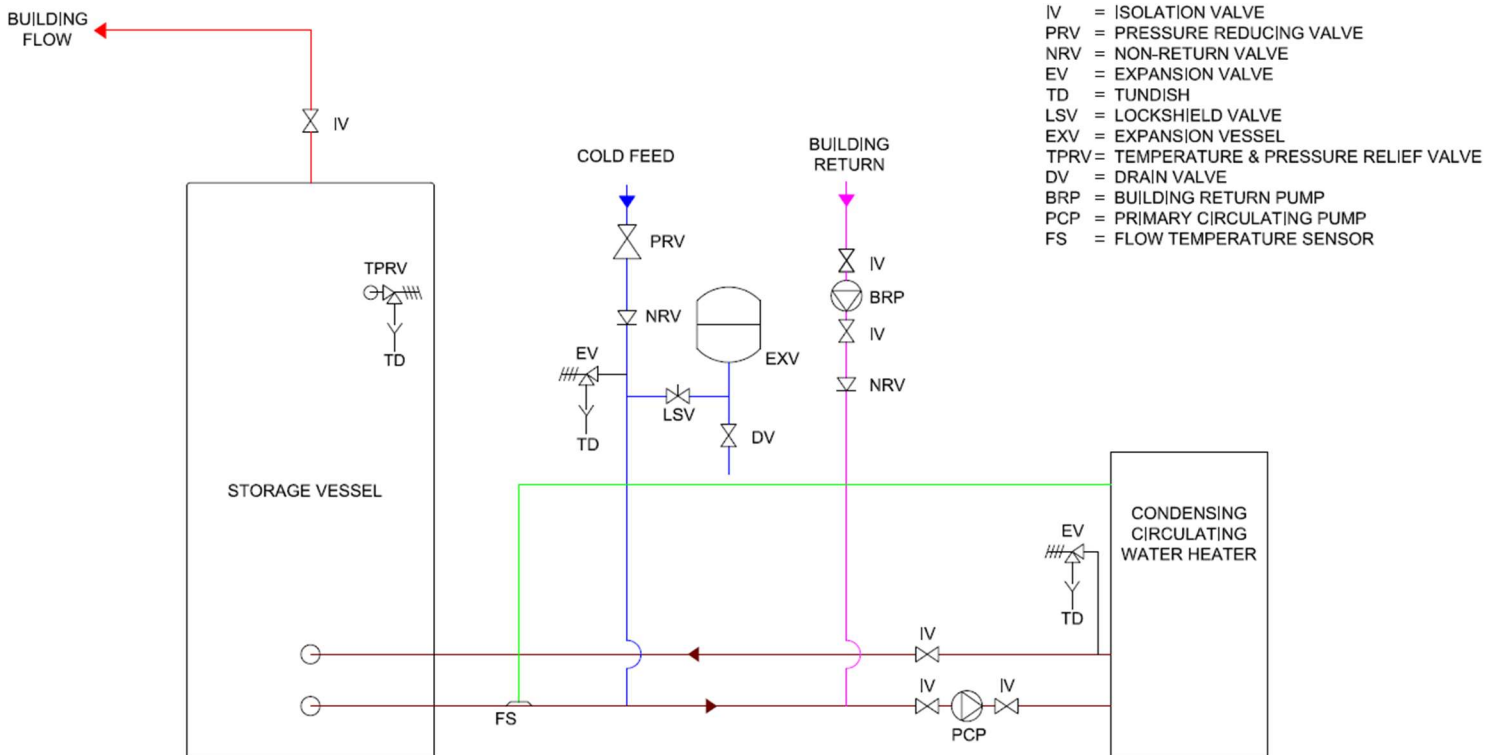
14.0 SCHEMATICS



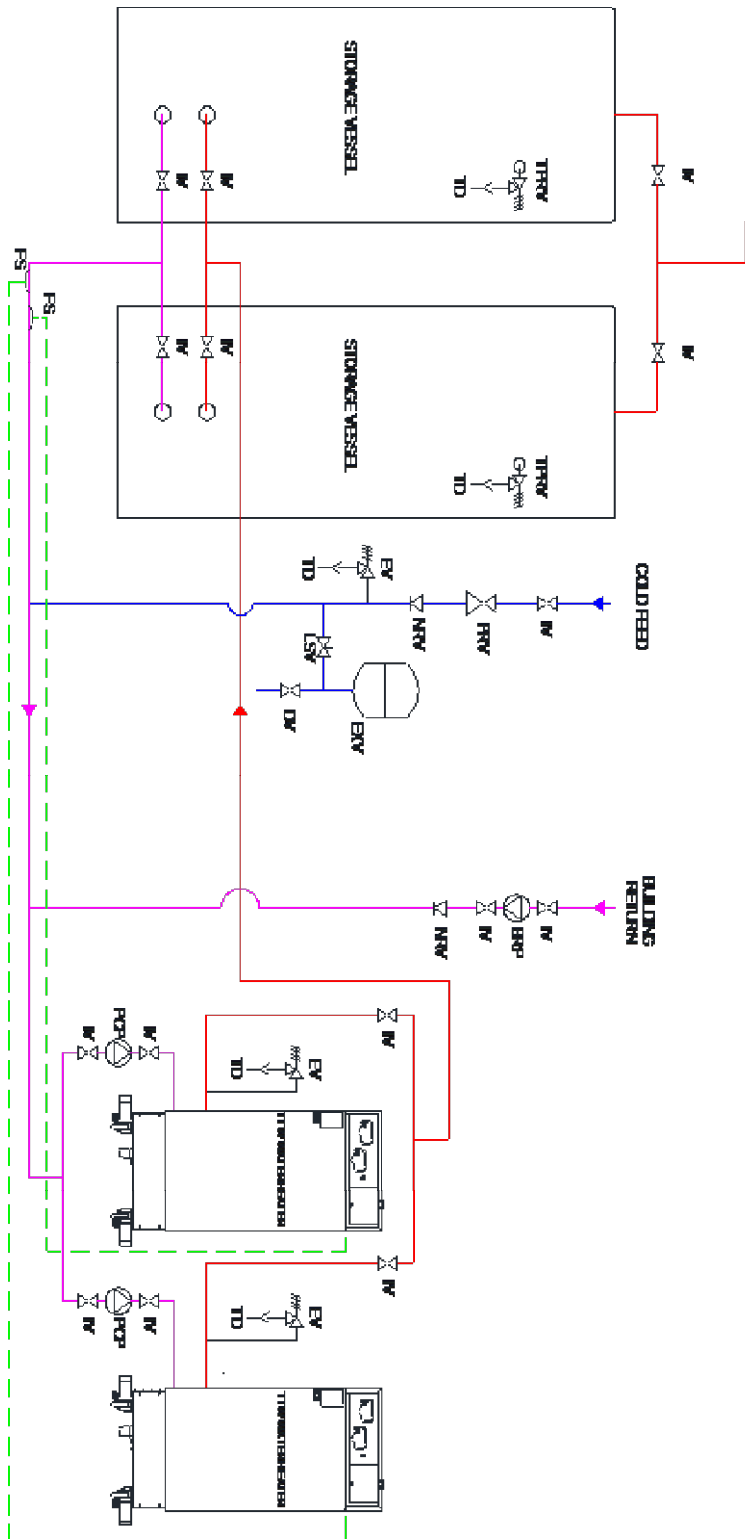
Lochinvar limited may provide technical advice and guidance to assist with best practice, optimisation and installation of Lochinvar products; however, we will not be liable for any duties as designers under construction (design and management regulations 2015). In all cases where information is provided, the customer must assess and manage risks associated with the technical information and advice provided.



When installing multiple units we would recommend cascading the water heaters, this will then mean only a single flow temperature sensor is required connected back to the lead water heater. If not cascading the water heaters then each water heater will require its own flow temperature sensor see xxx for further information.

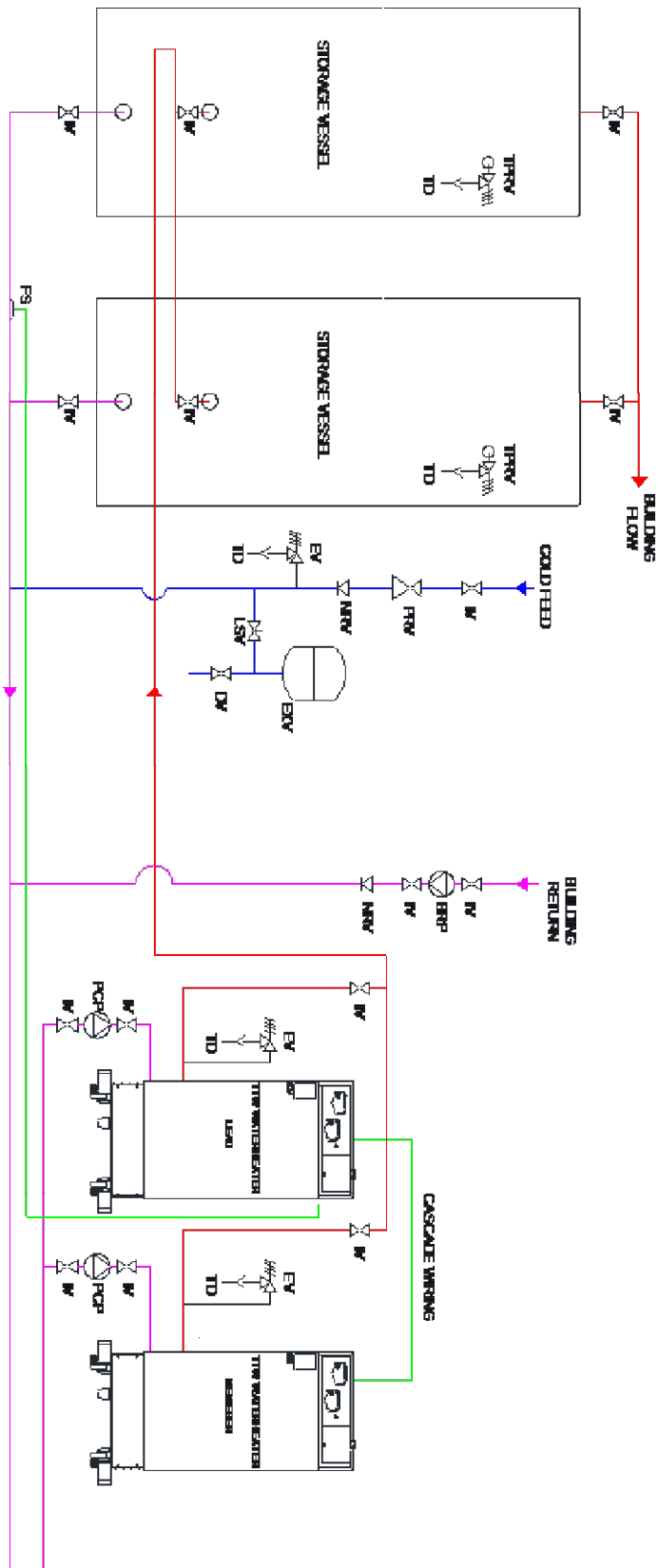


14.1 SINGLE WATER HEATER WITH SINGLE STORAGE VESSEL INSTALLATION



This configuration may only be used when there is no cascade control on the water heaters. Either internal or via BMS, if cascade control is required use the schematic shown on the next page.

14.2 MULTIPLE WATER HEATERS WITH MULTIPLE STORAGE VESSELS NOT IN CASCADE



14.3 MULTIPLE WATER HEATERS WITH MULTIPLE STORAGE VESSELS IN CASCADE

15.0 ELECTRICAL INSTALLATION

Wiring external to the equipment must be installed in accordance with the I.E.E. Regulations and any local regulations that apply.

MODEL	NORMAL SUPPLY VOLTAGE	EXTERNAL FUSE RATING	POWER CONSUMPTION
TTW410	230V AC/50 Hz 1 PH	6.0 A	752 W
TTW580			829 W

15.1.1 ELECTRICAL SUPPLY REQUIREMENTS



Warning: this appliance must be earthed



A suitably competent person MUST check wiring. Normal supply required is 230 volts AC, single phase, 50 Hz. An isolator with a contact separation of at least 3mm in all poles should be sited close to the equipment and must only serve that equipment. The double pole switch must be readily accessible under all conditions.

15.2 EXTERNAL CONTROLS

The TTW water heater control includes the following functions:

- Cascade control for up to 6 TTW water heaters.
- 0-10 VDC analogue input from a BMS.
- Pump control for the primary circulation pump.
- Open-Therm communication for advanced temperature controllers.

The TTW water heater has connections for:

- Remote fault indication from each burner
- Remote “burner-on” indication from each burner.
- Calorifier temperature sensor.

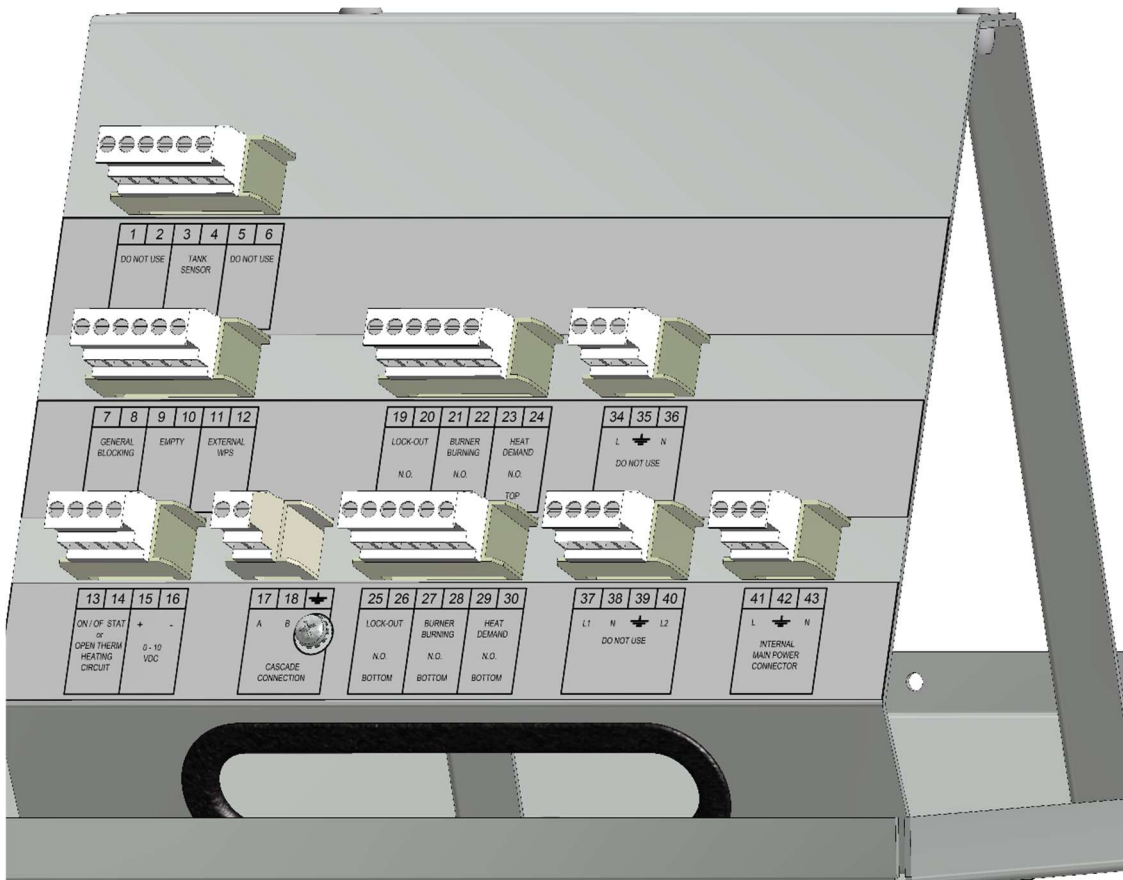
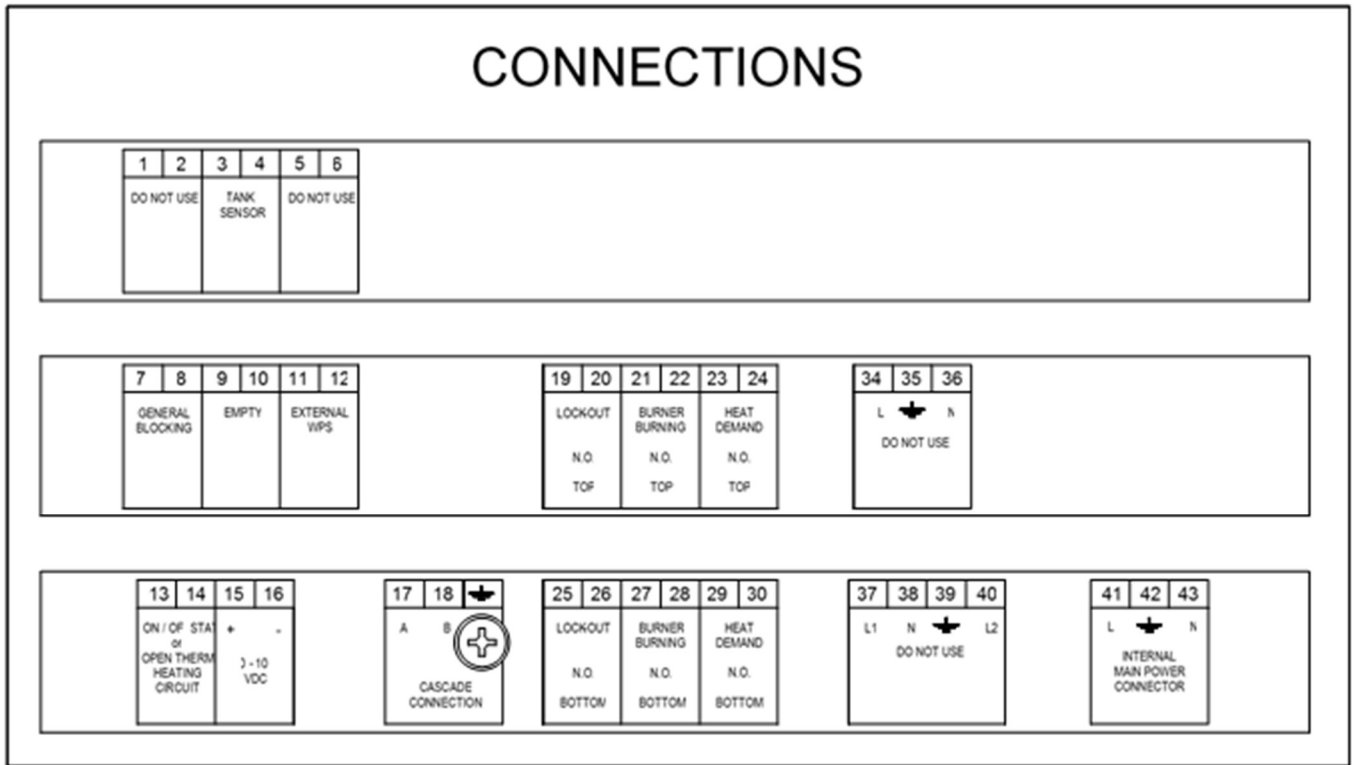
15.3 WIRING CONNECTIONS

15.3.1 ACCESSING WIRING CONNECTIONS

The connections are placed on top of the display panel. To access the wiring connections, the top-front control panel cover retaining screws (located either side of the control panel) should be removed. The cover can then be lifted forward and away from the appliance. The top-rear control panel cover can then be removed and the wiring terminals accessed.

15.3.2 WIRING CONNECTIONS

The following components can be connected to the water heater; see the figure below.
 For voltages from 110V to 250V use the left conduit and for low voltage use the right conduit.



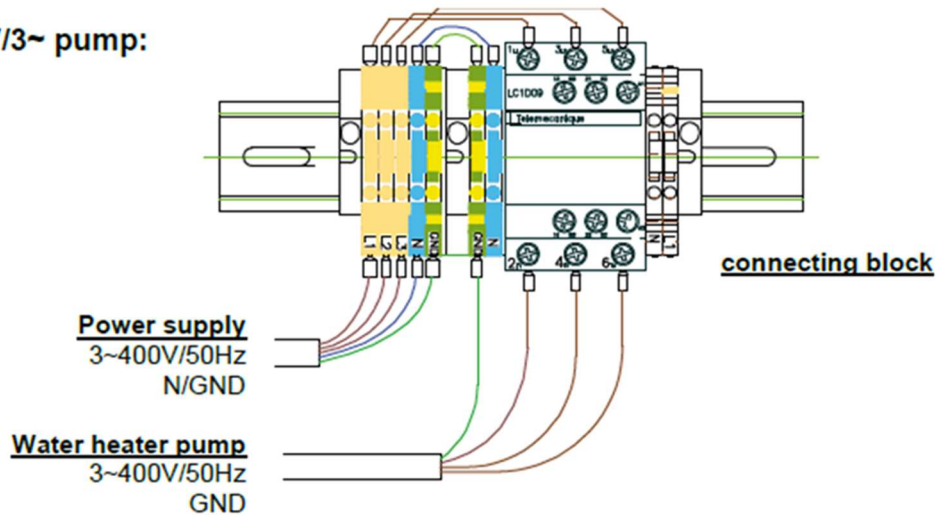
15.3.3 WIRING TERMINALS VIEW

TERMINAL NUMBER	LABEL	DESCRIPTION
1-2	DO NOT USE	Do not connect any cables to these connections
3-4	TANK SENSOR	Connect the tank sensor to this connection. This external flow sensor measures the flow temperature at the system side. The sensor must be mounted on the supply pipe at the system side, close to the tank. NOTICE: The sensor must be used when several water heaters are cascaded with the internal cascade manager.
5-6	DO NOT USE	Do not connect any cables to these connections
7-8	GENERAL BLOCKING	This connection is used for the flow switch, a standard part for the TTW
9-10	EMPTY	N/A
11-12	EXTERNAL FLOW WATER PRESSURE SWITCH	A water pressure sensor is mounted in the water heater.
13-14	ON/OFF STAT, OPEN THERM HEATING CIRCUIT	This connection has the following options: <ul style="list-style-type: none"> If 24 hour operation is required, a link wire should be fitted to terminals 13-14. The water heater will use the set/programmed flow temperature for the heating circuit when these terminals are linked. If an on/off thermostat and/or time programmer is to be used, they should be linked in series to these terminals. When there is a closed circuit, the water heater will use the set/programmed flow temperature for the heating circuit. An OpenTherm communication bus can be used to connect to an advanced time and temperature controller such as the Lochinvar RC Controller or EBC Controller. The controller will then communicate with the water heater and determine the optimum flow temperature to achieve the desired room temperature. When an external temperature sensor is connected, the water heater communicates the recorded temperature to the controller and the compensation curve is adjusted automatically.
15-16	0 – 10 VDC	The water heater can be driven by an external control through a 0 to 10 VDC control signal. A voltage of less than 1.4V gives no heat demand, 1.48 V or more gives minimum set point and 10V gives maximum set point. NOTE: This connection is polarity sensitive therefore the 0 – 10V line must be connected to terminal 15 and the 0V line to terminal 16. A link wire must not be connected to terminals 57 & 58 when 0 – 10V control is used.
17-18	CASCADE CONNECTION	The Lochinvar TTW water heater has a built in cascade management system. When two or more water heaters are connected in a cascade, each water heater of the cascade has to be connected to the next water heater using terminals 61 & 62. This connection is polarity sensitive (all terminals 61's to be linked and all terminal 62's to be linked) and should be made using screened cable. One water heater has to be appointed as a Master, while the other water heater(s) are the Slaves. All external controls such as Calorifier sensor, external temperature sensor, system pumps etc. are to be connected to the Master water heater. For a cascade to work correctly, it is essential that an external flow temperature sensor is used. In order for the cascade to work correctly, each connected water heater needs to be programmed with a different address using a computer interface. For further details, please contact Lochinvar Limited.
19-20	LOCK OUT TOP	This contact is N.O. (normally open max. 230 Vac, 0.8 A). When the unit is in lock-out this contact will close. This contact can also be used for the switching of a pump with a separate control input connection.
21-22	BURNER RUNNING TOP	This contact is N.O. (normally open max. 230 Vac 0.8 A). When the unit starts the burner and detects the flame, this contact will be closed. This contact can also be used to control an external (extra) water heater. This contact can also be used for the switching of a pump with a separate control input connection.
23-24	BURNER DEMAND TOP	This contact is N.O. (normally open max. 230 Vac 0.8 A). When the unit receives any heat demand this contact will close. This contact can also be used for the switching of a pump with a separate control input connection.
25-26	LOCK OUT BOTTOM	This contact is N.O. (normally open max. 230 Vac, 0.8 A). When the unit is in lock-out this contact will close.
27-28	BURNER RUNNING BOTTOM	This contact is N.O. (normally open max. 230 Vac 0.8 A). When the unit starts the burner and detects the flame, this contact will be closed. This contact can also be used to control an external (extra) water heater.
29-30	BURNER DEMAND BOTTOM	This contact is N.O. (normally open max. 230 Vac 0.8 A). When the unit receives any heat demand this contact will close.
29-30	BURNER DEMAND BOTTOM	This contact is N.O. (normally open max. 230 Vac 0.8 A). When the unit receives any heat demand this contact will close.
34-35-36	DO NOT USE	Do not connect any cables to these connections
37-38-39-40	DO NOT USE	Do not connect any cables to these connections
41-42-43	POWER SUPPLY 230VAC	This connection is pre-wired and should not be altered. Where a 3-phase supply is used, the water heater must have a 16 A fuse per phase. See Section 11.2.3: MAINS SUPPLY CONNECTION – THREE PHASE SUPPLY or Section 11.2.4: MAINS SUPPLY CONNECTION – SINGLE PHASE SUPPLY for details on the incoming supply connection.

15.3.4 WIRING TERMINALS DESCRIPTION

15.4 MAINS SUPPLY CONNECTION – THREE-PHASE SUPPLY.

Connecting a 400V/3~ pump:



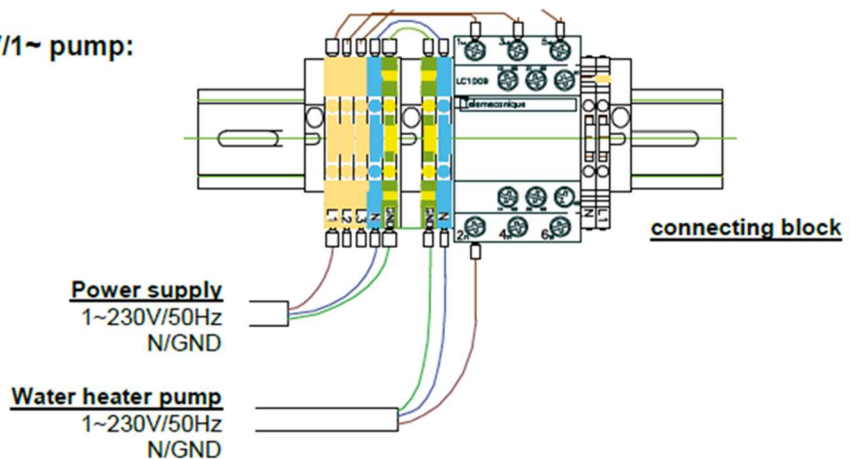
15.4.1 3-PHASE ELECTRICAL SUPPLY CONNECTION

When using a 3-Phase circulating pump, a 400 VAC/50 Hz/3 Ph/N/GND power supply should be connected to the rail-mounted terminal blocks located to the rear of the wiring connection panel via a suitable isolator. The 230 VAC power supplies to the control panel are already connected and should not be altered.

The 400 VAC/50 Hz/3 Ph pump should be connected to the relay adjacent to the terminal blocks. An overload protection device should be installed in accordance with **BS7671**.

15.5 MAINS SUPPLY CONNECTION – SINGLE PHASE SUPPLY

Connecting a 230V/1~ pump:

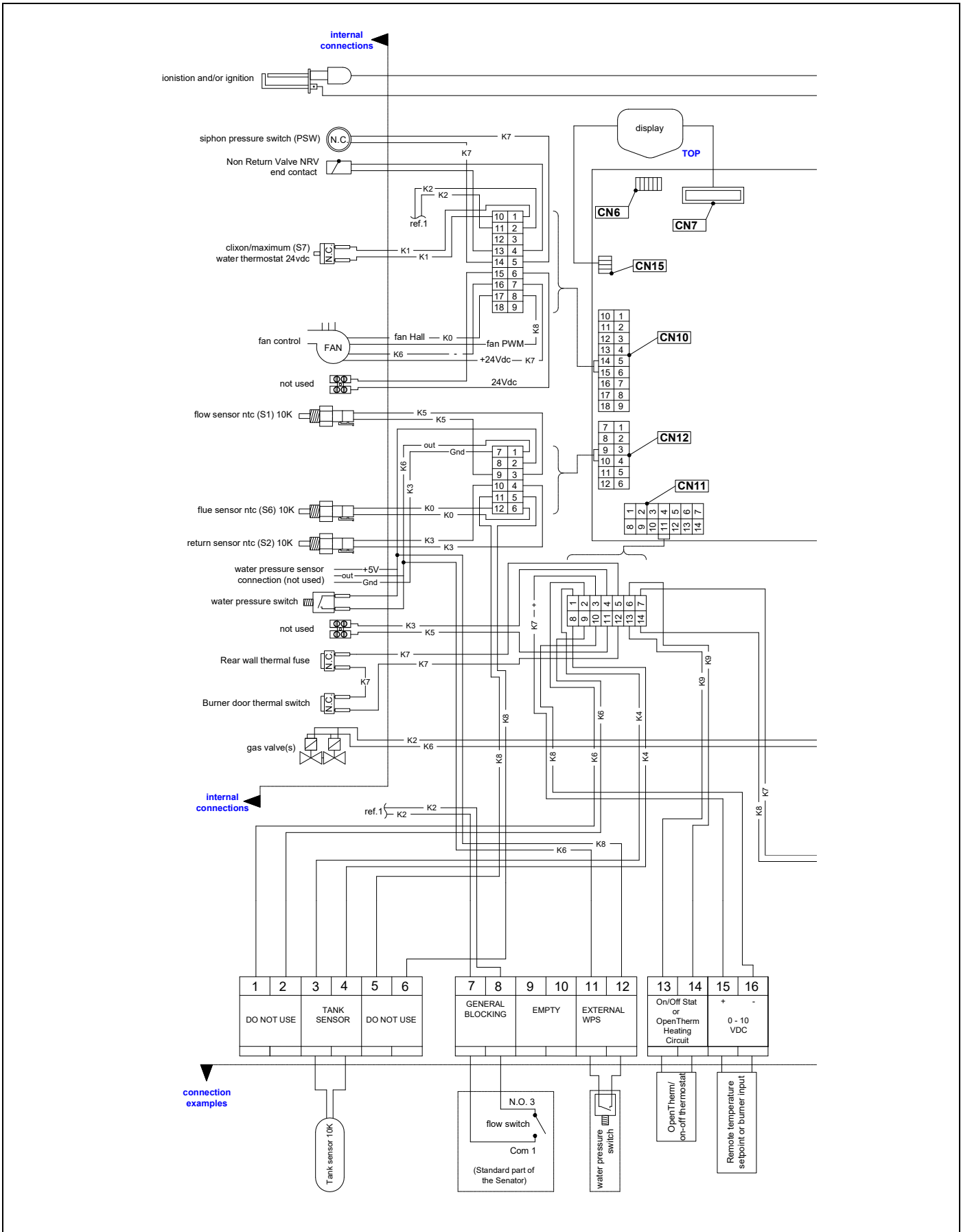


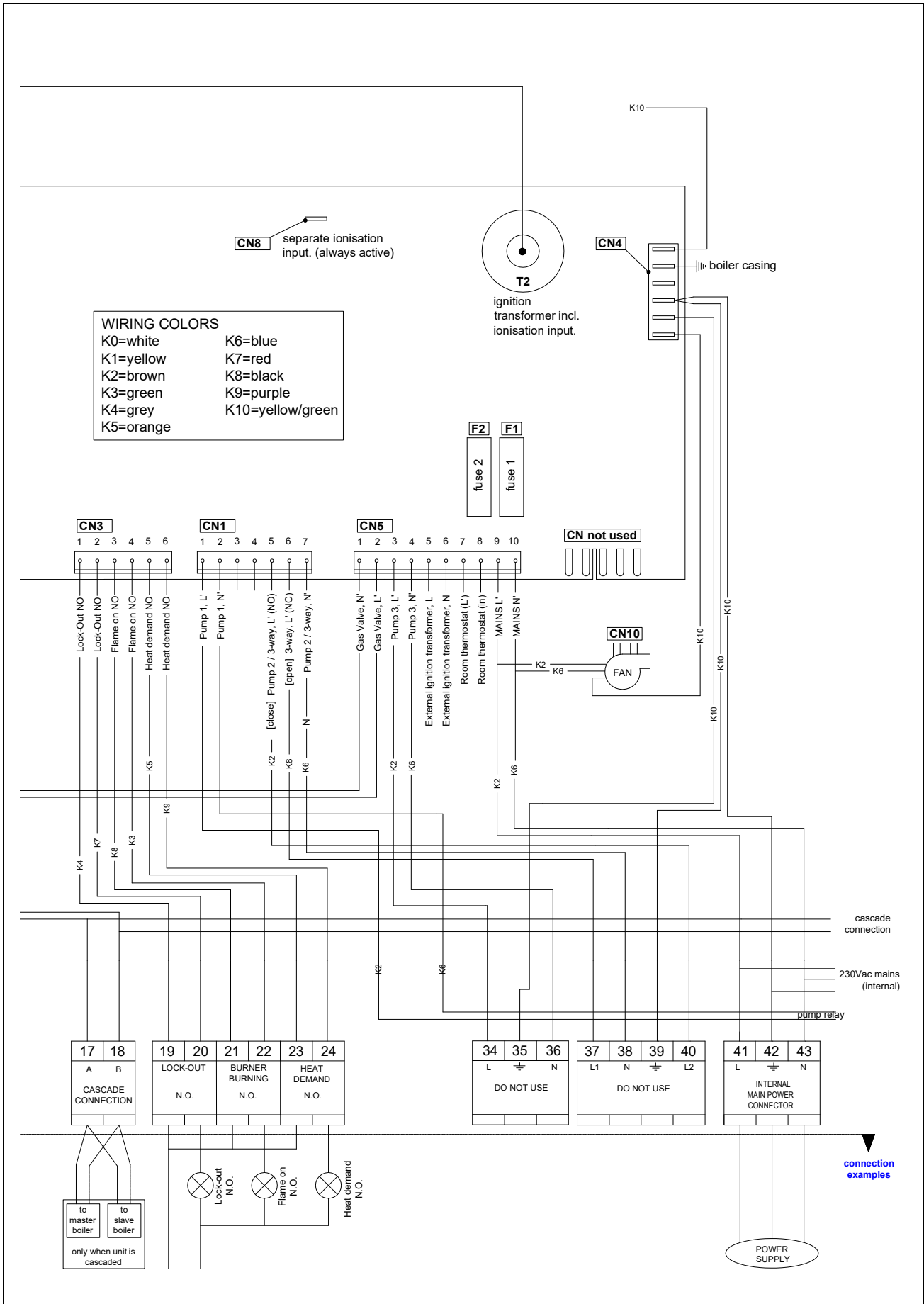
15.5.1 SINGLE PHASE ELECTRICAL SUPPLY CONNECTION

When using a 1-Phase circulating pump, a 230 VAC/50 Hz/1 Ph/N/GND power supply should be connected to the rail-mounted terminal blocks located to the rear of the wiring connection panel via a suitable isolator. The 230 VAC power supplies to the control panel are already connected and should not be altered.

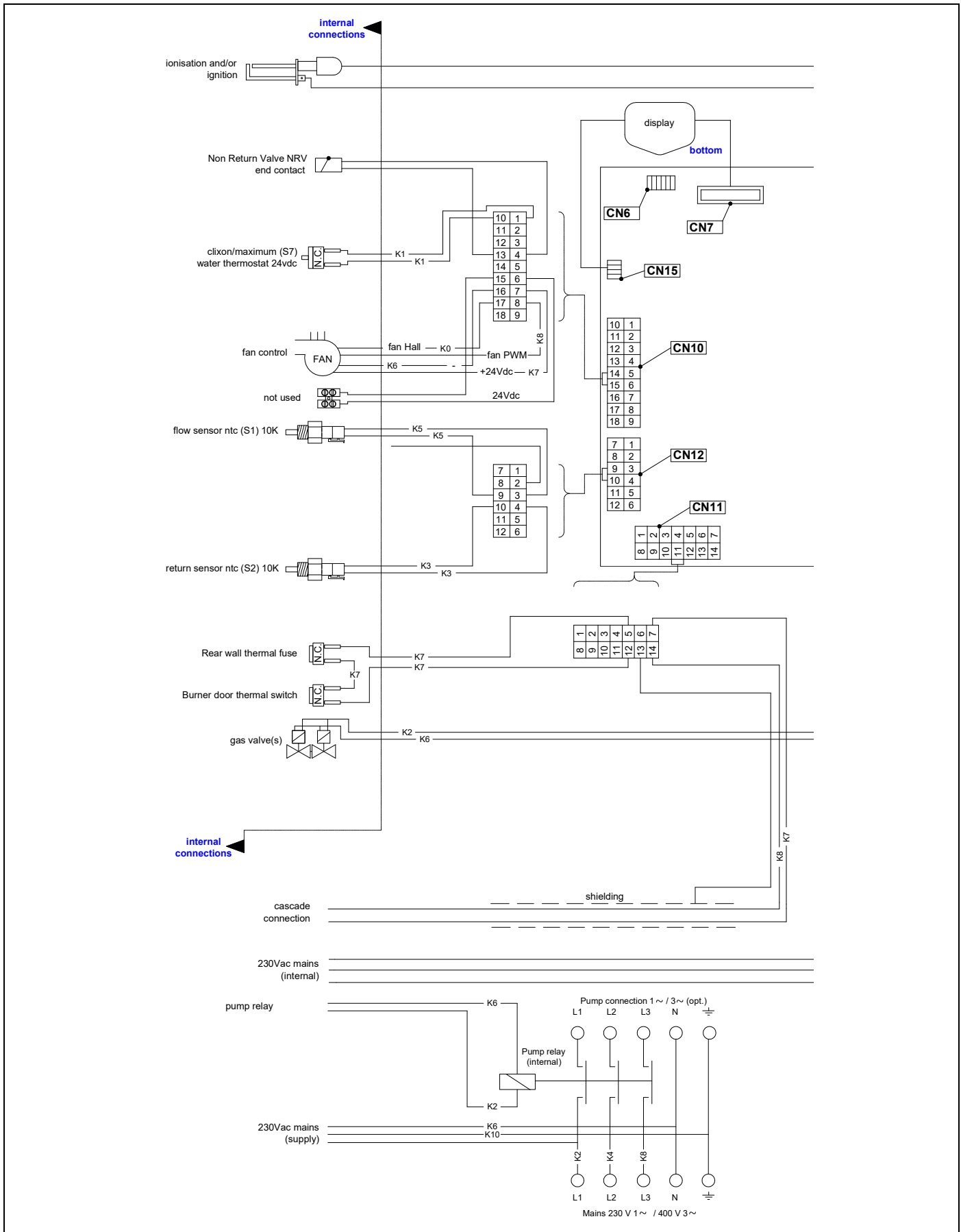
The 230 VAC/50 Hz/1 Ph pump should be connected to the relay adjacent to the terminal blocks. An overload protection device should be installed in accordance with **BS7671**.

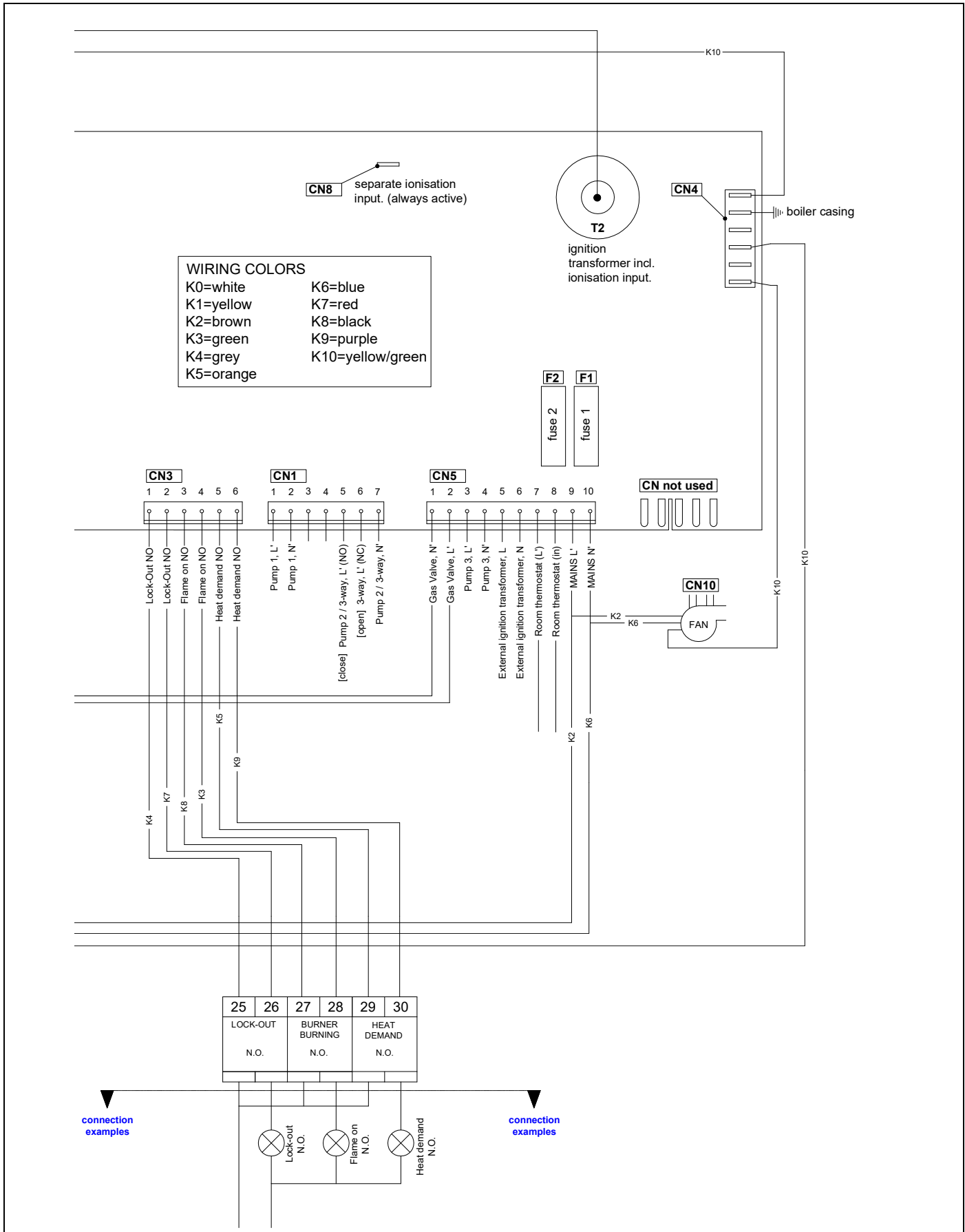
15.6 WIRING DIAGRAMS





15.6.1 UPPER BURNER CONTROL (PCB A, LEFT)





15.6.2 LOWER BURNER CONTROL (PCB B, RIGHT)

15.7 FUSES

On each PCB are 2 fuses, four fuses in total

FUSE NO.	APPLICATION	FUSED VALUE	FUSE TYPE
F1	Pump1 Pump2 / TWV	250VAC5ATH	5 AT ceramic filled fuse
F2	Switch mode supply, Gas valve Pump3, External Ignition	250VAC5ATH	5 AT ceramic filled fuse

15.7.1 FUSES

15.8 SENSORS

The following temperature sensors have been fitted in the Lochinvar TTW. Sensors S1 and S2 are located on the rear right-hand side of the heat exchanger with one of each connected to each burner control.

S1	=	Flow temperature sensor (orange wire)
S2	=	Return temperature sensor (green wire)
S3	=	External flow temperature sensor
S6	=	Flue sensor (white wire)

(S3') = if terminals S3 are not connected, the average value of S1 top and S1 bottom is taken and this value will be displayed.

The sensors used in the Lochinvar TTW are NTC (Negative Temperature Control) type and should have the following values:

SENSOR 1, 2, 3, 6	
TEMPERATURE [°C]	RESISTANCE [OHM]
0	32555
5	25339
10	19873
15	15699
20	12488
25	10000
30	8059
35	6535
40	5330
45	4372
50	3605
55	2989
60	2490
65	2084
70	1753
75	1481
80	1256
85	1070
90	915
95	786

15.8.1 SENSOR VALUES

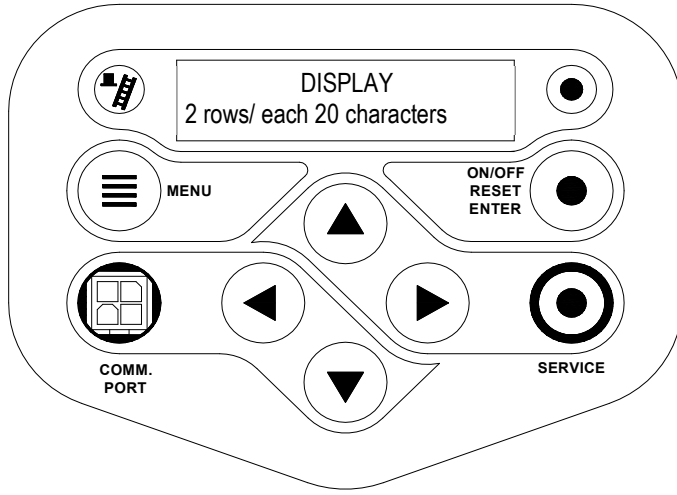
16.0 CONTROL SYSTEM




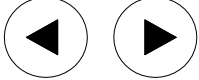
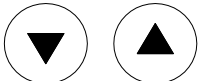



16.1 CONTROL PANEL

Two control panels have been placed on top of each other.

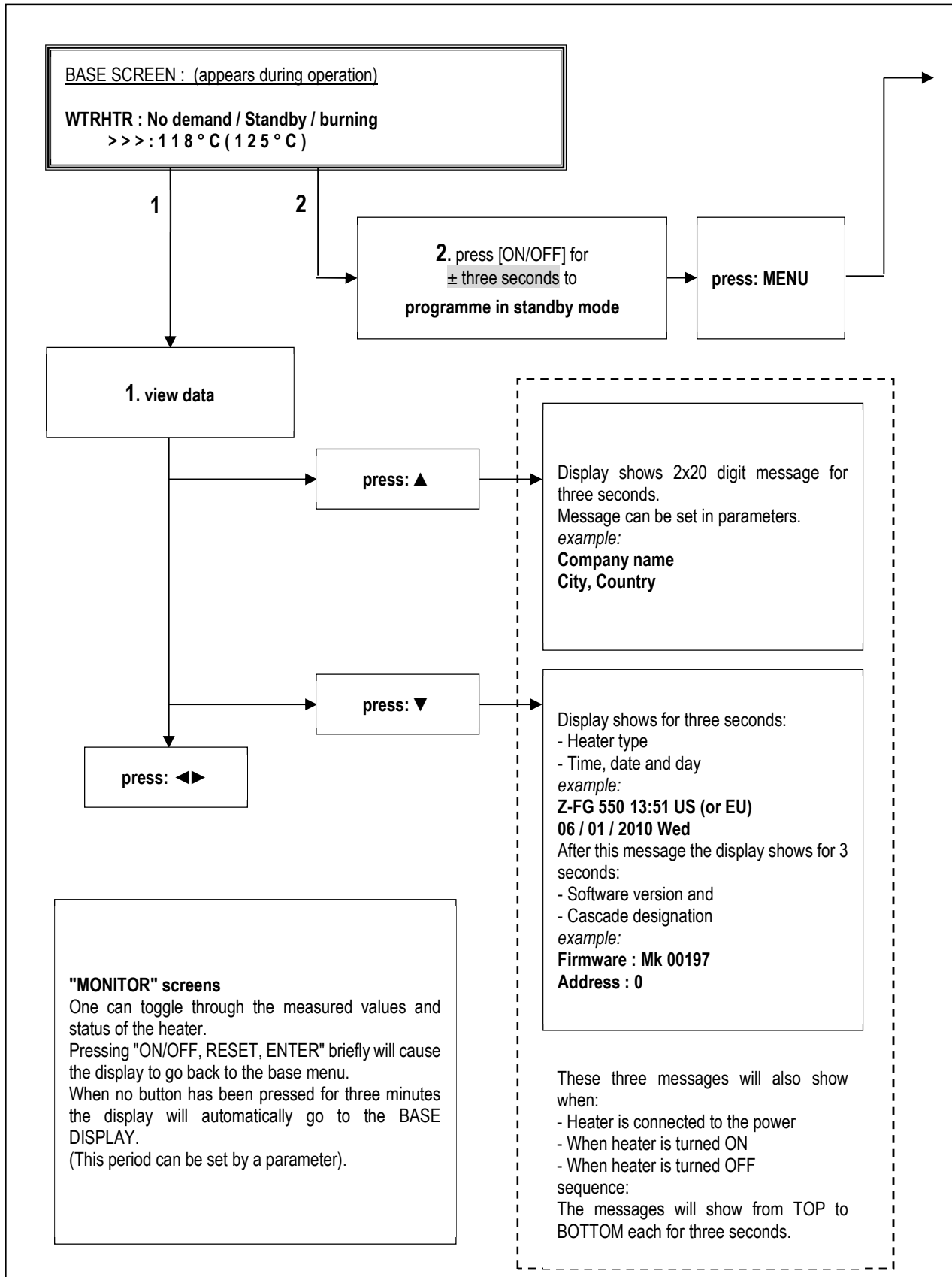
The top panel controls the burner at the top of the heat exchanger and is the “master”. This panel controls the complete water heater. Only when a lock out / error of the top burner has occurred, the water heater can be controlled by the bottom panel of the water heater (automatically).

CONTROL PANEL



	Press and hold for three seconds for stand-by/program. mode Press and hold for six seconds to switch boiler on/off. Used as RESET and ENTER button when programming.
	Connector for connecting computer cable.
	Button is pushed to open MENU.
	Buttons to toggle through measured temperatures. Also used for navigating through the menus and for changing values.
	
	Button to activate service function (hold for three seconds).
	Schornsteinfeger function (only for Germany).
	Light: lights when controller detects good flame signal. Lights when burner is burning.

16.2 CONTROL PANEL / MENU STRUCTURE



HOW TO CONFIRM CHANGES

When changes have been made in one of the nine menus below, the user presses ENTER to confirm these changes.

To prevent anyone from making changes by mistake, the following happens when changes are made:

Step 1: The user presses [ENTER] to confirm the change made or [MENU] to exit the menu without changes. HINT: First programme all changes planned, then only after that, press [ENTER]

Step 2: The display asks the user to be sure to make these changes. The user can cancel or confirm by using the left and right arrows.

CANCEL = ◀ CONFIRM = ▶

By pressing (◀ ▶) one can toggle through the available menus.

"TIME/DATE/DAY" menu
In this menu one can set the time and the date.

"SETPOINT" menu
In this menu one can change temperature settings without the need for a password.

- **Hot water set point**
Calorifier or Water heater (depends on heater type)

- **Hot water reduced**
The amount of degrees diff. relative to "Hot water set point" during night reduction.

- **Local set point water heater**
The temperature of the hot water supply from the DHW appliance to the tank is set here.

"PROGRAM" menu
In this menu one can set the DHW and Anti Legionella program.

"OPERATING HISTORY" menu
Shows burning hours DHW, etc.

"FAULT HISTORY" menu
press: ▼ Reading last fifteen faults (only reading!).

"MAINTENANCE" menu
By pressing (◀ ▶) one can set the following options:
- Maintenance reset
- Maintenance Mode
- All
- Date
- Ignition cycles
- Burning hours
- Mainten Off

"USER LOCK" menu
In this menu one can lock the menu for users
0= UNLOCKED
1= LOCKED
When un-locked the user can enter the "MENU" by pressing the menu button and all submenus will show.
When locked the user has to push the : MENU and simultaneously press ▼ for 6 seconds to get access to all submenus.
This is to prevent accidental changes!
NOTE: The parameters sub menu can always be accessed.

"PARAMETER" menu
In this menu one can change parameters. The possible access depends on the password that is used.

parameter menu

Enter password

Enter PW Level 1:
three second message
confirming access:
LEVEL 1

Enter PW Level 2:
three second message
confirming access:
LEVEL 2

16.3 DISPLAY DURING OPERATION

During normal operation, the text in the display shows the status of the water heater. In the following graphs, the displays during normal operation are explained.

Display at WATER HEATER / HOT WATER DEMAND																			
Heat demand type:							Actual status:												
W	A	T	R	H	T	R	:	S	T	A	N	D	-	B	Y				
>	>	>	:	1	2	3	.	4	°	C	(	1	2	3	.	4	°	C)
cascade communication indicator				temp. set point water temp.				measured temp.control.sens. showing the measured temp. Can be turned off by P5 BJ											

Explanation "Actual status" screen

Actual status:
B o i l e r o f f
When water heater is switched off (only text in the display during this status).
N o d e m a n d
No heat demand signal coming from the room thermostat and calorifier sensor (open).
S t a n d - b y
Room thermostat & calorifier sensor/thermostat detect heat demand but set point is reached.
P r e - p u r g e
The fan is purging before a burner start attempt.
P r e - i g n i t i o n
Ignition starts before opening of the gas valve.
I g n i t i o n
The igniter is igniting.
P o s t - p u r g e
The fan is purging after burner is switched off.
B u r n i n g 1 0 0 %
When the burner is firing, also the actual rpm% is shown.

Explanation "Cascade communication indicator"

NO CASCADE COMMUNICATION

> > >	no.1
-------	------

Always showing the fixed ">>>"

CORRECT CASCADE COMMUNICATION

> >	no.1
>	no.2

Showing alternating no.1 & no.2 with 1 second interval.

16.4 MONITOR SCREENS

During normal operation and stand-by, the “◀” and “▶” buttons can be used to show some water heater information, including measured temperatures, settings and data. In the following graphs is explained which values can be shown in the display. When no button is activated for 2 minutes, the display will return to its status display.

Pressing [◀] or [▶] while being at the "operating screen" toggles through the screens below.

When pressing [ON/OFF, RESET, ENTER] or [MENU] at any time the display returns to the base menu.

SCREEN: 1

T 1	F l o w	1 2 3 . 9 ° C	Measured value by the internal flow sensor.
T 2	R e t u r n	1 2 3 . 9 ° C	Measured value by the internal return sensor.
		O p e n	Shown when controller doesn't detect this sensor.
		S h o r t e d	Shown when sensor wires or sensor itself is shorted.

SCREEN: 2

T 3	E x t e r n a l	1 2 3 . 9 ° C	Measured value by the external sensor.
T 4	C a l o r i f i e r	1 2 3 . 9 ° C	Measured value by the calorifier sensor.
		O p e n	Shown when controller doesn't detect this sensor.
		S h o r t e d	Shown when sensor wires or sensor itself is shorted.

SCREEN: 3

T 5	O u t d o o r	1 2 3 . 9 ° C	Measured value by the outdoor sensor.
T 6	F l u e	1 2 3 . 9 ° C	Measured value by the flue gas sensor.
		O p e n	Shown when controller doesn't detect this sensor.
		S h o r t e d	Shown when sensor wires or sensor itself is shorted.

SCREEN: 4

d T F l o w R e t u r n	1 2 3 . 9 ° C	Temp. difference between internal flow & return sensor.
d T F l u e R e t u r n	1 2 3 . 9 ° C	Temp. difference between flue gas & internal return sensor.

SCREEN: 5

d T E x t R e t u r n	1 2 3 . 9 ° C	Temp. difference between external & internal return (ΔT LLH).
S i g n a l	P o w e r	External supplied 0-10 Volt dc signal.
	S e t p o i	"Power" = power input control or "Setpoi" = set point control.

SCREEN: 6

F a n s p e e d	9 9 9 9 r p m	Actual fan speed in rpm.
F a n s p e e d	1 0 0 %	Actual fan speed % of maximum allowable fan speed.



The maximum RPM may be lower than the maximum RPM set point. The fan may not be able to reach the maximum RPM set point due to the resistance in the unit, this is still correct according to the design of the unit.

SCREEN: 7

F l a m e s i g n a l	1 0 0 μ A	Flame signal given in μA.
W a t e r P r e s s u r e	1 . 0 b a r	Shows water pressure when sensor is connected.

SCREEN: 8

P u m p 1 H e a t e r	O f f	Pump 1 (HEATER PUMP) On or Off.
P u m p 1 S i g n a l	1 0 0 %	Modulating signal Pump 1 in (%).

SCREEN: 9

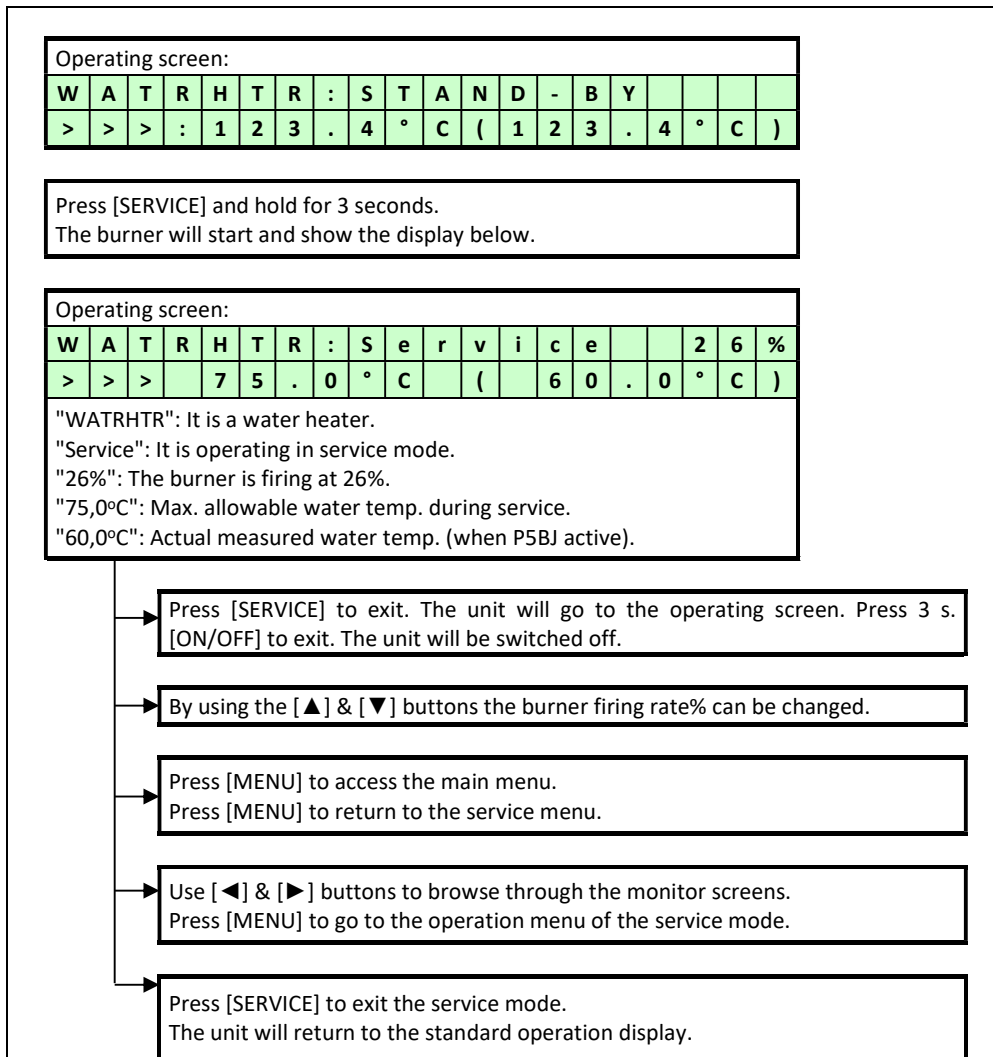
P u m p 2 C a l o r i f i e r	O f f	Shows when the calorifier pump is "ON" or "OF".
3 - w a y V a l v e H e a t i n g		Signal to the 3-way valve: "HEATING" or "HOTWATER".

SCREEN: 10

P u m p 3 S y s t e m	O f f	Shows when the system pump is "ON" or "OF".
h h : m m D D / M M / Y Y Y Y D a y		hh=hour; mm=minutes; DD=day; MM=month; YYYY=yr; Day of the week

16.5 SERVICE FUNCTION

The following graphs describe how to use the service function.



16.6 SCHORNSTEINFEGER FUNCTION



For use in Germany only

16.7 PROGRAMMING IN STANDBY MODE

Standby

Programming the settings of the water heater is done at the control panel of the top burner, this is the left panel.

Use the standby mode for modifying water heater settings without interaction with the water heater control. Changes are confirmed by leaving standby mode.

Properties of standby mode:

- Keys are active and the menu is accessible.
- Burner does NOT respond to an external heat demand.
- All control functions are ON: pumps, fans and cascade are operational; recirculation and frost protection are active.

How to programme the water heater:

- Disconnect or shut down the DHW thermostat and/or other external controllers from the water heater. The pump and fan will stop after a short time.
- Switch the water heater in standby mode by pressing [ON/OFF] for three seconds.
- The next display screen should appear:

Display message	W	A	T	R	H	T	R	:	b	o	i	l	e	r	o	f	f		
	>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C

- Programme the water heater at the control panel (see the following sections).
- Terminate programming mode by pressing [MENU], or [ENTER] and NO ◀ or YES ▶.
- Reactivate the water heater by pressing [ON/OFF] for three seconds again.

16.8 SETTING TIME & DATE

The following graphs describe how to program time and date of the unit.

Operating screen:

W	A	T	R	H	T	R	:	b	o	i	l	e	r	o	f	f			
>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)

Press [MENU]

Main menu screen:

M	a	i	n		M	e	n	u												
C	l	o	c	k																

The display shows "CLOCK" press [ENTER]

Setting Time and Date:

S	e	t		t	i	m	e	/	d	a	t	e		0	8	:	3	3	
3	0	/	0	3	/	2	0	1	0		T	u	e						

The day is now blinking/selected and can be changed.
Use [▲] & [▼] to change the value.
Use [◀] & [▶] to select another value.

Press [ENTER] for the confirmation screen after all changes are done.

Confirmation screen:

A	r	e		y	o	u		s	u	r	e								
<	C	a	n	c	e	l	;		>	C	o	n	f	i	r	m			

Press [◀] to cancel the changes made (display goes back to operating screen).
Press [▶] to confirm the changes made. The time and day will start blinking for a few seconds. After this, the display returns to its operating screen.

16.9 SET POINTS

The following graphs describe how to program the hot water set points.

DHW set point normal/day time: (parameter P4 AA = 1/2)														
D	H	W	s	e	t	p	o	i	n	t				
		6	0		°	C								
This is the water temperature set point that is active during the programmed DHW periods (parameter P4 AA = 1/2)														
DHW set point reduction: (parameter P4 AA = 1/2)														
D	H	W	R	e	d	u	c	e						
		1	0		°	C								
The reduction of the normal/day time set point. This reduction is used outside the programmed DHW periods.														
Max. set point flow temperature (parameter P4 AA = 2 and P5 DJ&DK =1)														
H	e	a	t	i	n	g	s	e	t	p	o	i	n	t
		7	5		°	C								
This parameter is the local setpoint of the water heater and is regulated on sensor S1 (parameter P4 AA = 2, P5 DJ = 1 and P5 DK =1).														



The maximum actual DHW temperature will never exceed the value set at heating setpoint regardless of the DHW setpoint. If the DHW setpoint needs to be higher than the heating setpoint, the heating setpoint will need to be increased to match.

16.10 SETTING THE TIMER PROGRAMS

Two different programs can be set with the water heater, these are:

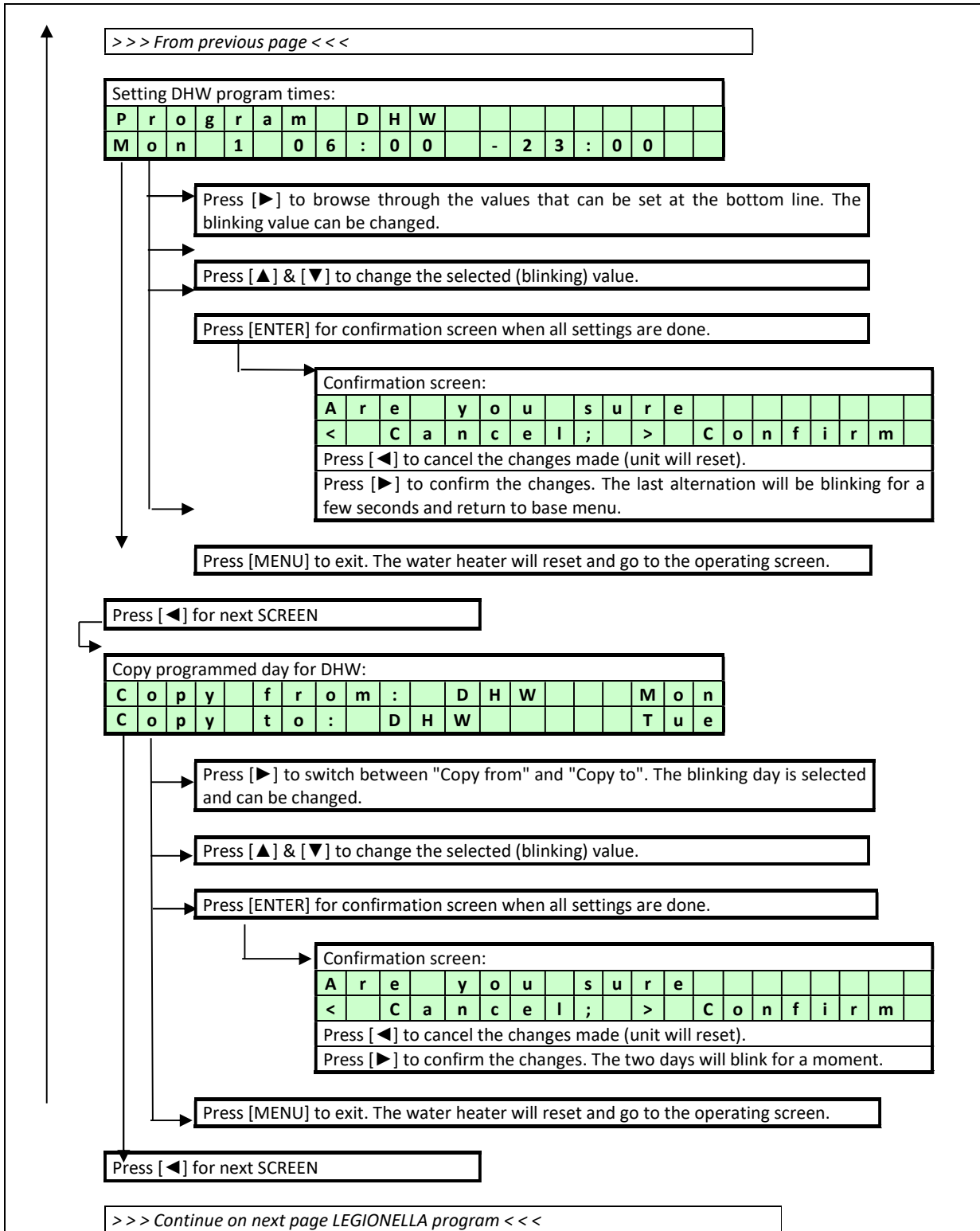
- DHW program
- Anti-Legionnaires' disease (pasteurisation) program

16.10.1 STARTING THE TIMER PROGRAMS

Three programmed periods each day can be set (period 1, 2 and 3). During this period the unit will use the normal DHW set point. Outside the programmed period(s) the unit will use the reduced temperature as set point. When no time is programmed for a period, it will not be used. (Example no time programmed in period 3 on Monday > "Mon 3 --:-- ----:--").

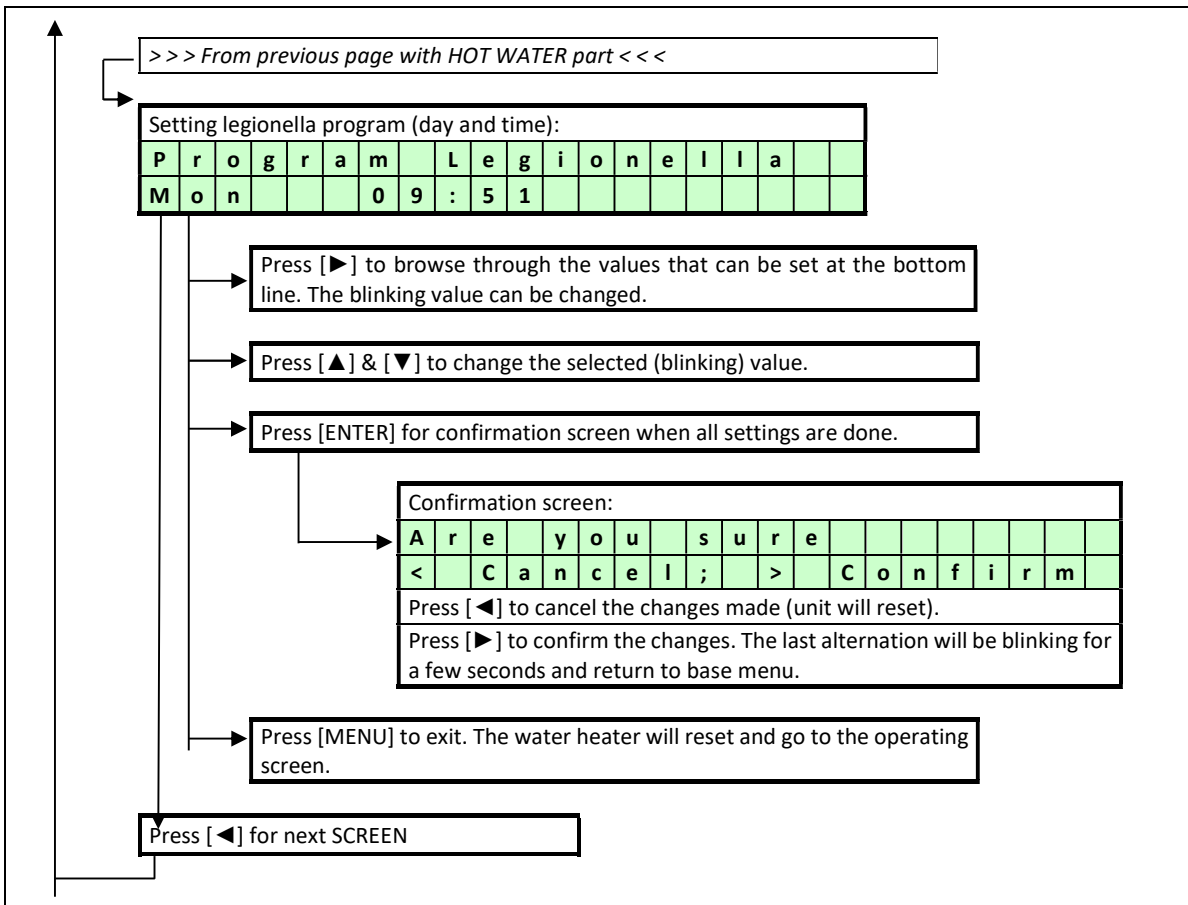
Operating screen:																			
W	A	T	R	H	T	R	:	b	o	i	l	e	r	o	f	f			
>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)
Press [MENU]																			
Select "Timer" using [◀] & [▶] and press [ENTER]																			
Main menu screen:																			
M	a	i	n	M	e	n	u												
T	i	m	e	r															
Press [ENTER]																			
Setting CH program times:																			
P	r	o	g	r	a	m	C	H											
M	o	n	1	0	6	:	0	0	-	2	3	:	0	0					
Press [◀] for next SCREEN																			
>>> Continue on next page HOT WATER program <<<																			

16.11 HOT WATER PROGRAM



16.12 ANTI LEGIONNAIRES' DISEASE PROGRAM

See the following graphs. The standard factory setting for this function is "OFF".



16.13 CHECKING THE OPERATING HISTORY

The following graphs describe how to check the operating history of the water heater.

Operating screen:																			
W	A	T	R	H	T	R	:	b	o	i	l	e	r	o	f	f			
>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)

Press [MENU]

Select "Operate" using [◀] & [▶] and press [ENTER]

Main menu screen:																			
M	a	i	n		M	e	n	u											
O	p	e	r	a	t	e													

Press [◀] & [▶] to browse through the 5 screens.
Press [MENU] or [ENTER] to exit. The unit will return to the operating screen.

SCREEN: 1

O	p	e	r	a	t	i	n	g		h	i	s	t	o	r	y					
P	o	w	e	r	O	n				h	r	s				1	3	1	4	0	0

Top line: Shows the operating history menu is activated.
Bottom line: Total hours the water heater is connected to power supply and switched on.

SCREEN: 2

h	r	s	C	h				T	o	t						1	0	0	0	0	0	0
h	r	s	D	h	w			T	o	t						1	0	0	0	0	0	0

Top line: Total burning hours for heating.
Bottom line: Total burning hours for domestic hot water.

SCREEN: 3

h	r	s	C	h				<	5	0	%					1	0	0	0	0	0	0
h	r	s	C	h				=	>	5	0	%				1	0	0	0	0	0	0

Top line: Burning hours for heating while the burner was firing less than 50%.
Bottom line: Burning hours for heating while the burner was firing equal or higher than 50%.

SCREEN: 4

h	r	s	D	h	w			<	5	0	%		:			1	0	0	0	0	0	0
h	r	s	D	h	w			=	>	5	0	%		:		1	0	0	0	0	0	0

Top line: Burning hours for hot water while the burner was firing less than 50%.
Bottom line: Burning hours for hot water while the burner was firing equal or higher than 50%.

SCREEN: 5

T	i	a	1	0	0	0	0	F	i	a						1	0	0	0	0	0	0
S	s	l	1	0	0	0	0	S	s	t						1	0	0	0	0	0	6

Top line: Shows Total Ignition Attempts (Tia) & Failed Ignition Attempts (Fia)
Bottom line: Shows Soft Starts last (Ssl) & Soft Starts Total (Sst)

16.14 CHECKING THE FAULT HISTORY

The following graphs describe how to check the fault history of the water heater.

Operating screen:																		
W	A	T	R	H	T	R	:	b	o	i	l	e	r	o	f	f		
>	>	>	:	1	2	3	.	4	°	C	(	1	2	3	.	4	°	C)

Press [MENU]

Select "Faulthist" using [◀] & [▶] and press [ENTER]																			
F	a	u	l	t	h	i	s	t							N	o	.	0	1
2	1	/	0	4	/	2	0	1	0	W	e	d		2	2	:	2	3	A

▲ blinking alternately ▼

S	i	p	h	o	n		S	w	i	t	c	h							
S	v	9	9	9	/	C	U	M	9	9	9	/	R	9	9	9	9	.	5

Press [◀] & [▶] to browse through the last 10 faults.
Press [MENU] or [ENTER] to exit. The unit will return to the operating screen.

The fault menu shows the last 10 faults. For each fault the display blinks between the two screens shown above. The top line of the top screen shows the fault number and the bottom line of the top screen shows the date, day and time the fault occurred.
On the top line of the bottom screen the fault type is displayed. The bottom line shows the following:

SV: The total amount of this fault that has occurred after the last time that the service history was erased (after service was done).

CUM: The total amount of this fault. The total amount cannot be erased after service, this shows the fault history of the water heater (electronics) since the start of operation.

R: Shows the elapsed time in hrs between the moment the fault occurred and the moment it was reset.

16.15 SETTING THE MAINTENANCE SPECIFICATIONS

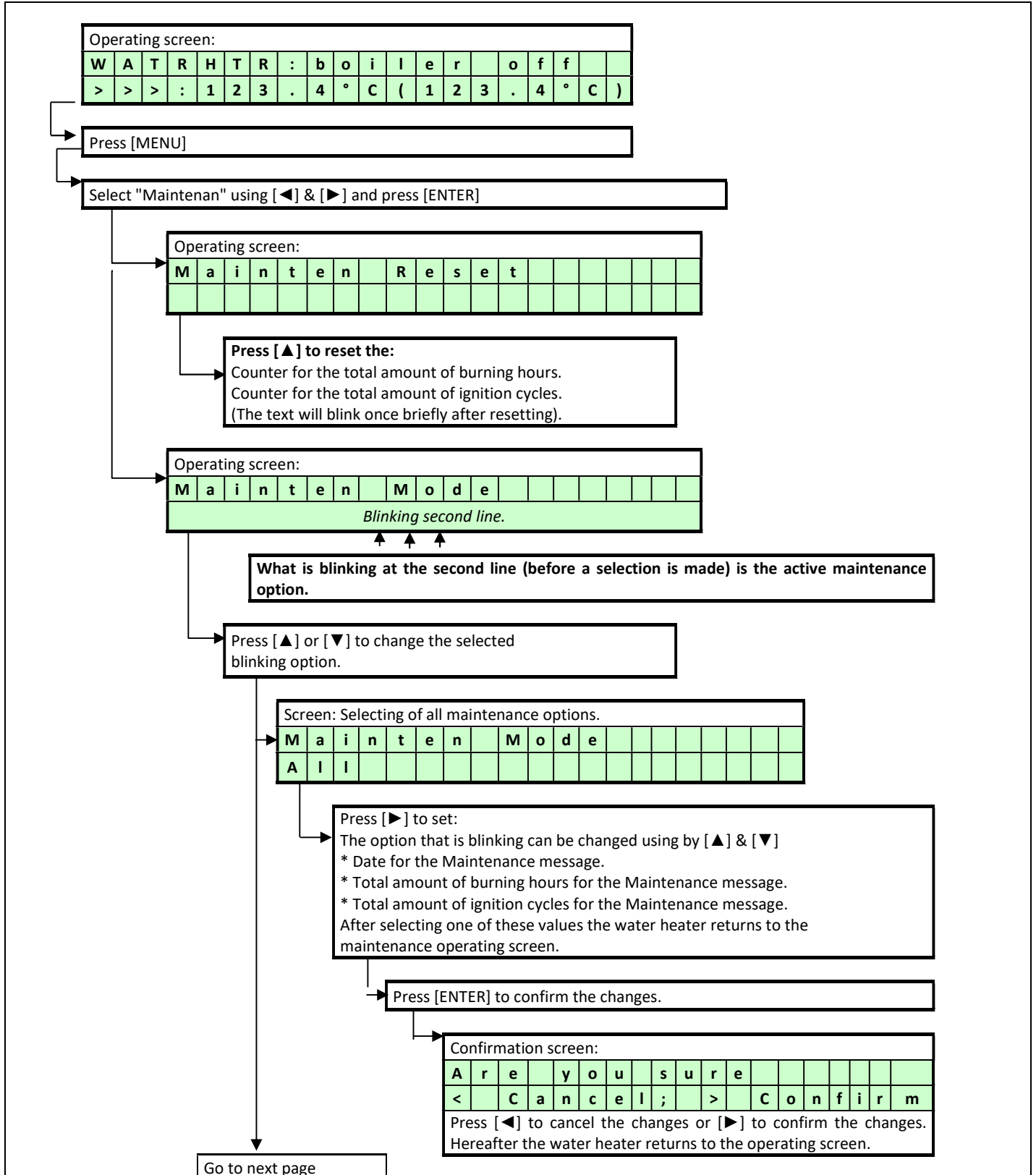
16.15.1 MAINTENANCE SETTINGS

The unit can be programmed in such a way that an automatic maintenance message is displayed.

There are three options that can be selected. A maintenance message appears after:

- * A programmed date is reached.
- * An amount of burning hours is reached.
- * An amount of ignition cycles is reached.

One single option can be activated or all three options.



From previous page

Screen: Selecting message at certain date.
M a i n t e n M o d e
D a t e

Press [▶] to set:
The date for the maintenance message.

Press [◀] to:
Return to maintenance mode selection.

Press [▶] to browse through the values that can be set
at the bottom line.
The blinking value can be changed with [▲] & [▼]

Press [ENTER] to confirm the changes.

Confirmation screen:
A r e y o u s u r e
< C a n c e l ; > C o n f i r m
Press [◀] to cancel the changes or [▶] to confirm the changes.
Hereafter the water heater returns to the operating screen.

Screen: Message after total amount of ignition cycles.
M a i n t e n M o d e
I g n i t i o n c y c l e s

Press [▶] to set:
The total amount of ignition cycles for the Maintenance message.

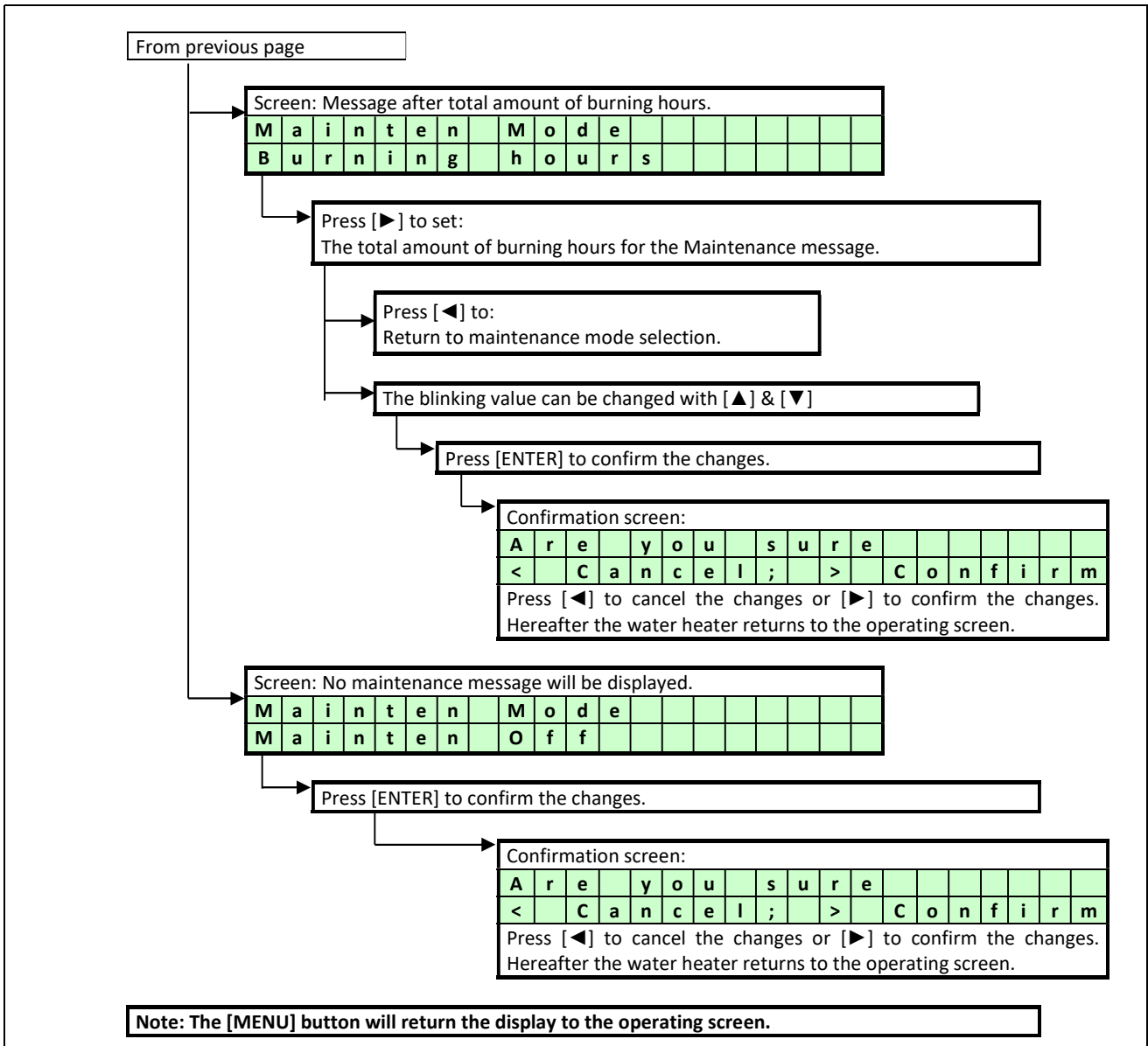
Press [◀] to:
Return to maintenance mode selection.

The blinking value can be changed with [▲] & [▼]

Press [ENTER] to confirm the changes.

Confirmation screen:
A r e y o u s u r e
< C a n c e l ; > C o n f i r m
Press [◀] to cancel the changes or [▶] to confirm the changes.
Hereafter the water heater returns to the operating screen.

Go to next page



The maintenance mode function is turned OFF as standard. We offer this programmable function to the installer to use as a reminder. As the function can be switched on and off, it cannot be used as an argument in warranty cases. Our water heaters must be maintained every 12 months whatever the settings/working of this function.



It is and remains the responsibly of the end user to have the unit maintained every twelve months

16.16 SETTING THE USER LOCK

The following graphs describe how to activate the user lock of the display. The standard factory setting for this function is "OFF".

<p>The "USER LOCK" menu. In this menu the water heater can be locked for (end-)users. 0 = UNLOCKED 1 = LOCKED</p>																																								
<p>When the water heater is unlocked, the user can enter the MENU by pressing the menu button and all screens will show up.</p>																																								
<p>When the water heater is locked, the user has to push the: [MENU] button together with the [▼] button for 5 s. to access all menu screens.</p>																																								
<p>This function is to prevent accidental changes.</p>																																								
<p>NOTICE: The PARAMETER screen always accessible.</p>																																								
<p>Operating screen:</p> <table border="1"> <tr> <td>H</td><td>E</td><td>A</td><td>T</td><td>I</td><td>N</td><td>G</td><td>:</td><td>b</td><td>o</td><td>i</td><td>l</td><td>e</td><td>r</td><td>o</td><td>f</td><td>f</td><td></td><td></td><td></td> </tr> <tr> <td>></td><td>></td><td>></td><td>:</td><td>1</td><td>2</td><td>3</td><td>.</td><td>4</td><td>°</td><td>C</td><td>(</td><td>1</td><td>2</td><td>3</td><td>.</td><td>4</td><td>°</td><td>C</td><td>)</td> </tr> </table>	H	E	A	T	I	N	G	:	b	o	i	l	e	r	o	f	f				>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)
H	E	A	T	I	N	G	:	b	o	i	l	e	r	o	f	f																								
>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)																					
<p>Press [MENU]</p>																																								
<p>Select "User lock" using [◀] & [▶] and press [ENTER]</p>																																								
<p>User lock screen:</p> <table border="1"> <tr> <td>S</td><td>e</td><td>t</td><td></td><td>U</td><td>s</td><td>e</td><td>r</td><td>l</td><td>o</td><td>c</td><td>k</td><td>=</td><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td></td><td></td><td></td><td></td><td>0</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>	S	e	t		U	s	e	r	l	o	c	k	=	0											0															
S	e	t		U	s	e	r	l	o	c	k	=	0																											
				0																																				
<p>The "0" is now blinking/selected and can be changed. Use [▲] & [▼] to change the value. 0 = User lock function OFF 1 = User lock function ON</p>																																								
<p>Press [ENTER] for the confirmation screen after the selection has been made.</p>																																								
<p>Confirmation screen:</p> <table border="1"> <tr> <td>A</td><td>r</td><td>e</td><td></td><td>y</td><td>o</td><td>u</td><td></td><td>s</td><td>u</td><td>r</td><td>e</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td><</td><td></td><td>C</td><td>a</td><td>n</td><td>c</td><td>e</td><td>l</td><td>;</td><td></td><td>></td><td></td><td>C</td><td>o</td><td>n</td><td>f</td><td>i</td><td>r</td><td>m</td><td></td> </tr> </table>	A	r	e		y	o	u		s	u	r	e									<		C	a	n	c	e	l	;		>		C	o	n	f	i	r	m	
A	r	e		y	o	u		s	u	r	e																													
<		C	a	n	c	e	l	;		>		C	o	n	f	i	r	m																						
<p>Press [◀] to cancel the changes (the unit will reset and the display returns to the operating screen).</p>																																								
<p>Press [▶] to confirm the changes. The changed value will be blinking for a few seconds. After this, the display returns to the operating screen.</p>																																								
<p>NOTICE:</p>																																								
<p>Using the [MENU] button during the User lock display, will reset the water heater and the water heater will return to the operating screen. Changes will be neglected in this case.</p>																																								

16.17 SETTING THE PARAMETERS BY THE DISPLAY MENU

The functions of the controller are embedded in the electronics. The values and settings of these controlling functions are called parameters. They can be changed by a skilled and trained service engineer with the help of a computer, the correct software and an interface cable. A selection of these parameters can be programmed on the unit itself, without the use of a computer. Setting is easily done at the control panel of the water heater. The following table gives a list of parameters that can be programmed at the control panel. All parameters that are shown in the display, can be changed. NOTICE: Only the password for level 1 is issued in this manual. When other "more advanced" parameters need to be programmed, it can only be done by a skilled and trained service engineer, who has access to level 2.

							PASSWORD: 1342	
MENU	SOFTW. PARAM	DESCRIPTION	UNITS	TEXT DISPLAY	LEVEL 1			
					Display	Modify		
HEATING A	1	P5BE	Step modulation (1=on 0=off)	-	S t e p m o d u l	yes	no	
	2	P5AO	Blocking offset flow temperature control	°C	H E s O f f 1 3	yes	yes	
	3	P5AP	Proportional range temperature control	°C	H E s P r b 1 3	yes	no	
	4	P5AL	Hysteresis CH Flow temperature control	°C	H E s c D i f 1 3	yes	yes	
	5	P2IC	Integration time temperature control	s	H E s I n t 1 3	yes	no	
	6	P2MI	Blocking offset System CH temperature control	°C	H E c O f f 3	yes	yes	
	7	P2MJ	Proportional range System CH temperature control	°C	H E c P r b 3	yes	no	
	8	P2MK	Integration time CH temperature control	s	H E c I n t 3	yes	no	
	9	P5AB	Timer Contact (1=on)	-	T i m e r C o n t	yes	yes	
DHW B	1	P4AB	DHW Pump Config 0=Pump 1=TWV	-	D H i p m p / t w v	yes	yes	
	2	P5CB	Flow temperature DHW tank low	°C	D H i f l o w L O	yes	yes	
	3	P5CK	Flow temperature DHW tank hi	°C	D H i f l o w H I	yes	yes	
	4	P5CL	Low Flow temperature time DHW	min	D H i L O t i m e	yes	yes	
	5	P5CD	Legionella temperature	°C	L e g i o t e m p	yes	no	
	6	P5CI	Legionella hyst DHW tank temperature	°C	L e g i o h y s t	yes	no	
	7	P5CJ	Legionella hold time (0=off)	min	L e g i o h o l d	yes	no	
	8	P2KI	CH interrupt by Legionella (0=yes)(1=no)	-	L e g i o i n t r	yes	no	
	9	P2LC	Regulation temperature offset DHWd	°C	D H d s c O f f 2	yes	yes	
	A	P2LE	Proportional range DHWd modulation	°C	D H d s c P r b 2 3	yes	no	
	B	P2LD	Regulation temperature hysteresis DHWd	°C	D H d s c D i f 2	yes	yes	
	C	P2LF	integration time DHWd modulation	s	D H d s c I n t 2 3	yes	no	
	D	P2ML	Sys temp blocking offset DHW tank	°C	D H d s c O f f 3	yes	yes	
	E	P2MM	Sys temp blocking hysteresis DHW tank	°C	D H d s c D i f 3	yes	yes	
	F	P5CA	Hysteresis DHW tank temperature	°C	D H i s c D i f 4	yes	yes	
G	P2KH	Gradient heat demand detect DHW tank temperature	°C	D H i d e t g r a d	yes	yes		
CASCADE C	1	P2MA	Max number extra water heaters	-	M a x C a s c U n t	yes	no	
	2	P5DA	Bus address water heater	-	B u s a d r e s s	yes	no	
	3	P5DC	DHW on entire cascade(0) only master(1)	-	D H i c a s / m a s	yes	no	
	4	P5DE	Extra Water heater output enable(1)	-	E x t r a u n i t	yes	yes	
	5	P5DF	Cascade detection (0=standalone 1=Leader)	-	C a s S i / M a	yes	no	
	6	P5BL	Power off total cascade (1)	-	P w r O f f T o C a	yes	no	
	7	P5DB	Number of water heaters with common flue 0=None	-	C o m F l u N u m	yes	no	
GENERAL D	1	P5BB	Analogue input Config (0=off 1=temp 2=power)	-	A n I n p C o n	yes	yes	
	2	P5AI	Minimum Temperature 0-10V input	°C	0 - 1 0 M i n T m p	yes	yes	
	3	P5BI	Altitude (in amounts of 100 ft.)	ft*100	A l t * 1 0 0 f t	yes	yes	
	4	P2LK	Max cooling time	min	M a x C o o l T i m	yes	yes	
	5	P5BJ	Temperature display 1=on	-	T e m p O n D i s p	yes	yes	
	6	P4AA	DHW 0=off 1=Indirect 2=Direct	-	D H W 1 = i 2 = d	yes	no	
	7	P4AD	pressure 0=off 1=sensor and 2=switch	-	c o n f i g	yes	no	
	8	P4BD	Gas type values 0-2	-	g a s t y p e	yes	no	
	9	P4BE	Soft start type values 0-2	-	c o n f i g	yes	no	
	A	P5BN	Pump modes 0-4	-	c o n f i g	yes	no	

In the parameter table shown above one can see all the parameters that can be set on the unit without the use of a laptop/computer. In the following chapter "Controlling options and settings" the controlling options for heating, indirect hot water and cascading are explained. In the explanation of these options there is a reference of all relevant parameters which are shown in the table above and can be set on the unit



DO NOT CHANGE the parameters P2LC, P2LD, P2ML, P2MM and P5BI; they are present in the controller for other purposes than DHW control. Changing these parameters may affect water heater operation negatively.

Parameter screens + explanation see next pages →

Operating screen:

H	E	A	T	I	N	G	:	b	o	i	l	e	r	o	f	f			
>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)

Press [MENU]

Select "Parameter" using [◀] & [▶] and press [ENTER]

Parameter menu:

I	n	s	t	a	l	l	e	r	c	o	d	e						
									0	0	0	0						



Enter the 4-digit code with the [◀] & [▶] and the [▲] & [▼] buttons and select [ENTER]

The code will blink a few seconds and when entered correctly, the following parameters will be displayed.

NOTICE: These codes are user based and give access to a selected amount of parameters, which can be changed (Installer level 1/2).

Menu A: Heating

A	1					S	t	e	p	m	o	d	u	l				
										1								

Function to activate the step modulation:

0 = Off

1 = On

Menu A: Heating

A	2					H	E	s	o	f	f	1	3				
									4	°	C						

CH supply temperature setting. This parameter is the offset of the programmed CH temperature.

Menu A: Heating

A	3					H	E	s	P	r	b	1	3				
									2	5	°	C					

Select the CH supply temperature control. This parameter is the proportional range of the selected CH supply temperature.

Menu A: Heating

A	4					H	E	s	c	D	i	f	1	3			
									1	0	°	C					

Select the CH supply temperature control. This parameter is the hysteresis of the selected CH supply temperature.

Menu A: Heating

A	5					H	E	s	I	n	t	1	3				
									6	0	S	e	c				

Select the CH supply temperature control. This parameter is the integration time of the selected CH supply temperature.

Menu A: Heating

A	6					H	E		c	O	f	f	3				
									4	°	C						

Select the cascaded water heaters supply temperature control. This parameter is the offset of the selected CH supply temperature of EACH water heater of the total cascade.



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.

Menu A: Heating

A	7					H	E			c	P	r	b		3				
										2	5			°	C				

Select the cascaded water heaters supply temperature control.
This parameter is the proportional range of the selected CH supply temperature of EACH water heater of the total cascade and of the external (cascade) sensor.

Menu A: Heating

A	8					H	E			c	I	n	t		3				
										8	0			S	e	c			

Select the cascaded water heaters supply temperature control.
This parameter is the integration time of the selected CH supply temperature of EACH water heater of the total cascade and of the external (cascade) sensor.

Menu A: Heating

A	9					T	i	m	e	r	C	o	n	t					
										0									

Function to activate "external time controller":
0 = Off
1 = On
Connect to 13-14. Contact closed = daytime setting,
Contact open = night-time setting.

Menu B: Hot water

B	1					D	H	i	p	m	p	/	t	w	v				
										1									

Hot water function of the water heater by:
0 = pump
1 = 3-way valve

Menu B: Hot water

B	2					D	H	i	f	l	o	w		L	O				
										2	5		°	C					

Hot water function of the water heater. This parameter is the CH supply temperature LOW level with an indirect hot water demand.

Menu B: Hot water

B	3					D	H	i	f	l	o	w		H	I				
										8	5		°	C					

Hot water function of the water heater. This parameter is the CH supply temperature HIGH level with an indirect hot water demand.

Menu B: Hot water

B	4					D	H	i		L	O	t	i	m	e				
										1				M	i	n			

Hot water function of the water heater. This parameter is the selectable time period after which the water heater switches from LOW to HIGH set point with an indirect hot water demand.



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.

Menu B: Hot water

B	5					L	e	g	i	o		t	e	m	p				
										8	5		°	C					

Pasteurisation function of the water heater. This parameter is the selected hot water temperature during the pasteurisation function of the water heater.

Menu B: Hot water

B	6					L	e	g	i	o		h	y	s	t				
											2		°	C					

Pasteurisation function of the water heater. This parameter is the selected hysteresis during the pasteurisation function of the water heater.

Menu B: Hot water

B	7					L	e	g	i	o		h	o	l	d				
											2		M	i	n				

Pasteurisation function of the water heater. This parameter is the selected time period for the pasteurisation function of the water heater.

Menu B: Hot water

B	8					L	e	g	i	o		i	n	t	r				
											0								

Pasteurisation function of the water heater. This parameter controls if the CH demand can be interrupted by the pasteurisation function of the water heater.
 0 = Yes
 1 = No

Menu B: Hot water

B	9					D	H	d	s	c	O	f	f	2					
											4		°	C					

Function for the direct hot water water heater.
 This parameter is de off set of the selected HW temperature of the water heater.

Menu B: Hot water

B	A					D	H	d	s	c	P	r	b	2	3				
											2	0		°	C				

Function for the direct hot water water heater.
 This parameter is the proportional range of the selected HW temperature of the water heater.

Menu B: Hot water

B	B					D	H	d	s	c	D	i	f	2					
											1	0		°	C				

Function for the direct hot water water heater.
 This parameter is the hysteresis of the selected HW temperature of the water heater.



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.

Menu B: Hot water

B	C					D	H	d	s	c	l	n	t	2	3				
									2	0	0			S	e	c			

Function for the direct hot water water heater.
This parameter is the integration time of the selected HW temperature of the water heater.

Menu B: Hot water

B	D					D	H	d	s	c	O	f	f	3					
											4		°	C					

Function for the cascaded direct hot water water heaters.
This parameter is the offset of the selected HW temperature of the cascaded water heaters.

Menu B: Hot water

B	E					D	H	d	s	c	D	i	f	3					
											8		°	C					

Function for the cascaded direct hot water water heaters.
This parameter is the hysteresis of the selected HW temperature of the cascaded water heaters.

Menu B: Hot water

B	F					D	H	i	s	c	D	i	f	4					
											5		°	C					

Function for the indirect hot water supply of the water heater (tank).
This parameter is the hysteresis of the selected HW temperature of the calorifier/tank.

Menu B: Hot water

B	G					D	H	i	d	e	t	g	r	a	d				
											3		°	C					

Function for the indirect hot water supply of the water heater (tank).
This parameter detects an (an accelerated) hot water demand, when a larger (water) amount is being used.

Menu C: Cascade

C	1					M	a	x	C	a	s	c	U	n	t				
											1	1							

Function for the cascading of the water heater(s).
This parameter sets the total amount of cascaded water heaters.
(Max. 12 water heaters).

Menu C: Cascade

C	2					B	u	s	a	d	d	r	e	s	s				
											0								

Function for the cascading of the water heater(s).
This parameter determines the address of the water heater for the total cascading control.
Master = 0, Slave 1 = 1 etc.

Menu C: Cascade

C	3					D	H	i	c	a	s	/	m	a	s				
											0								

Function for the cascading of the water heater(s).
This parameter determines if only the Master water heater or all boil-ers of the cascade are used for indirect hot water.
0 = All
1 = Master



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.

Menu C: Cascade

C	4					E	x	t	r	a		u	n	i	t				
												0							

Function for the cascading of the water heater(s).
This parameter is activated when an external (extra) water heater is connected to the Master water heater. Connect to the Master connections 21-22.

Menu C: Cascade

C	5					C	a	s		S	i	/	M	a					
												0							

Function for the cascading of the water heater(s).
This parameter sets the function of the water heater at a cascade alignment
0 = Single / Slave unit
1 = Master unit

Menu C: Cascade

C	6					P	w	r	O	f	f	T	o	C	a				
												0							

Function for the cascading of the water heater(s).
This parameter determines the function of the Slave water heaters when the Master water heater is switched off.
0 = Slave water heater(s) continue operation
1 = Slave water heater(s) switch off

Menu C: Cascade

C	7					C	o	m	F	l	u	N	u	m					
												0							

Function for the cascading of the water heater(s).
This parameter determines the number of cascaded water heaters, that are implemented with a common flue system.

Menu D: General

D	1					0	-	1	0	V	c	o	n	t	r				
												0							

Function for the external control of the water heater by using a 0-10 Volt signal (Connections 15-16).
0 = No external control
1 = Control based on temperature setting
2 = Control based on power setting

Menu D: General

D	2					0	-	1	0	M	i	n	T	m	p				
												2	0	°	C				

Function for the external control of the water heater by using a 0-10 Volt signal (Connections 15-16).
Control based on temperature (setting 1).
The minimum (desired) CH water temperature when supplying a 1.4 Volt signal.

Menu D: General

D	3					A	l	t		*		1	0	0	f				
												0							

Function for setting the location height (above sea level) of the water heater.
NOTICE: dimensions in English feet. One unit = 100 ft.
Use this function only in consultation with the supplier/manufacturer.



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.

Menu C: Cascade																			
C	4					E	x	t	r	a		u	n	i	t				
												0							

Function for the cascading of the water heater(s).
 This parameter is activated when an external (extra) water heater is connected to the Master water heater. Connect to the Master connections 21-22.

Menu C: Cascade																			
C	5					C	a	s		S	i	/	M	a					
												0							

Function for the cascading of the water heater(s).
 This parameter sets the function of the water heater at a cascade alignment
 0 = Single / Slave unit
 1 = Master unit

Menu C: Cascade																			
C	6					P	w	r	O	f	f	T	o	C	a				
												0							

Function for the cascading of the water heater(s).
 This parameter determines the function of the Slave water heaters when the Master water heater is switched off.
 0 = Slave water heater(s) continue operation
 1 = Slave water heater(s) switch off

Menu C: Cascade																			
C	7					C	o	m	F	l	u	N	u	m					
												0							

Function for the cascading of the water heater(s).
 This parameter determines the number of cascaded water heaters, that are implemented with a common flue system.

Menu D: General																			
D	1					0	-	1	0	V	c	o	n	t	r				
												0							

Function for the external control of the water heater by using a 0-10 Volt signal (Connections 15-16).
 0 = No external control
 1 = Control based on temperature setting
 2 = Control based on power setting

Menu D: General																			
D	2					0	-	1	0	M	i	n	T	m	p				
												2	0	°	C				

Function for the external control of the water heater by using a 0-10 Volt signal (Connections 15-16).
 Control based on temperature (setting 1).
 The minimum (desired) CH water temperature when supplying a 1.48 Volt signal.

Menu D: General																			
D	3					A	l	t		*		1	0	0	f				
												0							

Function for setting the location height (above sea level) of the water heater.
 NOTICE: dimensions in English feet. One unit = 100 ft.
 Use this function only in consultation with the supplier/ manufacturer.

Menu D: General												
D	4							M	a	x	C	o
								o	l	T	i	m
								2		M	i	n
Function for setting the maximum overrun time of the fan (Maximum 10 minutes). 0 = Switch off												

Menu D: General												
D	5							T	e	m	p	O
								n	D	i	s	p
								1				
Function to show the (measured) temperature of the water heater at the display.												

Menu D: General												
D	6							D	H	W	1	=
								i	2	=	d	
								1				
Function to set up the CH and HW water heater options. 0 = CH only (direct) 1 = CH/HW function (indirect) 2 = HW only (direct)												

Menu D: General												
D	7							c	o	n	f	i
								g				
Function for the setting of the water pressure. Up to 4 bar a sensor is used, up to 6 bar a switch. 0 = off 1 = sensor 2 = switch												

Menu D: General												
D	8							g	a	s	t	y
								p	e			
Function to select the gas type according to EN437 0 = G20, G25 1 = G31 2 = B/P												

Menu D: General												
D	9							c	o	n	f	i
								g				
Function for setting the 'soft start' option 0 = normal start-up 1 = reduced fan ramp-up speed (I) 2 = reduced fan ramp-up speed (II)												

Menu D: General												
D	A							c	o	n	f	i
								g				
Function: Pump mode 0 = normal 1 = relay 1, connector 19 and 20 (lock-out) 2 = relay 2, connector 21 and 22 (burner burning) 3 = relay 3, connector 23 and 24 (heat demand) 4 = relay CN10, connector 9 and 18												



The screen texts on these pages are standard part of the boiler software and apply to CH systems and/or hot water devices.

16.18 FAULT CODES DISPLAY

The following graphs describe the lock out codes of the water heater. A lock out code can only be removed by a manual resetting of the water heater. NOTICE: Before resetting the water heater always check the water heater, central heating system and all components corresponding to the related lock out description. Never just reset the water heater, before analysing the possible cause of failure.

16.18.1 LOCK-OUT CODES

Having a lockout means that the water heater needs a manual reset to start operating again. When the water heater is in lockout the backlight of the display is blinking on and off.

Explanation >

9	9	9	.	5	:	h	r	s
---	---	---	---	---	---	---	---	---

 = time elapsed after fault & message.

Explanation >

P	u	m	p	1	o	n
---	---	---	---	---	---	---

 = status of the pump during fault.

Display message	F	l	o	w	s	e	n	s	o	r	e	r	r	o	r			
F0	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Flow sensor not detected by the water heater caused by faulty connection/sensor.

Display message	F	l	o	w	h	i	g	h	T	e	m	p						
F1	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Flow temperature exceeds the limit as set in the parameters.

Display message	R	e	t	u	r	n	h	i	g	h	T	e	m	p				
F1	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Return temperature exceeds the limit as set in the parameters.

Display message	L	a	c	k	o	f	w	a	t	e	r							
F2	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason The general required gradient water lack has failed.

Display message	R	e	t	u	r	n	s	e	n	s	o	r	e	r	r	o	r	
F3	p	u	m	p	o	n					9	9	9	,	5	h	r	s

Reason Return sensor not detected by the water heater caused by faulty connection/sensor.

Display message	N	o	n	R	e	t	u	r	n	V	a	l	v	e				
F5	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Contact signal of the non-return valve failed.

Display message	F	l	u	e	s	e	n	s	o	r	e	r	r	o	r			
F6	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Flue gas sensor not detected by the water heater caused by faulty connection/sensor.

Display message	F	l	u	e	t	e	m	p	t	o	o	h	i	g	h			
F7	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Flue gas temperature exceeds the limit which has been set in the parameters.

Display message	F	a	i	l	e	d	b	u	r	n	e	r	s	t	a	r	t	
F8	p	u	m	p	o	n					9	9	9	.	5	h	r	s

Reason Water heater is not starting after the programmed starting attempts.

Display message F9	F l a m e l o s t																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Flame detected during normal operation, but was lost while running.

Display message F10	F a l s e f l a m e s i g n a l																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Flame signal is detected while it cannot be expected.

Display message F11	F a n s p e e d i n c o r r e c t																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason The controller does not detect a correct fan speed.

Display message F12	p r o g r a m m i n g e n d																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Software parameters have been programmed.

Display message F13	P a r a m / H a r d w f a u l t																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Fault during programming of the water heater software parameters.

Display message F14	H i g h G a s F a i l																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Gas supply pressure is too high.

Display message F15	C l i x o n F a u l t																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Rear wall thermostat (clixon) detects a too high temperature.

Display message F16	F l o w R e t u r n d t f a u l t																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Temperature difference T2-T1 has exceeded the blocking value.
Programmed as parameters P2 CO, P2 CR until P2 CV.

Display message F17	W a t e r h i g h l i m i t																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Maximum thermostat (clixon) measured a too high flow temperature.

Display message F18	A P S s w i t c h																			
	p u m p 1 o n							9	9	9	.	5			h	r	s			

Reason Air pressure switch is activated and exceeds the fixed time period.
Or combination of NRV blocking and an F11 lock out.

Display message F19	S i p h o n s w i t c h																			
	p u m p o n							9	9	9	.	5			h	r	s			

Reason Pressure switch detects a high pressure in the flue/siphon system.

The following graphs describe the blocking codes of the water heater. A blocking code is only a temporary blocking of the water heater, because of an extraordinary situation. The water heater will continue to operate after stabilisation of this situation.

16.18.2 BLOCKING CODES

The display is not blinking, but is lightened up during the blocking period.

The water heater is blocking an action because of an extraordinary situation. This action will be continued after stabilisation of this situation.

Display message	A	n	t	i	c	y	c	l	e	t	i	m	e						
											9	9	9	.	5		h	r	s

Reason The controller received a new heat demand too quick after the last ended demand.

Display message	F	l	u	e		t	e	m	p		h	i	g	h					
											9	9	9	.	5		h	r	s

Reason Flue gas temperature has exceeded the limit, as set in the parameters.

Display message	F	l	o	w		t	e	m	p		h	i	g	h					
											9	9	9	.	5		h	r	s

Reason Flow temperature has exceeded the blocking temperature, as set in the parameters, but it has not exceeded the lock-out value.

Display message	R	e	t	u	r	n		t	e	m	p		h	i	g	h			
											9	9	9	.	5		h	r	s

Reason Return temperature has exceeded the blocking temperature, as set in the parameters, but it has not exceeded the lock-out value.

Display message	T	2	-	T	1		h	i	g	h									
											9	9	9	.	5		h	r	s

Reason Temperature difference T2-T1 has exceeded the blocking value which has been set in the parameters.

Display message	D	e	a	i	r	a	t	i	o	n									
											9	9	9	.	5		h	r	s

Reason The water heater starts its deairation function and after will return to normal operation. This function can be activated by parameter P4AJ.

Display message	D	e	l	t	a		D	i	r	e	c	t		b	l	o	c	k	
											9	9	9	.	5		h	r	s

Reason Temperature difference T2-T1 has exceeded the blocking value, as set in the parameters P2CQ-P2CV.

Display message	H	e	a	t	e	x	c	h	a	n	g		a	t		r	i	s	k
											9	9	9	.	5		h	r	s

Reason Temperature difference T2-T1 has exceeded the blocking value, as set in the parameters P2CQ-P2CV, more than three times,.

Display message	G	a	s		p	r	e	s	s	u	r	e		l	o	w			
											9	9	9	.	5		h	r	s

Reason Gas supply pressure is (too) low.

Display message	W	a	t	e	r	p	r	e	s	s	u	r	e	f	a	u	l	t	s
												9	9	9	.	5	h	r	s

Reason Water pressure is too low or too high.

Display message	O	u	t	d	o	o	r	s	e	n	s	o	r	f	a	i	l	s
												9	9	9	.	5	h	r	s

Reason Outdoor temperature has exceeded the blocking temperature which is set in the parameters.

Display message	d	T	B	l	o	c	k												
												9	9	9	.	5	h	r	s

Reason Temperature difference between flow and return exceeds the blocking value but not the lock out value.

Display message	C	a	s	c	a	d	e	B	l	o	c	k							
												9	9	9	.	5	h	r	s

Reason One of the cascaded water heaters causes an error, because of a lock out.

Display message	A	P	S	f	a	u	l	t											
												9	9	9	.	5	h	r	s

Reason The activation of the air pressure switch.

Display message	N	R	V	o	r	F	a	n	f	a	u	l	t						
												9	9	9	.	5	h	r	s

Reason Non return valve contact signal activated, > 15 seconds will cause a lock-out.

Display message	L	i	n	e	f	a	u	l	t										
												9	9	9	.	5	h	r	s

Reason Wrong electrical power supply is connected (Not 50 or 60Hz, 220-240 Volt).

Display message	G	e	n	B	l	o	c	k											
												9	9	9	.	5	h	r	s

Reason The general blocking circuit is activated during operation = contact 7-8

16.18.3 IMPORTANT MESSAGE

The following graphs describe the messages at the water heater display. Depending on the selected and activated options for the water heater, it is possible that some messages will show up at the display of the water heater. For example a maintenance message after a certain programmed date has been reached. The water heater will operate independently of these messages.

The display shows alternating the base screen and this message, while the backlight is blinking.
The water heater is operating, but will count the exceeding hours.
A parameter must be changed, after service, to remove this message.

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	I	g	n	i	t	i	o	n	c	y	c	l	e	s			h	r	s

Reason Maintenance option of total amount of ignition cycles has been reached.

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	D	a	t	e													h	r	s

Reason Maintenance option of the date has been reached.

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	B	u	r	n	i	n	g	h	o	u	r	s			h	r	s		

Reason Maintenance option of total amount of burning hours has been reached.

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	A	I	I														h	r	s

Reason One of the abovementioned maintenance options has been reached.

17.0 CONTROLLING OPTIONS AND SETTINGS

17.1 GENERAL

17.1.1 EXTRA WATER HEATER CONTROL

When all units (cascaded) are firing at their maximum, it is possible to start an extra “external” heating source. This unit can be connected to the “Burner Burning” contacts (connection 21-22).

P5DE Extra water heater output enable (1) (display C4)

When this parameter is set at 1 the contact “Burner Burning” will close, but only when all units are firing at a certain (programmable) input percentage. The standard factory setting for this function is “OFF”.

17.1.2 MAX COOLING TIME

The fan will cool down the heat exchanger according to the temperature settings (parameters) of the software. With this cooling parameter, the maximum run time of the fan can be programmed.

P2LK Max cooling time (display D4) [min.]

The fan will cool the heat exchanger according to parameter P2 LJ, but the fan will never run for cooling longer than the period programmed with this parameter P2 LK. “0” = cooling function off.

For S1 > local set point P6BA – P2LJ → fan starts after 1 minute and stops after 3 minutes

During post pump circulation, no post ventilation takes place.

17.1.3 TEMPERATURE DISPLAY ON/OFF

Selection for showing the measured temperatures in the operation display of the water heater.

P5BJ Temperature display 1=on (display D5)

The measured temperature in the operation display.

0 = not visible

1 = visible

17.1.4 GAS TYPE SELECTION

Settings for gas types: natural gas, propane or butane-propane mixture (B/P).

P4 BD Gas type (0=standard, 1=propane, 2=B/P) (display D8).

This parameter is set 0 for the common used gas types such as natural gas G20.

By setting this parameter 1 for propane, fan speed is reduced. Set this parameter 2 for B/P.

- 0 = standard gas (e.g.: natural gas)
- 1 = propane
- 2 = B/P

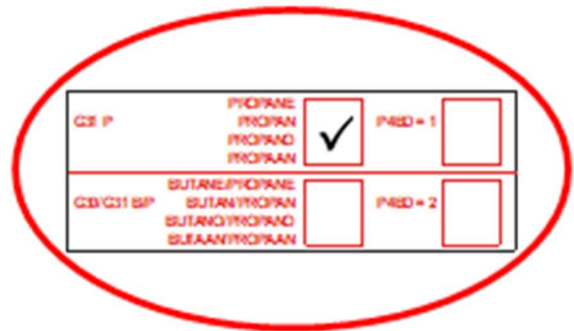
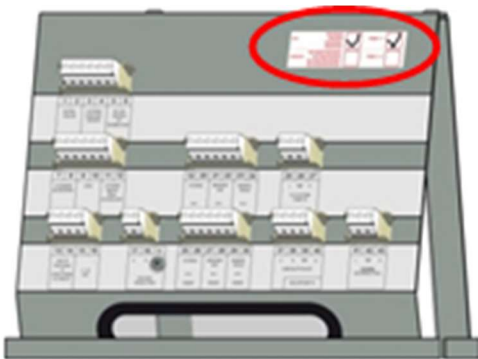
For each setting, the relevant Soft start settings are automatically adjusted, dependent of its main setting P4BE.



In case of gas conversion, paste the corresponding sticker at the appropriate position in the water heater and mark the square for the used gas type. Also, mark the square, indicating that the correct value has been set for parameter P4BD.

G31 P	PROPANE PROPAN PROPANO PROPAAN	<input type="checkbox"/>	P4BD = 1	<input type="checkbox"/>
G30/G31 B/P	BUTANE/PROPANE BUTAN/PROPAN BUTANO/PROPANO BUTAAN/PROPAAN	<input type="checkbox"/>	P4BD = 2	<input type="checkbox"/>

In the example below, 'propane' and 'P4BD = 1' have been marked).



17.1.5 SOFT START OPTION

Start parameters can be modified to achieve better start behavior, in case of noise or other difficulties. This is done by reducing the fan ramp-up speed. Two reduced settings are available (I and II).

P4 BE Soft start (0=normal, 1=reduced fan ramp-up speed (I), 2= reduced fan speed ramp-up (II)) (display D9).

- 0 = normal start-up
- 1 = reduced fan ramp-up speed (I)
- 2 = reduced fan ramp-up speed (II)

17.1.6 PUMP MODE (EC TECHNOLOGY)

When using a pump with Electronic Commutation technology and start-stop function, with a separate control connection, this parameter determines the relay for switching the pump on and off.

P5 BN Pump mode (0=modulating, 1=relay1, 2= relay2, 3= relay3, 4= do not use) (display DA).



Do not use the 230 Vac relay for the main power supply of the pump, but directly connect the pump to the mains of the water heater.

Pumps with an on/off control can be switched by one of the relay connections "lock-out", "burner burning" or "heat demand" (called 1, 2 and 3). Choose a connection which is not yet used.

- 0 = Normal mode.
- 1 = Start-stop through relay 1, connector 19 and 20 (lock-out)
- 2 = Start-stop through relay 2, connector 21 and 22 (burner burning)
- 3 = Start-stop through relay 3, connector 23 and 24 (heat demand)
- 4 = Do not use (reserved for future applications).

17.2 WATER HEATER OPTIONS

17.2.1 0-10 VDC REMOTE FLOW TEMPERATURE SET POINT

The hot water temperature is controlled by connecting an external 0-10 VDC signal to the water heater (connections 15-16).

P5 BB Analogue input Config (0=off 1=temp 2=power) (display D1).

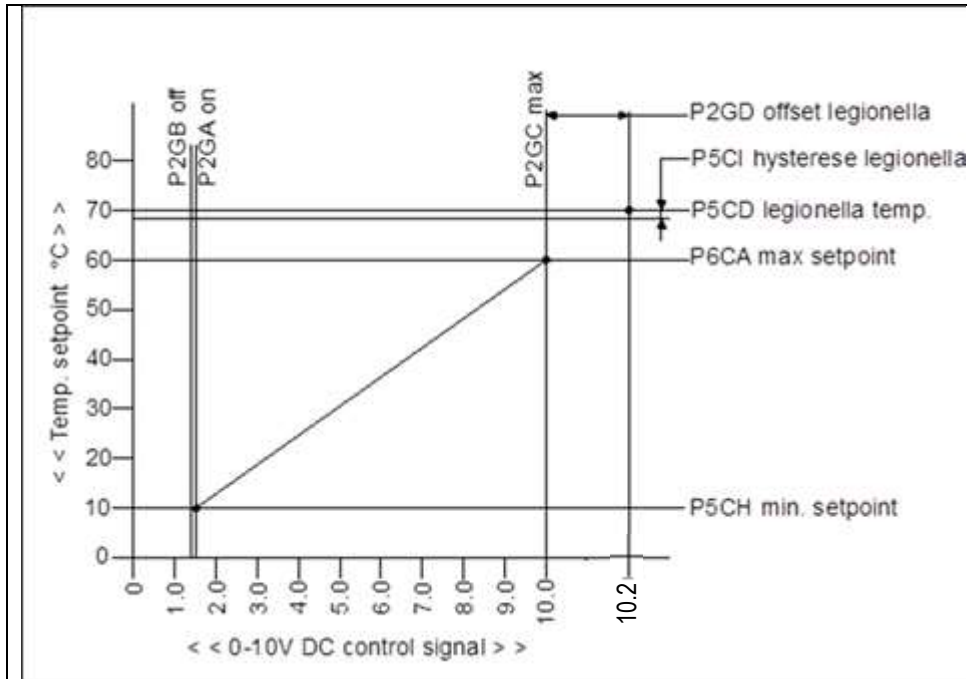
This parameter must be set at "1" so the supplied 0-10 V dc signal will control the temperature set point.

Possible settings are:

0 = 0-10V control off

1 = 0-10V temperature set point control active

See also the following graph for the relation between temperature and control signal.



Curve and values only for illustration purposes, programmed parameter values can deviate

17.2.2 ANTI-LEGIONNAIRES' DISEASE (PASTEURISATION) FUNCTION

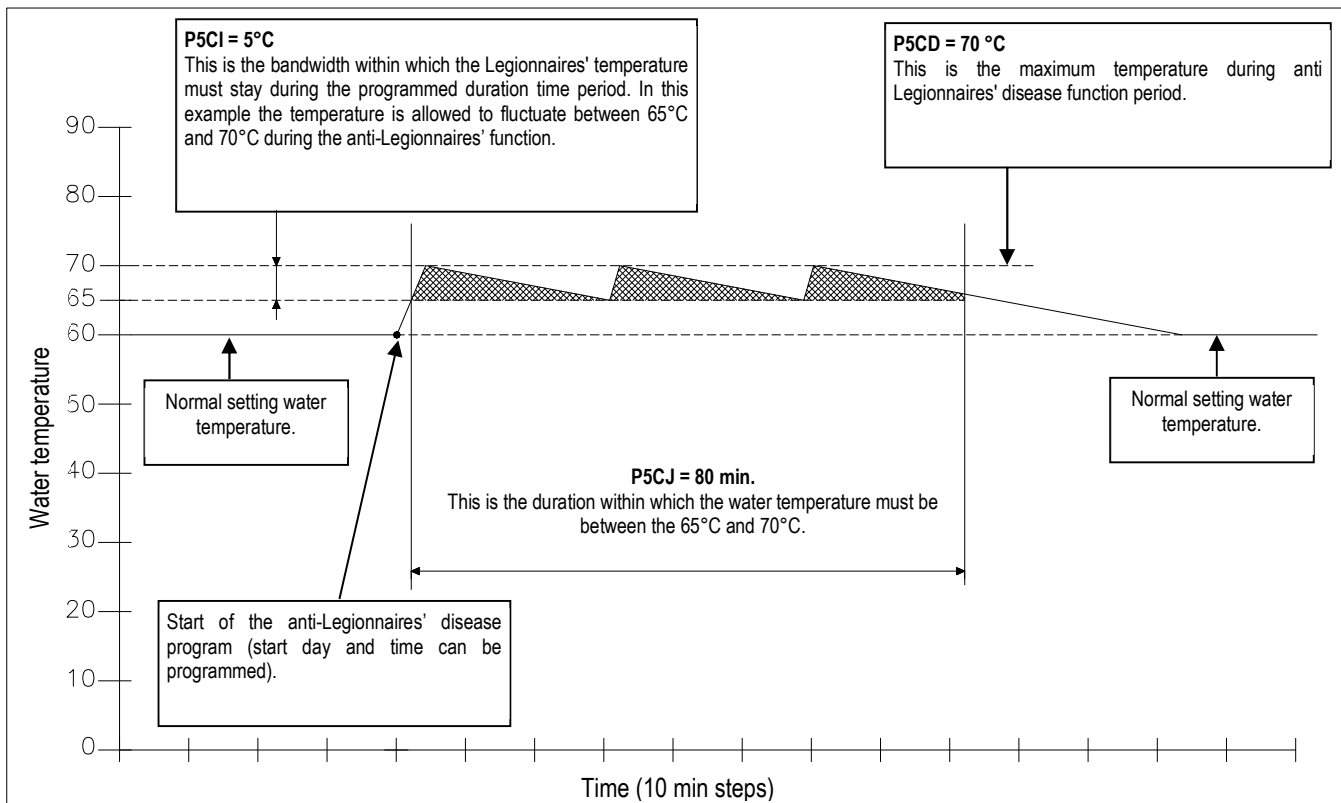
To help prevent Legionnaires' disease the water heater (software) provides a function for heating up the hot water storage tank (once a week or every day) to a higher water temperature than the normal active hot water set point. Also the time period, that this "higher" water temperature function must be active, can be programmed in P7BV start time (0:00) and P7BW (8) and is standard switched off.

Also an external 0-10 Vdc signal can be used to activate the pasteurisation function. This can be done by making the 0-10 V signal higher than 10.2 V.



The standard factory setting for this (pasteurisation) function is "OFF". To activate this Legionnaires' disease function some parameters must be programmed by the manufacturer/supplier. The starting day and time of this Legionnaires' disease function can be programmed at the control panel of the water heater.

Several parameters are used for this function. Three of these parameters are shown in the following graph.



Curve and values only for illustration purposes, programmed parameter values can deviate

The settings of these parameters P5 CI, P5 CJ and P5 CD must be programmed according to all applicable anti Legionnaires' disease preventing regulations.

The setting of these parameters can only be done by the manufacturer/supplier of the water heater and is possible by the display of the unit without the use of a computer.



The use and activation of this function will not guarantee a Legionnaires' disease free installation. The responsibility for a legionnaire's disease free installation remains at the end-user/owner.

17.2.3 TANK SENSOR SENSITIVITY

P2KH Gradient heat demand detection DHW tank temperature (display BG)

[0.1°C]

With S3 in use as tank sensor, it is possible to detect a fast cooling down of the tank through a large DHW flow. The sensitivity of this sensor can be set in parameter P2KH in tenths of degrees.

17.3 CASCADE CONTROL

Before commissioning a cascade installation, a number of parameters have to be changed. These parameters can be programmed on the unit itself, without the use of a computer.



NB! Remember that a TTW water heater is already a cascade of two burners, so cascading TTW water heaters gives a multiple of 2-burner cascades. Each burner will be given an address and only one burner in the whole cascade will be designated Master.



Only a skilled commissioning/service engineer, who has had specific training for setting up the TTW range water heaters, may carry out changes in parameters. He will be able to check whether the installation functions correctly after the parameter change has been done.

For programming **all parameters** of the water heaters a laptop with the appropriate software and an interface cable for connecting the laptop to the water heater control is required. This software is used for programming but also shows all measured temperatures and cascade behavior during operation and service/fault history.

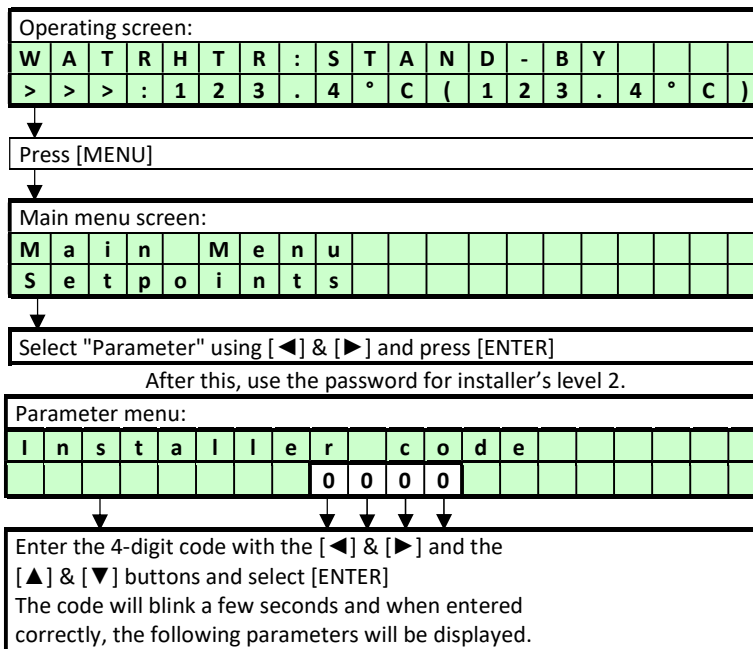
17.3.1 PARAMETER SETTINGS FOR CASCADED WATER HEATERS

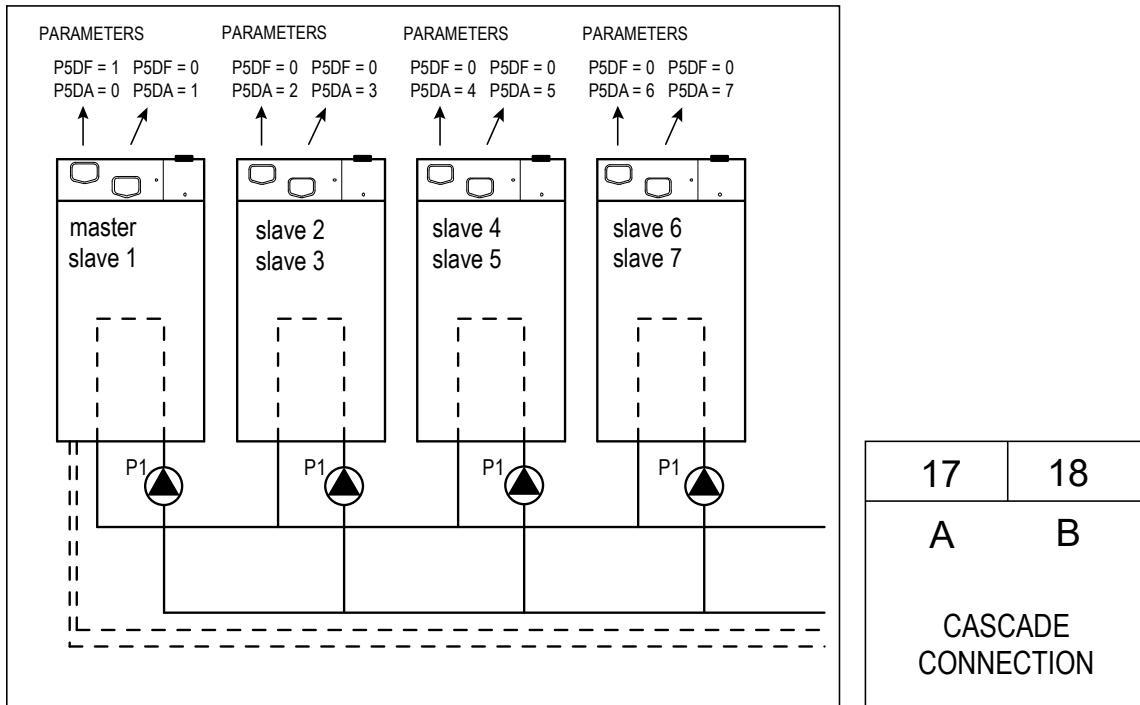
Before programming the cascaded water heaters, make sure that all water heaters are connected (wire) with each other. Use connection 17 and 18 of each water heater.



Do not alternate these connections, so always connect 17 to 17 and 18 to 18.

After connection, every water heater must be programmed. This can be done at the control panel. Press the [MENU] button and select the [PARAMETER] menu. See graphics below.





Now on each single water heater of the cascade, on both control panels, the following two parameters must be selected and programmed according to the above drawing.

Master:

C5 P5 DF **1**
 C2 P5 DA **0**

Slave 1:

C5 P5 DF **0**
 C2 P5 DA **1**

Slave 2:

C5 P5 DF **0**
 C2 P5 DA **2**

And so on.

Menu C: Cascade											
C	5			C	a	s	S	i	/	M	a
								0			
Function for the cascading of the water heater(s). This parameter sets the function of the water heater at a cascade alignment 0 = Slave unit1 = Single / Master unit											

Menu C: Cascade											
C	2			B	u	s	a	d	d	r	e
								0			
Function for the cascading of the water heater(s). This parameter determines the address of the water heater for the total cascading control. Master = 0, Slave1 = 1, etc.											

When the correct parameter is set, this must be confirmed at the confirmation screen. After activation, the value will blink for a few seconds while the parameter is programmed into the water heater.

When cascade connection is programmed correctly, the water heater display will show the following.

Explanation "Cascade communication indicator"			
NO CASCADE COMMUNICATION			
>	>	>	no.1
Always showing the fixed ">>>"			
CORRECT CASCADE COMMUNICATION			
>	>	>	no.1
>	>	>	no.2
Showing alternating no.1 & no.2 with 1-second interval.			

17.3.2 MONITOR SCREENS

To obtain cascade information, see 16.4.

17.3.3 OUTPUT CONTROL AND BURNER SEQUENCE

The total cascade set-up will act as one single big water heater, switching on- and off burners, depending on the total load necessary to adjust and keep the flow temperature at the calculated value.

When the heat demand rises, more burners are switched on, and when heat demand falls, one or more burners will be switched off. The burner that was switched on last will be switched off first, see table below.

To distribute operating hours equally over all burners, the working sequence of the burners will change every hour.

Hour	Switching ON sequence	Switching OFF sequence
X	Master – Slave 1 – Slave 2 – Slave 3 – Slave 4 – Slave 5 – Slave 6 – Slave 7	Slave 7 – Slave 6 – Slave 5 – Slave 4 – Slave 3 – Slave 2 – Slave 1 – Master
X+2	Slave 7 – Master – Slave 1 – Slave 2 – Slave 3 – Slave 4 – Slave 5 – Slave 6	Slave 6 – Slave 5 – Slave 4 – Slave 3 – Slave 2 – Slave 1 – Master – Slave 7
X+4	Slave 6 – Slave 7 – Master – Slave 1 – Slave 2 – Slave 3 – Slave 4 – Slave 5	Slave 5 – Slave 4 – Slave 3 – Slave 2 – Slave 1 – Master – Slave 7 – Slave 6
X+6	Slave 5 – Slave 6 – Slave 7 – Master – Slave 1 – Slave 2 – Slave 3 – Slave 4	Slave 4 – Slave 3 – Slave 2 – Slave 1 – Master – Slave 7 – Slave 6 – Slave 5
.....

Table: burner sequence example of a four water heater cascade (four TTW water heaters = eight burners).

In this table a total of four water heaters (one master burner, seven slaves) is mentioned as an example, in practice the maximum number in a cascade, without extra (external) control, is six water heaters (= twelve burners).

18.0 COMMISSIONING THE WATER HEATER

18.1 FIRST: FLUSHING THE WATER HEATER WITH WATER

After installation of the water heater the first step, before commissioning, is to flush the water heater and the whole DHW installation with fresh water to remove pollution, debris and other materials that might cause a blocking. This must also be done with installations, where only the water heater is replaced.

18.2 SECOND: FILLING & VENTING THE WATER HEATER AND THE SYSTEM

After flushing the water heater and the installation the system can be filled with fresh water by opening the water supply valve of the system and opening all the taps that are on the system. The water pressure of the system should be between a **minimum of 1 bar and a maximum of 8 bar**, also depending on the applied pressure safety valve fitted.

The water heater has an automatic air vent situated on top of the water heater (at the roof panel). This vent must be opened during the filling of the water heater and the DHW system to make sure that no air/oxygen is trapped in the heat exchanger of the water heater. NOTICE: Check that the screw cap has been loosened at least one twist.

Make sure that, during flushing and filling, no water can reach any electrical parts of the water heater.

18.3 THIRD: CHECK THE WATER FLOW

Before the water heater will be started it must be sure that the pump is functioning and that there is a water flow over the heat exchanger. Check the electrical power supply of the water heater and when this is connected correctly, the display will show either of the following:

Display message	B	o	i	l	e	r	o	f	f													

Reason Water heater is not active. To activate the water heater press [ON/OFF] button for six seconds.

Display message	W	A	T	R	H	T	R	:	b	o	i	l	e	r	o	f	f					
	>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)		

Reason Water heater is standby. To activate the water heater press [ON/OFF] button for three seconds.

Activate the water heater by pressing the ON/OFF button for six resp. three seconds. After this the following display will appear:

Display message	W	A	T	R	H	T	R	:	N	o	d	e	m	a	n	d						
	>	>	>	:	1	2	3	.	4	°	C	(1	2	3	.	4	°	C)		

Reason Water heater is active, but there is no heat demand.

When no water is present in the water heater or the water pressure is too low/high, the water heater will go into lock-out and will show a corresponding message in the display.

Display message	W	a	t	e	r	p	r	e	s	s	u	r	e	f	a	u	l	t				
														9	9	9	.	5	h	r	s	

Reason Water pressure is too low or too high

By pressing the [SERVICE] button of the water heater, the water heater can be started without a heating demand. The water heater will start to fire and also the pump will start to run. Firing of the water heater without a water flow (but filled with water!) will cause the so called “boiling noises”. Check during this “service function” operation also the flow and return temperatures of the water heater by pressing the [◀] button once. The temperature difference of the flow and return must be at least 13°C and maximum 25°C. This temperature difference indicates that there is a (enough) water flow over the water heater; this water flow prevents the heat exchanger of possible damage caused by a thermal overload.

18.4 FLOW MONITORING

Another safety feature of the water heater, to make sure that there is enough water flow over the water heater, is the monitoring of the flow and return temperatures (T2 and T1). When the temperature difference (delta T) between flow and return exceeds a certain (set) value (load dependent), the following warning messages will be shown in the display.

Display message	T	2	-	T	1		h	i	g	h										
												9	9	9	.	5		h	r	s

Reason Temperature difference T2-T1 has exceeded the blocking value, as set in the parameters P2CO, P2CR until P2CV.

Display message	D	e	l	t	a		D	i	r	e	c	t		b	l	o	c	k				
														9	9	9	.	5		h	r	s

Reason Temperature difference T2-T1 has exceeded the blocking value, as set in the parameters.

When this T2-T1 value exceeds the lock-out setting, the water heater will switch off and the following lock out code will be shown at the display.

Display message	F	l	o	w	R	e	t	u	r	n		d	t		f	a	u	l	t			
F16	p	u	m	p		o	n							9	9	9	.	5		h	r	s

Reason Temperature difference T2-T1 has exceeded the blocking value, or after three times Delta Direct block.

When these messages appear and/or the water heater will lock out, it means that there is not enough flow over the water heater. In this case check the functioning of the pump.

The water heater has a built in water pressure switch. If water pressure of the system drops under a certain limit, the water heater will go in a lock-out.

During and after the commissioning of the water heater, the operation of the water heater pump must be checked, before leaving the installation room.

NOTICE: Always check the running of the pump before firing the water heater.

19.0 STARTING THE WATER HEATER

19.1 GENERAL

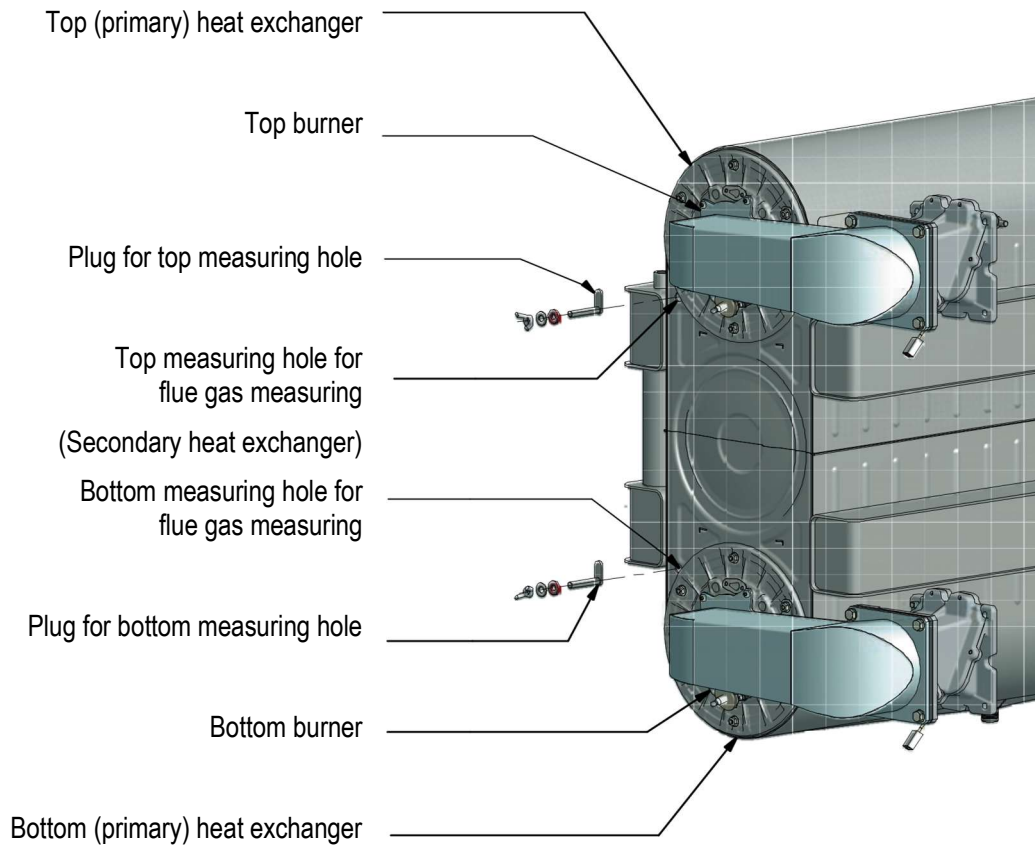
The gas input pressure for the water heater to operate properly under the correct load, must be at high fire more or equal to the minimum gas inlet pressure for the supplied gas type, as stated in the technical specification data table on page 5.

* Gas valve screws and nipples: see picture on page 76.

The water heater has two identical gas control valves: the top burner (MASTER) and the bottom burner (SLAVE 1). Both gas valves must be adjusted at maximum load and at minimum load.

Two burners are present in one heat exchanger. In fact, into one stainless steel casing, two heat exchangers have been built, a primary and a secondary. The primary exchanger, moreover, consists of an upper and a lower part. The upper part in which the top burner fires, is only transferring heat from the top burner. The lower part in which the bottom burner fires, is only transferring heat from the bottom burner. After the flue gases have passed the primary heat exchanger, they merge in the central part. In this secondary part the remaining heat is extracted from the flue gases of both burners, causing condensation of the gases, if cooled down sufficiently,

Measuring the O₂ percentage in the flue gas outlet outside the water heater, while both burners are burning, will result in an average O₂ value. It is possible that this average value is correct, while the O₂ setting of the top burner is too low and the O₂ setting of the bottom burner is too high. Therefore the O₂ levels of each burner must be adjusted separately. Measurements are performed at the front, by making use of two measuring holes. See drawing.



19.2 FIRING FOR THE FIRST TIME

After commissioning the water heater and avoiding any possible heat demand (remove the thermostat connection lead), the water heater displays the following message:

Display message	H	E	A	T	I	N	G	:	N	o	d	e	m	a	n	d			
	>	>	:	1	2	3	.	4	°	C	(	1	2	3	.	4	°	C)

Reason Water heater is active, but there is no heat demand.

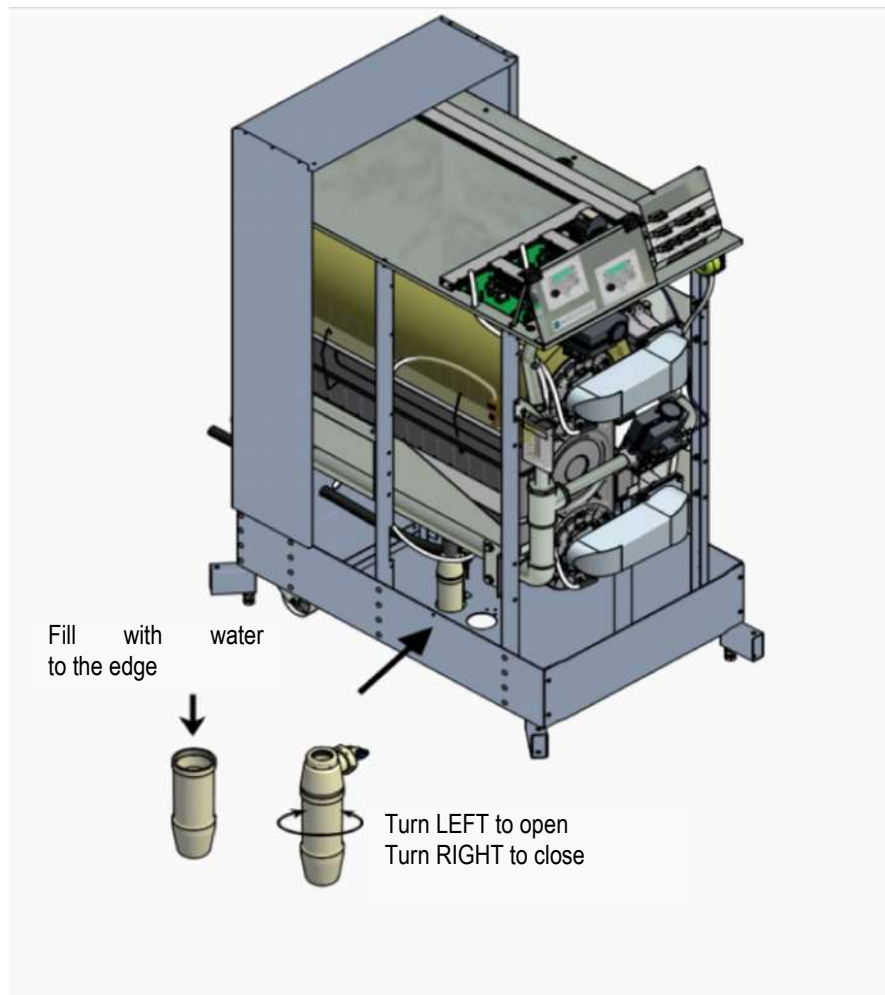
The display describes:

- The actual operation for heating or hot water
- If a heat demand is activated
- The temperature setting
- The temperature measured



When mounting the bottom part of the siphon, before commissioning the water heater and/or after maintenance, the siphon must ALWAYS be completely filled with water.

This is a safety measure: the water in the siphon keeps the flue gases from leaking into the plant room via the condensate drain.



20.0 ADJUSTING AND SETTING THE BURNERS



Before carrying out any adjusting of the burner, carefully read this complete chapter.

20.1 INTRODUCTION

Always adjust the burners after one of the following events:

- A.** - A new water heater has been installed
 - As part of a service/maintenance check, in case the CO₂ values prove to be incorrect

Adjustment procedures for case **A** are described in **20.2**.

- B.** - A gas control safety valve has been (re)placed
 - Another type of gas is applied: gas conversion

Adjustment procedures for case **B** are described in **20.3**.

In either of the four cases described in **A** and **B**, always check the gas/air ratio of the combustion figure (O₂) at maximum and minimum input. First adjust the water heater at maximum load and subsequently at minimum load, and repeat if necessary.

Set-up of this chapter:

First, all necessary values are given in below **TABLE 20.1.1**. A drawing of the gas valve(s) and setting screws is given in **20.1.4** on page 94. **20.1.5** shows how to operate the measuring holes. **20.1.6** is a general scheme, confirming which adjustment must be carried out. After that, in **20.2** and **20.3**, a detailed description is given of how to proceed in cases **A** and **B** respectively.

20.1.1 ADJUSTMENT TABLES

Gas type ¹⁾	O ₂ [%]			CO ₂ [%]	
	max load	min load		max load	min load
Natural gas G20	4.5 – 4.8	4.9 – 5.2		9.0 – 9.2	8.8 – 9.0
Propane³⁾ G31	4.6 – 4.9	5.7 – 6.0		10.5 – 10.7	9.8 – 10.0
B/P 3.4) G30/ G31	4.7 – 5.0	5.9 – 6.2		10.5 – 10.7	9.8 – 10.0

¹ Cf. EN437.

² All values measured without front door. The O₂ / CO₂ values should always be between the values set in this table. Nominal values can be found in Technical specifications datasheet page.

³ Fan settings must be changed by altering parameter P4BD (display D8). (only by a skilled mechanic).

⁴ B/P: Propane/butane mixture.



Using propane or butane/propane mixtures (B/P), maximum fan speed needs to be reduced by changing parameter P4BD

20.1.2 ADJUSTMENT VALUES

To make adjustments easier, values of table 1 are presented in the following figures.

The CO₂ / O₂ values should always be between the values set in this figure.

Nominal values can be found in the Technical specifications table at the beginning of this manual.

All values are measured without front door

Figure 1:

Natural gas G20

The O₂ / CO₂ level may never be in the hatched area.

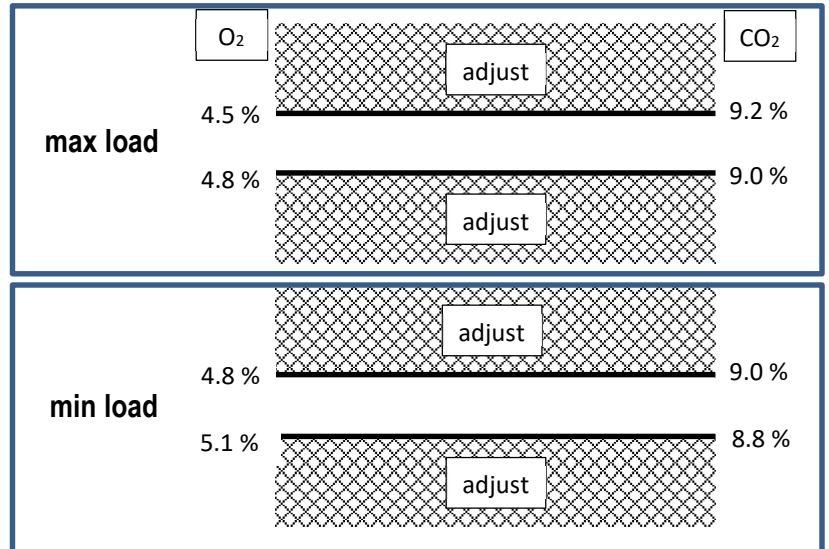


Figure 2:

Propane G31:

The O₂ / CO₂ level may never be in the hatched area.

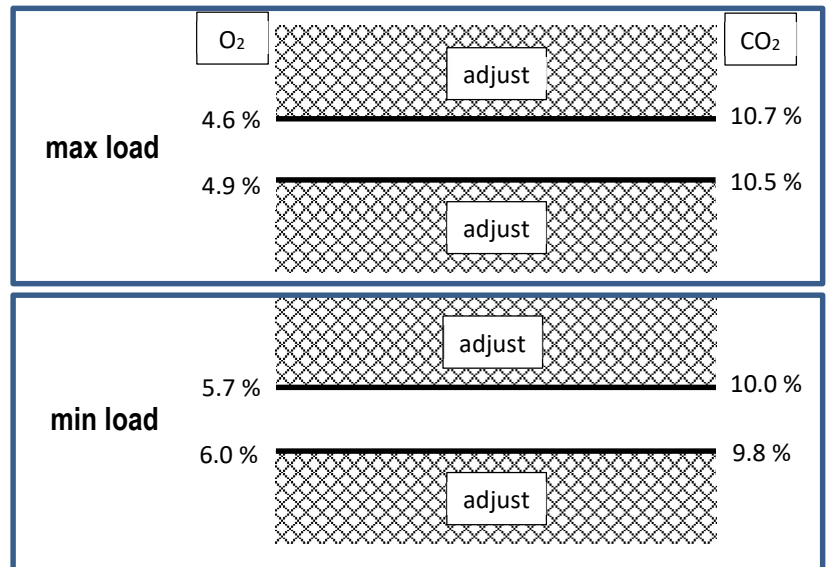
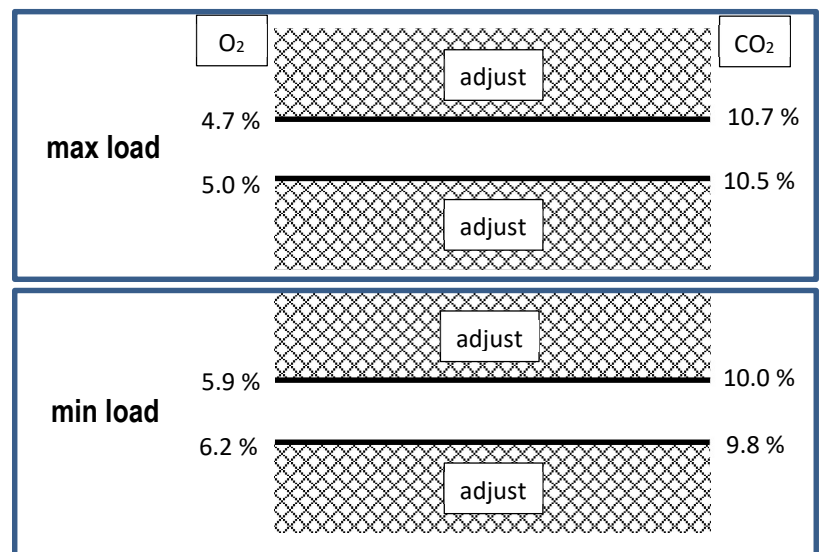


Figure 3:

B/P: propane/ butane mixture G30/ G31

The O₂ / CO₂ level may never be in the hatched area.





Check the setting of parameter P4BD (gas type)
 0 = Standard gas; e.g.: Natural gas G20
 1 = Propane G31
 2 = Mixture of Butane/Propane, B/P (G30/G31)
 Setting of the parameter is described 16.17.

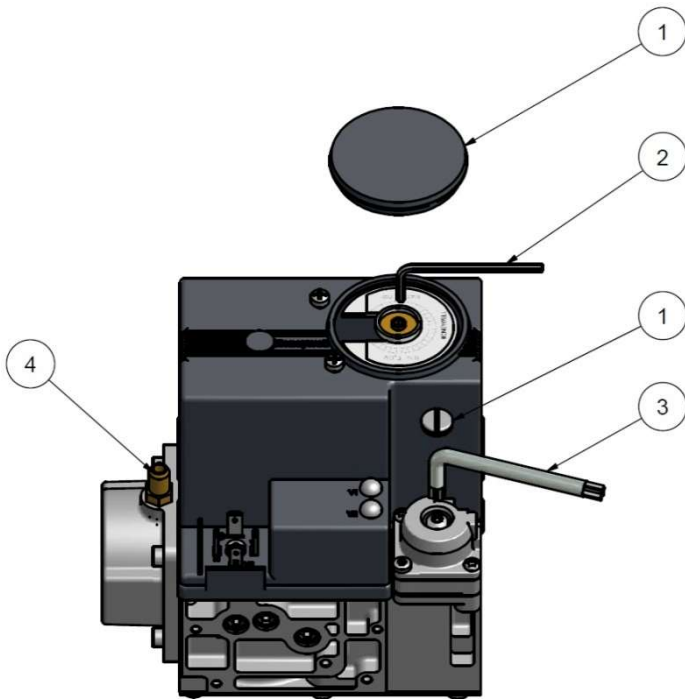
PRE ADJUSTMENT SETTINGS GAS VALVES

WATER HEATER TYPE	BURNER	NUMBER OF TURNS OPEN (COUNTER CLOCKWISE)	
		NATURAL GAS G20 ¹	PROPANE G31 ¹ AND B/P
TTW 410	top	2.5	0.75
	bottom	3.0	0.75
TTW 580	top	3.5	1.0
	bottom	3.5	1.0

¹ In accordance with EN437

20.1.3 PRE ADJUSTMENT SETTINGS FOR GAS VALVES

20.1.4 GAS VALVE SETTING SCREWS: DRAWING



Nr.	Description
1	Removable cap
2	Adjustment at maximum load. Use Allen key no. 3 higher: turn left (CCW) lower: turn right (CW)
3	Adjustment at minimum load. Use Torx T40 key higher: turn right (CW) lower: turn left (CCW)
4	Gas supply pressure nipple

20.1.5 HOW TO REMOVE AND MOUNT THE FLUE PLUG:



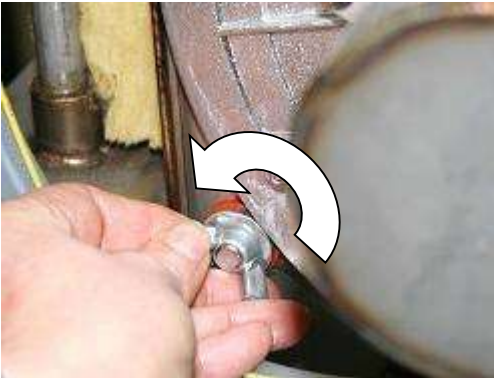
Make sure during measurement in one measuring hole, that the other one is closed.

When several measurements are done in both holes alternately, the unused hole may be temporarily Scotch taped or closed by means of a rubber plug.

AFTER FINISHING ALL MEASUREMENTS, CLOSE BOTH HOLES USING THE ORIGINAL PLUGS.

Removing plug from heat exchanger:

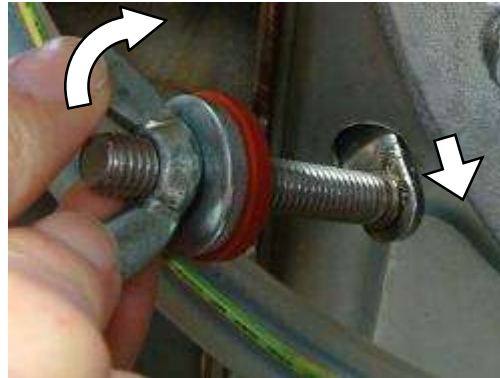
Loosen the plug:



Loosen M8 wing-nut counter clockwise approximately 20 mm.

DO NOT UNSCREW THE NUT ENTIRELY FROM THE BOLT.

Pull the plug out:



Pull and tilt the bolt so the metal lip can be extracted.

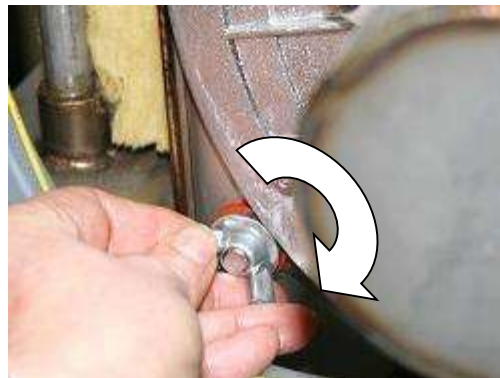
Mounting the plug:

Position the plug into heat exchanger:



Insert the metal lip upwards into the hole and tilt the bolt to a horizontal position, so the lip is completely inside the heat exchanger.

Fasten plug:



Turn the nut clockwise by hand to fasten plug.
- DO NOT USE EXCESSIVE FORCE.
- DO NOT USE TOOLS.

20.1.6 ADJUSTMENT ACTIONS: GENERAL SCHEME

General scheme for adjustment of the gas valve(s). Consult this scheme for an overview.

To complete all the necessary adjustments in the right order, follow case **A** or **B** top-down through the scheme (**B** involves a few extra steps (grey text blocks)):

GENERAL SCHEME: ADJUSTMENT STEPS		
	case A new water heater or service check	case B valve replacement or gas conversion
start	adjusting the top burner – upper measuring hole	
top burner	go to service mode	in case of gas conversion: set parameter P4BD to the correct gas type at the left panel (top burner)
		first close screw [2] of the valve, then open it according to table 20.1.3
		go to service mode
		if burner doesn't start, open screw [2] ¼ turn extra
		1) <u>maximum</u> load: check and adjust
	2) <u>minimum</u> load: check and adjust	
	repeat steps 1) and 2) until measurements match table 1 values within ± 0.1%	
	switch top burner off, proceed with bottom burner	
next	adjust the bottom burner – lower measuring hole	
bottom burner	go to service mode	in case of gas conversion: set parameter P4BD to the correct gas type at the right panel (bottom burner)
		first close screw [2] of the valve, then set it in accordance with table 2
		go to service mode
		if burner doesn't start, open screw [2] ¼ turn extra
		1) <u>maximum</u> load: check and adjust
	2) <u>minimum</u> load: check and adjust	
	repeat steps 1) and 2) until measurements match table 1 values within ± 0.1%	
check	check with both burners burning -	1. upper measuring hole 2. lower measuring hole
both burners	set bottom burner to 50% load, start top burner and set it to 50% load	
	set both burners simultaneously to maximum load (▲ 2x)	
	1)	check at maximum load. Measure 2x: top and bottom, and average
	set both burners simultaneously to minimum load (▼ 2x)	
	2)	check at minimum load. Measure 2x: top and bottom, and average
	If measurements 1) and 2) match table 1 values within ± 0.3%, adjustment is correct	
	If deviation is more than 0.3%, start all over again: check and adjust burners separately	
Water heater returns to NORMAL MODE after 40 minutes OR by pressing [SERVICE] button		

20.1.7 NOTE: O₂ MEASURING POSITION

This chapter describes the procedure for adjusting and checking O₂ values by measuring at the front of the water heater, using the upper measuring hole for adjusting the top burner and the lower measuring hole for adjusting the bottom burner.

When both burners are on, a deviation from the single burner measurements occurs: the upper hole shows O₂ values higher than the nominal value, the lower hole shows O₂ values lower than the nominal value. However, the average value of the upper and lower measurements can be used to check the nominal O₂ percentage.

If possible, measuring O₂ in the flue gas outlet outside the water heater, at the back, is preferred. The reason is that the flue gas in the common outlet is better mixed and measurements are less deviating, regardless of whether the top or the bottom burner is on, or both. This means that measuring and adjusting is easier: neither change of measuring hole, nor averaging values is necessary.

For an extensive description consult the next two sections (choose which is applicable, A or B):

20.2 ADJUSTING IN CASE OF A NEW WATER HEATER, OR AFTER MAINTENANCE (CASE A)

20.2.1 GENERAL REMARK

For all adjusting steps under **A** the following must be applied: no adjustment is required if measured values are within the margins **shown in 20.1.2**

20.2.2 CHECKING AND ADJUSTING THE TOP BURNER

- Start top burner.
- On the left control panel (controlling the top burner), go to service mode: press [SERVICE] button for about 4 seconds. After start-up it shows:

Display message	W	A	T	R	H	T	R	:	S	e	r	v	i	c	e		3	0	%
	>	>	>		1	2	3	.	4	°	C	(1	2	3	.	4	°	C

Water heater is activated and operates at service mode at minimum.

NB! The service mode of the water heater will be active for 40 minutes. After this the water heater will return to normal operation.

Make sure that only one burner is burning: the green LED on the other panel should be off.

Also check that the fan of the bottom burner is not running: the error message "NRV or fan fault" should not be on the display of the right panel.

Maximum load adjustment.

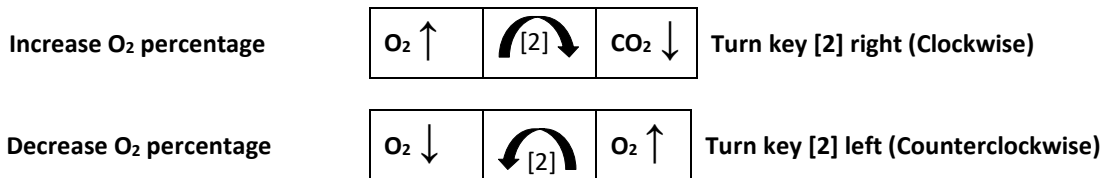
- Press [▲] button until maximum load is reached:

Display message	W	A	T	R	H	T	R	:	S	e	r	v	i	c	e		1	0	0	%
	>	>	>		1	2	3	.	4	°	C	(	1	2	3	.	4	°	C)

Water heater is activated and operates at service mode at 100% (maximum) (example).

- Measure O₂ / CO₂ in the upper measuring hole (top burner).

Adjust the O₂ within ± 0.1% according to figures **shown in 20.1.2** using key [2]:



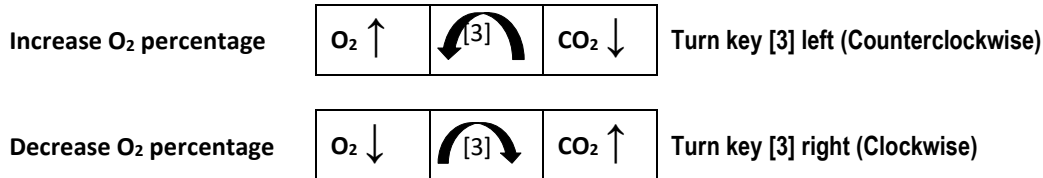
Minimum load adjustment.

- Press [▼] button until minimum load is reached.

Display message	W	A	T	R	H	T	R	:	S	e	r	v	i	c	e			3	0	%
	>	>	>		1	2	3	.	4	°	C	(	1	2	3	.	4	°	C)

Water heater is activated and operates at service mode at minimum.

- By setting screw [3], adjust the gas valve to obtain the O₂ / CO₂ value shown in 20.1.2



Repeat adjustments:

- Check again at maximum load and adjust if necessary.
- Check again at minimum load and adjust if necessary.
- Repeat previous steps until measurements match shown in 20.1.2.
- Switch the top burner off (press service button).

20.2.3 CHECKING AND ADJUSTING THE BOTTOM BURNER

- On the right control panel, go to service mode (press [SERVICE] button for 4 seconds). Make sure that only the bottom burner is on: the green LED on the left panel (top burner) should be off. Also check that the fan of the top burner is not running: the error message "NRV or fan fault" should not be on the display of the left panel.
- Set the load at maximum by pressing the [▲] button.
- Measure O₂ in the lower measuring hole (bottom burner).
- Adjust the O₂ within ± 0.1% according to shown in 20.1.2 using key [2].
- Set the load at minimum by pressing the [▼] button.
- Adjust the O₂ within ± 0.1% according to shown in 20.1.2 using key [3].
- Check again at maximum load and adjust if necessary.
- Check again at minimum load and adjust if necessary.
- Repeat previous steps until measurements match shown in 20.1.2 .
- Switch the bottom burner off (press [SERVICE] button).

20.2.4 CHECKING BOTH BURNERS

To switch both burners on at the same time: switch to service mode, set one burner at 50% load using the [▲] and/or [▼] buttons. While this burner is on, switch the other burner to service mode (press [SERVICE] button for 4 seconds). After start-up, set it also at 50% load.

- To set both burners at maximum load, press [▲] buttons on both panels simultaneously.
- Measure O₂ in the upper measuring hole (top burner); a tolerance of -0.1 to + 0.3% of the shown in 20.1.2 value is acceptable. Note down this value.
- Measure O₂ in the lower measuring hole (bottom burner); a tolerance of - 0.3 to +0.1% of the shown in 20.1.2 value is acceptable. Note down this value.
- Calculate the average of these two measurements: add the upper and lower values and divide by two.
- If this average O₂ at maximum matches shown in 20.1.2 within ± 0.1%, proceed with the next step: checking at minimum load. If the deviation is larger than ± 0.1%, check and re-adjust burners separately again.
- To change to minimum load, press [▼] buttons on both panels simultaneously.
- Check O₂ for the minimum load: measure O₂ in the upper measuring hole of the top heat exchanger; a deviation up to + 0.3% of the table 16.1 value is acceptable. Note down this value.
- Measure O₂ in the lower measuring hole of the bottom heat exchanger; a deviation down to - 0.3% of the shown in 20.1.2 value is acceptable. Note down this value.
- Calculate the average of these two measurements: add the upper and lower values and divide by two.
- If this average O₂ at minimum matches shown in 20.1.2 within ± 0.1%, adjustment is correct. If the deviation is larger than ± 0.1%, check and re-adjust burners separately again.
- If measurements at maximum and minimum match shown in 20.1.2 within ± 0.1%, adjustment is completed.
- Switch burners off (press [SERVICE] buttons on both panels).

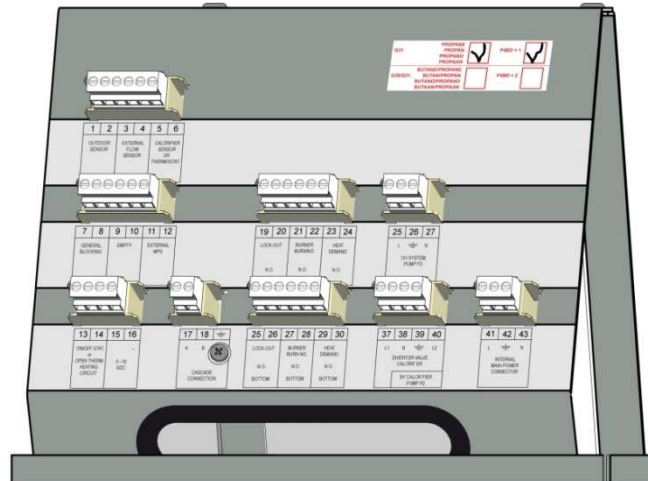
20.3 ADJUSTING AFTER GAS VALVE REPLACEMENT OR IN CASE OF GAS CONVERSION (CASE B)



In case of gas conversion, apply the corresponding sticker at the appropriate position in the water heater and mark the square for the used gas type. Also, mark the square, indicating that the correct value has been set for parameter P4BD.

(In the example below, 'propane' and 'P4BD = 1' have been marked).

G31 P	PROPANE PROPAN PROPANO PROPAAN	<input type="checkbox"/>	P4BD = 1	<input checked="" type="checkbox"/>
G30/G31 B/P	BUTANE/PROPANE BUTAN/PROPAN BUTANO/PROPANO BUTAAN/PROPAAN	<input type="checkbox"/>	P4BD = 2	<input type="checkbox"/>



20.3.1 GENERAL REMARKS

As can be seen in the general scheme, the main adjusting steps in case **B** are the same as in case **A**, except for these extra steps:

- set the right gas group; parameter P4BD (display D8). See also 17.1.4
- a pre adjusting step, to make sure the burner will fire

All adjustments must result in O₂ / CO₂ percentages shown in 20.1.1 or 20.1.2



In case of gas conversion: check parameter P4BD for the correct setting.

20.3.2 CASE B ADJUSTMENTS

Pre adjusting the top burner:

- Turn setting screw [2] of the upper gas valve **clockwise** until you feel resistance. This means that the valve is closed; *do not try to tighten the screw any further.*
- Now turn this screw **counter clockwise** (open), according to the number of turns in TABLE 20.1.3 for the used water heater and gas type.

→ proceed according to steps in 20.2.2.

If the burner does not start up in service mode, turn screw [2] an extra quarter turn counter clockwise, and try again.

Pre adjusting the bottom burner:

- Turn setting screw [2] of the lower gas valve **clockwise** until you feel resistance. This means that the valve is closed; *do not try to tighten the screw any further.*
- Now turn this screw **counter clockwise** (open), according to the number of turns in TABLE 20.1.3 for the used water heater and gas type.

→ proceed according to steps in 20.2.3.

If the burner does not start up in service mode, turn screw [2] an extra quarter turn counter clockwise, and try again.

Checking both burners:

→ proceed according to steps in 20.2.4.

21.0 PUTTING THE WATER HEATER OUT OF OPERATION

It is recommended to have the water heater operational all year round to prevent any frost damage during the winter and/or rotating parts getting jammed during other times of the year (built in water heater safety features).

OUT OF OPERATION: On/off function.

To be used when the appliance must be put out of operation for a long period because of a defect or another safety risk.

Act as follows:

- Disconnect or switch off the tank thermostat and/or other external controllers from the water heater. The pump and fan will stop after a short time.
- Switch off the water heater by pressing the [ON/OFF] button for six seconds.
- Make sure the following display screen is visible.

Display message	B	o	i	l	e	r	o	f	f										

Properties of the 'off' function:

- The keys do NOT respond and the menu is NOT accessible.
- The burner does NOT respond to an external heat demand.
- The water heater CAN, however, be switched on again by pressing the [ON/OFF] button.
- Pump(s), fan(s) and cascade (if applicable) are operational, and so are both recirculation protection (if applicable) and frost protection.
- To reactivate the water heater, switch on the burner by pressing [ON/OFF] for six seconds again.



**The frost protection module can still activate the burner(s).
To prevent this, switch off this protection or put the water heater in 'power off' mode.**

OUT OF OPERATION: Power off.

To assure that the water heater cannot become active at all anymore, power should be cut off completely.

Act as follows:

- Disconnect or switch off the tank thermostat and/or other external controllers from the water heater. The pump and fan will stop after a short time.
- Switch off the water heater by pressing the [ON/OFF] button for six seconds.
- Make sure the following display screen is visible.

Display message	B	o	i	l	e	r	o	f	f										

- Switch off the electrical power supply of the water heater (remove connection from the wall socket, or switch off the main power).
- Close the gas valve / gas supply.
- In case of possible frost damage: drain both the water heater and the DHW system.
- NOTICE: Before starting to drain the water heater, first start draining the DHW system and subsequently open also the two drains of the water heater.

22.0 FAULT CODES, BLOCKING CODES

22.1 FAULT CODES

IMPORTANT:

To avoid electric shocks, disconnect electrical supply before performing troubleshooting. To avoid burns, allow the unit to cool before performing troubleshooting.

Be aware that a fault code is an indication that the unit or the system needs attention. When repeatedly having faults these should not be neglected.

The first step is to check if the unit is installed according to the instructions. If not, first make sure the installation complies with the installation manual.

Always check the fuses on the control board before replacing any major components. A blown fuse can prevent the controller or other components from operating.

Most faults can also be caused by a bad wiring and/or connections, even if it is not specifically mentioned. With every fault it is wise to check wiring and connections (at both ends) that connect to the safety device/component that generates the fault.

22.1.1 LOCK-OUT CODES:

Having a lockout means that the water heater needs a manual reset to start operating again. When the water heater is in lockout the backlight of the display is blinking on and off.

Explanation > **9 9 9 . 5 : h r s** = time elapsed after fault/message.

Explanation > **P u m p 1 o n** = status of the pump during fault.

Display message	F l o w s e n s o r e r r o r
F0	p u m p o n 9 9 9 . 5 h r s
Reason:	Flow sensor is not detected.

Cause:	Bad wiring/connection in the flow sensor circuit.
Corrective action:	Check for loose wiring/connections in the flow sensor circuit.

Cause:	Bad temperature sensor causing a fault signal.
Corrective action:	Replace flow sensor.

Display message	F l o w h i g h T e m p
F1	p u m p o n 9 9 9 . 5 h r s
Reason:	Max. flow temperature exceeds limitation (lock-out) value.

Cause:	The water flow is restricted.
Corrective action:	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.

Display message F1	R e t u r n h i g h T e m p
	p u m p o n 9 9 9 . 5 h r s
Reason:	Maximum return temperature exceeds limit value.

Cause:	Systems that pre-heat the water heater return temperature too high.
Corrective action:	Reduce pre heat temperature of external heat source.

Cause:	The need for heat in the system suddenly drops causing hot return water to the.
Corrective action:	Dampen external heating system control to prevent sudden water heater temperature rise.

Display message F2	L a c k o f w a t e r
	p u m p o n 9 9 9 . 5 h r s
Reason	No temperature rise measured during firing.

Cause:	When the unit starts firing it expects to measure a temperature rise. If this temperature rise is not detected, there is suspicion that there is no medium (water) present, to transfer heat from combustion to the sensor. The lack of water can cause this fault when the unit is firing.
Corrective action:	Make sure there is water present in the unit before firing.

Display message F3	R e t u r n s e n s o r e r r o r
	p u m p o n 9 9 9 . 5 h r s
Reason	Return sensor is not detected by the water heater PCB.

Cause:	Bad wiring/connection in the return sensor circuit.
Corrective action:	Check for loose wiring/connections in the return sensor circuit.

Cause:	Bad temperature sensor causing a fault signal.
Corrective action:	Replace return sensor.

Display message F5	N o n R e t u r n V a l v e
	p u m p o n 9 9 9 . 5 h r s
Reason	NR valve contact (signal) lost for fixed time period. (If P2MT = 2 or 3)

Cause:	It is not proven that the non-return of the burner that is not burning is closed.
Corrective action:	Check the state of the Non Return Valve: > Is the valve moving freely to the open and closed position. > Is there debris/fouling or corrosion in the valve to prevent the valve to move freely. Check for loose wiring/connections in the circuit to the proximity switch of the NRV Check the parameter settings of the burner controller

Cause:	It is not proven that the non-return valve of the unit is closed.
Corrective action:	Check and repair or replace NRV.

Display message F6	F l u e s e n s o r e r r o r
	p u m p o n 9 9 9 . 5 h r s
Reason	Flue sensor is not detected by the water heater PCB.

Cause:
Bad wiring/connection in the flue gas sensor circuit.
Corrective action:
Check for loose wiring/connections in the flue gas sensor circuit.

Cause:
Bad temperature sensor causing a fault signal.
Corrective action:
Replace flue gas sensor.

Display message F7	F l u e t e m p t o o h i g h
	p u m p o n 9 9 9 . 5 h r s
Reason	Flue gas temperature exceeded three times the limitation value within a certain period.

Cause:
Heat exchanger polluted and not able to transfer enough heat to system water.
Corrective action:
Check and clean heat exchanger.

Cause:
Bad flue gas sensor or sensor connection (partly shorted).
Corrective action:
The sensor is of the type NTC. This means as the temperature rises the measured resistance is lowered. A partly shorted sensor will drop the resistance and therefore 'measure' a raise in temperature when actually there is none. Check for moist in the sensor connections or replace sensor.

Cause:
There is no water in the unit while firing.
Corrective action:
This is an unlikely situation while all the safeties for checking the water presence didn't detect anything. Only a lot of air in the system/unit (under pressure) can cause the water pressure switch to switch while no water is present. Also the water leak detection did not react. Bleed all air from the unit so the heat from combustion can be transferred to the water and won't leave through the flue system.

Cause:
Heat exchanger failure.
Corrective action:
This is an unlikely situation but when there is severe damage to the heat exchanger, the combustion product will not be able to transfer all heat to the system water. The heat that is not transferred will convert to an increased flue gas temperature.

Display message F8	F a i l e d b u r n e r s t a r t
	p u m p o n 9 9 9 . 5 h r s
Reason	Water heater not operational after 4 starting attempts.

Cause:
No spark.
Corrective action:
<p>Check the ignition electrode and replace/clean if necessary.</p> <p>Check the state of the ceramic insulator. A small crack can prevent the spark to form at the end of the electrode.</p> <p>Check the distance between the electrode pin, earth pin and burner.</p> <p>Check the state of the ignition cable and replace it if necessary.</p> <p>Check the state of the earth wire/connection of the ignition and replace if necessary.</p> <p>Check the state of the sparkplug cap and replace it if necessary.</p> <p>Check power supply. Voltage must be 230 Vac nom.</p> <p>Check for proper electrical grounding of unit.</p> <p>Bad ignition transformer. Change the electronics of the unit.</p>

Cause:
Ignition spark, but no flame.
Corrective action:
<p>Check if all gas valves in the supply line are completely open.</p> <p>Check if there is no air in the gas supply (start-up new systems).</p> <p>Check if the gas valve opens. When there is power supply to the gas valve, but the valve does not open, the gas valve must be replaced.</p> <p>Check if the gas valve opens. When there is no power supply to the gas valve, check the gas valve wiring/connections.</p> <p>Check if the gas valve settings are correct and adjust if necessary.</p> <p>Check if the gas pressure is correct and sufficient.</p> <p>Check if the air supply is open/not blocked.</p>

Cause:
Flame, but not enough ionisation to establish the flame.
Corrective action:
<p>Check the ignition electrode and replace/clean if necessary.</p> <p>Check the state of the ceramic insulator.</p> <p>Check the distance between the electrode pin, earth pin and burner.</p> <p>Check the state of the ignition wire (also the ionisation wire) and replace it if necessary.</p> <p>Check the state of the earth wire/connection of the ignition and replace if necessary.</p> <p>Check for proper electrical grounding of unit.</p> <p>Check power supply. Voltage must be 230 Vac nom.</p> <p>Check the state of the sparkplug cap and replace it if necessary.</p>

Display message F9	F	I	A	M	E	I	O	S	T											
	P	U	M	P	O	N					9	9	9	.	5					
Reason	Flame signal lost during operation.																			

Cause:
Bad gas supply pressure.
Corrective action:
<p>Be aware that the specified gas pressure must be met during all operation conditions.</p> <p>Check if all gas valves in the supply line are completely open.</p> <p>Check if the dirt filters mesh in the gas valve inlet is clean.</p> <p>Check if the external dirt filter in the gas supply line is not blocked.</p> <p>Check if an external gas pressure regulator is selected/installed correctly.</p> <p>Check the gas pressure that is supplied to the building > call the supplier if necessary.</p>

Cause:
Bad gas valve or gas valve settings.
Corrective action:
Check and set gas valve settings.

Cause:
Bad electrode, electrode wiring/connection (bad ionisation signal).
Corrective action:
<p>Check ionisation signal.</p> <p>Check the ignition electrode and replace/clean if necessary.</p> <p>Check the state of the ceramic insulator.</p> <p>Check the distance between the electrode pin, earth pin and burner.</p> <p>Check the state of the ignition wire (is also ionisation wire), and replace if necessary</p> <p>Check the state of the ignition earth wire/connection and replace if necessary.</p> <p>Check for proper electrical grounding of unit.</p>

Cause:
Bad flue gas and/or air supply system.
Corrective action:
<p>Check if the design of the flue gas and air supply system complies with the max. combined resistance as specified.</p> <p>Check if the flue gas and air supply system is installed according a good installation practice by a skilled installer.</p> <p>Check all seals in the flue gas and air supply system.</p>

Cause:
External factors.
Corrective action:
<p>Check if there were extreme weather/wind conditions when the fault occurred.</p> <p>Check if the plant room pressure is equal to the pressure at the position of the flue gas outlet. (If combustion air is drawn from the plant room).</p>

Display message F10	F a l s e f l a m e s i g n a l
	p u m p o n 9 9 9 . 5 h r s
Reason	Flame signal detected, while water heater should not fire for operation.

Cause:	The flame detection circuit detects a flame which is not supposed to be present.
Corrective action:	Check the ignition/ionisation electrode and make sure it is clean (or replace it). Check the power supply voltage for a correct polarity. Check the power supply for bad frequency or voltage peaks. Check external wiring for voltage feedback. Check the internal wiring for bad connections. Check if the gas valve is closing correctly. Replace the main control board (PCB).

Display message F11	F a n s p e e d i n c o r r e c t
	p u m p o n 9 9 9 . 5 h r s
Reason	Actual fan speed differs from the unit rpm set point.

Cause:	An incorrect fan speed is detected.
Corrective action:	Check the 4 wired wiring and connections at the fan and at the main control board. Check the 3 wired power supply wiring and connections at both ends. Replace the fan. Replace the main control board.

Cause:	The fan of the non-burning burner is not able to run, to prevent recirculation.
	Check the 4 wired wiring and connections at the fan and at the main control board. Check the 3 wired power supply wiring and connections at both ends. Replace the fan. Replace the main control board of that specific burner.

Display message F12	p r o g r a m m i n g e n d
	p u m p o n 9 9 9 . 5 h r s
Reason	Programming of the parameters completed successfully.

Cause:	Programming of the parameters completed successfully.
Corrective action:	This message occurs to confirm the end of programming. Pressing RESET will return the unit in normal operating status.

Display message F13	P a r a m / H a r d w f a u l t
	p u m p o n 9 9 9 . 5 h r s
Reason	Failure during programming of the parameters.

Cause:	Programming of the parameters NOT successfully completed.
Corrective action:	

<p>Unit is not in stand-by mode (fan must not run during programming). Check programming wire and connections and try again. Check if the software complies with the PCB. Replace the programming wire. Replace the display PCB.</p>												
Display message	C	I	I	X	O	N	F	A	U	L	T	
F15	p	u	m	p	o	n				9	9	9 . 5 h r s
Reason:	Heat exchanger fuse exceeded maximum value.											

Cause:	The thermal fuse of the heat exchanger has opened permanently.
Corrective action:	Switch off the electrical power and gas supply and contact supplier.

Display message	W	a	t	e	r	h	i	g	h	l	i	m	i	t	
F17	p	u	m	p	o	n				9	9	9 . 5 h r s			
Reason:	Maximum thermostat exceeds limitation value.														

Cause:	The water flow is restricted.
Corrective action:	<p>Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences the flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.</p>

Display message	A	P	S	s	w	i	t	c	h					
F18	p	u	m	p	1	o	n			9	9	9 . 5 h r s		
Reason	Air pressure switch activated for a certain time. Or combination of NRV blocking and an F11 lock-out.													

Cause:	The fan of the non-burning burner is not able to run to prevent recirculation.
Corrective action:	<p>Check the 4 wired wiring and connections at the fan and at the main control board. Check the 3 wired power supply wiring and connections at both ends. Replace the fan. Replace the main control board of that specific burner.</p>

Cause:	It is not certain that the non-return valve of the burner, that is not burning, is closed.
Corrective action:	<p>Check the state of the Non Return Valve: > Is the valve moving freely to the open and closed positions. > Is there debris/fouling or corrosion in the valve to prevent the valve to move freely.</p>

Display message F19	S	i	p	h	o	n	s	w	i	t	c	h							
	p	u	m	p		o	n					9	9	9	.	5		h	r	s
Reason:	Siphon pressure switch detects high pressure in the flue/siphon system.																		

Cause:
There is too much resistance in the flue gas circuit causing high pressure in the heat exchanger at the flue gas side.
Corrective action:
Check if the flue gas system is blocked. Extreme fouling of the heat exchanger also causes the resistance to rise. Check the state of the heat exchanger and clean if necessary. Check the flue gas system diameter & length (most likely in a new system).

Cause:
The condensate drain system is blocked. The condensate will build up above the measuring point of the pressure switch and creates a static pressure larger than the measuring point.
Corrective action:
Check if the condensate drain hose between the heat exchanger and the siphon is open, so the condensate can flow freely to the siphon. Check if the siphon is free of debris that might block the condensate flow and clean the siphon if necessary. Check the condensate drain hose between the siphon and the condensate drain point in the external installation. Condensate must be able to flow freely.

Cause:
The condensate drain hose must have an open connection to the external system. If not, pressure fluctuations in the building drainage system can have effect on the pressure in the heat exchanger of the water heater.
Corrective action:
Make sure that there is an open connection between the siphon hose and the drainage system of the building installation. The condensate should flow in the drainage system through a freely "breathing" connection, so pressure fluctuations of the external drainage system cannot affect the pressure in the heat exchanger of the water heater.

Cause:
Blockage of the pressure signal hose going to the pressure switch.
Corrective action:
Check the pressure signal hose and clean or replace it if necessary.

Cause:
Bad pressure switch causing a fault signal.
Corrective action:
Replace the pressure switch.

Cause:
Bad wiring/connection in the pressure switch circuit.
Corrective action:
Check for loose wiring/connections in the pressure switch circuit.

22.1.2 BLOCKING CODES

The display is not blinking, but is lightened up during the blocking period.
 The water heater is blocking an action, because of an extraordinary situation. This action will be continued after stabilisation of this situation.

Display message	F l o w t e m p h i g h 9 9 9 . 5 h r s
Reason:	Flow temperature has exceeded the blocking temperature, but it has not exceeded the lock-out value.
Cause:	The water flow is restricted.
Corrective action:	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences the flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.

Display message	R e t u r n t e m p h i g h 9 9 9 . 5 h r s
Reason	Return temperature has exceeded the blocking temperature, but it has not exceeded the lock-out value.
Cause:	System that pre-heats the water heater return temperature too much/high.
Corrective action:	Reduce pre heat temperature of external heat source.
Cause:	The need for heat in the system suddenly drops causing hot return water to the water heater.
Corrective action:	Dampen external heating system control to prevent sudden water heater temperature rise.

Display message	F l u e t e m p h i g h 9 9 9 . 5 h r s
Reason	Flue gas temperature has exceeded the limit.
Cause:	Heat exchanger polluted and not able to transfer enough heat to the system water.
Corrective action:	Check heat exchanger.

Cause:	Bad flue gas sensor or sensor connection (partly shorted.)
Corrective action:	The sensor is of the type NTC. This means when the resistance is lowered the measured temperature rises. A partly shorted sensor will drop the resistance and therefore raise the measured temperature. Check for moist in the sensor connections or replace the sensor.
Cause:	There is no water in the unit while firing.
Corrective action:	This is an unlikely situation while all the safeties for checking the water presence didn't detect anything. Only a lot of air in the system/unit (under pressure) can cause the water pressure switch to switch while no water is present. Also the water leak detection did not react. Bleed all air from the unit so the heat from combustion can be transferred to the water and won't leave through the flue system.
Cause:	Heat exchanger failure.
Corrective action:	This is an unlikely situation but when there is severe damage to the heat exchanger, the combustion product will not be able to transfer all heat to the system water. The heat that is not transferred will convert to an increased flue gas temperature.
Display message	A n t i c y c l e t i m e

	9 9 9 . 5 h r s
Reason	The controller received a new heat demand too fast after the last demand ended.
Cause:	
	Opening and immediately thereafter closing of the external thermostat.
Corrective action:	
	Controlled water flow cools down too quickly after loss of heat demand. Controlled water flow heats up too quickly after start of heat demand. Immediately opening and closing of the external thermostat. Check switching differential of the ON/OFF thermostat. Controller settings need to be changed. Be aware that the standard settings work fine for all common systems. When anti-cycling is active, because of immediate heating or cooling of the controlled water flow/temperature, it concerns an unconventional system.

Display message	W a t e r p r e s s u r e f a u l t 9 9 9 . 5 h r s
Reason	Water pressure is too low or high.
Cause:	
	The water pressure in the system is too low.
Corrective action:	
	Check if there is no leakage in the system that causes the pressure to drop. Fix any leakage and fill the system. Check if there is an external system pump that sucks water through the water heater, causing an under pressure. (bad installation design).

Display message	L i n e f a u l t p u m p o n 9 9 9 . 5 h r s
Reason	Bad power supply
Cause:	
	The supplied power does not comply with the specifications.
Corrective action:	
	Check if the power supply is connected correctly to the unit. Check the voltage and frequency. (Should be Life Neutral, Gnd > 230Vac/50Hz). Make sure there is no signal fail or voltage peaks in the power supply.

Display message	T 2 - T 1 h i g h 9 9 9 . 5 h r s
Reason	Difference between T2 and T1 has exceeded the blocking value which has been set in the parameters.
Cause:	
	The water flow through the unit is too low.
Corrective action:	
	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump. Make sure the heat exchanger is clean. Heat exchanger fouling (partly blockage) will increase the resistance causing the water flow to drop.

Display message	N R V o r F a n f a u l t
	9 9 9 . 5 h r s
Reason	Non return valve still open.
Cause:	It is not proven that the non-return valve of the burner, that is not burning, is closed.
Corrective action:	When a closed non return valve is proven this message will disappear. If not a lockout message will appear.
Cause:	It is not proven that the non-return valve of the burner, that is not burning, is closed, but the fan is running to prevent recirculation. (If P2MT =1)
Corrective action:	Check the state of the Non Return Valve: > Is the valve moving freely to the open and closed position. > Is there debris/fouling or corrosion in the valve to prevent the valve to move freely.
Cause:	The fan of the non-burning burner is not able to run to prevent recirculation, but the non-return valve is closed to prevent recirculation. (If P2MT =1)
Corrective action:	Check the 4 wired wiring and connections at the fan and at the main control board. Check the 3 wired power supply wiring and connections at both ends. Replace the fan. Replace the main control board of that specific burner.
Cause:	It is not proven that the non-return valve of the unit is closed.
Corrective action:	Check and repair or replace NRV.

Display message	D e l t a D i r e c t b l o c k
	9 9 9 . 5 h r s
Reason	Temperature difference between flow and return has exceeded the blocking value
Cause:	The water flow through the unit is too low.
Corrective action:	Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences the flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump. Make sure the heat exchanger is clean. Heat exchanger fouling (partly blockage) will increase the resistance causing the water flow to drop.

Display message	H e a t e x c h a n g a t r i s k
	9 9 9 . 5 h r s
Reason	Temperature difference between flow and return has exceeded the blocking value 3 times (P2LL = 2)
Cause:	Low water flow.
Corrective action:	Clean the heat exchanger on the water side. Heat exchanger fouling (partly blockage) will increase the resistance causing the water flow to drop. Check functioning of the pump. Check/open all valves that might restrict the water flow through the unit. Check for an external system pump that influences the flow through the unit. Check if the system resistance exceeds the spare capacity of the unit pump.

Display message	G e n B l o c k
-----------------	-----------------

																				9	9	9	.	5	h	r	s
Reason	General blocking circuit is activated during operation (general blocking contacts 7-8).																										
Cause:	The circuit connected to the general blocking terminals is not closed.																										
Corrective action:	Check all external components that are connected to the general blocking terminals and check why the contact is not closing at heat demand.																										

Cause: If used in combination with flow switch:	The water flow through the unit is too low.																										
Corrective action:	<p>Check functioning of the pump and the flow switch.</p> <p>Check/open all valves that might restrict the water flow through the unit.</p> <p>Check for an external system pump that influences flow through the unit.</p> <p>Check if the system resistance exceeds the spare capacity of the unit pump.</p> <p>Make sure the heat exchanger is clean. Heat exchanger fouling (partly blockage) will increase the resistance causing the water flow to drop.</p>																										

Display message	C	a	s	c	a	d	e		B	l	o	c	k															
																					9	9	9	.	5	h	r	s
Reason	Connection failure with one of the water heaters of the cascade.																											
Cause:	The unit is programmed in such a way that none of the water heaters in a cascade will fire, if one has a lockout. One unit has a lockout and therefore the whole cascade is blocked.																											
Corrective action:	Troubleshoot the fault of the unit in lock-out.																											

Display message	W	A	T	R	H	T	R	:	T	3		E	x	t	e	r	n	a	l										
	>	>	>	:	6	0	.	0	°	C	(-	3	0	.	7	°	C)										
Reason:	T3 external water heater sensor is not connected to the terminals.																												
Cause:	The sensor is not connected to the terminal, or the wire is broken. The sensor is malfunctioning.																												
Corrective Action:	<p>Connect the sensor to the terminals 3 and 4.</p> <p>Check the wires from the sensor to the terminals.</p> <p>Check the sensor on resistance 10K at 25°C.</p>																												

22.1.3 MAINTENANCE ATTENTION MESSAGE

The display shows alternating the base screen and this message, while backlight is blinking.
 The water heater is operating, but will count the exceeding hours.
 A parameter must be changed, after service, to remove this message.

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	I	g	n	i	t	i	o	n										h	r	s
Reason	Maintenance option of total amount of ignition cycles has been reached.																		

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	D	a	t	e													h	r	s
Reason	Maintenance option of the date has been reached.																		

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	B	u	r	n	i	n	g											h	r	s
Reason	Maintenance option of total amount of burning hours has been reached.																		

Display message	N	e	e	d	s	M	a	i	n	t	e	n	a	n			0	.	0
	A	l	l														h	r	s
Reason	One of the abovementioned maintenance options has been reached.																		



This function/message is standard not activated, but can be activated/set by a trained engineer. This function does not overrule the need for annual maintenance. The end user is always responsible for arranging annual maintenance.

23.0 MAINTENANCE

23.1 GENERAL

To ensure the TTW water heater continues to perform safely and efficiently regular maintenance must be carried out at least every 12 months.

Maintenance and inspection of the water heater should be carried out at the following occasions:

- When a number of similar error codes and/or lock-outs appear.
- At least every twelve months maintenance must be done to ensure safe and efficient operation.

Damage caused by lack of maintenance will not be covered under warranty

23.2 MAINTENANCE REMINDER FUNCTION.



This function/message is standard not activated, but can be activated/set by a trained engineer. This function does not overrule the need for annual maintenance. The end user is always responsible for arranging annual maintenance.

23.3 SERVICE INTERVALS

The normal service interval for the water heater is once a year. Every year the water heater should be cleaned and checked, according to the maintenance procedures. If there is doubt whether the water heater is operating with the correct water and/or combustion air quality, it is advised that a first check is executed after half a year. This will determine the frequency of future service intervals. The maximum interval between two services is 12 months.



Inspection and maintenance must be carried out at least every 12 months to ensure safe and efficient operation of the water heater.

23.4 INSPECTION & MAINTENANCE

Inspection, maintenance and the replacement of water heater parts should only be done by a skilled service engineer. Apart from the maintenance proceedings, it is advised to have a log chart for every water heater that describes the following aspects:

- Serial number.
- Date and time of maintenance.
- Name of maintenance engineer.
- Which parts were exchanged during maintenance
- Which settings (software) were changed during maintenance.
- Special remarks / findings.
- Future aspects that need extra attention.
- Additional aspects: measurement reports, complaints by the (end)-user, lock-out codes, etc.

During maintenance, the following parts and aspects of the water heater should be checked and inspected.

NOTICE: Before starting to work on the water heater:



Switch off the electrical power to the water heater (service switch and/or unplug water heater).



Close the gas valve to block gas supply to the water heater.

23.4.1 CUSTOMER COMMENTS

Comments and remarks from the customer should be analysed and used to find possible causes for any occurring problems and complaints.

23.4.2 SERVICE HISTORY

The operational and fault history (total amount and since the last service) of the water heater can be retrieved with the help of a computer, correct software and an interface cable. This information can be used to specify the maintenance and service proceedings in relation to the water heater (parts).

23.4.3 FLUE GAS & AIR SUPPLY

The flue gas pipes and the air supply pipes must be checked for gas tightness. Also check if the mounting of these pipes is correct, safe and not damaged. Check the rooftop of the water heater housing for signs of water leakage and traces of water coming from the air supply pipe, the air vent or any condensate coming from the flue gas pipes.

23.4.4 GAS SUPPLY & SAFETIES

The gas pipes must be checked for gas tightness. Also check if the mounting of these pipes is correct, safe and not damaged. Any built in safeties should be checked for a correct functioning.

23.4.5 REMOVE THE BURNER UNIT

NOTICE: watch out not to damage the burner plate insulation during this operation!

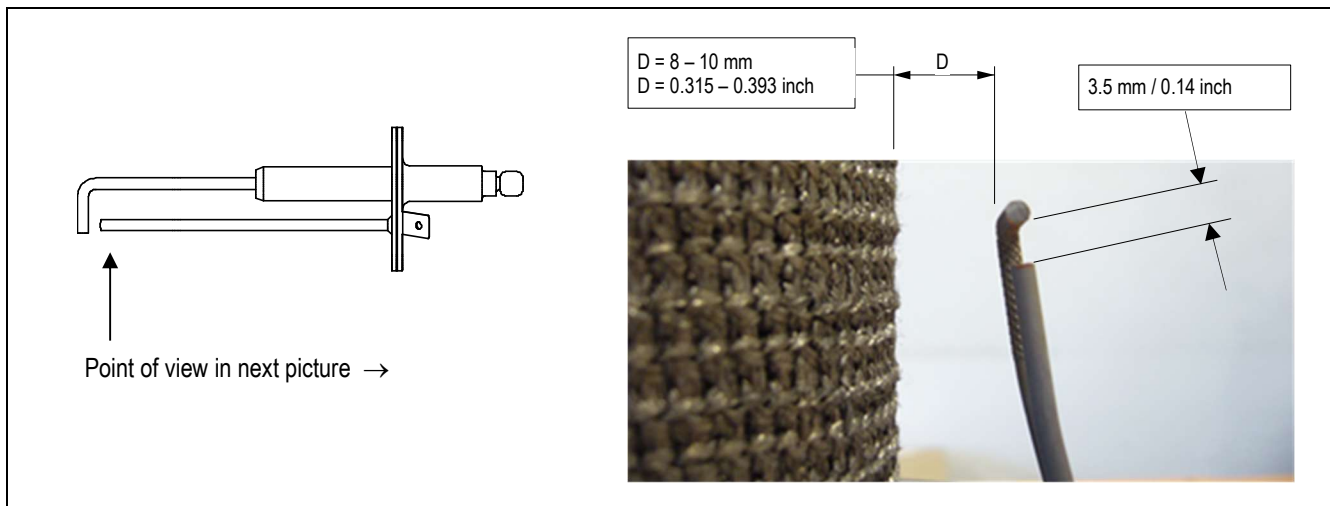
The burner unit consists of the burner plate, the burner nose and the internal burner. To remove this part for an internal heat exchanger check: remove the six M6 nuts, the nuts that connect the burner nose to the non-return valve and the ignition cable. After this take out the burner unit by moving it forward out of the water heater housing.

23.4.6 BURNER

Check the burner surface if it has damages, signs of rust and/or cracks. When the burner surface is damaged the burner must be replaced. The burner can be cleaned by using a vacuum cleaner or pressurized air.

23.4.7 IGNITION / IONISATION ELECTRODE

When the complete burner is removed, it is also very easy to check the ignition electrode. First check if the distances between the electrodes and between the electrode and the burner are according to the graph below. When these are not correct, try to bend the electrodes in the right position. NOTICE: the electrodes undergo high temperatures; therefore the electrodes become hard and are difficult to bend. While bending used electrodes they might break or burst. Check the electrode, after bending, for any tear/crack and signs of rust. When they are burst/cracked or rusty, replace the electrode. Also replace the electrode when there is a crack in the ceramic insulation of the electrode. When the electrode is going to be replaced also the gasket should be renewed.



23.4.8 BURNER DOOR GASKETS

When these gaskets have changed colours at some parts, the rubber has cured and/or is damaged, then these gaskets must be replaced. NOTICE: Only use the gaskets that are supplied by the water heater manufacturer.

23.4.9 NON RETURN VALVE

Remove the non-return valve from the fan by loosening the nuts and remove the wiring by disconnecting the connector. Check if there is any moist or any traces of moist on the fan side of the valve. This can indicate that there is a possible leakage of the non-return valve (danger of recirculation).

Check always if the rubber seat on which the valve closes isn't damaged or if there is any debris on this seat, if so clean or replace the seat. Also check if the valve itself isn't jammed and can move freely up and down and if the magnet pulls the valve into its seat, if not so replace the complete non return valve.

23.4.10 INSULATION

The insulation of the heat exchanger (located on the rear wall inside the heat exchanger and burner door) must be inspected. If this insulation disk shows any signs of (water) damage or degradation it should be exchanged. Also check if there are any indications in the burner room of a high condensate level (caused by a blocked siphon) that might have wetted the rear wall insulation. When this has happened the rear wall insulation should also be replaced.

Only use the insulation disk that is supplied by the water heater manufacturer.

The same procedure must be applied on the insulation and gaskets fitted on the burner door.

23.4.11 HEAT EXCHANGER AND BURNER ROOM

After the removal of the complete burner unit check if there is any debris and dirt in the heat exchanger. The coils of the heat exchanger can be cleaned by using a **non-metallic** brush. After this the dirt and dust can be removed with a vacuum cleaner and by flushing the burner room with water. Don't forget afterwards to clean the siphon once again



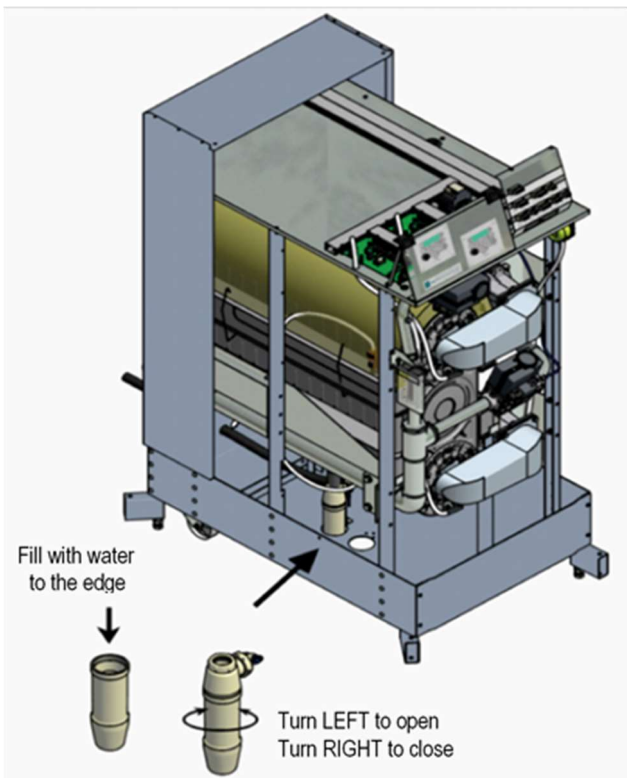
Cleaning the burner room with acid or alkali products is prohibited.

23.4.12 FAN

When the fan blades are polluted and dirty, carefully clean the blades with a soft brush. NOTICE: do not use too much force on the blades or else the fan might be out of balance and run irregularly, causing noises and fan failures. Check the fan also for any water damages. In doubt always replace the fan of the water heater.

23.4.13 SIPHON

Disassemble the siphon and clean every part of it. Check the siphon connection of the heat exchanger for any blocking or pollution and clean it (if necessary). Check the functioning of the siphon by pouring clean tap water in the burner room (when burner door is removed). This water will exit the heat exchanger by the siphon.



Do NOT operate unit without mounted and filled siphon reservoir. This is a safety measure: the water in the siphon keeps the flue gases from leaving the heat exchanger via the condensate drain. Do NOT wet the rear wall insulation

23.5 MOUNTING THE BURNER DOOR CORRECTLY BACK ONTO THE HEAT EXCHANGER:

IMPORTANT:

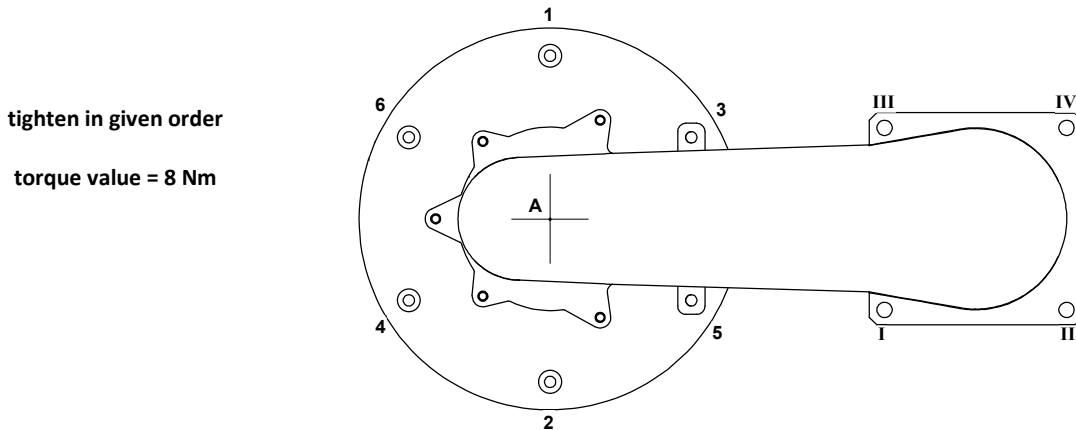
Before mounting the burner door, make sure that its gaskets and insulation are in excellent shape. If any signs of damage or ageing are present, these parts must be replaced.

The burner door must be mounted back on the heat exchanger as follows, see picture below:

- Place the burner door with its holes over the six threaded studs, numbered 1 to 6 in the picture.
- Careful! When handling too rough or misplacing the holes over the threaded studs, the burner door insulation and/or gaskets may be damaged.*
- Assure yourself that the door is well positioned with respect to the threaded studs, before pushing it onto the exchanger.
- Now keep the burner door in place and first turn one flange nut onto stud 1 so the door won't fall down. After that first mount the other end of the gas/air mixing pipe to the non-return valve, starting at point I, and make sure it's well tightened.
 - Now keep the burner door firmly in place by pushing the gas/air nose with one hand at the middle at point A.
 - Then turn-tighten the flange nuts with the other hand as far as possible onto the threaded studs.

Now the burner door is in place and the nuts can be tightened with a torque key.

- Tighten the nuts in the order given in the picture below.
- The specified torque value for tightening the burner door flange nuts is 8 Nm.



23.5.1 GAS/AIR RATIO

With every service check and/or maintenance of the water heater always check the gas/air ratio by measuring the CO₂ / O₂ percentage (flue gas) at the maximum and minimum load of the water heater. If necessary adjust these values, see for information chapter 15 "Adjusting and setting the burner".

23.5.2 PUMP

Check the electrical parts and the motor of the pump for a correct functioning. The pump must generate a sufficient water flow over the (heat exchanger of) the water heater. When the pump produces noise, is operational for more than five years or has signs of water leakage it is recommended to replace the pump as a precaution.



When the service engineer finds defects and abnormalities during service and maintenance and these are not repairable, this information should be reported to the owner/end-user of the installation. These defects should be reported in the service report / log file of the water heater.



During service and maintenance the gas, supply air, flue gas and condensate connections are disconnected, checked and replaced. Make sure that all these components are mounted correctly before commissioning the water heater again.

24.0 ErP DATA TABLE

Water Heater Type		TTW410	TTW580
Manufacturer			
Load Profile		4XL	4XL
Energy Efficiency	%	87.7	85.3
Daily Electricity Consumption	kWh	0.633	0.69
Daily Fuel Consumption	kWh	105	107.9
Mixed Water V40 @40°C	litre	∞	∞
Emissions of Nitrogen Oxides (EN15502-1:2012+A1:2015)	mg/kWh	44	41
Sound Power Level (EN15036-1:2006)	LWA(db)	74	78

The ErP data shown above relates to the TTW water heater only, the domestic hot water efficiency will depend on:

- The number and size of water heaters fitted
- The number, size and type of direct storage vessels fitted
- The length and insulation of the interconnecting pipework
- The type of shunt pumps used

25.0 USER INSTRUCTIONS

Demonstrate to the user the operation of the entire system. Above all, the user should be made familiar with all safety precautions. The user should be told that service and maintenance of the water heater is required every twelve months. Regular service is essential for the safe and efficient operation of the water heater. Hand the user the documents supplied with the heater and mention that they are important and need to stay close to the water heater.

25.1 RECYCLING

When the boiler has reached the end of its technical or economical lifespan, it must be disposed of in the correct way.

Disposal



Old end-of-life appliances contain materials that need to be recycled. When you discard devices at the end of their service life, you must obey local legislation related to waste disposal.

Never discard your old device together with regular waste. Put the device into a municipal waste collection depot for electrical and electronic equipment. If necessary, ask your supplier or your service and maintenance engineer for advice.

26.0 WARRANTY

Full warranty terms and conditions are available at www.lochinvar.ltd.uk



IMPORTANT INFORMATION

These instructions must be read and understood before installing, commissioning, operating or maintaining the equipment.

