EcoForce™
Wall mounted gas fired condensing water heater

Installation, Commissioning, User and Maintenance Instructions

MODELS:

EF80

EF100

EF120

EF150

EF180

Installation manual_EF_July 2023

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

TABLE OF CONTENTS

1.0 INTRODUCTION

This manual has been written for:

- The installer
- System design engineers
- Service engineers
- End user

READ AND UNDERSTAND THE INSTRUCTIONS

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

1.1 REGULATIONS

It is the law in the UK that a competent person registered with the HSE approved body and in accordance with the Gas Safety regulations installs all Gas appliances.
Failure to install the appliance correctly could lead to prosecution. It is in your own interest and that of safety to ensure the appliance is installed correctly.
The installation of the water heater 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 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 Water heaters of rated inputs between 70 kW (net) and 1.8 MW (net) (2nd and 3rd family gases).
BS 6700: 2006 +A1: 2009	Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages.
BS 6880: 1988 Parts 1, 2 and 3	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 + A3: 2015	Requirements for electrical installations, I.E.E. wiring regulations seventeenth edition.
BS 7671: Amendment 2: August 2013	Requirements for electrical installations, I.E.E. wiring regulations seventeenth edition.
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.
IGE/UP/1 - Edition 2:	Installation pipework on industrial and commercial premises.
IGEM/UP/2: - Edition 3:	Gas installation pipework, boosters and compressors on industrial and commercial premises.
IGEM/UP/4 - Edition 4:	Commissioning of gas-fired plant on industrial and commercial premises.
IGEM/UP/10 - Edition 4:	Installation of flued gas appliances in industrial and commercial premises.

Gas Safety (Installation and Use) Regulations 1998
CIBSE: Guides
Part A Environmental Design
Part G Public health engineering
H.S.E. guidance
INDG 436 Safe management of industrial steam & hot water Water heaters
SAFED BG01Guidance on safe operation of Water heaters
Third edition of the 1956 Clean Air Act Memorandum on Chimney Heights

2.0 SAFETY GUIDELINES

Keep these instructions near the Water heater for quick reference.

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

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 mounting 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.

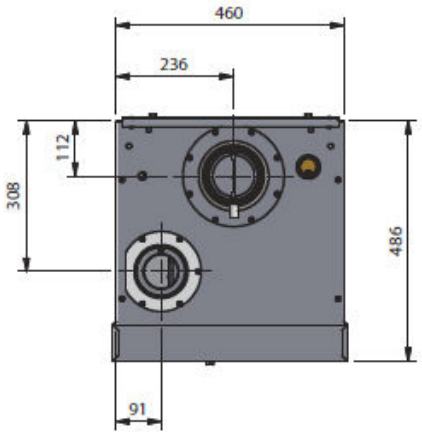
3.0 TECHNICAL DATA

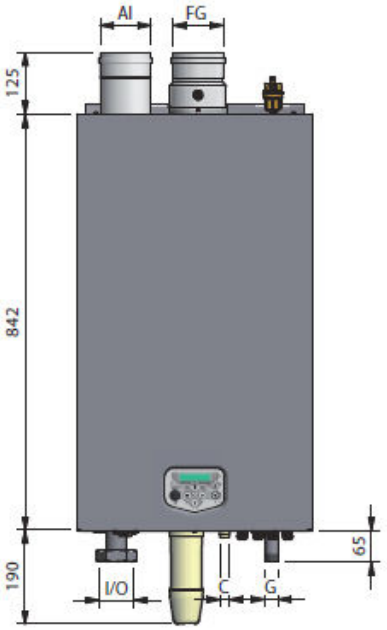
GENERAL DATA					
Product Identification Number	CE 0063 BR3190				
Classification	II2H3P				
Gas Appliance Type	B23, B23P, C13, C33, C43, C53, C63, C83				
MODEL NUMBER	**EF80**	**EF100**	**EF120**	**EF150**	**EF180**
Nominal Input (Net) (kW)	14.6 - 74.3	17.2 - 92.2	26.0 - 111	34.0 - 138	45.0 - 166
Nominal Input (Gross) (kW)	16.2 - 82.5	19.1 - 102	28.9 - 123	37.8 - 153	50.0 - 184
Nominal Output	15.2 – 77.5	18.0 – 96.2	27.2 – 116	35.5 – 144	47.3 – 175
Heat Generator Seasonal Efficiency (%)	94.5	95	94	94	94.5
Emissions of nitrogen oxides (EN15502-1:2012+A1:2015) (mg/kWh)	39	35	39	36	37
HOT WATER SUPPLY					
Recovery Rate @ 44°C (l/hr)	1524	1895	2267	2813	3400
Recovery Rate @ 50°C (l/hr)	1341	1667	1995	2475	2992
Recovery Rate @ 56°C (l/hr)	1198	1489	1781	2210	2671
TECHNICAL DATA					
Water Content (Litres)	5	6.5	8.3	10.4	12.9
Weight (Empty) (Kg)	68	73	78	87	96
Flow/Return Connections (B.S.P.)	1 ½"	2"	2"	2"	2"
Gas Connection (B.S.P.)	¾"	¾"	¾"	1"	1"
Flue Size (Concentric) (mm)	80/125	100/150	100/150	100/150	100/150
Flue Size (Parallel) (mm)	80 - 80	100 - 100	100 - 100	130 - 130	130 - 130
Waterside Pressure Loss (@ 17K ΔT) (m WC)	5.8	4.7	4.1	6	5.5
Max. Outlet temp. (°C)	75				
Operating Pressure – min./max. (bar)	1 – 8				
Average Flue Gas Temperature (°C)	85-95				
NG G20					
CO_2 – Flue Gas (G20) (%)	8.7 - 9.0	8.7 - 9.0	8.7 - 9.0	8.7 - 9.0	8.7 - 9.0
Gas Flow Rate (G20) (m^3/hr)	1.54 - 7.86	1.82 - 9.76	2.75 - 11.8	3.60 - 14.6	4.76 - 17.6
Gas Supply Pressure(G20) (mbar)	20				
Max Flue Gas Mass Rate (G20) (g/sec)	6.52 - 38.6	7.69 - 47.9	11.6 - 57.7	15.2 - 71.7	20.1 - 86.2
LPG G30/G31					
CO_2 – Flue Gas (G30) (%)	9.3 - 10.4	9.3 - 10.4	9.3 - 10.4	9.3 - 10.5	9.3 - 10.6
Gas Flow Rate (G30) (m^3/hr)	0.45 - 2.29	0.53 - 2.85	0.81 - 3.44	1.05 - 4.28	1.4 - 5.15
Gas Supply Pressure(G30) (mbar)	50				
Max Flue Gas Mass Rate (G30) (g/sec)	6.52 - 38.6	7.69 - 47.9	11.6 - 57.7	15.2 - 71.7	20.1 - 86.2
LPG G31					
CO_2 – Flue Gas (G31) (%)	9.3 - 10.3	9.3 - 10.3	9.3 - 10.3	9.3 - 10.4	9.3 - 10.5
Gas Flow Rate (G31) (m^3/hr)	0.60 - 3.04	0.70 - 3.77	1.06 - 4.54	1.39 - 5.65	1.84 - 6.79
Gas Supply Pressure(G31) (mbar)	30/37				
Max Flue Gas Mass Rate (G31) (g/sec)	6.52 - 38.6	7.69 - 47.9	11.6 - 57.7	15.2 - 71.7	20.1 - 86.2
ELECTRICAL DATA					
Power Consumption (W)	136	142	151	214	229
Protection Class	IPX40				

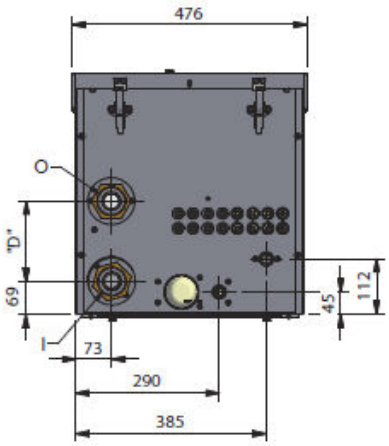
3.1.1 Technical data

3.1.2 Dimensions EF80, 100 & 120

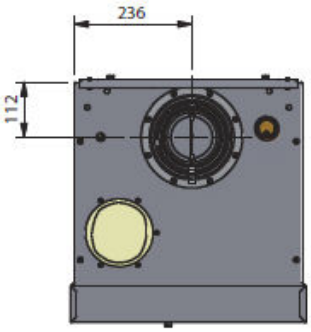
TWIN PIPE

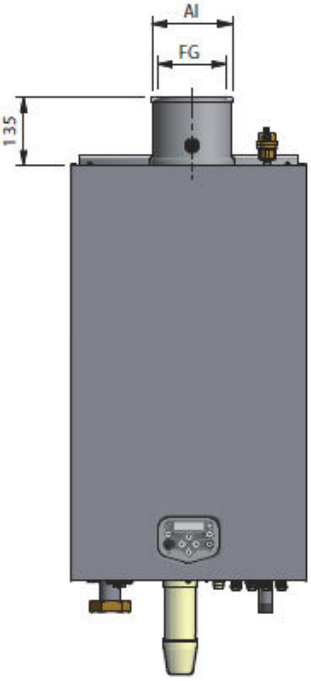






CONCENTRIC

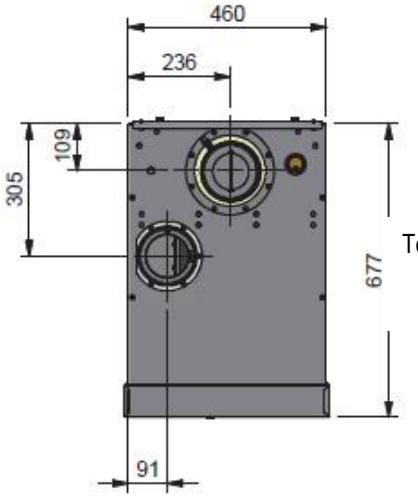




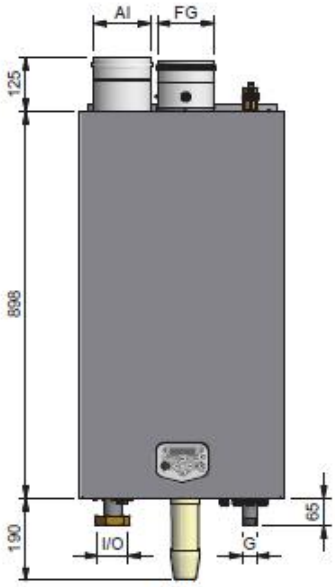
Connections (mm/ ")		Twin Pipe			Concentric		
		EF80	EF100	EF120	EF80	EF100	EF120
F G	Flue gas	Ø80	Ø100		Ø80	Ø100	
AI	Air inlet	Ø80	Ø100		Ø125	Ø150	
I	Cold water inlet	Rp 1½" (swivel)	Rp 2" (swivel)		Rp 1½" (swivel)	Rp 2" (swivel)	
O	Hot water outlet	Rp 1½" (swivel)	Rp 2" (swivel)		Rp 1½" (swivel)	Rp 2" (swivel)	
G	Gas	R ¾" (male)					
C	Condensate	flexible hose Ø25/21 x 750 mm.					
dimension "D"		175	160		175	160	

3.1.3 Dimensions EF150 &180

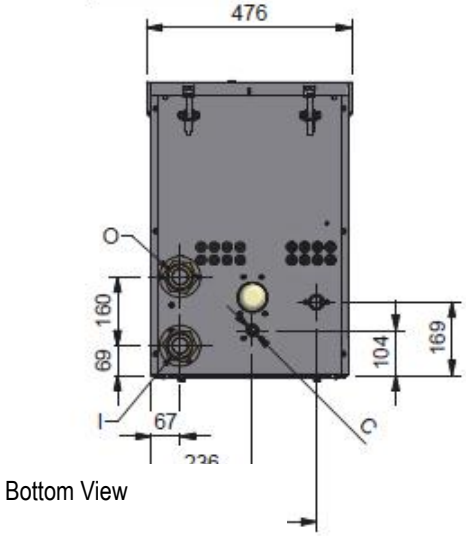
TWIN PIPE



Top View

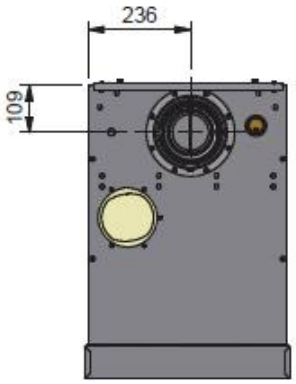


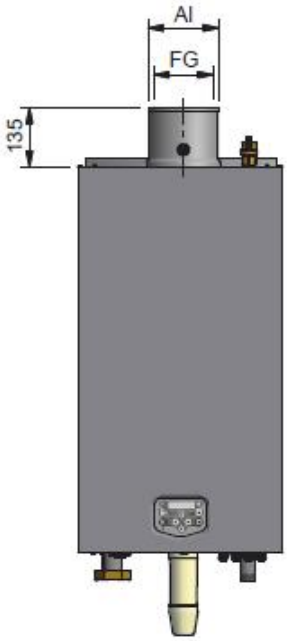
Front View



Bottom View

CONCENTRIC

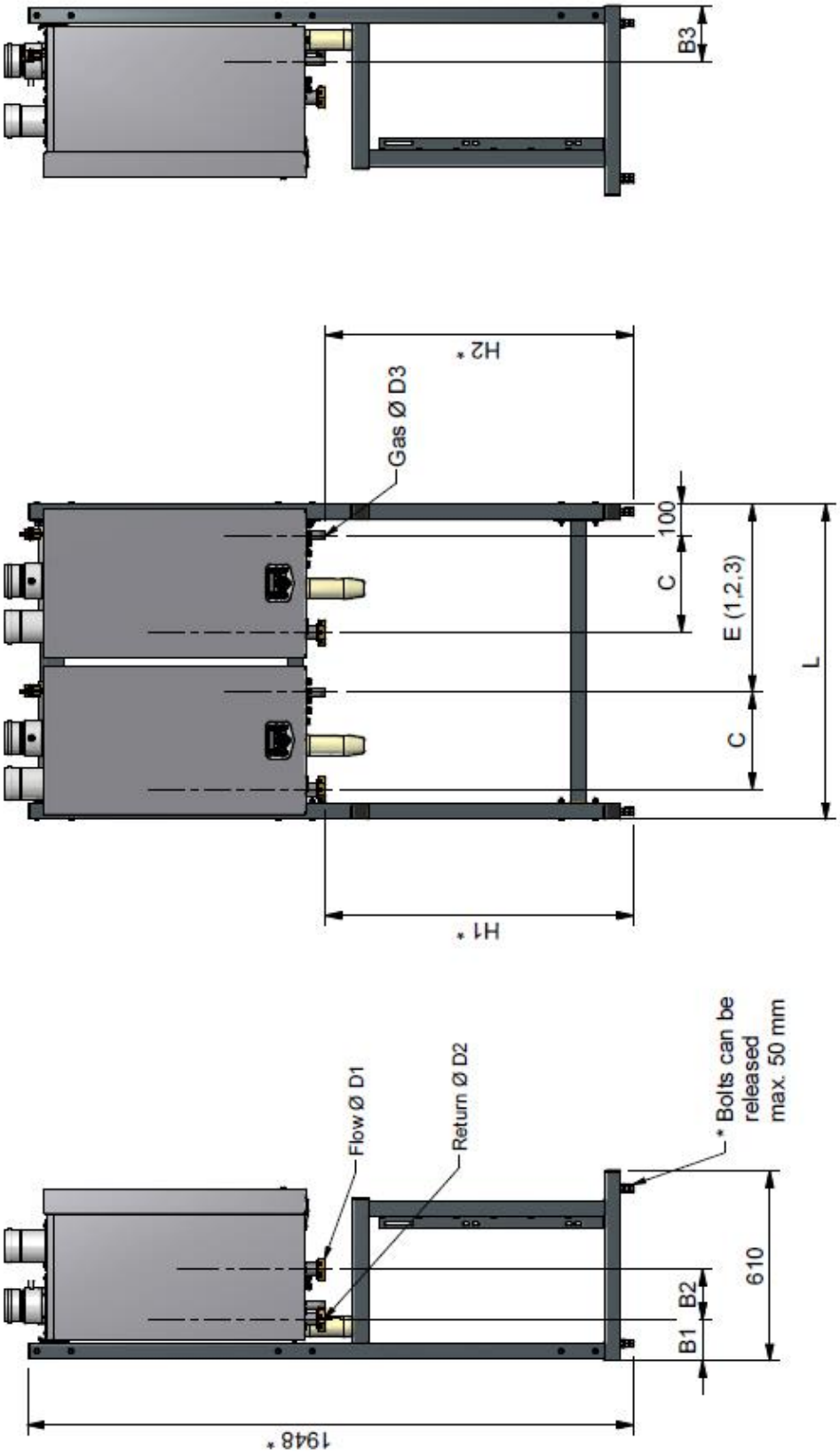




Connections (mm/ ")		Twin Pipe	Concentric
		EF 150 -180	EF 150 -180
FG	Flue gas	Ø130	Ø100
AI	Air inlet	Ø130	Ø150
I	Cold water inlet	Rp 2" (swivel)	Rp 2" (swivel)
O	Hot water outlet	Rp 2" (swivel)	Rp 2" (swivel)
G	Gas (male)	R 1"	R 1"
C	Condensate	flexible hose Ø25/21 x 750 mm.	

3.1.4 Cascade frames

Frames are available to mount up to 4 EcoForce water heaters if required.



		EF80				EF100 - 120				EF150 - 180			
Number of water heaters cascaded →		1	2	3	4	1	2	3	4	1	2	3	4
L (frame)	mm	510	1015	1520	1980	510	1015	1520	1980	510	1015	1520	1980
B1 (return)	mm	133	133	133	133	133	133	133	133	133	133	133	133
B2 (return/flow)	mm	175	175	175	175	160	160	160	160	160	160	160	160
B3 (gas)	mm	177	177	177	177	177	177	177	177	235	235	235	235
C (water/gas)	mm	310	310	310	310	314	314	314	314	317	317	317	317
D1 (flow)	"	Rp 1½	Rp 1½	Rp 1½	Rp 1½	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2
D2 (return)	"	Rp 1½	Rp 1½	Rp 1½	Rp 1½	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2	Rp 2
D3 (gas)	"	R ¾"	R ¾"	R ¾"	R ¾"	R ¾"	R ¾"	R ¾"	R ¾"	R 1"	R 1"	R 1"	R 1"
E1 (gas 2nd water heater)	mm	n.v.t.	605	605	590	n.v.t.	605	605	590	n.v.t.	605	605	590
E2 (gas 3rd water heater)	mm	n.v.t.	n.v.t.	1110	1080	n.v.t.	n.v.t.	1110	1080	n.v.t.	n.v.t.	1110	1080
E3 (gas 4th water heater)	mm	n.v.t.	n.v.t.	n.v.t.	1570	n.v.t.	n.v.t.	n.v.t.	1570	n.v.t.	n.v.t.	n.v.t.	1570
H1 (flow/return)	mm	990	990	990	990	990	990	990	990	935	935	935	935
H2 (gas)	mm	990	990	990	990	990	990	990	990	935	935	935	935

4.0 WATER QUALITY

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 lime scale which 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's 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 lime scale 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

5.0 ACCESSORIES AND UNPACKING

5.1 ANCILLARY ITEMS

A number of accessories are available for use with the EF water heater depending on site requirements as below, contact Lochinvar Limited for prices and further information.

Item Description	Item Number
2 Water heater Mounting frame	E00-000-127
3 Water heater Mounting frame	E00-000-130
4 Water heater Mounting frame	E00-000-161
Condensate Neutralisation Kit	KIT2000
Flue System Components	See section 8.0
Un-vented system kits	Contact Lochinvar
Stainless steel buffer vessels 300-750litre	See website www.lochinvar.ltd.uk
Glass lined buffer vessels 300-2850Litres	See website www.lochinvar.ltd.uk

5.2 UNPACKING

The EcoForce Water heater will be supplied with the following documents and accessories:

- One "Mounting Instructions" manual for the installer
- One suspension bracket with locking plate and bolts
- Three spare nuts for mounting the burner plate, two spare fuses for the Water heater control and a gas conversion sticker (all in a bag attached to the front of the gas valve)
- Bottom part of the siphon
- Strap on pipe Flow sensor

After delivery, check the Water heater package to see if it everything is included and undamaged. Report any missing items or damage immediately to Lochinvar Customer service.

6.0 INSTALLATION

6.1 GENERAL NOTES

The minimum clearances shown below must be maintained to enable service access and prevent operational problems:

Side	50mm
Top	350mm
Bottom	250mm

The installation area/room must have the following provisions:

- 230 V - 50 Hz power source socket with earth connection.
- Open connection to a drain system for the condense trap waste connection.
- A suitable solid load bearing wall, which must be level.

The wall used for mounting the Water heater must be able to hold the weight of the Water heater. If not, a suitable mounting frame is available from Lochinvar Limited. **See section 5.1**

Other considerations related to the Water heater location.

- Ventilation of the Water heater room.
- Both the air Inlet and the flue gas outlet must be connected to the outside wall and/or the outside roof using a suitable flue system. See section 8.0
- The installation area must be dry and frost-free.
- The Water heater has a built-in fan that will generate noise, depending on the total heat demand. The Water heater location should minimise any disturbance this might cause. Preferably mount the Water heater on a brick wall.
- There must be sufficient lighting available in the Water heater room to work safely on the Water heater.

It is the law in the UK that a competent person registered with the HSE approved body and in accordance with the Gas Safety regulations installs all Gas appliances.
Failure to install the appliance correctly could lead to prosecution. It is in your own interest and that of safety to ensure the appliance is installed correctly.

6.1.1 Mounting the heater on a frame

Before mounting and installing the Water heater the following connections should be considered:

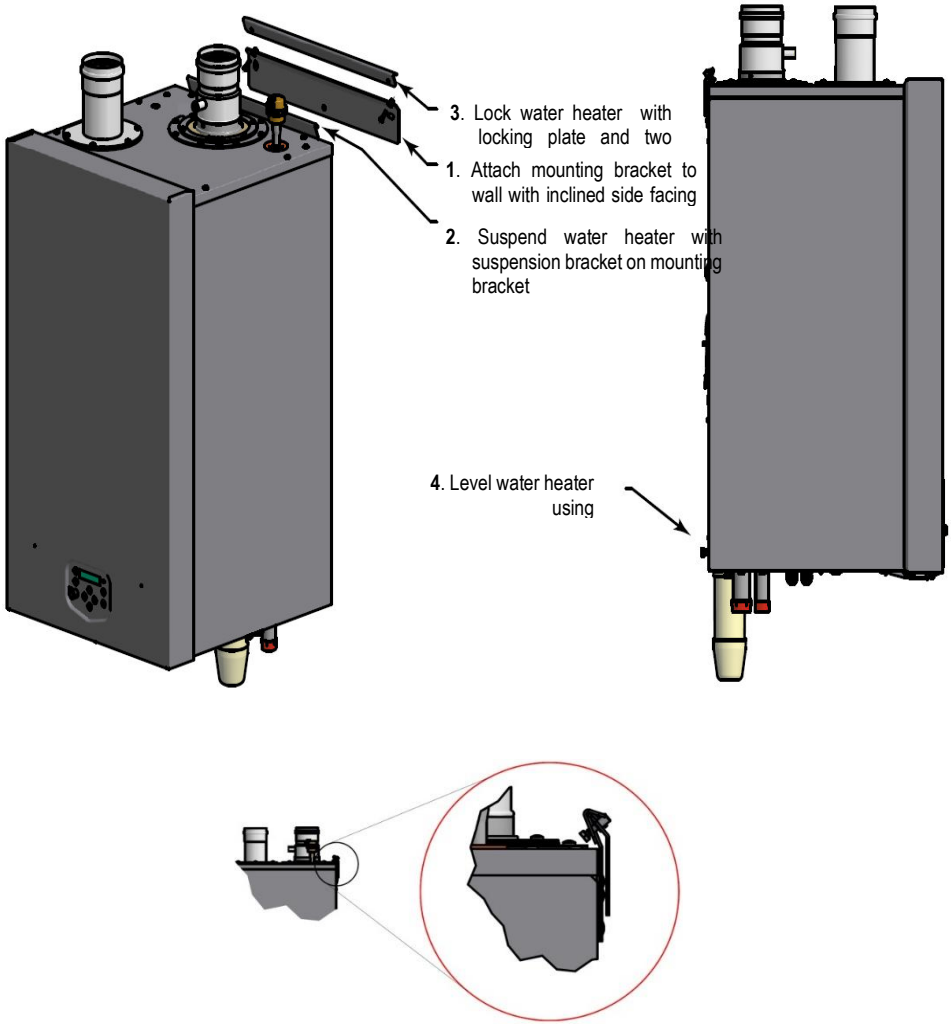
- Flue gas system, pipe run and termination
- Ventilation if required
- Flow and return pipe connection
- Condensate and pressure relief valve drain
- Power supply
- Gas pipework

All pipework connections to the Water heater must be self-supporting to prevent damage to the Water heater and Water heater connections.

While marking the holes, ensure that the suspension bracket or frame is perpendicular and the Water heater does not lean forward. If necessary adjust the position with the adjusting bolts at the lower rear side of the back panel (see drawing). When the adjusting bolts do not give sufficient adjustment, fill the gap behind the bolts to get the Water heater in position. The exact Water heater position lies between the Water heater hanging level and hanging slightly backwards.

The Water heater should not lean forward in the mounted position.

Lock the suspension bracket with the security cover before making any other connections to the Water heater. This security cover will prevent the Water heater from falling off the bracket. Don't use excessive force during the mounting of the Water heater connections.



6.1.2 Water heater mounting detail

6.2 CONDENSATE DRAIN

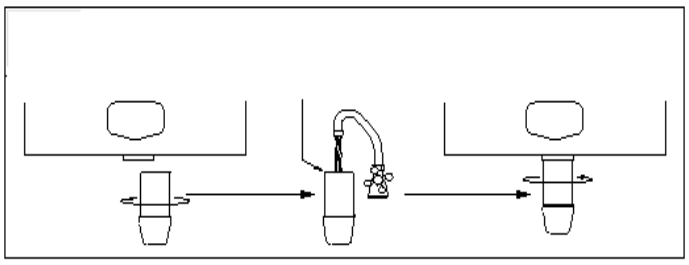
The condensate drain is located in the centre of the water heater underside. The clean out bowl is supplied in a separate box within the heater packaging; this must be fitted and the condensate water trap filled before the appliance is fired. The condensate trap is fitted with a ¾" flexible hose that should be connected to an appropriate condensate drain, sloping continuously away from the water heater at an angle of at least 3° (50mm per metre).

The Water Resources Act requires that trade effluent is discharged to municipal sewers between pH 6.5 and 10.0. If it is determined that these levels cannot be achieved, an in-line condensate neutralisation kit is available as an ancillary option from Lochinvar Limited. This unit is capable of neutralising 4000 litres of condensate to a pH of 7.0 before releasing it to a drain.

6.3 FILLING THE CONDENSATE TRAP

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

This is a safety measure: the water in the siphon keeps the flue gases from leaking out of the heat exchanger via the condensate drain.



7.0 GAS SUPPLY

The Lochinvar ECOFORCE™ range is suitable for use on second and third family gasses 2H - G20 - 20mbar / 3B – G30 – 50mbar / 3P - G31 - 37mbar.

7.1 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.

7.2 METERS

A new gas meter will be connected to the service pipe by the local gas distributor contractor. 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.

7.3 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**.

7.4 BOOSTED GAS 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.

7.5 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.

7.6 EQUIPMENT GAS SYSTEM LEAK CHECK

An approved gas inlet appliance isolating valve and union should be installed for each unit in a convenient and safe position and be clearly marked. Ensure that the gas inlet appliance isolating 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.

8.0 FLUE SYSTEM

8.1 GENERAL

The Water heater has a positive pressure flue system. The available combined pressure drop for the inlet and outlet system **is 200 Pa for the complete Water heater range.**

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.

EF 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.

The EF Water heater 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.

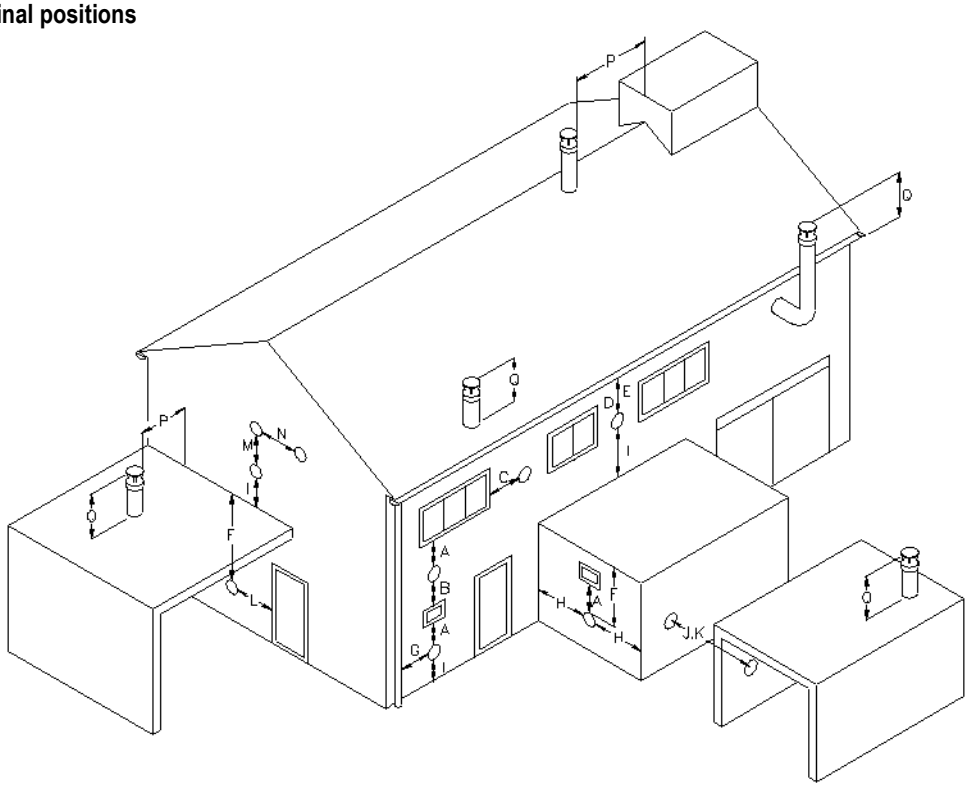
Before installation of any flue system read the installation manual carefully for both the appliance and flue system to be used. Information on the flue system Supplied by Lochinvar can be found within this manual.

8.2 FLUE SYSTEM TECHNICAL DETAILS

Model Number		EF80	EF100	EF120	EF150	EF180
FLUE DATA TYPE B_{23}						
Nominal flue diameter	mm	80	100			130
Maximum flue gas temp	°C	120				
Flue gas temperature	°C	85 - 95				
Flue draught requirements	mbar	-0.03 to -0.1				
Available pressure for the flue system	Pa	200				
Maximum flue gas volume	g/s	6.52 to 38.6	7.69 to 47.9	11.6 to 57.7	15.2 to 71.7	20.1 to 86.2
FLUE DATA TYPE C_{13} & C_{33}						
Nominal flue diameter	mm	80/125	100/150			
Maximum flue gas temp	°C	120				
FLUE DATA TYPE C_{43} & C_{53}						
Nominal flue diameter	mm	80	100			130
Maximum flue gas temp	°C	120				

8.3 FLUE TERMINAL LOCATION

8.3.1 Flue terminal positions



Location	Description	EF80 – EF180
A	Directly below an opening, air brick, opening windows etc.	2000
B	Above an opening, air brick, opening windows etc.	960
C	Horizontally to an opening, air brick, opening windows etc.	960
D	Below a gutter or sanitary pipework	75
E	Below the eaves	200
F	Below a balcony or car port roof	200
G	From a vertical drain or soil pipe	144
H	From an internal or external corner	300
I	Above ground, roof or balcony level	300*
J	From a surface facing the terminal	960
K	From a terminal facing the terminal	2000
L	From an opening in the car port (e.g. door, window) into the dwelling	1160
M	Vertically from a terminal on the same wall	1440
N	Horizontally from a terminal on the same wall	577
P	From a vertical structure on the roof	300
Q	Above intersection with the roof	300

8.3.2 Flue terminal minimum distances

*Any termination of a room sealed appliance shall 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 height to the centreline of the terminal shall not be less than 2m from occupied external areas.

Detailed recommendations for the flue system are given in **BS5440-1** for equipment of rated input not exceeding 70kW net, **BS6644** for equipment above 70kW net and **IGE/UP/10** for equipment of rated input above 54kW net. The following notes are intended to give general guidance only.

8.4 APPROVED FLUE SYSTEM

The approved flue system is not suitable for use external to the building. If external routes cannot be avoided, a flue system manufacturer must be consulted to supply a suitable alternative.

EF80 – EF120 Water heaters are supplied for connection to a concentric flue system. If twin pipe or conventional flue is used, a conversion kit will be required.

EF150 and EF180 Water heaters are supplied for connection to a twin pipe or conventional flue system. If concentric flue is to be used, a conversion kit will be required.

When used as a Type C (Balanced Flued) appliance, the approved, purpose designed adaptive flue system from Lochinvar should be used. Concentric and twin-pipe options are available.
When used as a Type B (Conventional Flued) appliance, a suitable flue system constructed of Stainless Steel or Polypropylene with a temperature rating in excess of 120°C should be used. Internal flue items are available from Lochinvar. For further details of available components see EF Flue assembly and ancillaries' document available at www.lochinvar.ltd.uk

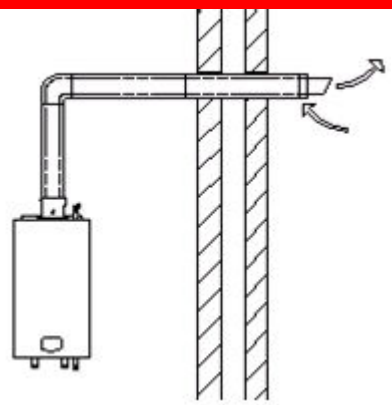
Aluminium flue pipe must not be used on this appliance as it may lead to premature failure of the heat exchanger and will invalidate the warranty.

8.5 INSTALLATION PRECAUTIONS

- The approved flue system is rated to 120°C max.
- The heater must not be operated unless the complete flue system is installed. This includes the Water heater connections, twin-pipe conversion kit (if required) flue pipes, air ducts (if required) and terminals. If discharging at low level, a suitable flue guard must be installed.
- 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 of the flue system, precaution should be taken to ensure that the internal 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.

8.6 C13, C33 CONCENTRIC FLUE SYSTEMS

C_{13}



FLUE SYSTEM SPECIFICATION

- MANUFACTURER MUELINK & GROL
- TEMPERATURE CLASS T120
- FLUE GAS MATERIAL PP

EACH HORIZONTAL CONCENTRIC FLUE ASSEMBLY IS SUPPLIED WITH THE FOLLOWING ITEMS:

- CONCENTRIC WALL TERMINAL
- WALL PLATES
- 90° BEND

ADDITIONAL FLUE ITEMS ARE AVAILABLE SEE FLUE ASSEMBLY AND ANCILLARIES GUIDE AT WWW.LOCHINVAR.LTD.UK

8.6.1 C_{13} horizontal concentric flue system components

Model	Description	Flue Assembly Item number
EF80	Horizontal Concentric flue kit 80/125mm	EFHF002
EF100	Horizontal Concentric flue kit 100/150mm	EFHF004
EF120	Horizontal Concentric flue kit 100/150mm	EFHF004
EF150	Horizontal Concentric flue kit 130/200mm	EFHF005
EF180	Horizontal Concentric flue kit 130/200mm	EFHF005

8.6.2 C_{13} horizontal concentric flue assemblies

8.6.3 Horizontal terminal installation

When the heater is installed as a Type C_{13} appliance, the flue system should be installed as follows:

1. Determine the location of the flue terminal, taking into account minimum distances as detailed in **Section 8.3.1** and the relevant British Standards.
2. Taking care to protect the appliance from debris and dust, drill a hole in the desired location. The diameter of the hole should be no more than 10mm greater than the diameter of the air supply pipe of the terminal.
3. Determine the required length of the terminal and cut as necessary.

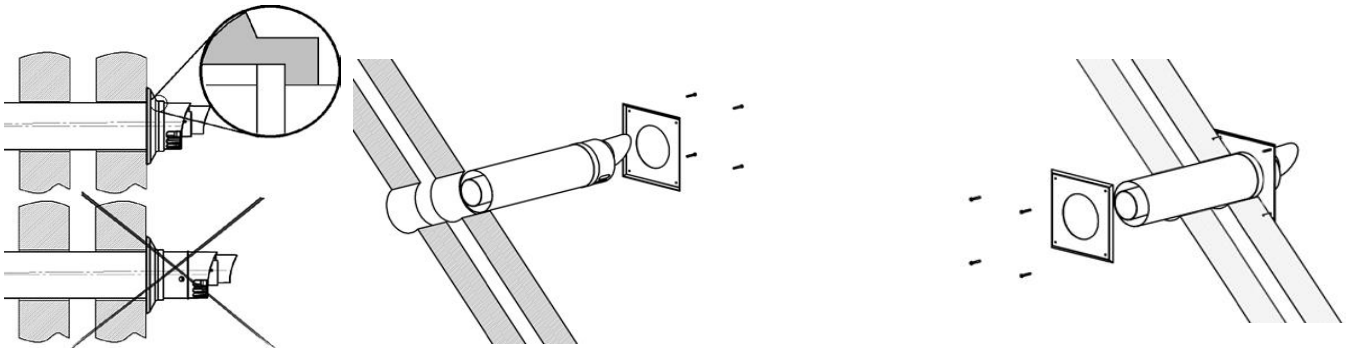
NOTE: When determining the required length for the flue terminal, the outer wall plate or rosette should be flush to the wall. See Section 8.6.4

NOTE: Once cut; remove all burrs and sharp edges.

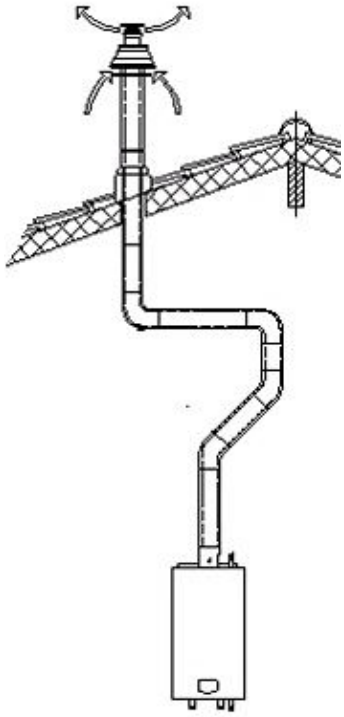
4. Insert the terminal into the drilled hole. The terminal section should be installed level or with a fall to outside (Max. 10 mm per metre) to prevent the ingress of water.

NOTE: When inserting the terminal, ensure the air intake section is at the bottom.

5. Fill the void between the terminal and wall with water resistant sealant.
6. Fit the wall plates or rosette using appropriate fixings.
7. Install the remainder of the flue system working progressively away from the Water heater supporting the pipes as necessary.



8.6.4 Installation of concentric terminal



FLUE SYSTEM SPECIFICATION

- MANUFACTURER MUELINK & GROL
- TEMPERATURE CLASS T120
- FLUE GAS MATERIAL PP

EACH VERTICAL CONCENTRIC FLUE ASSEMBLY IS SUPPLIED WITH THE FOLLOWING ITEMS:

- CONCENTRIC VERTICAL TERMINAL Ø80/125MM PP
- CONCENTRIC EXTENSION Ø80/125mm (500mm) PP CUT TO LENGTH

ADDITIONAL FLUE ITEMS ARE AVAILABLE SEE FLUE ASSEMBLY AND ANCILLARIES GUIDE AT WWW.LOCHINVAR.LTD.UK

8.6.5 C_{33} vertical concentric flue assembly

Model	Description	Flue Assembly Item number
EF80	Vertical Concentric flue kit 80/125mm	EFVF002
EF100	Vertical Concentric flue kit 100/150mm	EFVF004
EF120	Vertical Concentric flue kit 100/150mm	EFVF004
EF150	Vertical Concentric flue kit 130/200mm	EFVF005
EF180	Vertical Concentric flue kit 130/200mm	EFVF005

8.6.6 C_{33} vertical concentric flue assemblies

8.6.7 Vertical terminal installation

When the heater is installed as a Type C_{33} appliance, the flue system should be installed as follows:

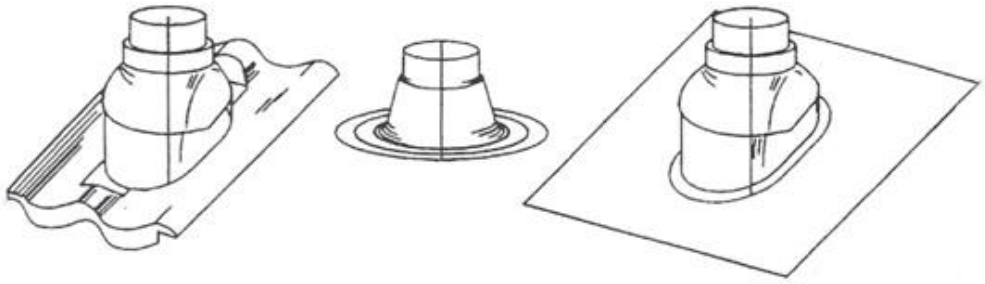
1. Confirm that the roof flashing is correct for the type of roof through which the terminal is to be installed. (See **Section 8.11**)
2. Determine the desired location for the flue terminal, taking into account minimum distances as detailed in **Section 8.3.1** and the relevant British Standards.
3. Taking care to protect the appliance from debris and dust, drill a hole in the desired location. The diameter of the hole should be no more than 10mm greater than the diameter of the air supply pipe of the terminal.

NOTE: The hole should be drilled from the outside to ensure that no damage is done to the roofing material. Extra care should be taken to ensure that the hole is drilled vertically.

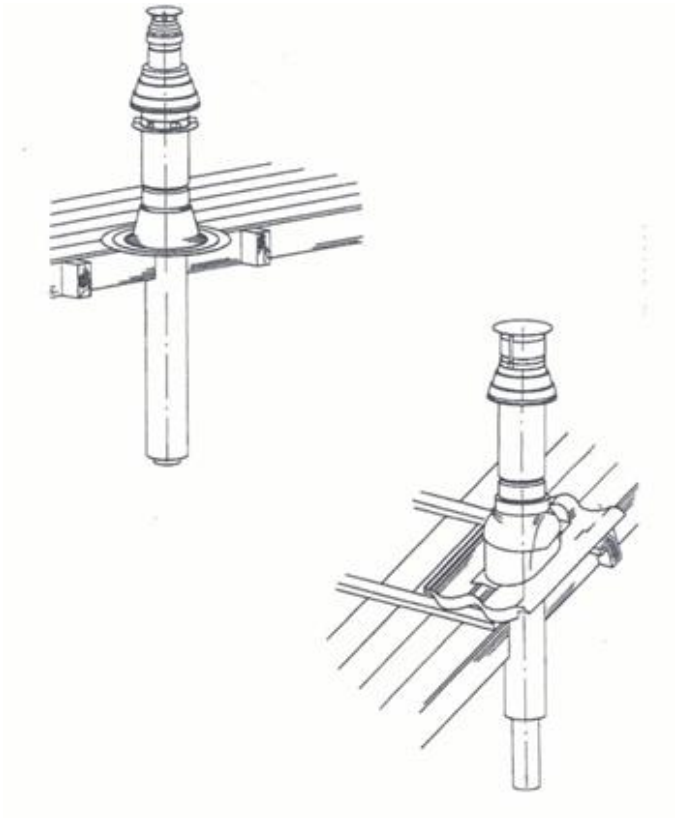
4. Install the roof flashing and secure as appropriate.
5. Carefully insert the roof terminal through the roof flashing and hole in the roof.

NOTE: When inserting the roof terminal do not support or turn the terminal using the cap.

6. Ensure the terminal is vertical using a spirit level.
7. Fit the support bracket around the terminal and secure using appropriate fixings. Do not tighten the support bracket.
8. Install the remainder of the flue system working progressively away from the Water heater supporting the pipes as necessary.
9. Once the flue system is fully installed, tighten the clamp to secure the terminal in place.



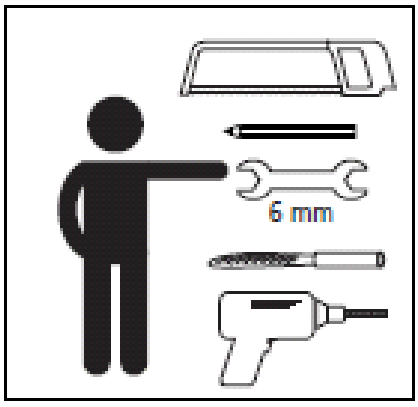
8.6.8 Vertical terminal roof flashings for synthetic, flat and tiled roofs

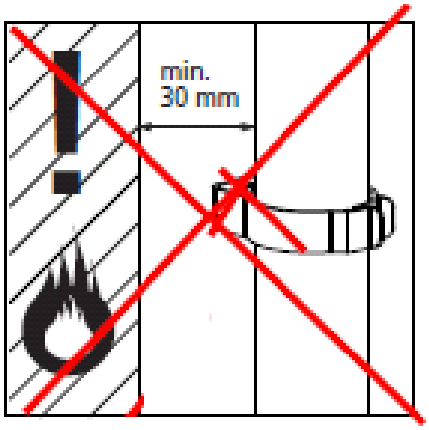


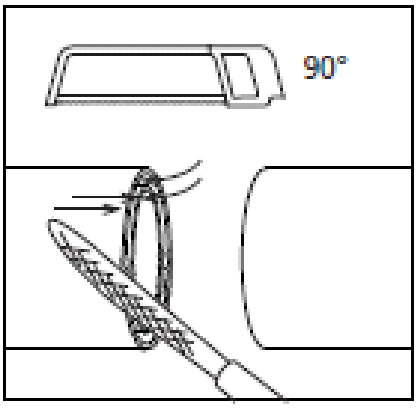
8.6.9 Installing terminal through roof flashing

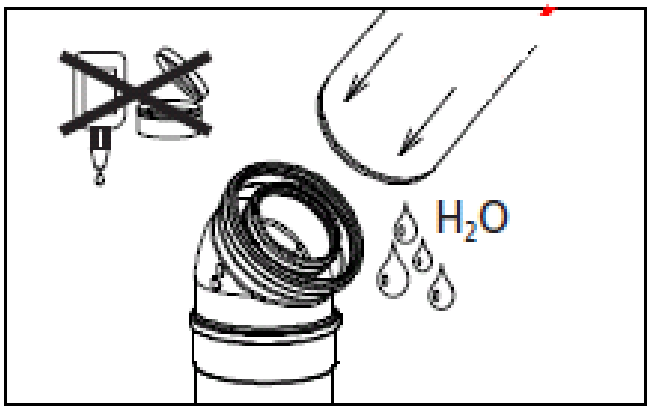
8.6.10 General concentric flue system installation guidelines

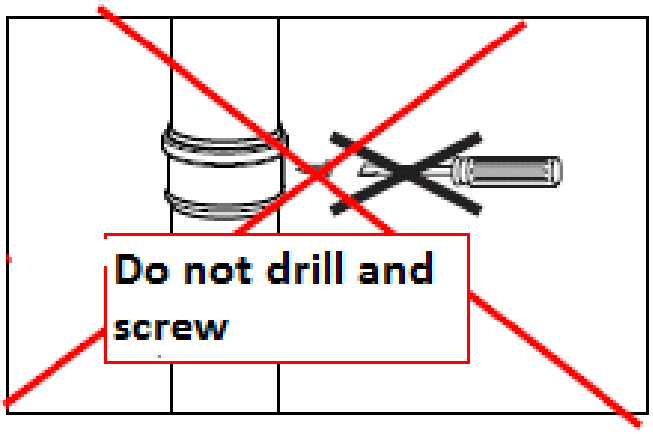
The images shown below may not represent the equipment supplied, images and instructions are for general guidance only

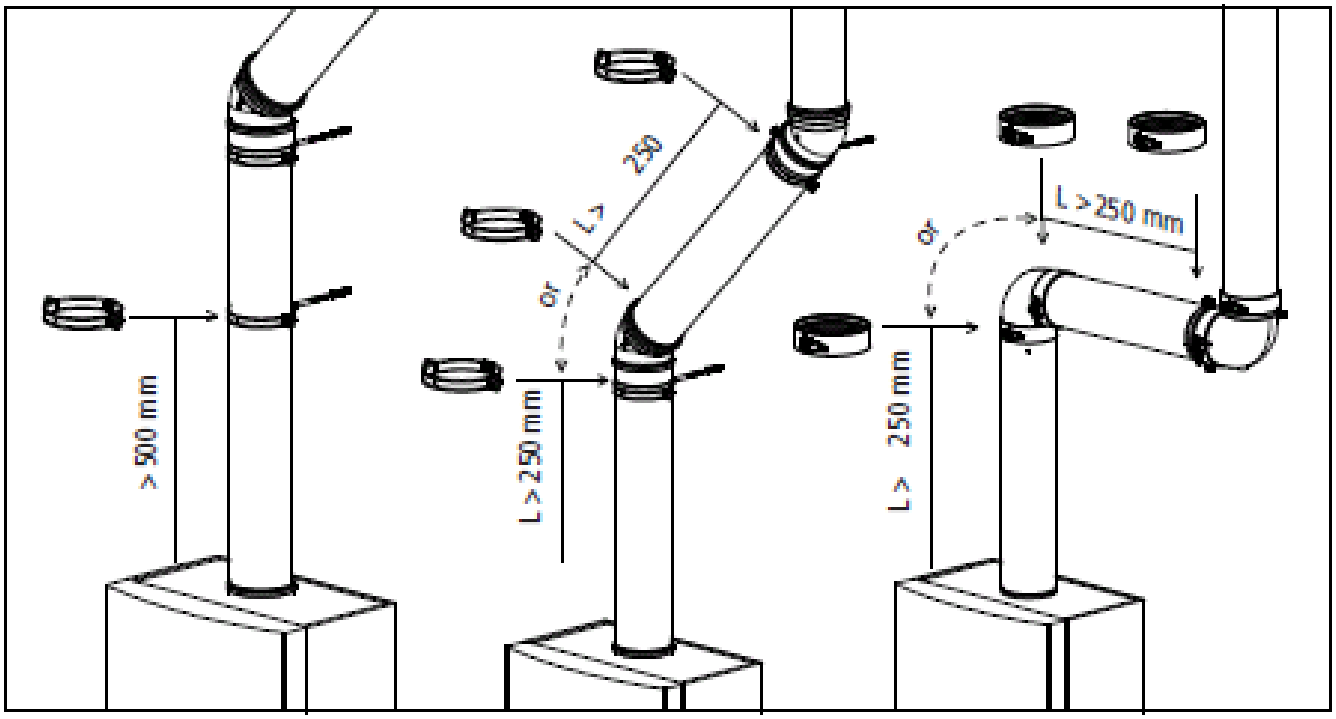


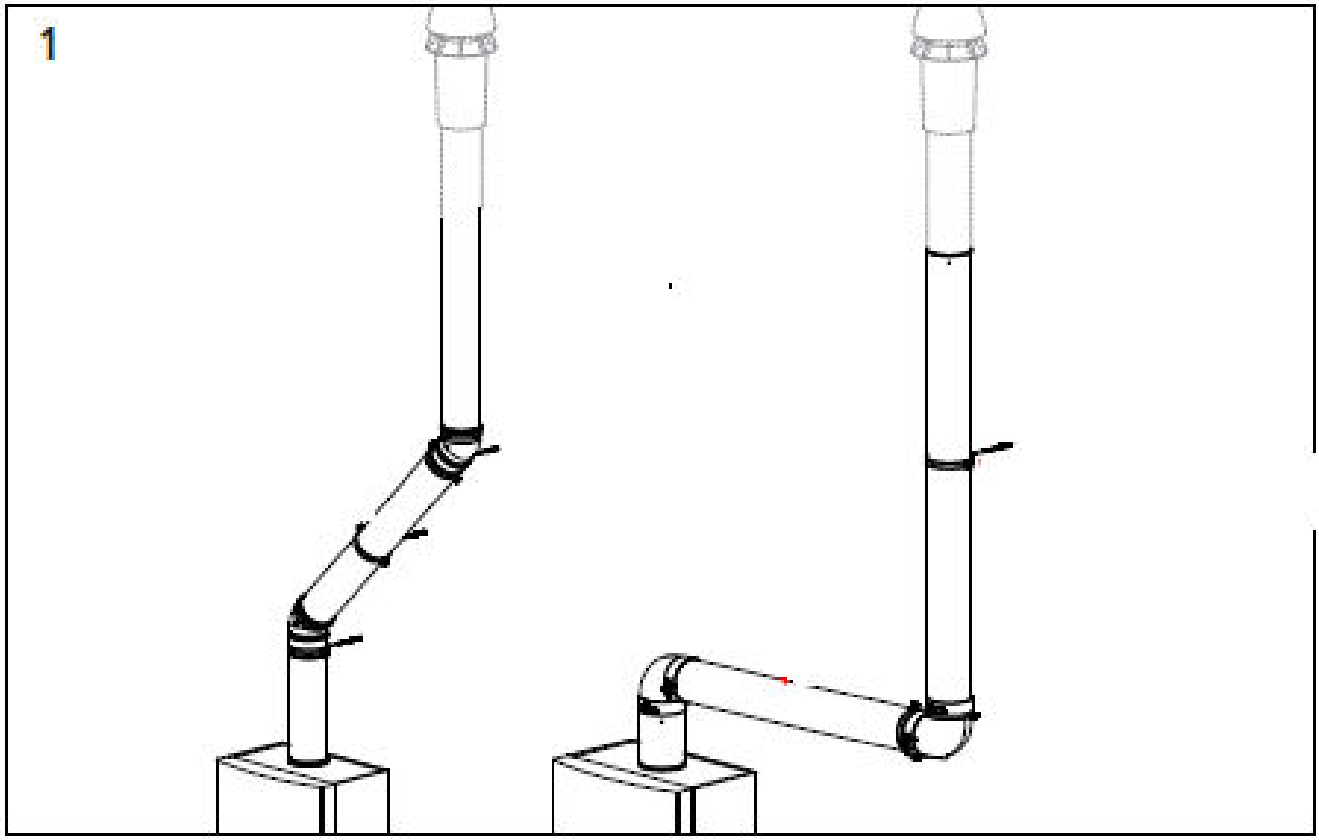








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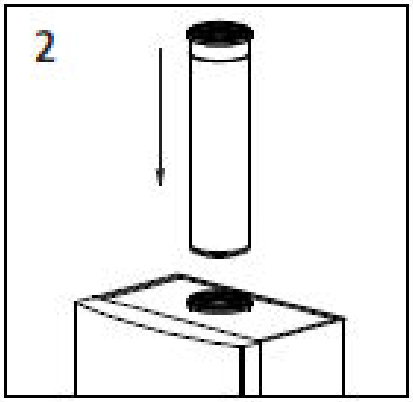
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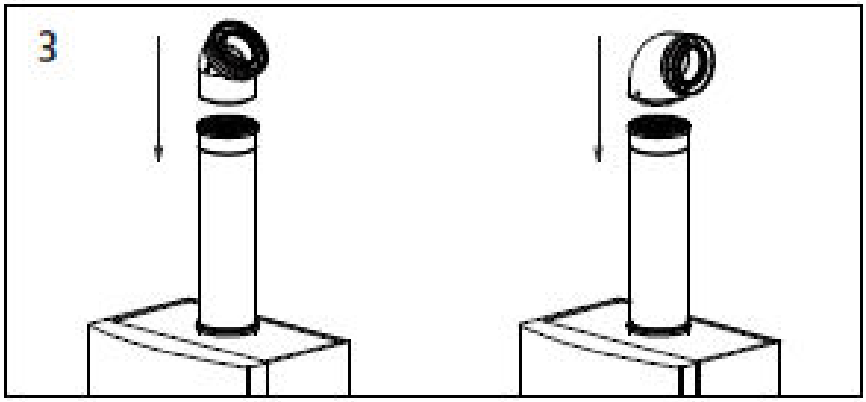
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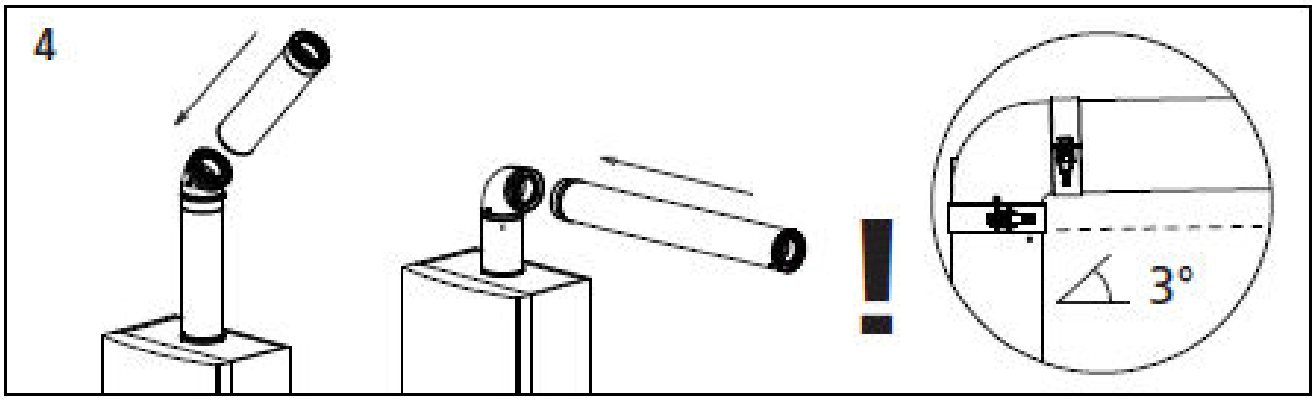
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3°

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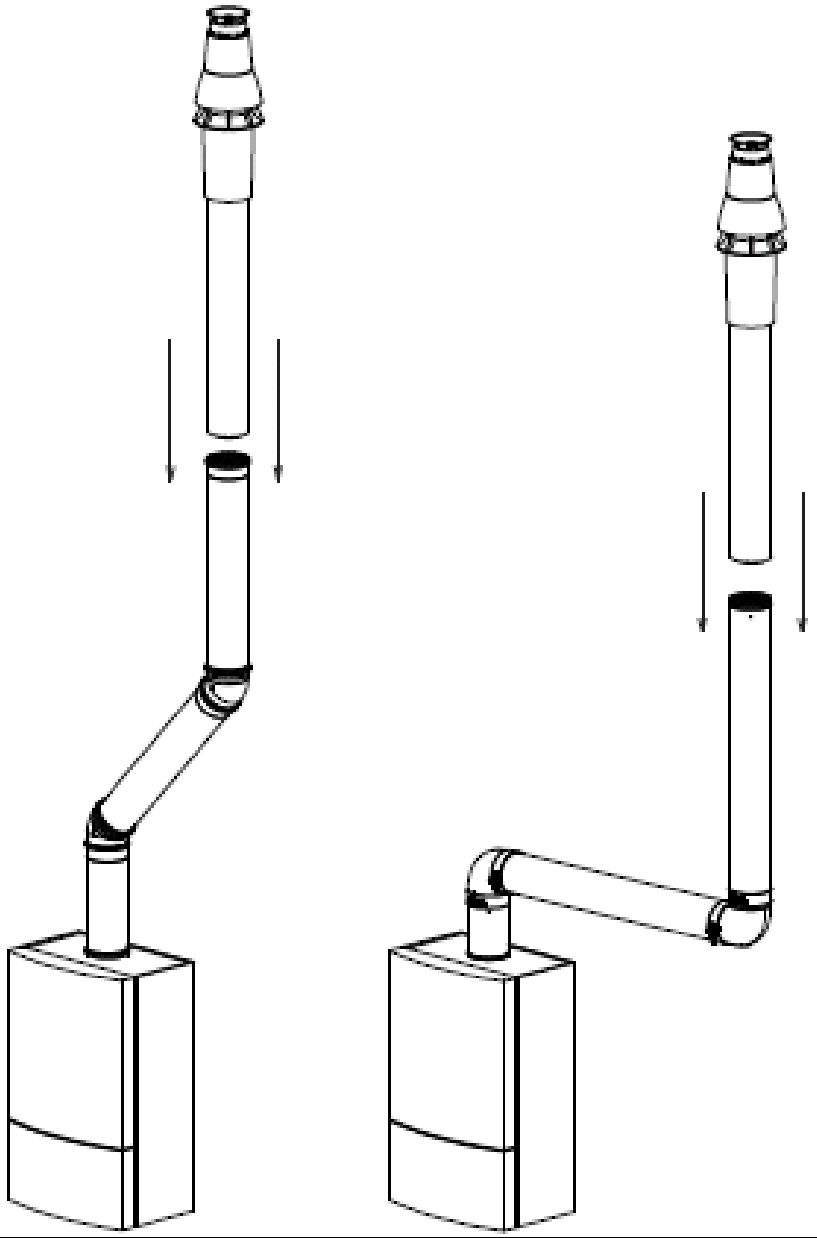

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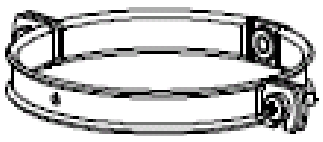
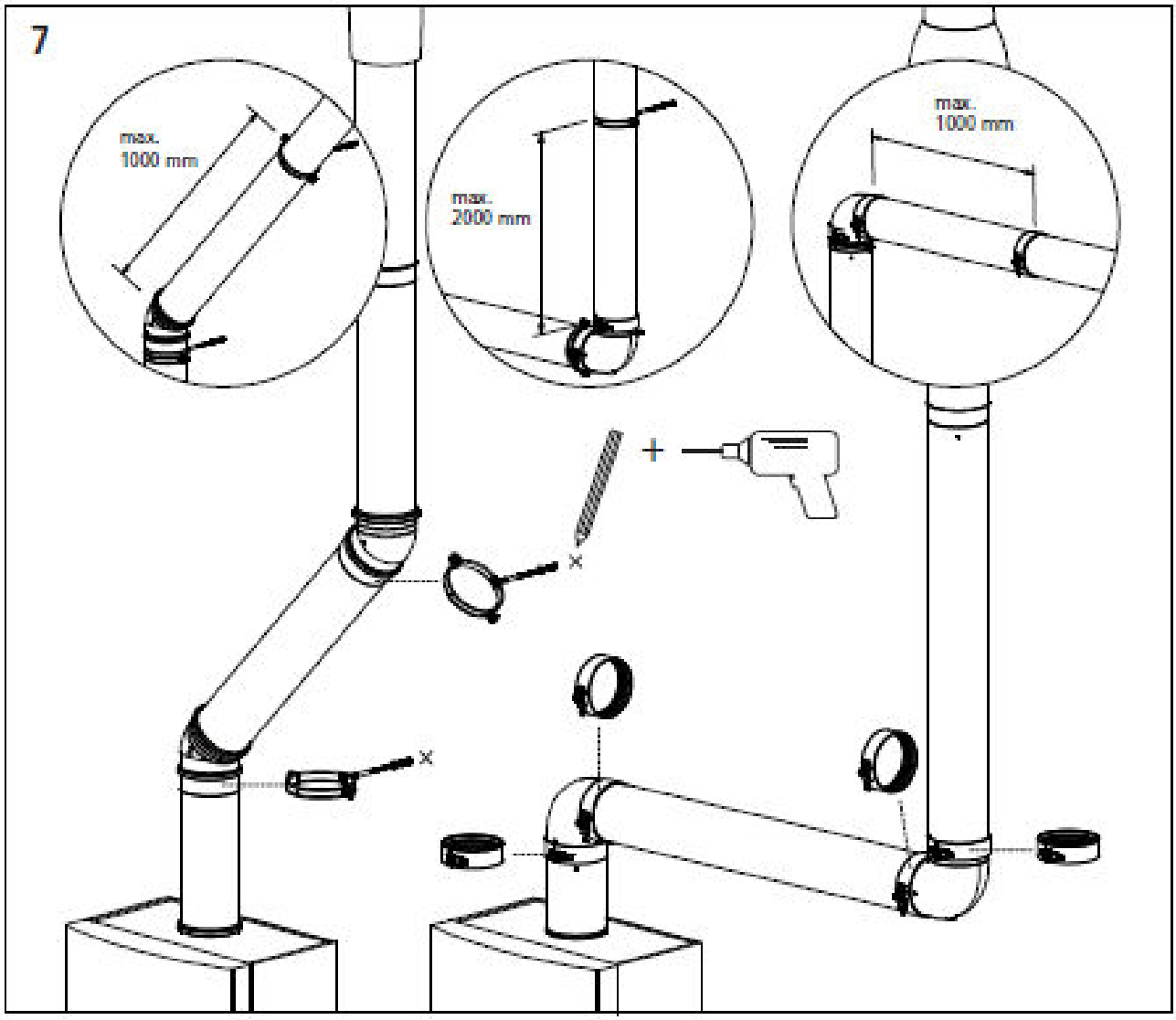
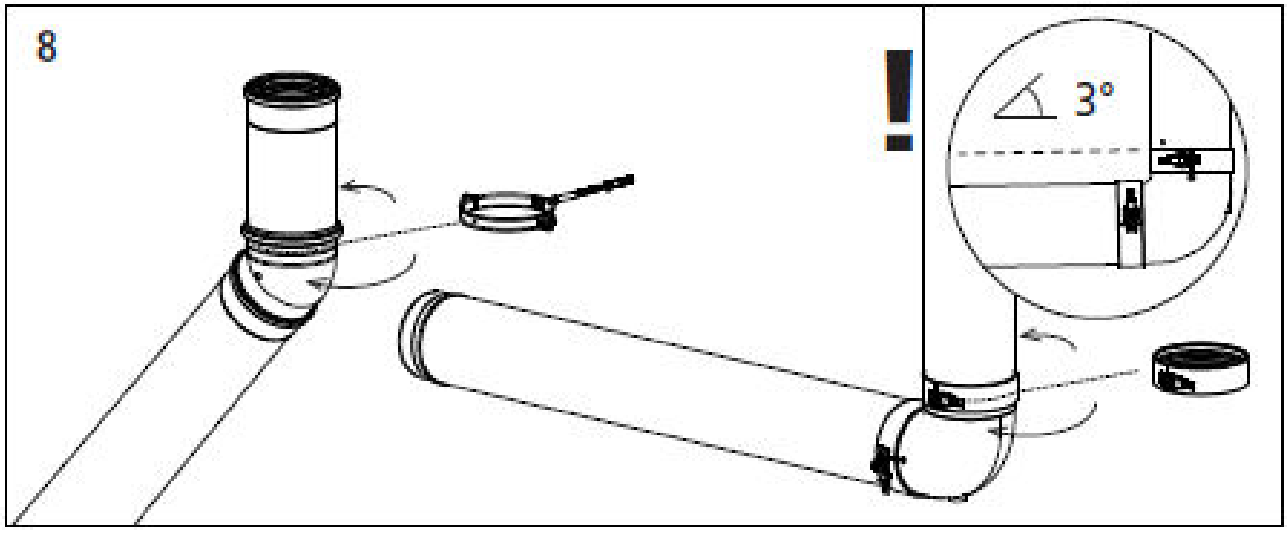



7
max.
1000 mm
max.
2000 mm
max.
1000 mm


8
3°

8.6.11 Maximum length – concentric flue

The maximum length of the flue system is determined by the resistance of the components within the flue.

The resistance must not exceed 200 Pa.

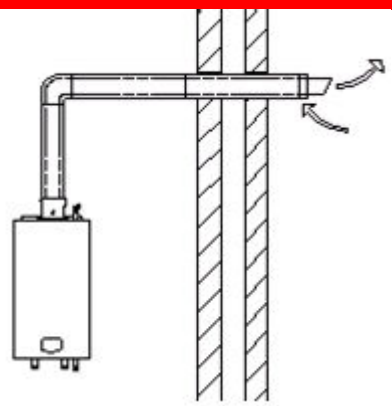
The information shown in table 8.6.12 is for the Lochinvar supplied flue system only; other flue system suppliers may have different values.

	EF80 (80/125)	EF100 (100/150)	EF120 (100/150)	EF150 (100/150)	EF180 (100/150)
Wall terminal	80.1	58	84	129.9	188
Roof terminal	109.8	80	115.9	179.2	259.3
Straight tube (m)	18.1	13	18.9	29.2	42.2
45° Elbow	15.4	15.5	22.4	34.7	50.2
90° Elbow	28.7	23.6	34.2	52.9	76.5

8.6.12 Concentric flue component resistances (pa)

8.6.13 Worked example – concentric flue

Flue Resistance Calculation Example



EXAMPLE A
EF100 WATER HEATER WITH HORIZONTAL CONCENTRIC TERMINAL
3000mm VERTICAL FLUE LENGTH
6000mm HORIZONTAL FLUE LENGTH
90° BEND

EXAMPLE B
EF150 WATER HEATER WITH HORIZONTAL CONCENTRIC TERMINAL
3000mm VERTICAL FLUE LENGTH
600mm HORIZONTAL FLUE LENGTH
90° BEND

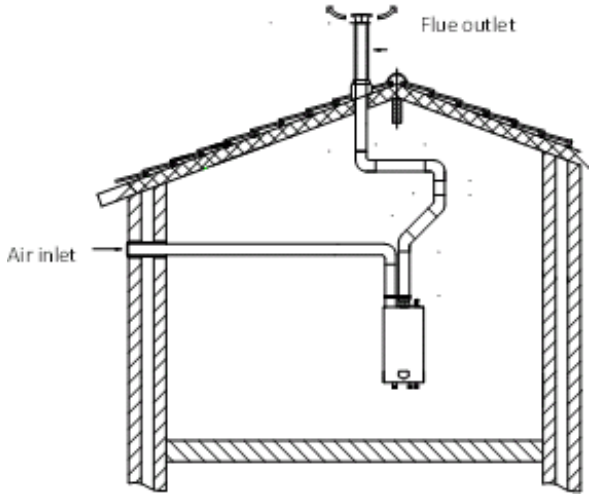
100/150mm Concentric flue

Example A			
Item	**Quantity**	**Resistance**	**Total**
Wall terminal	1	58	58
Roof terminal	0	80	0
Straight tube (m)	9	13	117
45° Elbow	0	15.5	0
90° Elbow	1	23.6	23.6
		Total Resistance (Pa)	**198.6**
			198<200 FLUE SYSTEM DESIGN HAS PASSED

Example B			
Item	**Quantity**	**Resistance**	**Total**
Wall terminal	1	129.9	129.9
Roof terminal	0	179.2	0
Straight tube (m)	9	29.2	262.8
45° Elbow	0	34.7	0
90° Elbow	1	52.9	52.9
		Total Resistance (Pa)	**445.6**
			446>200 FLUE SYSTEM DESIGN HAS FAILED USE TWIN PIPE OR CONVENTIONAL FLUE INSTEAD

8.7 C53 TWIN PIPE FLUE SYSTEMS

C_{53}



FLUE SYSTEM SPECIFICATION

- MANUFACTURER MUELINK & GROL
- TEMPERATURE CLASS T120
- FLUE GAS MATERIAL PP

VARIOUS FLUE ITEMS ARE AVAILABLE SEE FLUE ASSEMBLY AND ANCILLARIES GUIDE AT WWW.LOCHINVAR.LTD.UK

8.7.1 C_{53} twin pipe flue system components

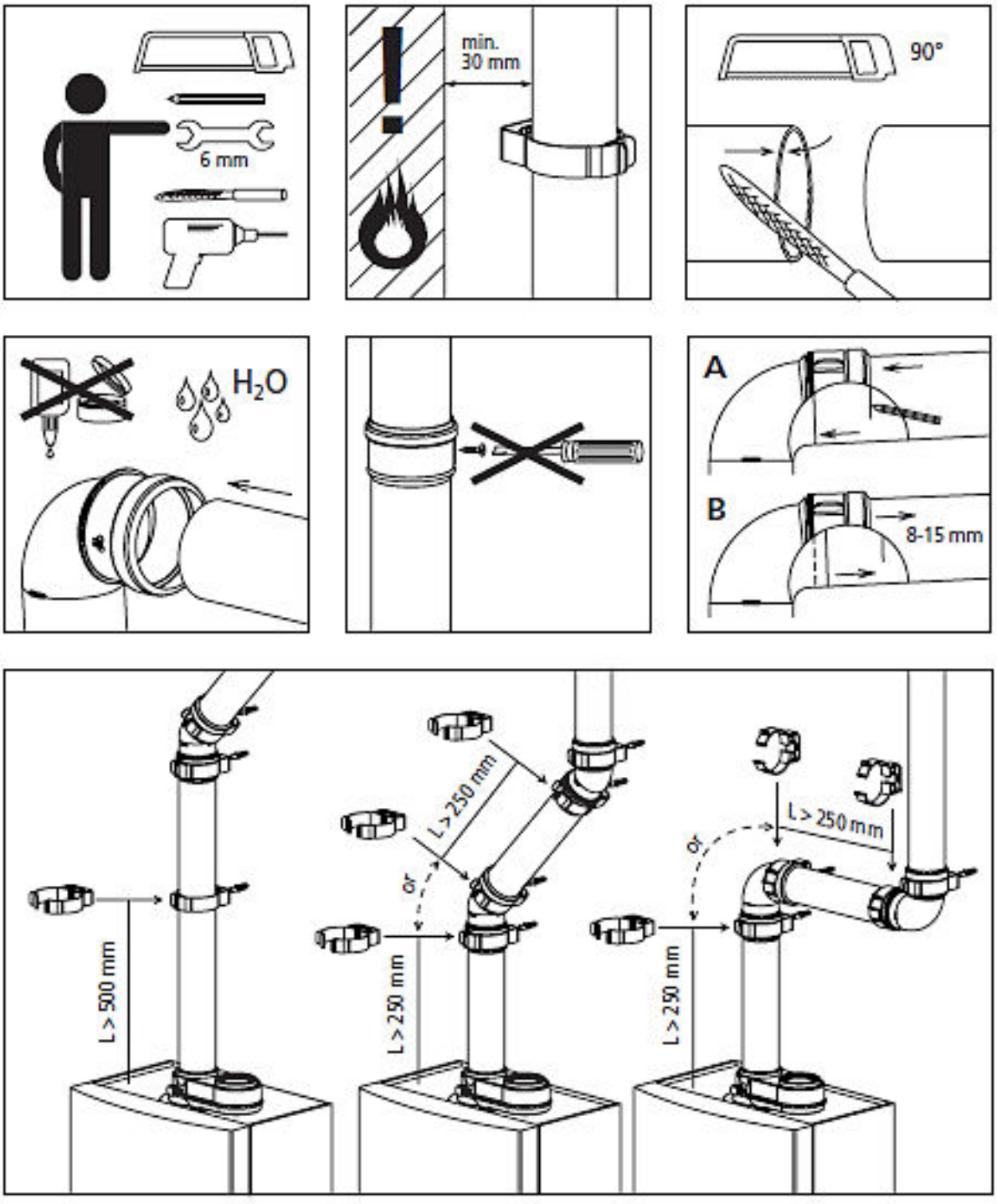
In order to install the EF Water heater in a Twin-pipe configuration models EF80-EF120 require a Twin-pipe conversion kit as below, further flue ancillary items are available to complete the installation.

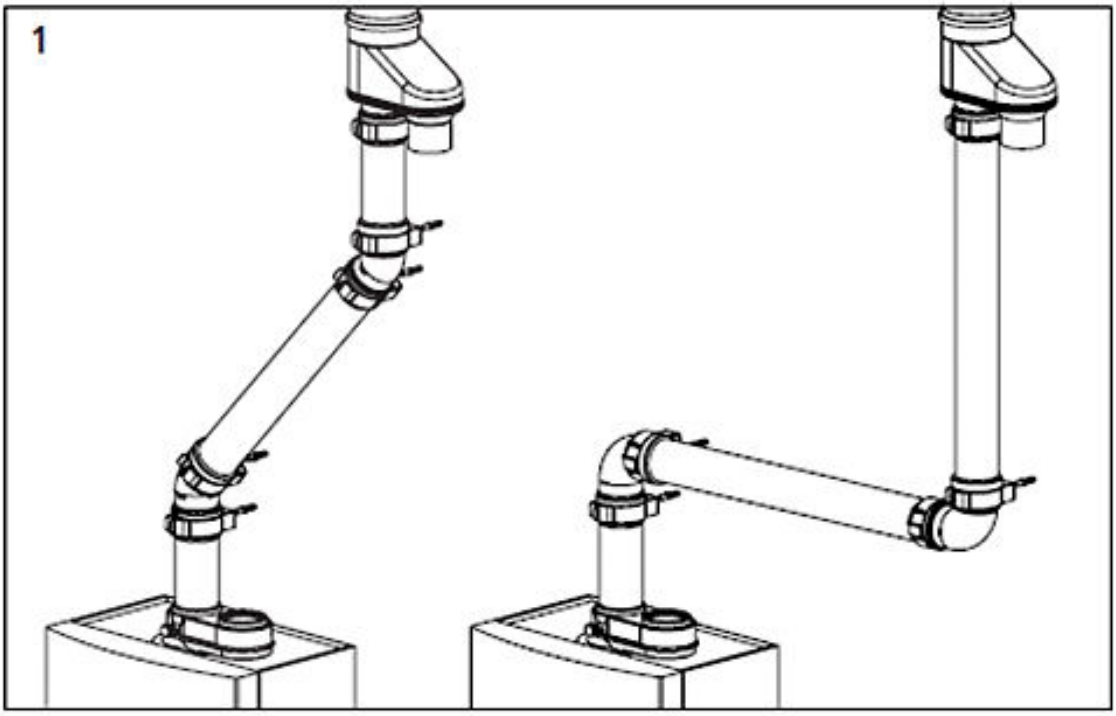
Model	Conversion kit Item number
EF80	E61-001-163
EF100,EF120	E61-001-164

When installing the Water heater as a type C_{53} appliance, it should be noted that the terminals must not be installed on opposite sides of the building.

8.7.2 General twin-pipe installation guidelines

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

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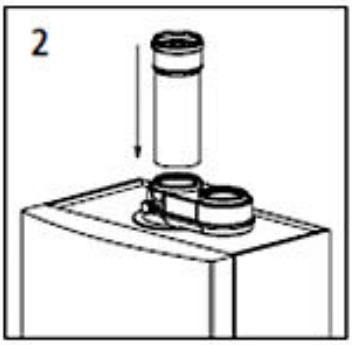
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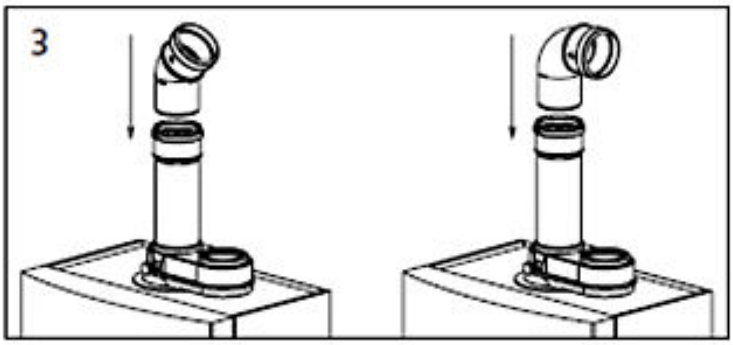
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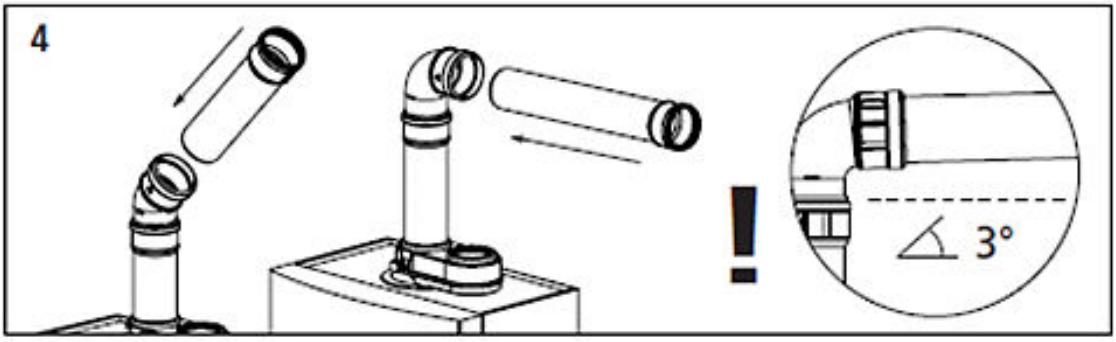
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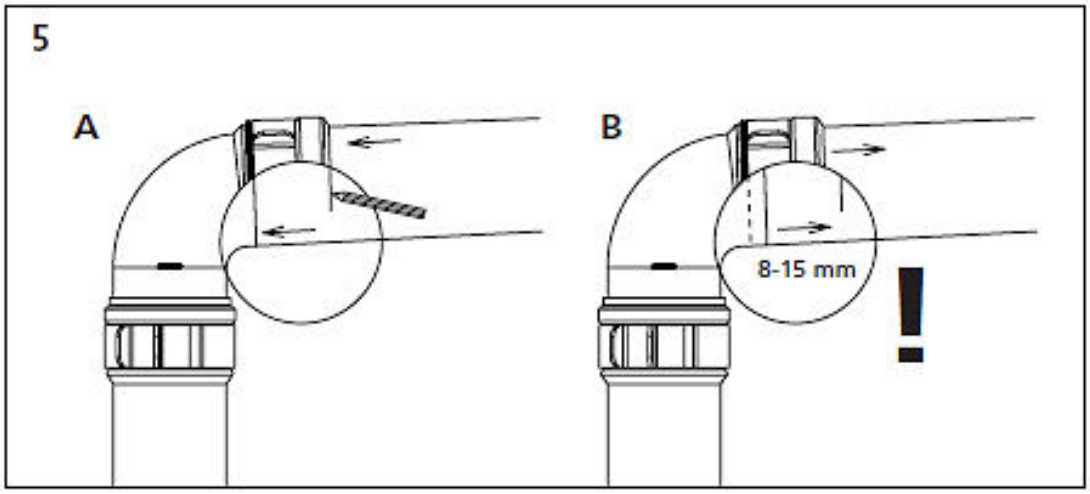
5
A
B
8-15 mm
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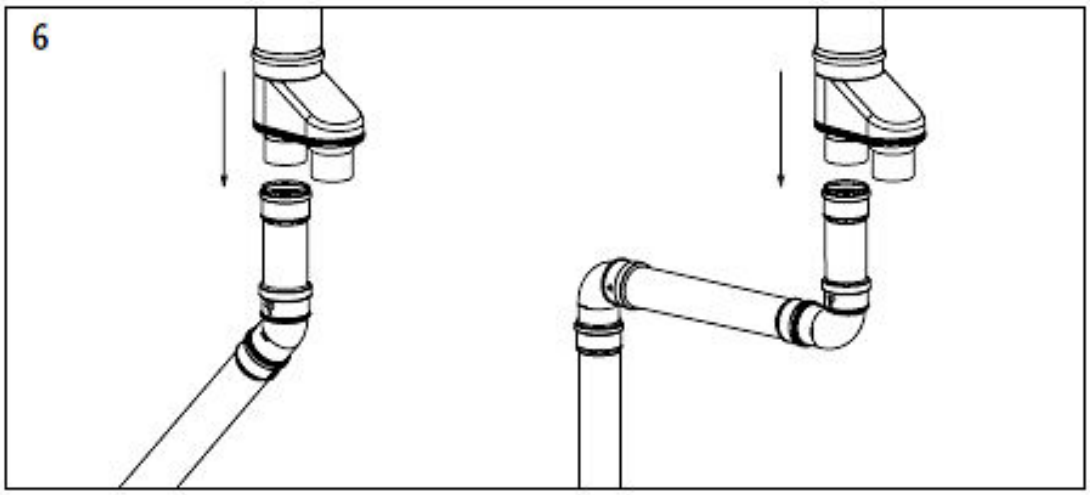
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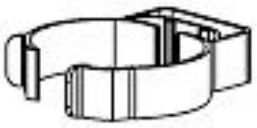
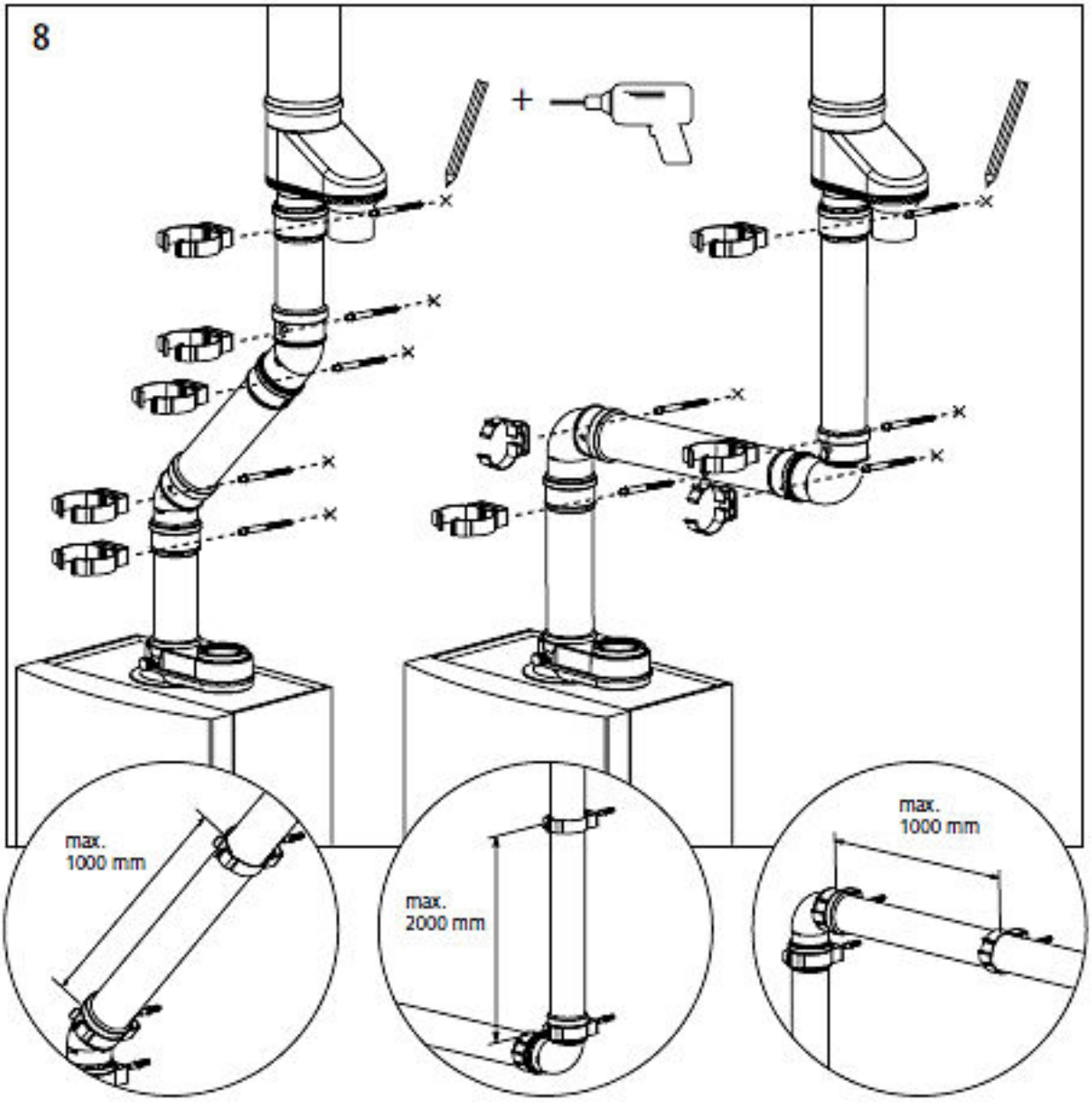
7

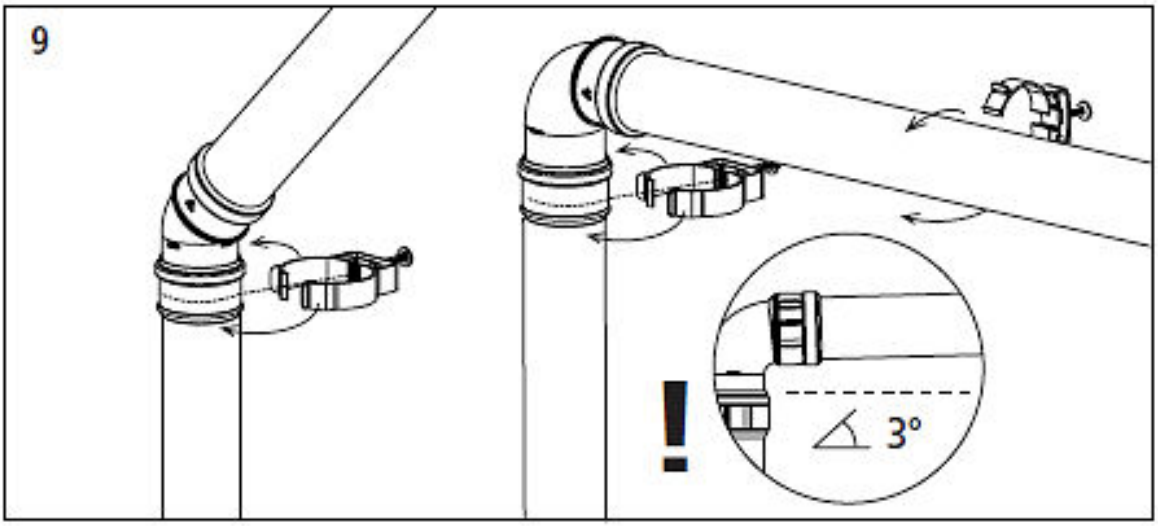


Ø 60, 80, 100 mm

Ø 130, 150, 200 mm

8

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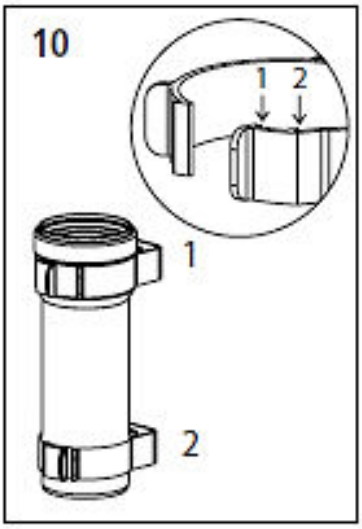
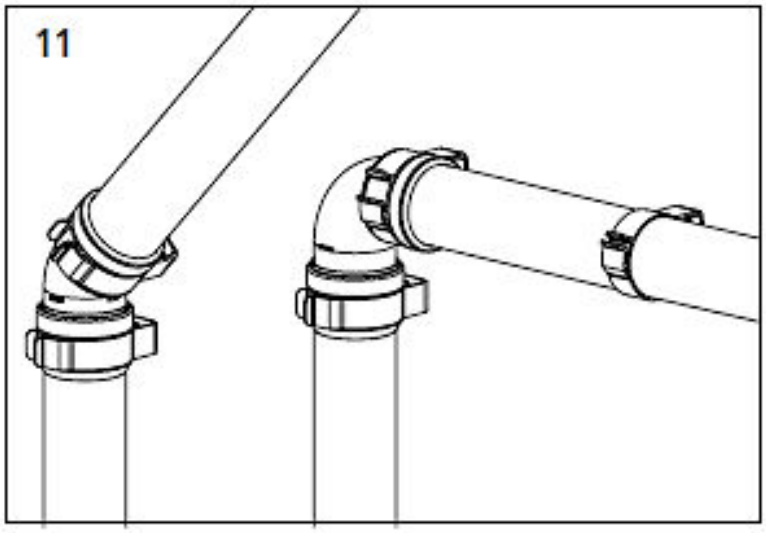
3°


10
1
2
1
2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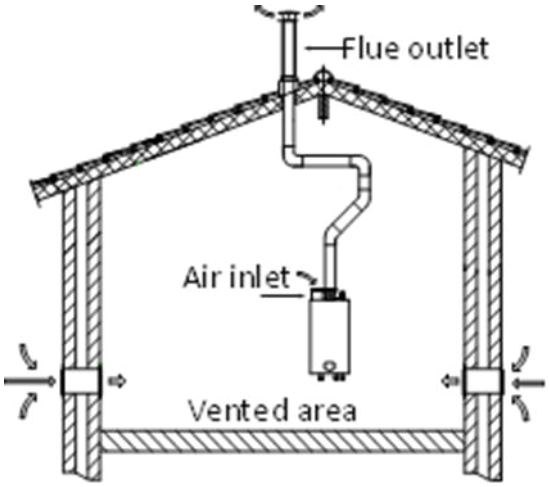
8.8 B23 CONVENTIONAL FLUE INSTALLATIONS

B_{23}



FLUE SYSTEM SPECIFICATION

- MANUFACTURER MUELINK & GROL
- TEMPERATURE CLASS T120
- FLUE GAS MATERIAL PP

VARIOUS FLUE ITEMS ARE AVAILABLE SEE FLUE ASSEMBLY AND ANCILLARIES GUIDE AT WWW.LOCHINVAR.LTD.UK

8.8.1 B_{23} conventional flue system components

When installing as a fan assisted conventional flue appliance models EF80-EF120 require a Twin-pipe conversion kit and additionally require an Air inlet guard as below.

Model	Conversion kit Item number	Air Inlet guard Item number
EF80	E61-001-163	M73039
EF100,EF120	E61-001-164	M86787

When installing as a fan assisted conventional flue appliance models EF150-EF180 are factory supplied in a Twin-pipe configuration so only require an Air inlet guard as below

Model	Air Inlet guard Item number
EF150	M81660
EF180	M81660

Due to the large Flue pipe size required Lochinvar does not supply conventional flue components for models EF150, EF180 except the air inlet guard. For this installation type a flue system designer/installer should be consulted.

8.8.2 Maximum length – conventional/twin-pipe flue

The maximum length of the flue system is determined by the resistance of the components within the flue When a conventional or twin-pipe flue is to be used, the maximum length of the flue system is limited by the combined resistance of the inlet (if used) and outlet flue components as detailed in the following tables.

The resistance must not exceed 200 Pa.

The information shown in table 8.6.12 is for the Lochinvar supplied flue system only; other flue system suppliers may have different values.

Item	Size (mm)	Resistance (Pa)				
		EF80	EF100	EF120	EF150	EF180
Straight tube (per metre)	80	8.2	X	X	X	X
Straight tube (per metre)	100	2,3	3.5	5.0	X	X
Straight tube (per metre)	130	0.6	0.9	1.2	1.9	2.8
45° Elbow	80	7.6	X	X	X	X
45° Elbow	100	5.1	7.9	11.5	X	X
45° Elbow	130	1.0	1.6	2.3	3.5	5.1
90° Elbow	80	18.0	X	X	X	X
90° Elbow	100	8.3	12.7	18.4	X	X
90° Elbow	130	2.4	3.7	5.4	8.4	12.1
Vertical inlet cap	80	22.2	X	X	X	X
Vertical inlet cap	100	8.7	13.4	19.4	X	X
Vertical inlet cap	130	2.9	4.5	6.5	10.1	14.6

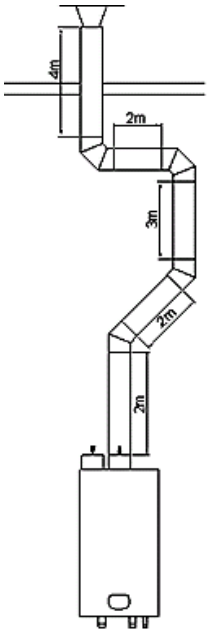
8.8.3 Air inlet component resistances (pa)

Item	Size (mm)	Resistance (Pa)				
		EF80	EF100	EF120	EF150	EF180
Straight tube (per metre)	80	7.1	X	X	X	X
Straight tube (per metre)	100	2.0	3.0	4.4	X	X
Straight tube (per metre)	130	0.5	0.7	1.1	1.7	2.4
45° Elbow	80	6.5	X	X	X	X
45° Elbow	100	4.4	6.8	9.9	X	X
45° Elbow	130	0.9	1.4	2.0	3.0	4.4
90° Elbow	80	15.6	X	X	X	X
90° Elbow	100	7.1	11.0	16.0	X	X
90° Elbow	130	2.1	3.2	4.7	7.2	10.5
Vertical exhaust cap	80	19.2	X	X	X	X
Vertical exhaust cap	100	7.5	11.6	16.8	X	X
Vertical exhaust cap	130	2.5	3.9	5.6	8.7	12.6

8.8.4 Exhaust component resistances (pa)

8.8.5 Worked example – conventional flue

Flue Resistance Calculation Example



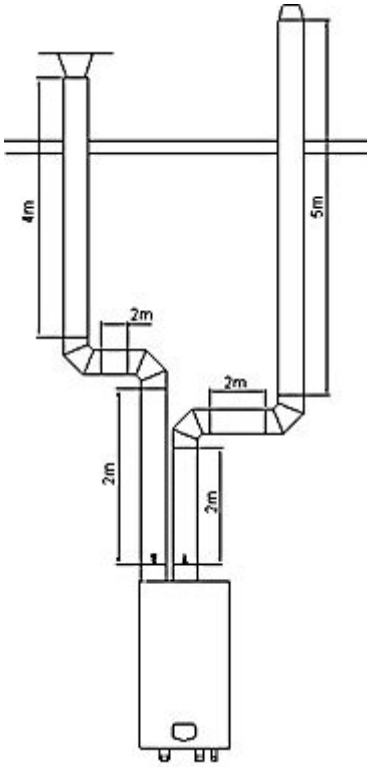
EXAMPLE EF100 WATER HEATER WITH VERTICAL TERMINAL
11000mm VERTICAL FLUE LENGTH
2000mm HORIZONTAL FLUE LENGTH
2X 90° BEND
2X 45° BEND
AIR SUPPLY FROM PLANT ROOM

100mm flue pipe

Item	Quantity	Resistance	Total
Straight tube (m)	13	3.0	39
45° Elbow	2	6.8	13.6
90° Elbow	2	11.0	22.0
Vertical terminal	1	11.6	11.6
		Total Resistance (Pa)	86.2
			Total Resistance 86<200 FLUE SYSTEM DESIGN HAS PASSED

8.8.6 Worked example – twin-pipe flue

Flue Resistance Calculation Example



EXAMPLE EF120 WATER HEATER
FLUE EXHAUST
7000mm VERTICAL FLUE LENGTH
2000mm HORIZONTAL FLUE LENGTH
2X 90° BEND
1X FLUE TERMINAL
AIR INLET
6000mm VERTICAL LENGTH
2000mm HORIZONTAL LENGTH
2X 90° BEND
1X AIR INLET

100mm flue and air inlet pipe

	Item	Quantity	Resistance	Total
Flue exhaust	Straight tube (m)	9	4.4	39.6
	45° Elbow	0	9.9	0
	90° Elbow	2	16.0	32.0
	Vertical terminal	1	16.8	16.8
			Total Resistance (Pa)	**88.4**
Air Inlet	**Item**	**Quantity**	**Resistance**	**Total**
	Straight tube (m)	8	5.0	40.0
	45° Elbow	0	11.5	0
	90° Elbow	2	18.4	36.8
	Air Inlet	1	19.4	19.4
			Total Resistance (Pa)	**96.2**
				Total Resistance= 88.4+96.2 = 184.6<200 FLUE SYSTEM DESIGN HAS PASSED

8.9 FLUE DISCHARGE

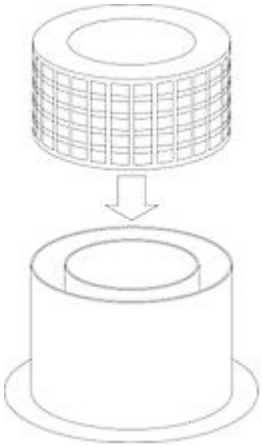
The flue system must ensure safe and efficient operation of the equipment to which it is attached, protect the combustion process from wind effects and disperse the products of combustion to open external air.

The flue must terminate in a freely exposed position and be so situated as to prevent the products of combustion entering any opening in a building.

For further information on terminal locations, please refer to **Section 8.3.1**.

8.10 TYPE B23 (CONVENTIONAL FLUE)

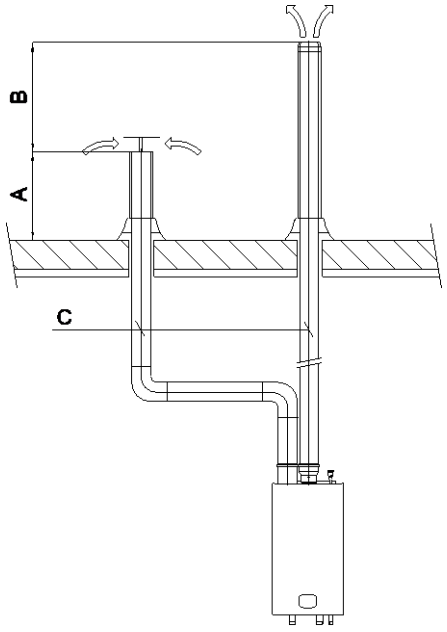
To convert the EF80 – EF120 to conventional flued operation, the approved air intake grille should be fitted to the concentric flue spigot. The grille will have an opening in the top plate that allows the connection of the flue system to the exhaust port of the Water heater.



FITTING AIR INLET GRILLE

When the heater is installed as a Type B_{23} appliance, the flue system should be installed in accordance with the flue manufacturer's specific instructions.

8.11 CONVENTIONAL AND TWIN-PIPE FLUE TERMINATION (FLAT AND TILED ROOFS)



Height A

This is the height of the air inlet. A rain hood should prevent rainwater entering the air supply system.

When the inlet 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 the air inlet should be at 45+30=75 cm. 75 cm is more than the minimum 60 so the height will be 75 cm.

Example 2:

When the maximum snow level on the roof surface is 15 cm then the air inlet should be at 15+30=45 cm. 45 cm is less than the minimum 60 cm so the height will be 60 cm.

Height difference B

This is the distance between the flue outlet and the air inlet.

The flue gas outlet should be at least 70 cm above the air inlet. It is advised to be equipped with a conical outlet.

When no air inlet connection is applied on the roof, the flue outlet should be situated at least 100 cm above the roof surface.

Distance C

The horizontal mutual distance at roof level.

This distance should be at least 70 cm.

8.12 TYPE C43 U DUCT

This appliance can operate on a U-Duct common flue system. The maximum lengths for the interconnecting flue can be calculated using the information in **Section 8.8.2:**
Concrete components of the U-Duct must meet the requirements of **BS EN 1858**

	EF80	EF100	EF120	EF150	EF180
Flue Gas Mass Rate (G20) 96% (g/sec)	29.8	37.1	45.1	55.6	67.3
Flue Gas Mass Rate (G20) 25% (g/sec)	7.5	9.3	11.3	13.9	16.8
Flue Gas Mass Rate (G31) 96% (g/sec)	30.6	38.8	46.2	57.0	69.0
Flue Gas Mass Rate (G31) 25% (g/sec)	7.7	9.7	11.6	14.3	17.3

8.12.1 Flue gas mass rates

8.13 COMMON FLUE SYSTEMS

The EF Water heater 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.

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.

A cascaded common flue system which operates on a positive pressure is available from Lochinvar Limited. Further details can be found in the Cascade Flue Systems guide, available from www.lochinvar.Limited.uk.

8.14 FLUE TERMINAL GUARDING

If a Vertical flue terminal is to be fitted less than 2 metres from ground level or in a location where it can be touched from a window, door or balcony, a terminal guard must be fitted.
The terminal guard should be positioned centrally around the terminal and secured using appropriate wall fixings.

8.15 CONDENSATE DRAIN

For flue runs of less than 6 metres, provided that the flue system rises at an angle of at least 3° (50mm per metre), no additional condensate drain will be required. Failure to provide an adequate rise in the flue system may lead to pooling of condensate which may lead to premature failure of the flue system.
If the flue run is greater than 6 metres, it is recommended that an inline condensate drain and trap be fitted. The condensate trap should be connected to a suitable drainage system as described in **Section 6.2**

8.16 C63 CERTIFIED FLUE SYSTEMS

In general Water heaters are certified with their own purpose supplied Concentric or Twin Pipe flue systems, C63 certified appliances allow the installer to use other flue systems when installing the Water heater however they must be of a suitable minimum standard as per **Table 8.16.1**

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

8.16.1 C63 flue system specification

Material	Water heater	$d_{nom\ mm}$	$D_{outside\ mm}$	$d_{inside\ mm}$	$L_{insert\ mm}$
SS	EF80	80	80 + 0.3 / -0.7	81 + 0.3 / -0.3	50 + 2 / -2
SS	EF100-EF120	100	100 + 0.3 / -0.7	101 + 0.3 / -0.3	50 + 2 / -2
SS	EF150-EF180	130	130 + 0.3 / -0.7	131 + 0.5 / -0.5	50 + 2 / -2
PP	EF80-EF80	80	80 + 0.6 / -0.6		50 + 20 / -2
PP	EF100-EF120	100	100 + 0.6 / -0.6		50 + 20 / -2
PP	EF150-EF180	130	130 + 0.9 / -0.9		50 + 20 / -2

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.

9.0 AIR SUPPLY

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.

9.1 COMBUSTION VENTILATION

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	Gross Input (kW)	Net Input (kW)	Plant Room						Enclosure					
			Low Summer Use		Medium Summer Use		High Summer Use		Low Summer Use		Medium Summer Use		High Summer Use	
			High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)
EF80	82.2	74.0	148	296	222	370	296	444	370	740	444	814	518	888
EF100	102.2	92.0	184	368	276	458	368	552	458	920	552	1012	644	1104
EF120	123.3	111.0	222	444	333	555	444	666	555	1110	666	1221	777	1332
EF150	153.3	138.0	276	552	414	690	552	828	690	1377	828	1518	966	1656
EF180	184.3	166.0	332	664	498	830	664	996	830	1658	996	1826	1162	1992

9.1.1 Combustion ventilation requirements – EF80 – EF180

9.2 COOLING VENTILATION

When used as a type C appliance, installed in a compartment or an enclosure, cooling ventilation should be provided as follows:

Model	Input (Gross) kW	Input (Net) kW	Enclosure/Compartment (Direct to Outside)		Enclosure/Compartment (To Internal Space)		Water heater Room	
			High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)	High (cm^2)	Low (cm^2)
EF80	82.2	74.0	370	370	740	740	148	148
EF100	102.2	92.0	458	458	920	920	184	184
EF120	123.3	111.0	555	555	1110	1110	222	222
EF150	153.3	138.0	690	690	1377	1377	276	276
EF180	184.3	166.0	830	830	1658	1658	332	332

9.2.1 Cooling ventilation requirements

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

9.3 MECHANICAL VENTILATION

In situations where combustion air cannot be provided by the means of ventilation grilles, it can be supplied by a fan. The minimum flow rate for the fan should be in accordance with **Table 9.4**.

If required, extract air can also be through the use of a fan. When sizing the extract fan, the extract flow rate should be calculated by subtracting the difference volume (from **Table 9.4**) from the actual supplied volume of inlet air. If therefore, a larger than required inlet volume is provided, the extract flow rate will need to be increased accordingly.

If the ventilation discharge from the plant room is through the means of simple openings relying on thermal effects, the minimum free areas of the openings and any associated grilles should be as specified for natural ventilation (see **Section 9.1:**). The ventilation openings shall be at high level and the air supply shall be at low level.

Ventilation must not be provided through natural inlet and mechanical extract as this will cause a negative pressure within the plant room and may lead to the products of combustion being drawn into the plant room.

Appliance Type	Flow rate per kW total rated net input (m^3/h)	
	Minimum Inlet Air (Combustion, Ventilation)	Difference between Inlet and Extract Air (Inlet minus Extract Ventilation)
Without draught diverters. (with or without draught stabilisers)	2.58	1.35 ± 0.18

9.3.1 Mechanical ventilation flow rates

9.3.2 Worked example – mechanical inlet/natural discharge

Lochinvar EF100

Heat input (net):			=	92.0 kW
Minimum combustion air flow rate:	=	92.0 x 2.6 m^3/h	=	239.2 m^3/h
Ventilation grille size (high level):			=	184 cm^2

9.3.3 Worked example – mechanical inlet/mechanical discharge (minimum combustion air flow rate)

Lochinvar EF100

Heat input (net):			=	92.0 kW
Minimum combustion air flow rate:	=	92.0 x 2.6 m^3/h	=	239.2 m^3/h
Difference between inlet and extract air (maximum value):	=	92.0 x (1.35 + 0.18) m^3/h	=	140.76 m^3/h
Difference between inlet and extract air (minimum value):	=	92.0 x (1.35 - 0.18) m^3/h	=	107.64 m^3/h
Extract air (maximum value):	=	239.2 m3/h - 107.64 m^3/h	=	131.56 m^3/h
Extract air (minimum value):	=	239.2 m3/h - 140.76 m^3/h	=	98.44 m^3/h

9.3.4 Worked example – mechanical inlet/mechanical discharge (alternate combustion air flow rate):

Lochinvar EF100

Heat input (net):			=	92.0 kW
Minimum combustion air flow rate:	=	92.0 x 2.6 m^3/h	=	239.2 m^3/h
Actual combustion air flow rate:	=	92.0 x 3.15 m^3/h	=	289.8 m^3/h
Difference between inlet and extract air (maximum value):	=	92.0 x (1.35 + 0.18) m^3/h	=	140.76 m^3/h
Difference between inlet and extract air (minimum value):	=	92.0 x (1.35 - 0.18) m^3/h	=	107.64 m^3/h
Extract air (maximum value):	=	289.8 m^3/h - 107.64 m^3/h	=	182.16 m^3/h
Extract air (minimum value):	=	289.8 m^3/h - 140.76 m^3/h	=	149.04 m^3/h

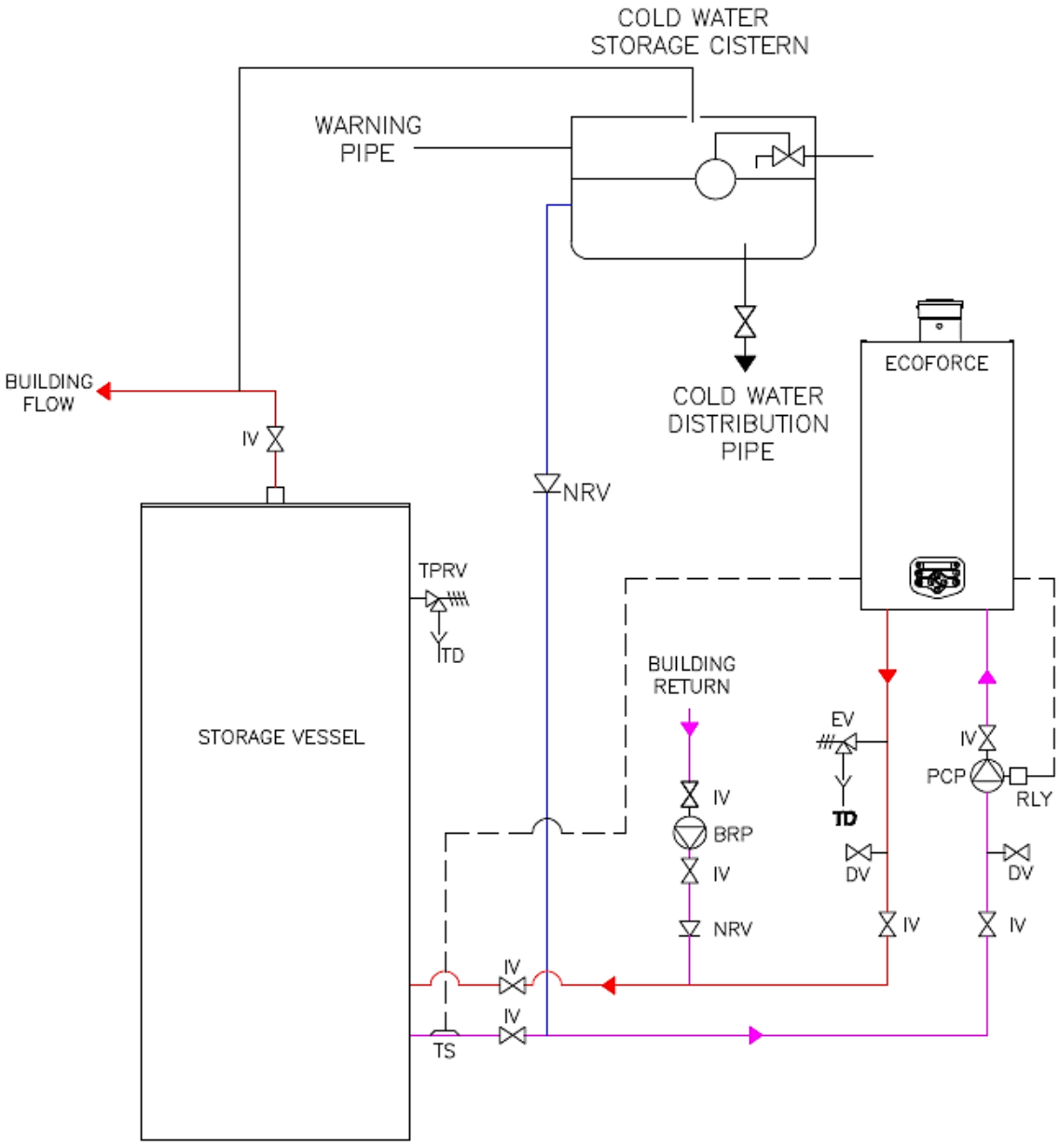
10.0 WATER CONNECTIONS

EcoForce water heaters must always be installed with a suitable buffer vessel and Bronze shunt pump; suitable bronze shunt pumps and buffer vessels will always be quoted alongside the EcoForce water heater.

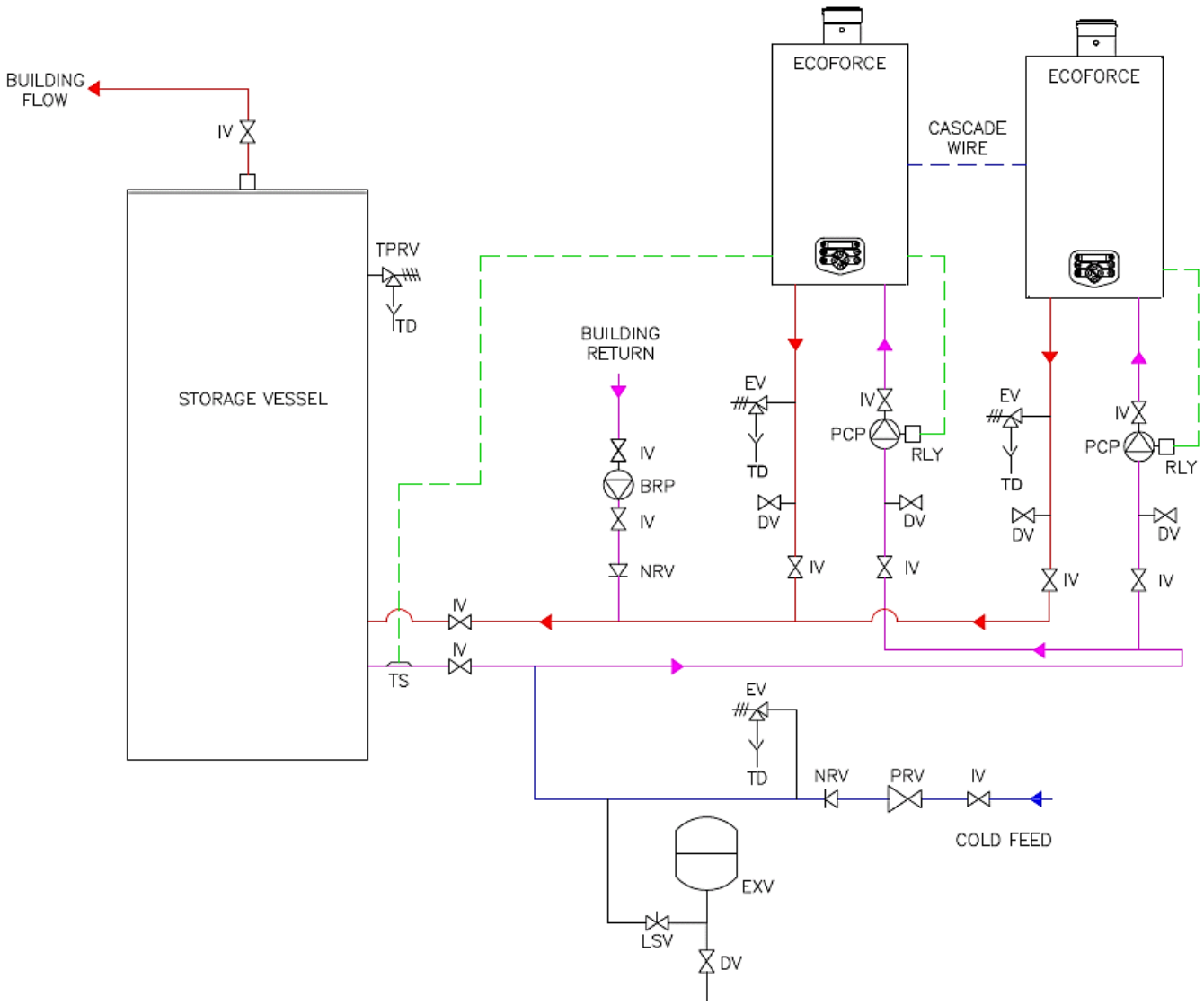
Failure to install a suitable Glanded Bronze shunt pump and buffer vessel will render all warrantees on the EcoForce water heater null and void.

The type and number of EcoForce water heaters as well the pipe length and number of buffer vessels must be taken into account when sizing the interconnecting pipework, the pipe should be sized to ensure the correct flow through the EcoForce water heater. 10.7 gives general guidance on pipe header sizing based on small <14 meter pipe runs, additional help with sizing the pipework header is available please contact Lochinvar Technical Support.

10.1 INSTALLATION SCHEMATIC DRAWINGS



10.1.1 1 ECOFORCE™ with 1 Lochinvar storage vessel- Vented installation



10.1.2 2 EcoForce™ with 1 Lochinvar storage vessel-Un-vented installation

These installation schematic drawings are given only as examples. If your installation is more complex or you require any help or clarifications please contact Lochinvar technical support.
It is recommended that isolation valves are fitted to the cold-water inlet and hot water draw off connections to aid in any routine maintenance work that needs to be carried out.

10.1.3 Drawing key

	ITEM	DESCRIPTION
	IV	Isolation Valve
	PRV	Pressure reducing Valve
	NRV	Non Return Valve
	EV	Expansion (safety) valve
	TPRV	Temperature and Pressure relief valve
	TD	Tundish
	EXV	Expansion vessel
	DV	Drain Valve
	LSV	Lock Shield Valve
	BRP	Building return pump
	PCP	Primary Circulating Pump
	FS	Appliance Flow Sensor

10.2 OPEN VENTED SYSTEM ARRANGEMENT

The Lochinvar ECOFORCE™ can be used in an open vented arrangement provided that a vent pipe in accordance with CP 342, BS6644 or BS6700 as appropriate is fitted. The minimum static head requirement for an open vented system is 0.5 bar.

10.3 UNVENTED SYSTEM ARRANGEMENT

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

If the Lochinvar ECOFORCE™ is to be used in an unvented arrangement, the system should follow the guidance given in BS6700 and must comply with The **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, contact Lochinvar Technical Support.

10.3.1 Expansion vessel sizing

The following information is based on an inlet pressure of 3.5 bar. If a different inlet pressure is to be used, please consult **BS6700.**

$$V_V = \frac{S_V * e}{0.45}$$

Where:

V_V = Vessel Volume
S_V = System Volume
e = Coefficient of Expansion (See **Table 10.2**)

Stored Temp. °C	30	35	40	45	50	55	60
e	0.005	0.006	0.008	0.010	0.012	0.015	0.017
Stored Temp. °C	**65**	**70**	**75**	**80**	**82**	**85**	**90**
e	0.020	0.023	0.026	0.030	0.031	0.033	0.037

10.3.2 Coefficient of expansion of water at 3.5 bar inlet pressure

10.4 DE-STRATIFICATION

If the hot water system does not include a constantly circulated building return, it is recommended that a de-stratification pump be fitted, between the flow connection and the circulation connection on the right hand side of the storage vessel, to ensure an even temperature distribution throughout the stored water. De-stratification pump kits are available from Lochinvar Limited as an ancillary option.

10.5 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 heat exchanger and a primary pipework loop.
The specification of this range of pumps ensures that the bronze body and associated parts in contact with water are suitable for potable use. They have a "glanded" construction to ensure that any scale in 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** due to the fact that in hard water areas, scale can build up within the rotor and failure can occur, not only of the pump but also the heater itself.

The warranty will be invalid if a failure of the heat exchanger occurs due to the installation of a glandless/canned rotor pump

The pump must not be connected directly to the terminal connections, use a starter relay with overload protection device between this pump and terminal 25-27

Model	FLOW (m^3/h)	FLOW (l/s)	Heat Exchanger Pressure Loss (Metre-H_20)
EF80	3.97	1.10	8.5
EF100	4.77	1.325	6.5
EF120	6.36	1.76	6.5
EF150	7.15	1.98	8.0
EF180	9.54	2.65	5.5

10.5.1 System head loss based on a 15°k differential

A pump sized for the water heater and primary pipework loop is available as shown below. This pump or a suitable approved alternative must be installed alongside each EcoForce water heater in order to maintain the EcoForce warranty.

Model	Pump part number)
EF80	LM900140A
EF100	LM900141A
EF120	LM900141A
EF150	LM900140A
EF180	LM900141A

10.5.2 Shunt pump part numbers

The pumps as shown have been sized to provide the correct flow through the water heater and include an allowance for the primary loop which should be no longer than 14 metres of 54mm tubing plus the following fittings:

- 6 x 90° Elbows
- 2 x Unions
- 2 x Full bore lever ball valves
- 2 x Tee fittings (cold feed & HWS return)

For longer distances or a greater number of fittings, the pump will have to be resized, contact Lochinvar Technical Support before proceeding with the installation.

10.6 STORAGE/BUFFER VESSELS

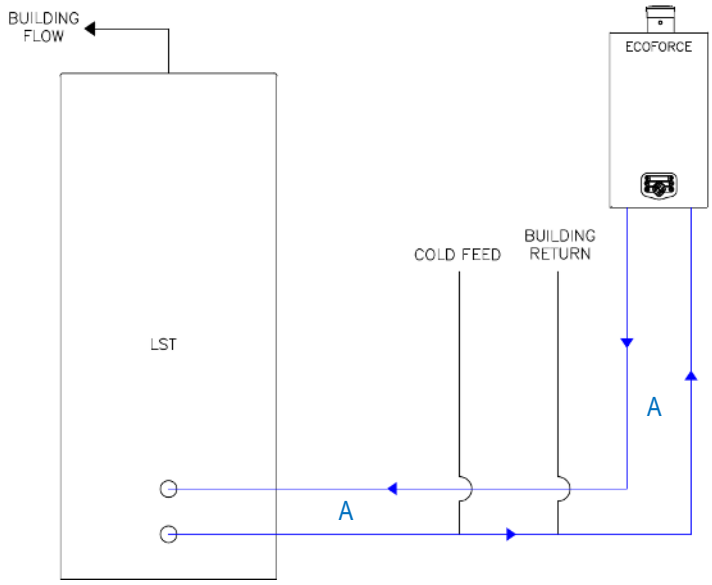
EcoForce must be installed with a suitable buffer vessel(s) these are available as ancillary items from Lochinvar and are Glass lined models up to 2850litres. For more details go to www.lochinvar.ltd.uk

10.7 MINIMUM PIPE HEADER SIZING

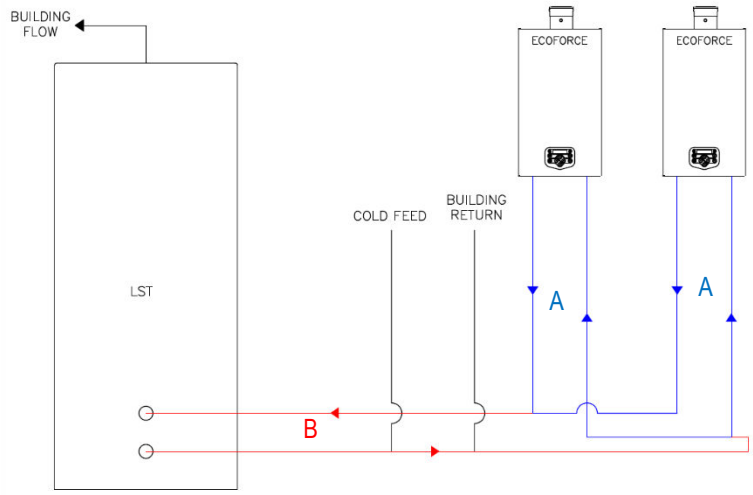
The below pipe header sizes are recommended, these should be checked against the available head on the pump and the proposed pipework run.

MODEL	PIPEWORK A BLUE SIZE (mm)	PIPEWORK B RED SIZE (mm)		
	NUMBER OF WATER HEATERS			
	1	2	3	4
EF80	42	54	54	67
EF100	54	54	67	67
EF120	54	54	67	76
EF150	54	67	76	108
EF180	54	67	108	108

10.7.1 PIPEWORK HEADER SIZES FOR COMMON INSTALLATIONS



10.7.2 Pipework schematic showing pipework A and pipework B on single model



10.7.3 Pipework schematic showing pipework A and pipework B on multiple models

10.8 FLOW MONITORING

If the water flow through the heat exchanger drops and the temperature differential is too high, the water heater will shut down until the differential drops during this time the display shows the message DELTA DIRECT BLOCK. If this situation occurs more than four times, the water heater will lock out and will display the message FLOWRETURN DT FAULT. Upon resetting the water heater, the output will be limited to 50% in order to protect the heat exchanger.
If this situation occurs, please contact Lochinvar Technical support immediately for further guidance.

10.9 WATER PRESSURE SWITCH

The EcoForce water heater is fitted with a water pressure switch that will block the water heater from operating at pressures less than 0.75bar to protect the heat exchanger from damage. The display will show the following message:

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.

11.0 ELECTRICAL SUPPLY

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

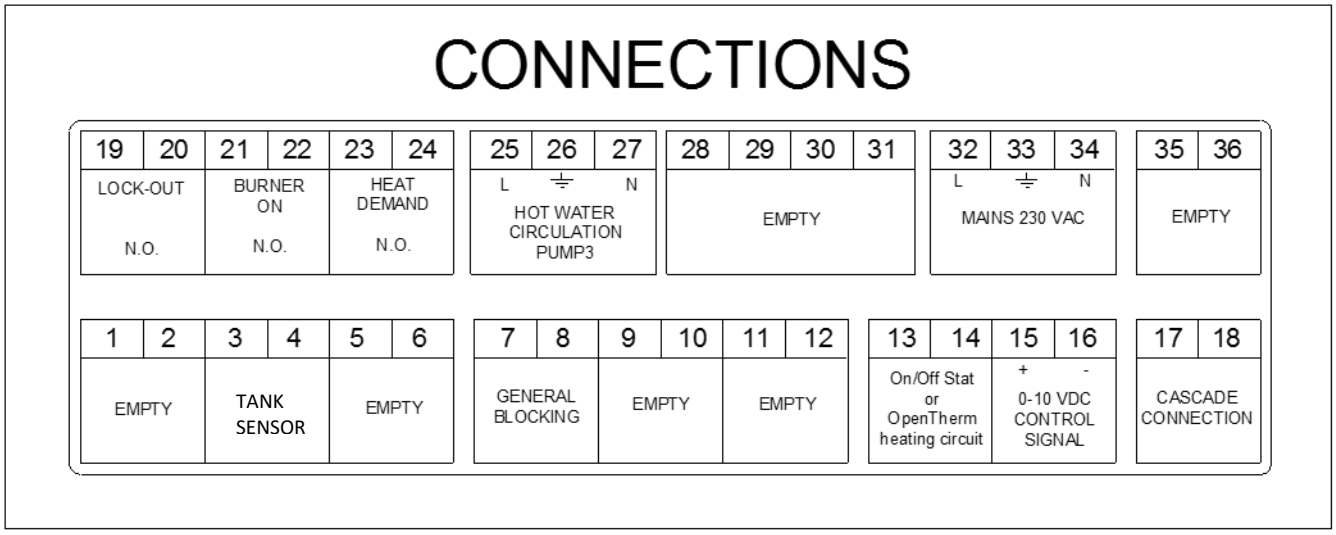
Model	Normal Supply Voltage	External Fuse Rating	Power Consumption
EF80	230V AC 50 Hz 1 PH	6.0 Amps	136W
EF100			142W
EF120			151W
EF150			214W
EF180			229W

11.1.1 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.

11.2 CONNECTOR STRIP



1-2	**DO NOT USE**
Do not connect any cable to these connections	
3-4	**TANK SENSOR**
This external flow sensor measures the flow temperature at the system side. The sensor must be mounted on the pipework close to the buffer vessel as shown in section Installation Schematic Drawings. NOTICE: The sensor must be used. PARAMETER: No parameter settings needed.	
5-6	**DO NOT USE**
Do not connect any cable to these connections	
7-8	**GENERAL BLOCKING**
A heat demand that will start the burner will be blocked when terminals 7 and 8 are not bridged. This connection is for the use of external safety devices (terminals must be bridged for allowing burner to fire).	
9-10	**EMPTY**
11-12	**EXTERNAL WATER PRESSURE SWITCH**
A water pressure switch is mounted in the water heater. As an option an external water pressure switch can be wired to the terminals. In this case remove connectors from 'internal water pressure switch'. When terminals 11-12 are not bridged, the water heater will lock-out. PARAMETER: A parameter change is needed.	
13-14	**ON/OFF STAT OR OPENTHERM WATER TANK**
OPTION 1: an ON/OFF thermostat can be connected. The water heater will use the set/programmed tank temperature when these terminals 13 and 14 are bridged. OPTION 2: an OpenTherm (OT) controller can be connected to the terminals 13 and 14. The water heater software will detect and use this OpenTherm signal automatically.	
15-16	**0-10 VDC CONTROL SIGNAL**
These terminals are used for an external 0-10 VDC control signal. PARAMETER: A parameter change is needed. NOTICE: Terminal 15 [+] (positive) and terminal 16 [-] (negative).	
17-18	**CASCADE CONNECTION**
These connections are used when water heaters are cascaded with the internal cascade manager for controlling the total cascade. NOTICE: Connect all terminals 17 and all terminals 18 together, do not switch between these terminals.	
19-20	**LOCK-OUT OR PUMP ON/OFF**
This contact is N.O. (normally open). 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. (PARAMETER: A parameter change is needed).	
21-22	**BURNER ACTIVE OR EXTRA WATER HEATER OR PUMP ON/OFF**
This contact is N.O. (normally open). 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. (PARAMETER: A parameter change is needed).	
23-24	**BURNER DEMAND OR PUMP ON/OFF**
This contact is N.O. (normally open). 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. (PARAMETER: A parameter change is needed).	
25-26-27	**CIRCULATION PUMP P3**
Each water heater must be installed with an external pump. **The pump must not be connected directly to the terminal connections, use a starter relay with overload protection device between this pump and terminal 25-27** Pump is switched off, when there is no heat demand, after post running time.	
28-29-30-31	**DO NOT USE**
Do not connect any cable to these connections. **TAKE CARE! 230 V electric voltage on these connections**	
32-33-34	**POWER SUPPLY**
The power supply connection of the unit. 32 = phase wire; 33 = ground wire; 34 = neutral wire.	

11.2.1 Connection terminal details

11.3 ECOFORCE WIRING DIAGRAM

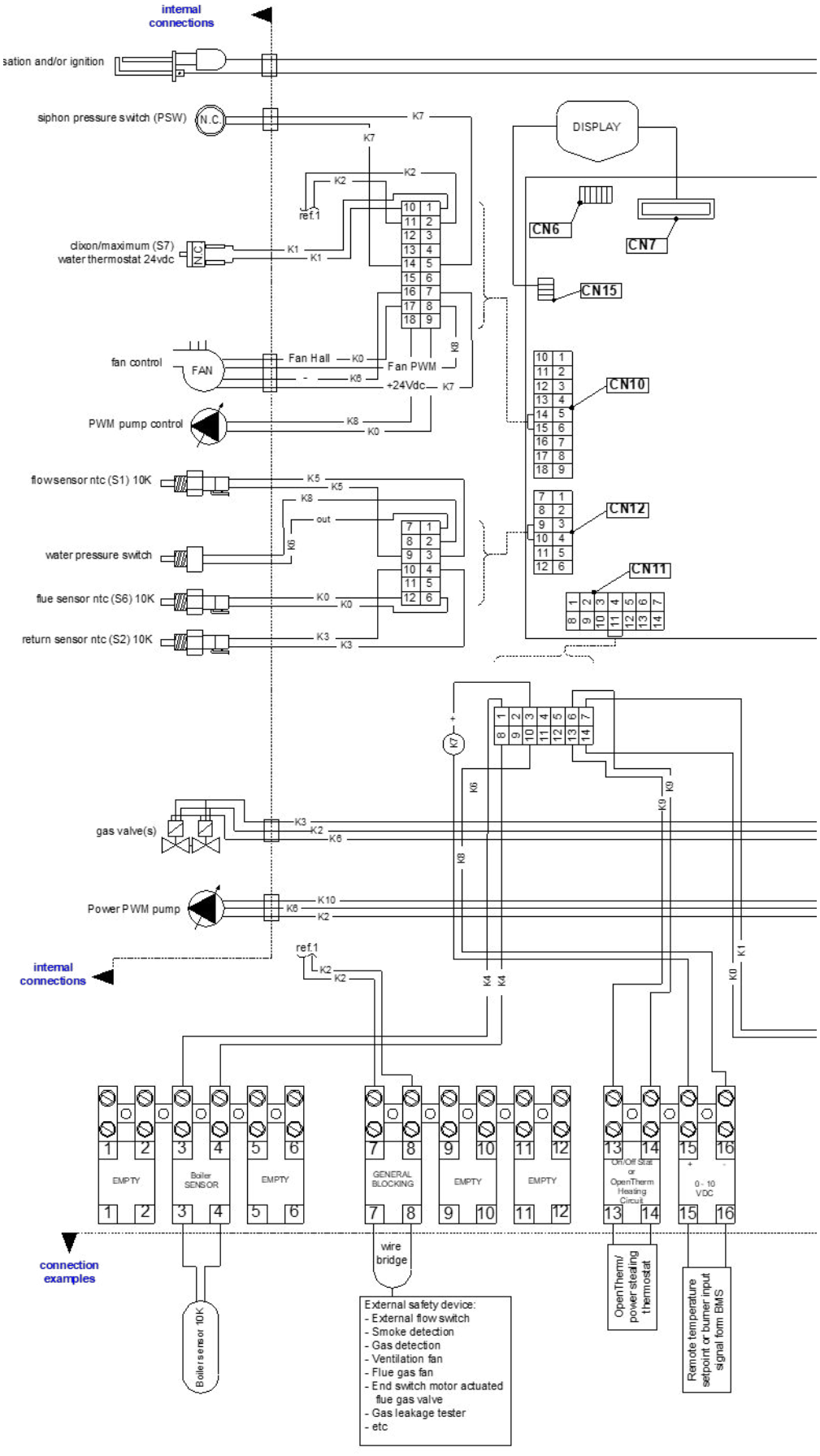


FIGURE 11.2 WIRING DIAGRAM PART 1

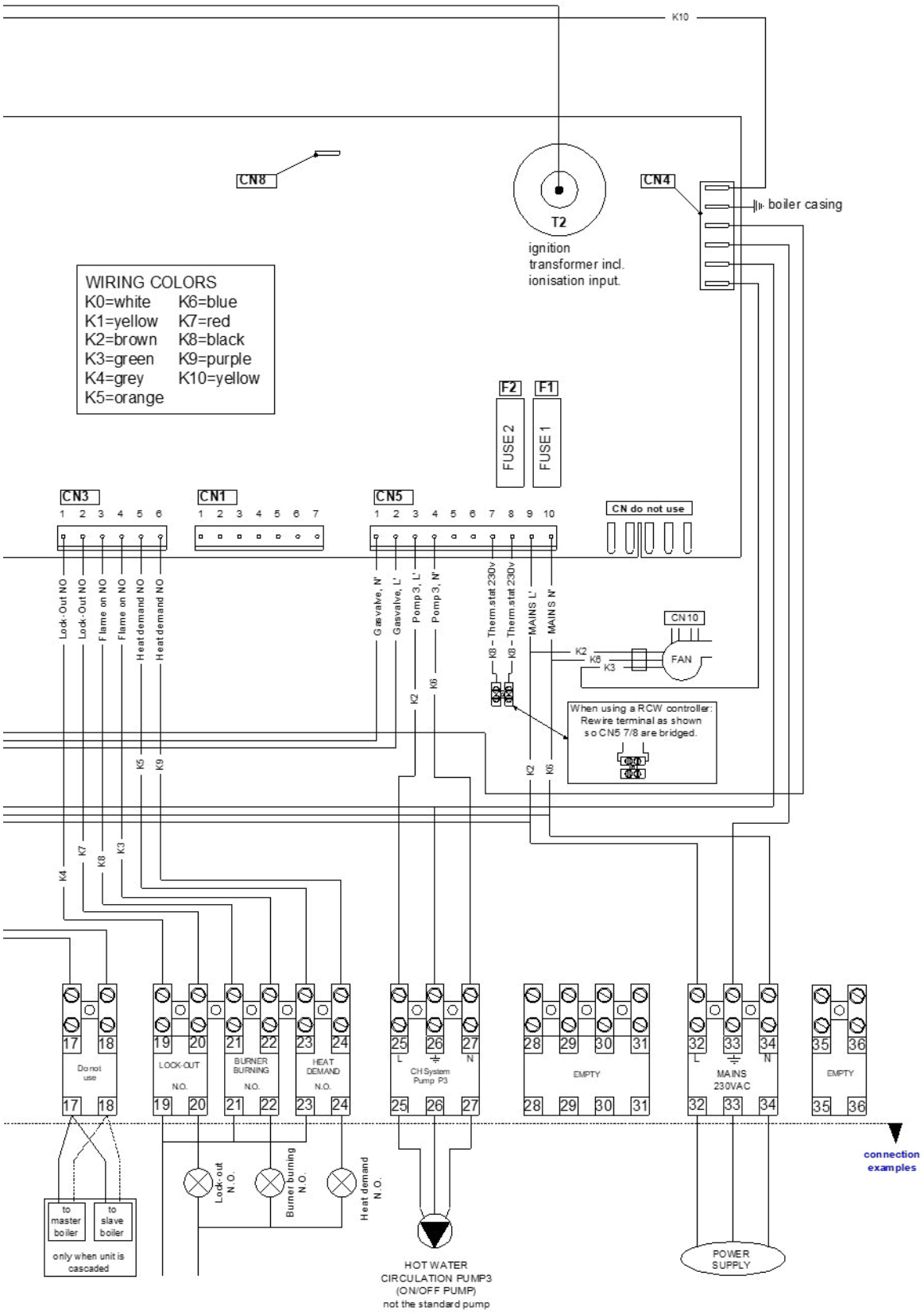


FIG 11.3 WIRING DIAGRAM PART 2

11.4 SENSORS

SENSOR	SENSOR TYPE	SENSOR VALUE
S1	Internal flow sensor	NTC-10K
S2	Internal return sensor	NTC-10K
S3	Tank sensor	NTC-10K
S6	Flue gas sensor	NTC-10K

11.4.1 Sensor values

Temperature (°C)	Resistance (Ω)	Temperature (°C)	Resistance (Ω)	Temperature (°C)	Resistance (Ω)	Temperature (°C)	Resistance (Ω)
-30	175203	20	12488	70	1753	120	387
-25	129289	25	10000	75	1481	125	339
-20	96360	30	8059	80	1256	130	298
-15	72502	35	6535	85	1070	135	262
-10	55047	40	5330	90	915	140	232
-5	42158	45	4372	95	786	145	206
0	32555	50	3605	100	677	150	183
5	25339	55	2989	105	586	155	163
10	19873	60	2490	110	508	160	145
15	15699	65	2084	115	443	165	130

11.4.2 Conversion table temperature vs resistance for all sensors

11.5 FUSES

The ECOFORCE™ has four internal fuses. Three will automatically reset, the fourth is rated at 3.15 A, and is located at the rear of the main control board.

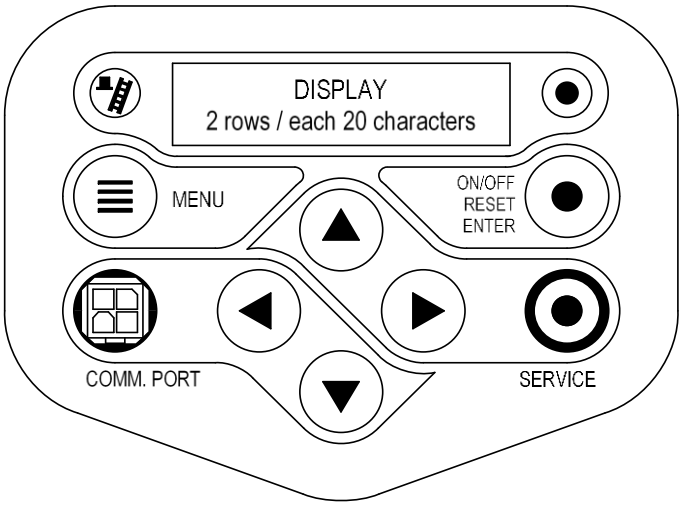
11.6 ARC WELDING PRECAUTIONS

The appliance must be isolated from the mains electricity supply in the event of electric arc welding being carried out on any connecting pipework.

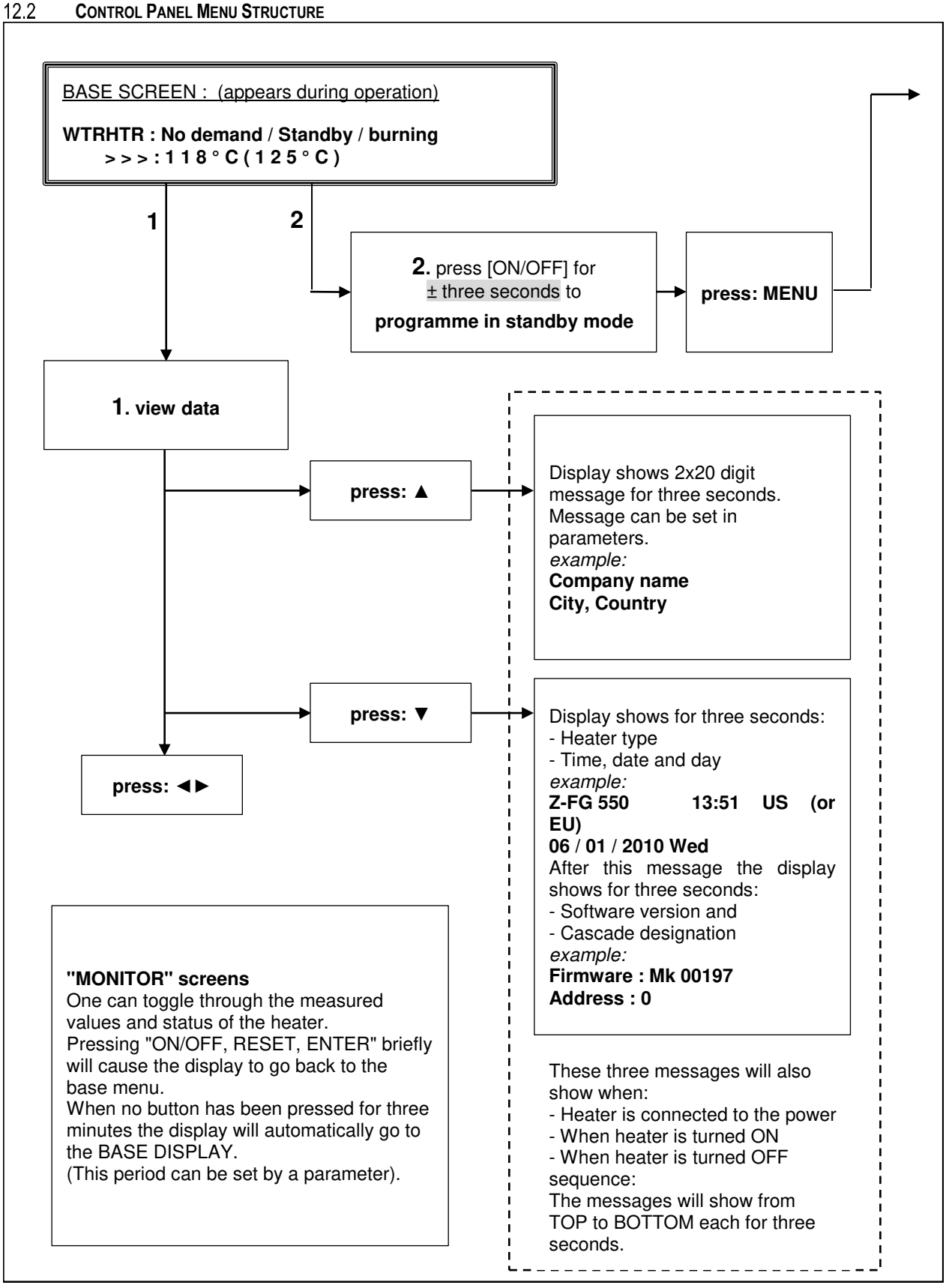
12.0 CONTROL INTERFACE

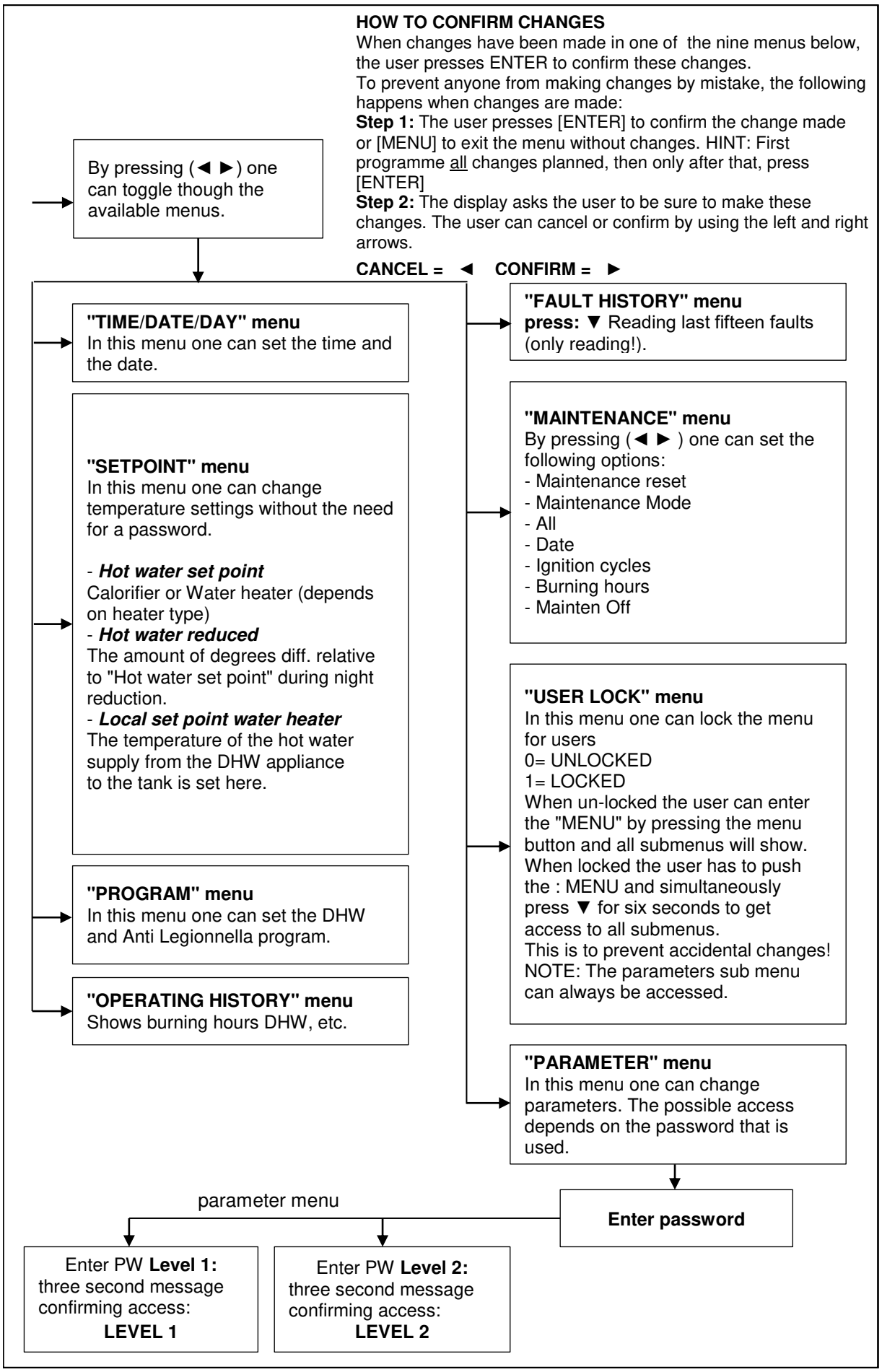
Note the BIC control system is used on both our water heaters (EF) and Boilers (CPM) some of the functions shown within the control pages relate to the Boiler version and will not be applicable to the EcoForce water heater. If in doubt contact Lochinvar Technical Support before proceeding with any Parameter changes.

12.1 CONTROL PANEL/DISPLAY UNIT



ON/OFF RESET ENTER	Press and hold for three seconds for stand-by/progr. Mode Press and hold for six seconds to switch boiler on/off. Used as RESET and ENTER button when programming.
COMM. PORT	Connector for connecting computer cable
MENU	Buttons can be pushed to open menu. [hold for 1 second]
◀ ▶ ▼ ▲	Buttons to toggle through measured temperatures. These are also used for navigating through the menus and used for changing values.
SERVICE	Button to activate service function. [hold for 3 seconds]
	Schornsteinfeger function (**Germany Only).**
	Light: will light up when controller sees good flame signal. Lights when burner is burning.


BASE SCREEN : (appears during operation)
WTRHTR : No demand / Standby / burning
> > > : 1 1 8 ° C (1 2 5 ° C)
1
2
2. press [ON/OFF] for ± three seconds to programme in standby mode
press: MENU
1. view data
press: ▲
Display shows 2x20 digit message for three seconds. Message can be set in parameters.
example:
Company name
City, Country
press: ▼
Display shows for three seconds:
- Heater type
- Time, date and day
example:
Z-FG 550 13:51 US (or EU)
06 / 01 / 2010 Wed
After this message the display shows for three seconds:
- Software version and
- Cascade designation
example:
Firmware : Mk 00197
Address : 0
press: ◄►
These three messages will also show when:
- Heater is connected to the power
- When heater is turned ON
- When heater is turned OFF
sequence:
The messages will show from TOP to BOTTOM each for three seconds.
"MONITOR" screens
One can toggle through the measured values and status of the heater.
Pressing "ON/OFF, RESET, ENTER" briefly will cause the display to go back to the base menu.
When no button has been pressed for three minutes the display will automatically go to the BASE DISPLAY.
(This period can be set by a parameter).


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 though 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 Legionnella 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 six 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.
Enter password
parameter menu
Enter PW Level 1: three second message confirming access: LEVEL 1
Enter PW Level 2: three second message confirming access: LEVEL 2

12.3 DISPLAY DURING OPERATION

During normal operation the text in the display shows the status of the water heater. The following graphs show the displays during normal operation with explanations.

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 calorifier sensor (open).											
S	t	a	n	d	-	b	y				
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.

12.3.1 Display screen during operation

12.4 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. The following explains 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		
T1 Flow	123.9 °C	Measured value by the internal flow sensor.
T2 Return	123.9 °C	Measured value by the internal return sensor.
	Open	Shown when controller doesn't detect this sensor.
	Shorted	Shown when sensor wires or sensor itself is shorted.

SCREEN: 2		
T3 External	123.9 °C	Measured value by the external sensor.
T4 Calorifi	123.9 °C	Measured value by the calorifier sensor.
	Open	Shown when controller doesn't detect this sensor.
	Shorted	Shown when sensor wires or sensor itself is shorted.

SCREEN: 3		
T5 Outdoor	123.9 °C	Measured value by the outdoor sensor.
T6 Flue	123.9 °C	Measured value by the flue gas sensor.
	Open	Shown when controller doesn't detect this sensor.
	Shorted	Shown when sensor wires or sensor itself is shorted.

SCREEN: 4		
dT FlowReturn	123.9 °C	Temp. difference between internal flow & return.
dT FlueReturn	123.9 °C	Temp. difference between flue gas & internal return.

SCREEN: 5		
dT ExtReturn	123.9 °C	Temp. difference between external & internal return (ΔT LLH).
Signal	Power	External supplied 0-10 Volt dc signal.
	Setpoi	"Power" = power input control or "Setpoi" = set point control.

SCREEN: 6		
Fan speed	9999 rpm	Actual fan speed in rpm.
Fan speed	100 %	Actual fan speed % of maximum allowable fan speed.

Fan maximum RPM: The maximum actual rpm may be lower than the maximum rpm set point. The fan may not be able to reach the maximum rpm set point, because of the unit's resistance, which is still correct according to the design of that specific unit.

SCREEN: 7		
Flamesignal	100 µA	Flame signal given in µA.
WaterPressur	1.0 bar	Shows water pressure when sensor is connected.

SCREEN: 8		
Pump1 Heater	Off	Pump 1 (HEATER PUMP) On or Off.
Pump1 Signal	100 %	Modulating signal Pump 1 in (%).

SCREEN: 9		
Pump2 Calori	Off	Shows when the calorifier pump is "ON" or "OF".
3-wayValve	Heating	Signal to the 3-way valve: "HEATING" or "HOTWATER".

SCREEN: 10		
Pump3 System	Off	Shows when the system pump is "ON" or "OF".
hh:mm DD/MM/YYYY	Day	hh=hour; mm=minutes; DD=day; MM=month; YYYY=yr; Day of the week

SCREEN: 11		
Casc Design	0	0 = MASTER, 1 ..... 11 = SLAVES
Casinf	0 1 2 3 4 5 6 7 8 9 A B	Displays number, priority and state of cascade water heaters.

DESCRIPTION "CASCINFO" Screen 11

Shows the number of water heaters connected with the cascade. The lead water heater is designated as 0. lag water heaters will be designated 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B. When a "-" is used instead of a number, then that water heater is either not connected, or in a lockout mode and not available for the cascade. When an "x" is used instead of a number, then that water heater is connected, but in lockout mode.
When the number is flashing, then that water heater is providing heat to the cascade. When the leading water heater is changed according to the set priority change time, then that water heater's address will be shown first in the row of numbers.
Example 1: "3 4 5 - - - - - - 0 1 2"
There are six water heaters present and nr. 3 has priority.
Example 2: "3 4 x - - - - - - 0 1 2"
There are six water heaters present and nr. 3 has priority. Water heater 5 is present, but in a lock-out.

SCREEN: 12	
Casc Power 999% 999%	% heat demand of total (cascade) power available (%).
Dual Burner: No	One heat exchanger equipped with two burners: "Yes" or "No".

SCREEN: 13	
Max Therm Open	Status of the maximum thermostat: "Open" or "Closed".
Gen Block Closed	Status of the general blocking contact: "Open" or "Closed".

SCREEN: 14	
Siphon press Closed	Status of the siphon pressure switch: "Open" or "Closed".
NRV Contact Open	Status of the non-return valve contact: "Open" or "Closed".

* REMARK at screen 14: No NRV used in this type of Water heater.

12.4.1 Monitor screen display

12.5 SERVICE FUNCTION

The following describes how to use the service function.

Operating screen:
WATRHTR: STAND-BY
>>>: 123.4°C (123.4°C)

Press [SERVICE] and hold for 3 seconds.
The burner will start and show the display below.

Operating screen:
WATRHTR: Service 26%
>>> 75.0°C (60.0°C)

"WATRHTR": It is an appliance for DHW.
"Service": It is operating in service mode.
"26%": The burner is firing at 26%.
"75,0°C": Max. allowable water temp. during service.
"60,0°C": Actual measured water temp. (when P5BJ active).

- Press [SERVICE] to exit. The unit will go to the operating screen. Press 3 s. [ON/OFF] to exit. The unit will be switched off.
- By using the [▲] & [▼] buttons the burner firing rate% can be changed.
- Press [MENU] to access the main menu.
  Press [MENU] to return to the service menu.
- Use [◄] & [►] buttons to browse through the monitor screens.
  Press [MENU] to go to the operation menu of the service mode.
- Press [SERVICE] to exit the service mode.
  The unit will return to the standard operation display.

12.5.1 Service function display

12.6 SCHORNSTEINFEGER FUNCTION (GERMANY ONLY)

12.7 PROGRAMMING IN STANDBY MODE

Standby

Use the standby mode for modifying water heater settings without interaction with the Water heater control. Changes are activated 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 active: pumps, fans and cascade are operational; recirculation and frost protection are working.

How to programme the water heater:

- First disconnect or shut down the room thermostat and/or other external controllers from the water heater. The CH pump and fan will stop after a short delay time.
- Switch the Water heater to 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	)

- Program 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.

12.8 SETTING THE TIME AND DATE

The following shows how to set the time and the date of the unit.

Operating screen:																			
W	A	T	R	H	T	R	:	S	T	A	N	D	-	B	Y				
>	>	>	:	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.

12.8.1 Setting time and date display

12.9 SETPOINTS

The following show how to programme the hot water set points

Heating set point normal/day time: (parameter P4 AA = 1/2)
DHW setpoint
60 °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)
DHW Reduce
10 °C
The reduction of the normal/day time set point. This reduction is used outside the programmed CH periods.

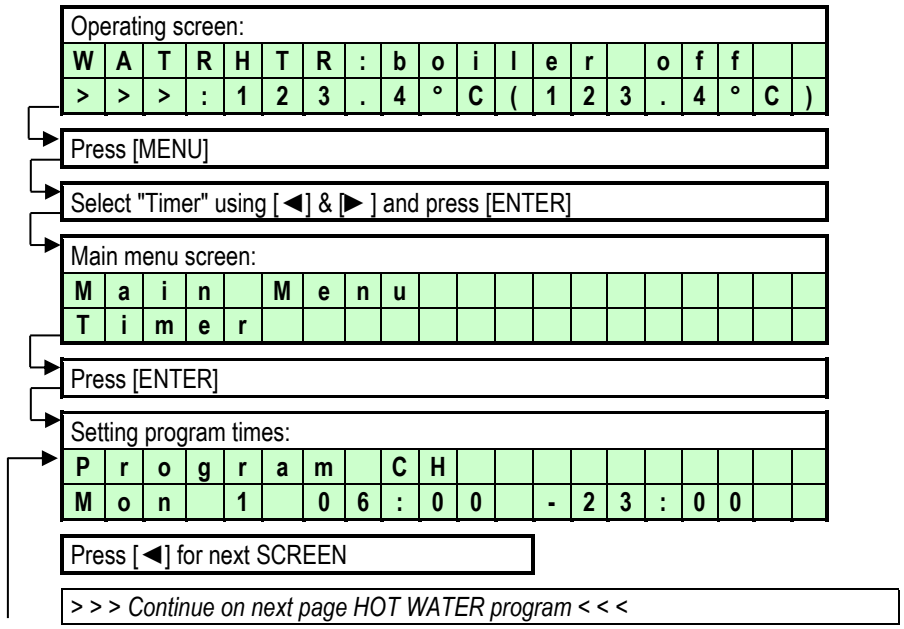
DHW setpoint reduction: (parameter P4 AA = 2 and P5 DJ&DK =1)
Heating setpoint
75 °C
This parameter is the local setpoint of the water heater and is regulated on sensor S1 (parameter P4 AA = 2, P5 DJ = 1 and P5 DK =1).

NOTICE:
The max. actual DHW temperature will never exceed the value set at Heating Setpoint Regardless the set DHW setpoint
If higher DHW setpoint are needed the Heating Setpoint has to be set higher also.

12.9.1 Set points display

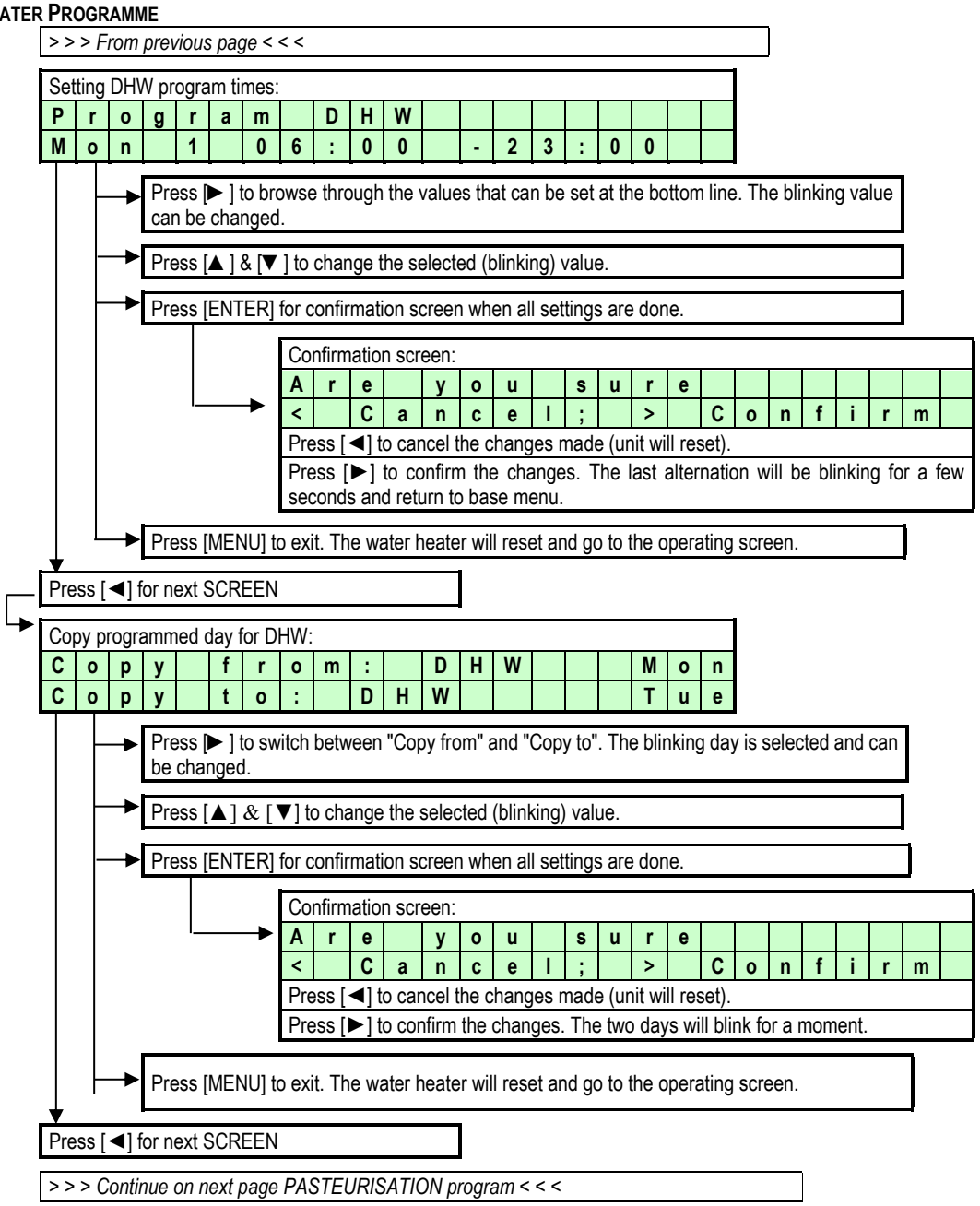
12.10 SETTING THE TIMER PROGRAMS

Two different programmes can be set within the water heater, DHW programme and Pasteurisation programme
Three programmed periods each day can be set (period 1, 2 and 3) During this time the water heater will operate at the normal DHW set point. Outside these time periods the water heater will operate at the reduced temperature set point. When no time is programmed for a period the period will not be used.



12.10.1 Start programme display screen

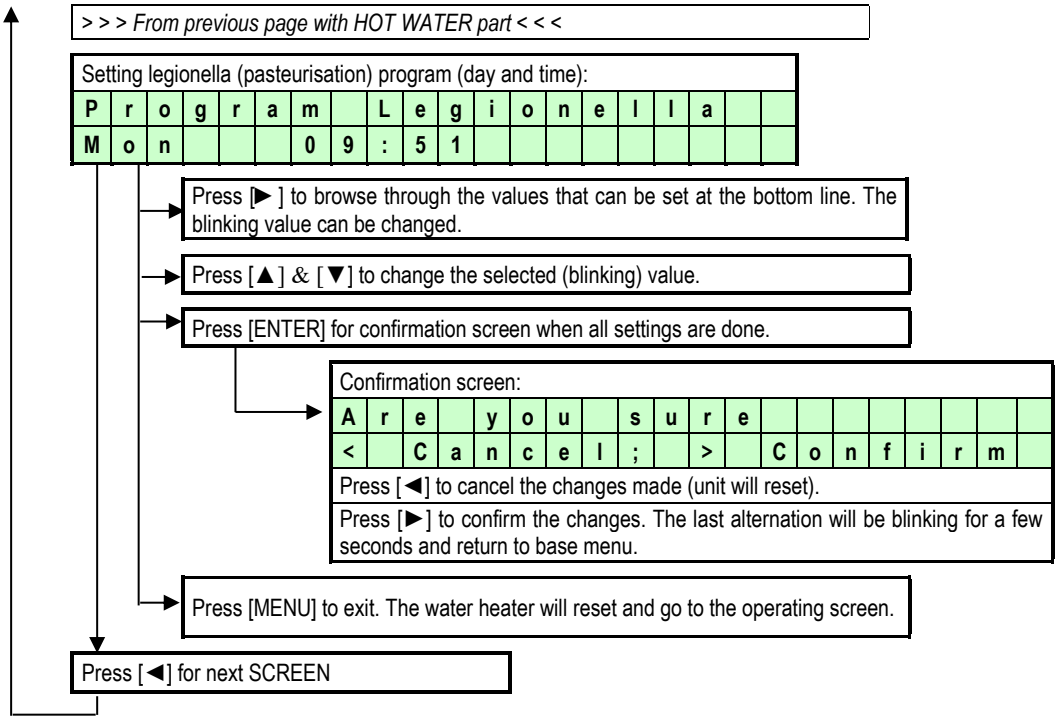
12.11 HOT WATER PROGRAMME



12.11.1 Hot water programme display screen

12.12 PASTEURISATION PROGRAMME

Factory setting is off



12.12.1 Pasteurisation programme display screen

12.13 CHECKING THE OPERATING HISTORY

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

Operating screen:
WATR:STAND-BY
>>>:123.4°C(123.4°C)

Press [MENU]

Select "Operate" using [◄] & [►] and press [ENTER]

Main menu screen:
Main Menu
Operate

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

SCREEN: 1

Operating history
PowerOn hrs 13140 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

hrsCh Tot 1000000
hrsDhw Tot 1000000
Top line: Total burning hours for heating.
Bottom line: Total burning hours for domestic hot water.

SCREEN: 3

hrsCh <50% 1000000
hrsCh =>50% 1000000
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

hrsDhw <50%: 1000000
hrsDhw =>50%: 1000000
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

Tia 10000 Fia 10000
Ssl 10000 Sst 10006
Top line: Shows Total Ignition Attempts (**Tia**) & Failed Ignition Attempts (**Fia**)
Bottom line: Shows Soft Starts last (**Ssl**) & Soft Starts Total (**Sst**)

12.13.1 Checking the operating history

12.14 CHECKING THE FAULT HISTORY

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

Operating screen:																	
W	A	T	R	H	T	R	:	S	T	A	N	D	-	B	Y		
>	>	>	:	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 ▼

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 creen.

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.

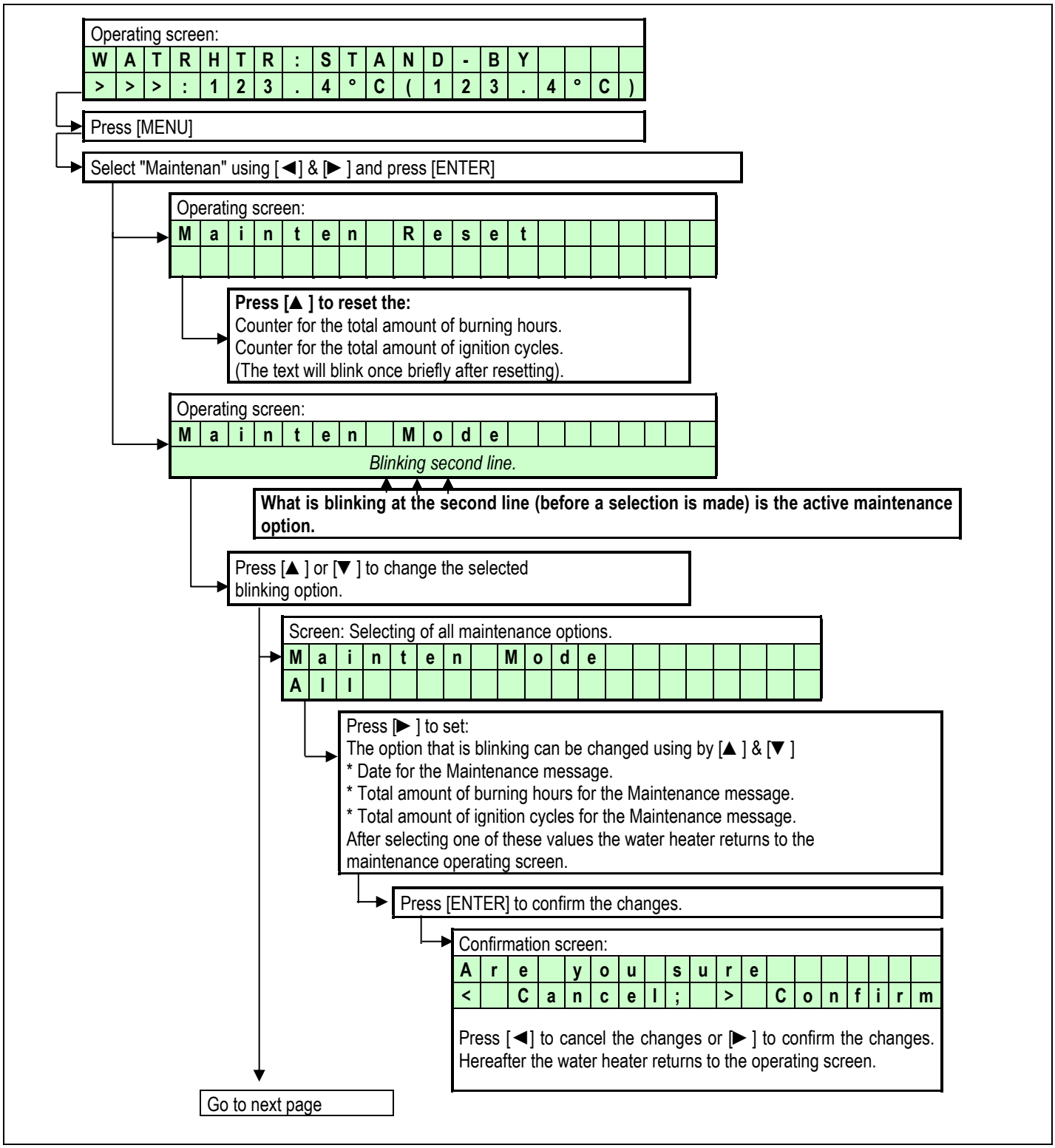
R: Shows the elapsed time in hrs between the moment the fault occurred and the moment it was reset.

12.14.1 Checking the fault history

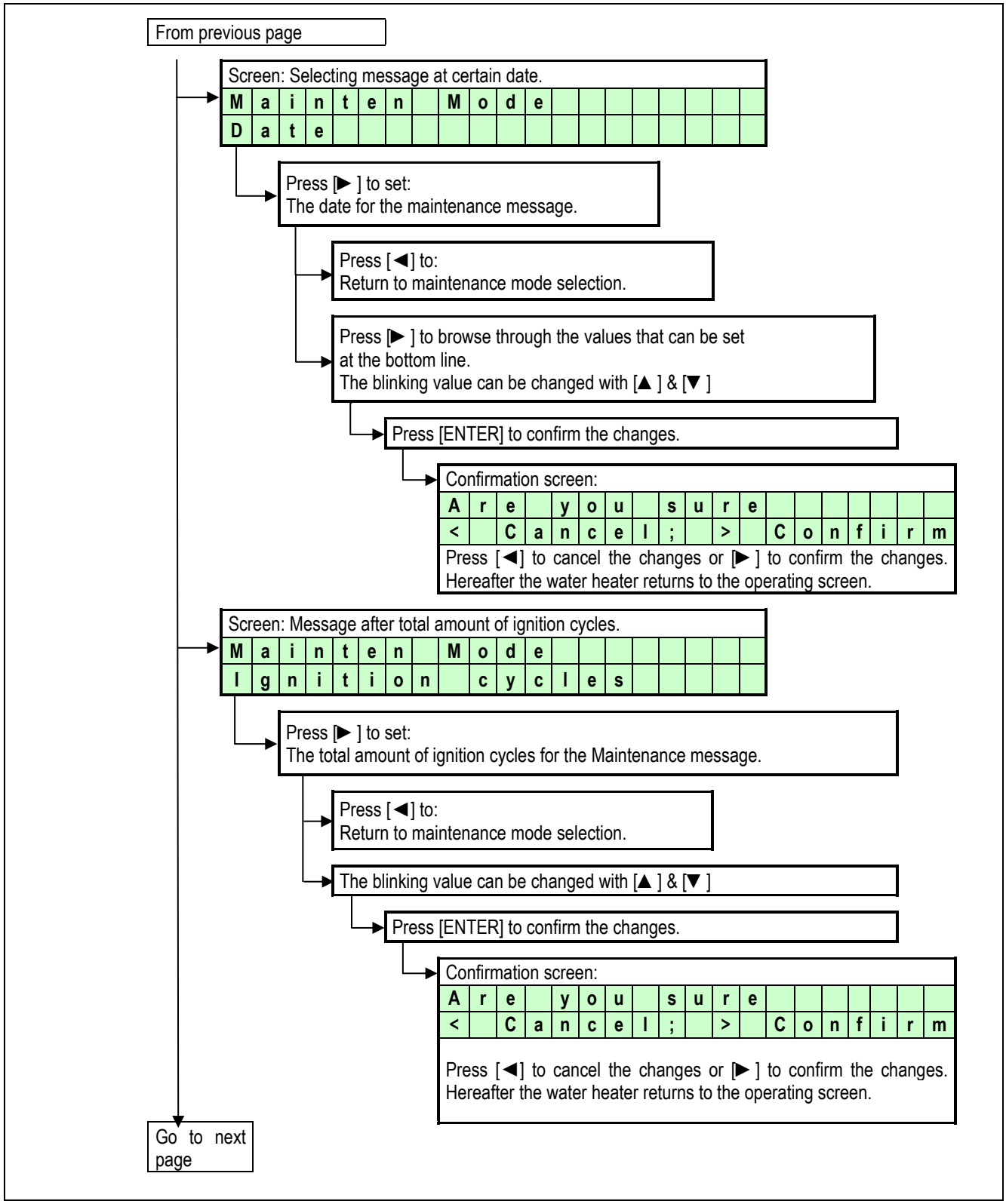
12.15 SETTING THE MAINTENANCE SPECIFICATIONS

The water heater can be programmed in such a way that an automatic maintenance message is displayed, there are three options that can be selected, you can either select a single option or all three can be activated:

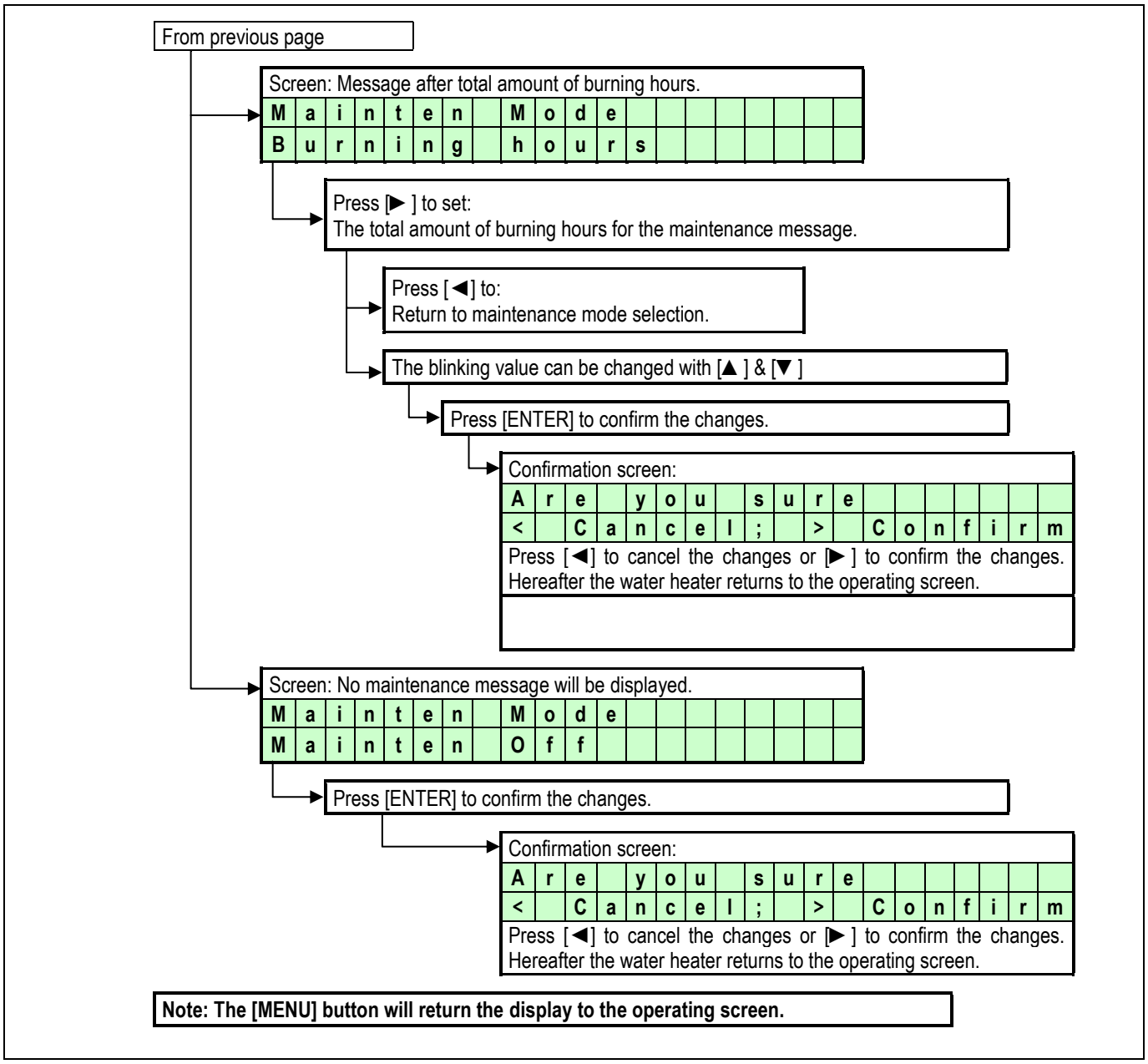
1. A programmed date is reached
2. A number of burning hours are reached
3. A number of ignition cycles are reached



12.15.1 Maintenance settings



12.15.2 Maintenance settings continued



12.15.3 Maintenance settings continued

It is and remains the responsibility of the end user to have the unit maintained every twelve months. Any warranty claims are dependent on proof the appliance has been serviced correctly.

The Water heater must be maintained in accordance with MAINTENANCE irrespective of the settings/working of this function.

12.16 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”.

The "**USER LOCK**" menu.
In this menu the water heater can be locked for (end-)users. 0 = UNLOCKED 1 = LOCKED
When the water heater is unlocked, the user can enter the MENU by pressing the menu button and all screens will show up.
When the water heater is locked, the user has to push the: [MENU] button together with the [▼] button for 5 seconds. to access all menu screens.
This function is to prevent accidental changes!
NOTICE: The PARAMETER screen is always accessible.

Operating screen:

H	E	A	T	I	N	G	:	S	T	A	N	D	-	B	Y				
>	>	>	:	1	2	3	.	4	°	C	(	1	2	3	.	4	°	C	)

Press [MENU]

Select "User lock" using [◄] & [►] and press [ENTER]

User lock screen:

S	e	t		U	s	e	r	l	o	c	k	=	0						
			0																

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

Press [ENTER] for the confirmation screen after the selection has been made.

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 (the unit will reset and the display returns to the operating screen).

Press [►] to confirm the changes. The changed value will be blinking for a few seconds. After this, the display returns to the operating screen.

NOTICE:

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 rejected in this case.

12.16.1 Setting the user lock

12.17 SETTING THE PARAMETERS WITH THE DISPLAY MENU

The following table gives a list of parameters that can be programmed by the display. 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.
In the parameter table shown below are 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 hot water and cascading are explained. In the explanation of these options there is reference to all relevant parameters which are shown in the table below and can be set on the unit.

When 'Modify = no', the parameter can only be programmed at level 2

PASSWORD: 1342

MENU			PARA-METER	DESCRIPTION	UNITS	TEXT DISPLAY	LEVEL 1 Modify
HEATING	A	1	P5BE	Step modulation (1=on 0=off)	-	Step modus	no
		2	P5AO	Blocking offset flow temperature control	°C	HE sOffset	yes
		3	P5AP	Proportional range temperature control	°C	HE sProp	no
		4	P5AL	Hysteresis CH Flow temperature control	°C	HE sCDiff	yes
		5	P2IC	Integration time temperature control	s	HE sInt	no
		6	P2MI	Blocking offset System CH temperature control	°C	HE cOff	yes
		7	P2MJ	Proportional range System CH temperature control	°C	HE cProp	no
		8	P2MK	Integration time CH temperature control	s	HE cInt	no
		9	P5AB	Timer Contact (1=on)	-	Timer Cont	yes
DHW	B	1	P4AB	DHW Pump Config 0=Pump 1=TWV	-	DHW pump/v	yes
		2	P5CB	Flow temperature DHW tank low	°C	DHW flow L	yes
		3	P5CK	Flow temperature DHW tank hi	°C	DHW flow H	yes
		4	P5CL	Low Flow temperature time DHW	min	DHW LOtime	yes
		5	P5CD	Legionella temperature	°C	Legio temp	no
		6	P5CI	Legionella hyst DHW tank temperature	°C	Legio hyst	no
		7	P5CJ	Legionella hold time (0=off)	min	Legio hold	no
		8	P2KI	CH interrupt by Legionella (0=yes)(1=no)	-	Legio int	no
		9	P2LC	Regulation temperature offset DHWd	°C	DHWdoff2	yes
		A	P2MN	Proportional range DHWd modulation	°C	DHWdProp	no
		B	P2LD	Regulation temperature hysteresis DHWd	°C	DHWdDiff2	yes
		C	P2MO	integration time DHWd modulation	s	DHWdInt	no
		D	P2ML	Sys temp blocking offset DHW tank	°C	DHWoff3	yes
		E	P2MM	Sys temp blocking hysteresis DHW tank	°C	DHWDiff3	yes
		F	P5CA	Hysteresis DHW tank temperature	°C	DHWDiff4	yes
		G	P2KH	Gradient heat demand detect DHW tank temperature	°C	Demand det	yes
CASCADE	C	1	P2MA	Max number extra water heaters	-	Max Casc Unt	no
		2	P5DA	Bus address Water heater	-	Bus addr s	no
		3	P5DC	Dhw on entire cascade(0) only master(1)	-	DHW casc/ms	no
		4	P5DE	Extra Water heater output enable(1)	-	Extra unit	yes
		5	P5DF	Cascade detection (0=standalone 1=Leader)	-	Cas Slave/M	no
		6	P5BL	Power off total cascade (1)	-	Pwr Off Casc	no
		7	P5DB	Number of water heaters with common flue 0=None	-	Com Flue Num	no
GENERAL	D	1	P5BB	Analogue input Config (0=off 1=temp)	-	An In Conf	yes
		2	P5AI	Minimum Temperature 0-10V input	°C	0-MinTemp	yes
		3	P5BI	Altitude (in amounts of 100 ft.)	ft*100	Alt *100	yes
		4	P2LK	Max cooling time	min	Max Cool t	yes
		5	P5BJ	Temperature display 1=on	-	Temp Disp	yes
		6	P4AA	DHW 0=off 1=Indirect 2=Direct	-	DHW =i2=d	no
		7	P4AD	pressure 0=off 1=sensor and 2=switch	-	conf	no
		8	P4BD	Gas type values 0-2	-	gas type	no
		9	P4BE	Soft start type values 0-2	-	conf	no
		A	P5BN	Pump modes 0-3	-	conf	no

IMPORTANT:
Do not change the parameters *P2LC, P2LD, P2ML, P2MM and P5BI*; they are used within the controller for purposes other than DHW control. Changing these parameters may affect water heater operation negatively!

The following graphs describe how to program the parameters by using the display:

Operating screen:

W	A	T	R	H	T	R	:	S	T	A	N	D	-	B	Y				
>	>	>	:	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.

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

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.																			

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	l				
										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.																			

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

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.																		

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.																		

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

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.																		

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).																		

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

Menu C: Cascade
C 2 Bus adress
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 DHicas/mas
0
Function for the cascading of the Water heater(s). This parameter determines if only the Master Water heater or all water heaters of the cascade are used for indirect hot water. 0 = All 1 = Master

Menu C: Cascade
C 4 Extra unit
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 Cas Si/Ma
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 PwrOffToCa
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 ComFluNum
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.

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

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.																			

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)																			

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

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
0 = natural gas
1 = G31*
2 = B/P G30*/G31*
* (cf. EN437)

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 = Do not use (reserved for future applications).

The Screen Text on these pages show Parameters used on our EF water heater and also our CPM Boilers. Certain functions may not apply to the appliance you are working on. If there is any doubt contact Lochinvar Limited.

13.0 FAULT CODE DISPLAY

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

13.1 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 blinks 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 which has been 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 The maximum return temperature as set in the parameters is exceeded.

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	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	F	l	a	m	e		l	o	s	t										
F9	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	F	a	l	s	e		f	l	a	m	e		s	i	g	n	a	l		
F10	p	u	m	p		o	n					9	9	9	.	5		h	r	s

Reason Flame signal is detected when it cannot be expected.

Display message	F	a	n		s	p	e	e	d		i	n	c	o	r	r	e	c	t	
F11	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	p	r	o	g	r	a	m	m	i	n	g		e	n	d					
F12	p	u	m	p		o	n					9	9	9	.	5		h	r	s

Reason Software parameters have been programmed.

Display message	P	a	r	a	m	/	H	a	r	d	w		f	a	u	l	t			
F13	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	C	l	i	x	o	n		F	a	u	l	t								
F15	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	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 between flow and return exceeds limitation value, or ‘dT block or delta direct block ’has occurred 3 times

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 (clixon) measured a too high flow temperature.

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

Reason The 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.

13.2 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 the situation.

Display message	Antcycle time
	999.5 hrs

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

Display message	Flue temp high
	999.5 hrs

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

Display message	Flow temp high
	999.5 hrs

Reason The flow temperature has exceeded the blocking temperature, as set in the parameters

Display message	Return temp high
	999.5 hrs

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

Display message	T2-T1 high
	999.5 hrs

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

Display message	Deairation
	999.5 hrs

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	Delta Direct block
	999.5 hrs

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

Display message	Waterpressure fault
	999.5 hrs

Reason Water pressure is too low or too high.

Display message	Cascade Block
	999.5 hrs

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

Display message	Line fault
	999.5 hrs

Reason Wrong electrical power supply is connected (Not 50 or 60 Hz, 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

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 tank sensor is not connected to the terminals

Display message	F	l	o	w		h	i	g	h		D	H	W							
												9	9	9	.	5		h	r	s

Reason Setpoint return (tank) temperature DHW (S3) is higher than
Setpoint heating = flow temperature (S1)

13.3 MESSAGES

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.

13.4 MAINTENANCE ATTENTION MESSAGE

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	l	l														h	r	s	

Reason One of the abovementioned maintenance options has been reached.

14.0 CONTROL OPTIONS AND SETTINGS

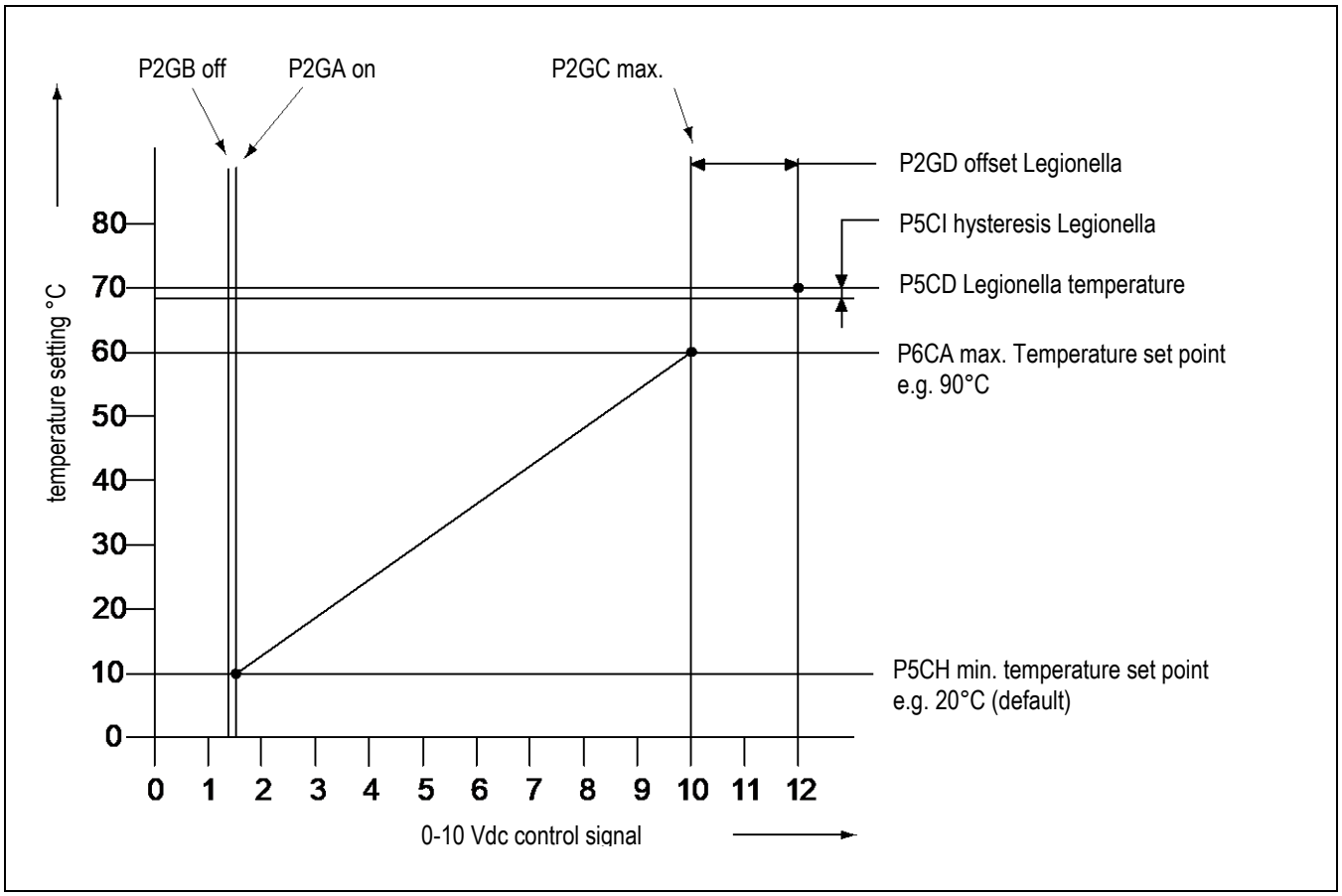
14.1 WATER HEATER OPTIONS

0-10V DC remote flow temperature set point
The hot water temperature is controlled by connecting an external 0-10V DC signal to the water heater (connections 15-16).

P5BB Analogue input Config (0=off 1=temp) (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 the temperature and the control signal.



Values for illustration purposes, programmed parameter values can deviate!

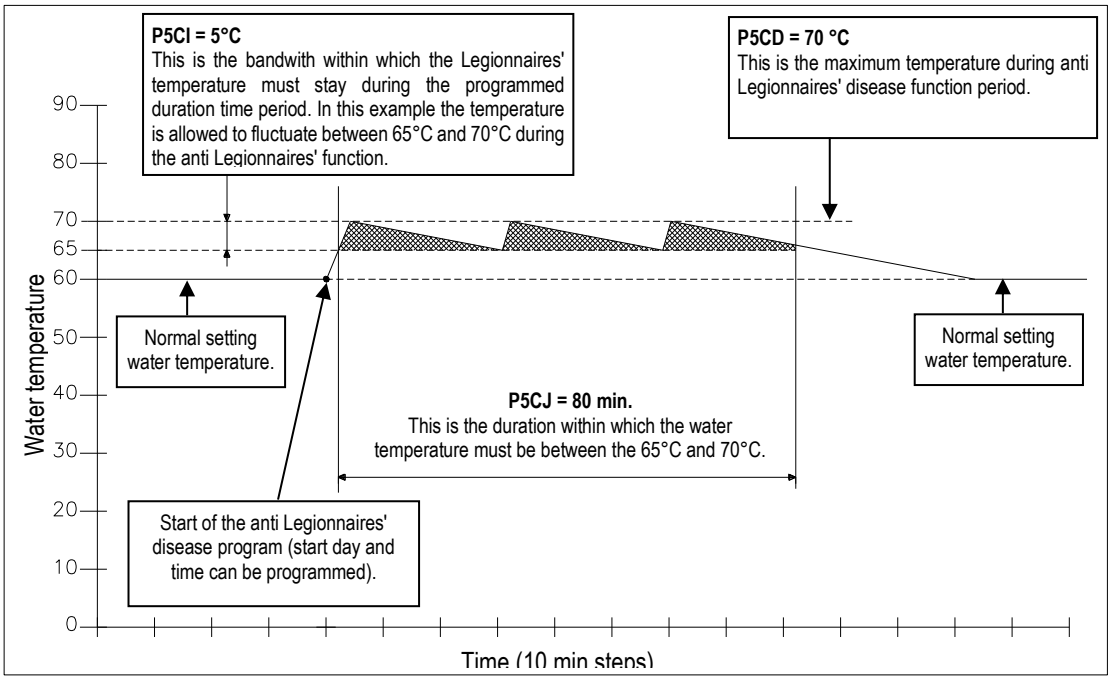
14.2 ANTI-LEGIONELLA (PASTEURISATION) FUNCTION

To 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 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 0-10Vdc signal can be used to activate the pasteurisation function this can be done by making the 0-10V signal higher than 10,2V.

The standard factory setting for this pasteurisation function is "OFF". To activate this' function some parameters must be programmed by a trained service engineer. The starting day and starting time of this function can be programmed by the control panel of the water heater and by using a computer, interface cable and the water heater software.

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



Values for illustration purposes, programmed parameter values can deviate!

The settings of these parameters P5CI, P5CJ and P5CD must be programmed according to local regulations and requirements for the site.

The setting of these parameters can only be done by a trained service engineer and is also possible by the control panel of the unit without the use of a computer.

The use and activation of this function cannot guarantee a Legionnaires' free installation. A suitable risk assessment and regular monitoring should be in place

14.3 CASCADE CONTROL

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

Changes in parameter may only be carried out by a skilled commissioning/service engineer, who has had specific training for setting up the EcoForce water heater. They will be able to check whether the installation operates correctly after the parameter change has been done

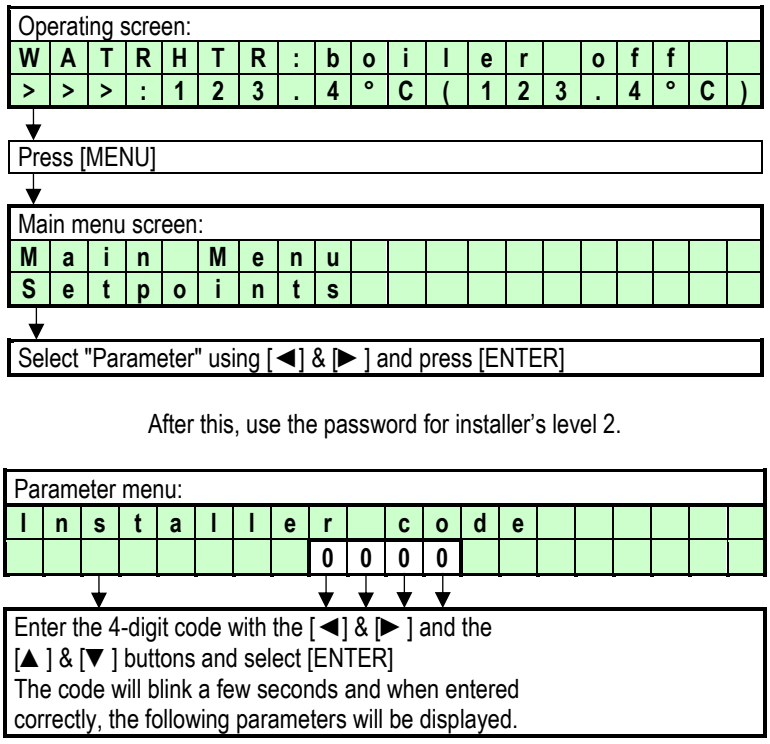
For programming **all parameters** of the water heaters, an interface cable for connecting the laptop to the water heater control and a laptop with the appropriate software is required. Contact Lochinvar Technical support for further details. This software is used for programming but also shows all measured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

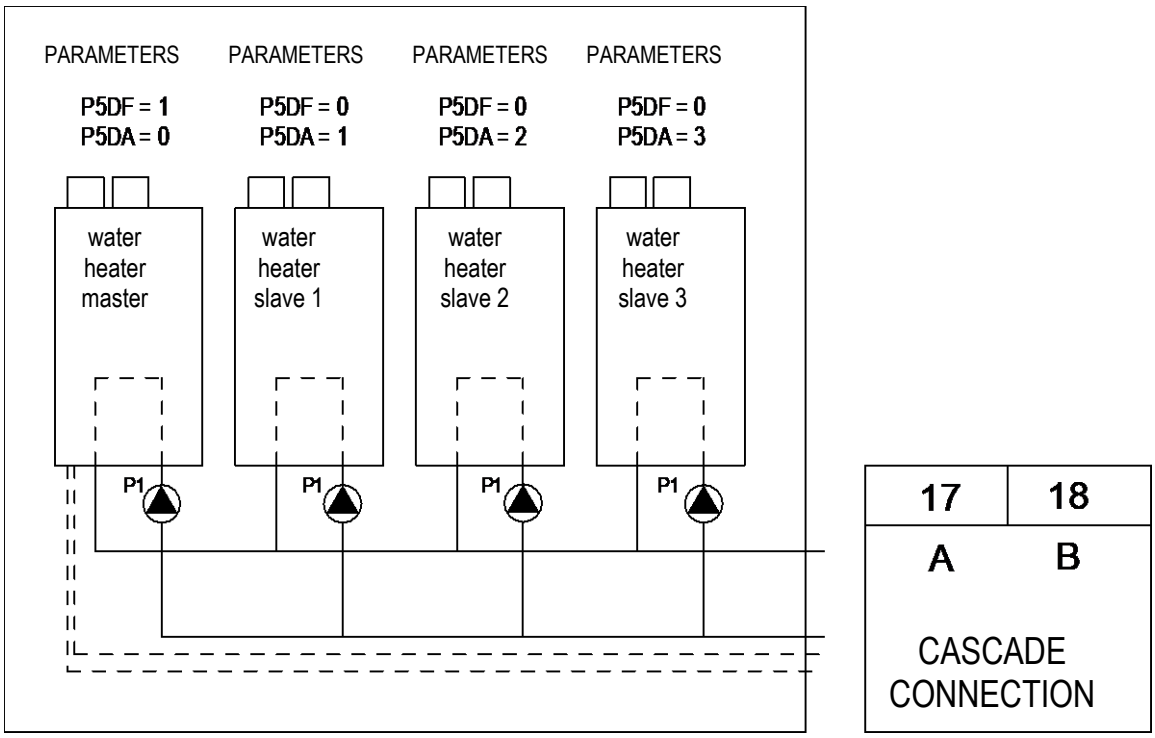
14.3.1 Parameter settings for cascade set-ups

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 for every single water heater of the cascade 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 Cas Si/Ma
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 unit 1 = Single / Master unit

Menu C: Cascade
C 2 Bus address
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.

15.0 GENERAL

The following sections describe some general functions of the water heater and their possible use.

15.1 MAXIMUM 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.

15.2 TEMPERATURE DISPLAY ON/OFF

This parameter can be used to turn the temperature display function off/on.
P5BJ Temperature display 1=on (display D5)

0 = not visible
1 = visible

15.3 GAS TYPE SELECTION

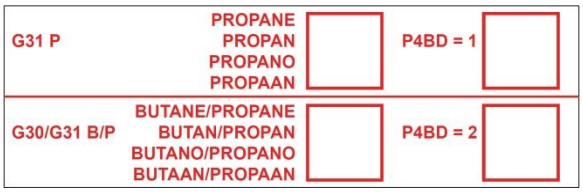
Settings for gas types: natural gas, propane or butane-propane mixture (B/P).
P4 BD Gas type (0=standard, 1=propane, 2=butane/propane (B/P)) (display D8).

This parameter is set to 0 for the natural gas G20.
By setting this parameter to 1 for propane, fan speed is reduced.
Set this parameter to 2 for B/P.

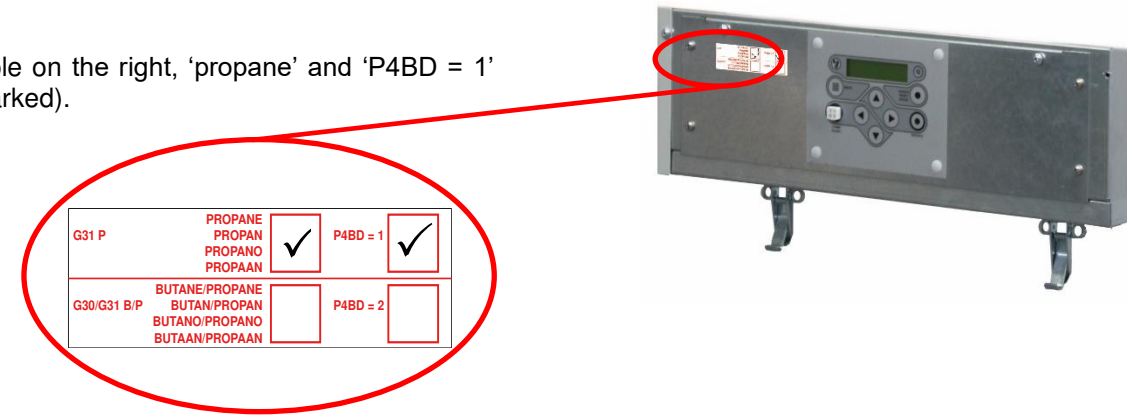
0 = natural gas
1 = propane
2 = B/P

For each setting, the relevant Soft start settings are automatically adjusted, depending on 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.



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



15.4 SOFT START OPTIONS

Start parameters can be modified to achieve better starting behaviour, 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).

P4BE **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)

15.5 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.

P5BN **Pump mode (0 = modulating, 1 = relay 1, 2 = relay 2, 3 = relay 3) (display DA).**

Do not use the 230 Vac relay for the main power supply of the pump, but directly connect the pump to an external power supply.

A modulating pump with PWM control: the power supply is directly connected to the mains, the PWM connection is connected to CN10, contacts 9 and 18.
Pumps with an on/off control can be switched by one of the relay connections “lock-out”, “burner burning” or “heat demand”. Choose a connection which is not yet used.

0 = PWM 0-100% modulating pump, connection **CN10**, connector 9 and 18
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).

15.6 TANK SENSOR SENSITIVITY

P2KH Gradient heat demand detection DHW tank temperature (display BG)[0.1°C]

With S3 in use as tank sensor, the water heater can detect a large demand on the buffer tank allowing the water heater to react faster to this demand. The sensitivity of this sensor can be set in parameter P2KH in tenths of degrees.

16.0 COMMISSIONING AND TESTING

16.1 WATER HEATER FIRST FLUSH

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 blockage. This must also be done with installations, where only the water heater is replaced.

16.2 FILLING AND VENTING THE SECONDARY SYSTEM AND WATER HEATER(S)

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 10 bar, depending on the installed pressure safety valve.

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.

16.3 CHECKING WATER FLOW THROUGH THE WATER HEATER

Before the water heater is first started, be sure that the pump is functioning and that there is water flow over the heat exchanger. Check the electrical power supply of the water heater. When this is connected correctly, the display will show:

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 6 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 not active. To activate the water heater press [ON/OFF] button for 6 seconds.

Activate the water heater by pressing the ON/OFF button for at least 6 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 there is no water present in the water heater or the water pressure is too low, 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 demand. The water heater will start to fire and also the pump will start to run. Firing of the water heater without water flow (but filled with water!) will cause the so called “boiling noises”. During this “service function” you should also check 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 13ºC and maximum 25ºC. This temperature difference indicates that there is enough water flow over the water heater; this water flow prevents the heat exchanger being damaged by a thermal overload.

If the temperature difference is outside the parameters shown above the commissioning must be aborted until a satisfactory flow rate has been established or damage will occur to the heat exchanger which would be outside the scope of the water heater warranty.

16.4 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 (T1 and T2). 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 T12-T2 has exceeded the blocking value, as set in the parameters.

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

Reason The temperature difference between flow and return has exceeded the blocking value

When this temperature difference 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 between flow and return exceeds limitation value,
or 'dT Direct block' has occurred three times.

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 pump is operating correctly.

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.

Always check the pump is running before firing the water heater.

17.0 ELECTRICAL INSTALLATION

Notes on the requirements for electrical installation are provided in **ELECTRICAL SUPPLY**. A schematic drawing of the control circuit is shown in EcoForce Wiring Diagram

18.0 GAS INSTALLATION

For design see **GAS SUPPLY.** See 3.0 for details on the position of the gas connection.

In case the water heater should use propane or propane/butane as a fuel, following applies:

It is strongly recommended that, on LPG installations, gas detection equipment is fitted. This equipment should be positioned near the appliance and at low level. It is also important that the space housing the appliance is adequately ventilated at high and low level. This appliance must not be located below ground e.g. in a cellar

In addition to the documents listed in **Section 1.1: Regulations** the gas installation should also comply with the guidance offered in the following document:

BS 5482-1: 2005	Code of practice for domestic butane and propane gas burning installations. **Part 1:** Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding dn25 for steel and dn28 for corrugated stainless steel or copper.

19.0 WATER CONNECTIONS

For design see **WATER CONNECTIONS**

The system should be thoroughly flushed out with cold water without any circulating pump in position. Ensure all the valves are open.

If a return pump is to be fitted, it should be fitted before the system is filled and air locks cleared. Check the system for leaks and repair as necessary. If the system is configured in an unvented arrangement, check the expansion vessel cushion pressure.

20.0 COMMISSIONING THE EQUIPMENT

20.1 GENERAL CHECKS PRIOR TO LIGHTING

A person deemed competent MUST be responsible for the commissioning of this equipment. Before attempting to commission any equipment, ensure that personnel involved are aware of what action is about to be taken and begin by making the following checks:

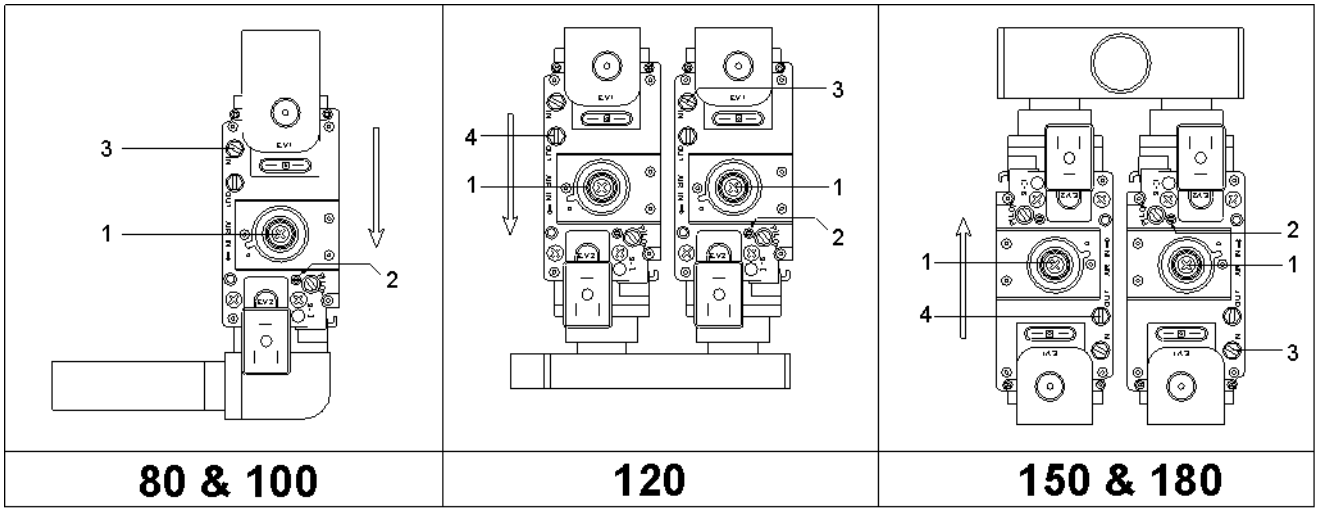
1. Flueway passages to chimney are clear.
2. Adequate ventilation exists in the plant room (if necessary)
3. The system is fully charged with water, ready to receive heat. All necessary valves are open and the building return pump (if fitted) is circulating water.
4. The gas supply pipework is clear of any loose matter, tested for soundness and purged.
5. The condensate drain is installed correctly and the condensate trap is filled with water.

20.2 EQUIPMENT CHECKS PRIOR TO LIGHTING

1. Gas supply is connected but turned to the "off" position. Any unions or fittings are correctly tightened, test points are closed and the ignition electrode lead is connected correctly. Ensure the ceramic sheath around the ignition electrode is not cracked or broken.
2. Ensure electricity supply is connected.
3. Check that the circulating pump is fully bled.

20.3 GENERAL

Check the gas pressure available at the gas connection pipe of the water heater. Use the pressure nipple (3) of the gas safety valve for this measurement. The gas pressure for the water heater, to operate properly under the correct load, must be at least 20 mbar.
The graphs below show the position of the pressure nipple (3) for the complete water heater range.



20.4 FIRING FOR THE FIRST TIME

After the commissioning of the water heater, the water heater display will show the following graph.

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	)

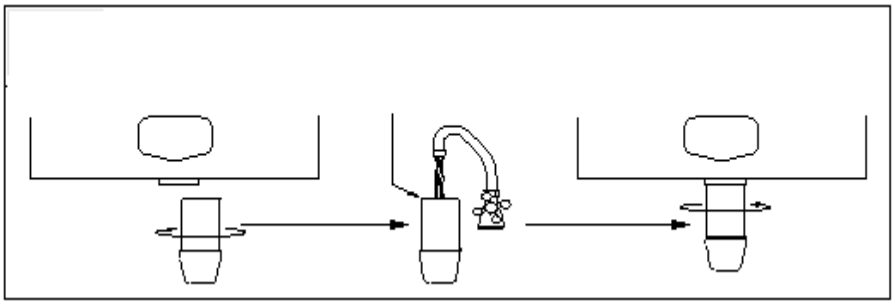
Reason Water heater is active, but there is no heat demand.

The display describes:

- The actual operation
- If a heat demand is activated
- The temperature setting
- The temperature measured

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

This is a safety measure: the water in the siphon keeps the flue gases from leaking out of the heat exchanger via the condensate drain.



When the water heater receives a heat demand the electronics will start the operation of the water heater. Before the water heater is used, the water heater burner must be adjusted and set at the minimum and maximum load.

21.0 ADJUSTING AND SETTING THE BURNER

Before carrying out any adjustments to the burner, carefully read this complete chapter.

21.1 INTRODUCTION

The burner must always be adjusted when:

A. - A new water heater is installed
- As part of a service/maintenance check, in case the O_2 / CO_2 values turn out to be incorrect

Adjustment procedures for the above can be found in 21.5.

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

Adjustment procedures for the above can be found in 21.5 .

In either of the four cases described in **A** and **B**, always check the gas/air ratio of the combustion figure (O_2) at maximum and minimum input. First set the water heater at maximum load and subsequently at minimum load, and repeat if necessary.

Set-up of this chapter:
First, all required values are given in 21.1.1 and 21.2 below. A drawing of the gas valve(s) and setting screws is given in 21.4. In 21.4.1 a general scheme is presented to ensure you fully comply with these instructions using the correct procedure, A or B. After that, in 21.5 and 21.6 – 21.8, a thorough description is given of how to proceed in cases **A** and **B** respectively. Finally, the two main procedures used in the previous sections are described in detail.

21.1.1 Adjustment tables

gas type [1]		O_2 [%]			CO_2 [%]	
G20	**water heater type**	max load	min load		max load	min load
	EF 80-180	4.5 - 4.8	5.4 - 5.7		9.0 - 9.2	8.5 - 8.7

		O_2 [%]			CO_2 [%]	
propane G31[3]	**water heater type**	max load	min load		max load	min load
	EF 80-120	4.9 - 5.2	6.7 – 7.0		10.3 - 10.5	9.1 – 9.3
	EF 150	4.7 - 5.0			10.4 - 10.6	
	EF 180	4.6 - 4.9			10.5 - 10.7	

		O_2 [%]			CO_2 [%]	
B/P [3] [4] G30/ G31	**water heater type**	max load	min load		max load	min load
	EF 80-120	5.1 - 5.4	7.0 – 7.3		10.4 - 10.6	9.1 – 9.3
	EF 150	4.9 - 5.2			10.5 - 10.7	
	EF 180	4.8 - 5.1			10.6 - 10.8	

	Cf. EN 437.
2	All values measured without front door. The O_2 / CO_2 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 Service technician).
4	B/P: Propane/butane mixture.

Maximum fan speed has to be reduced to convert the boiler into a propane or B/P appliance.
Setting of parameter P4BD.

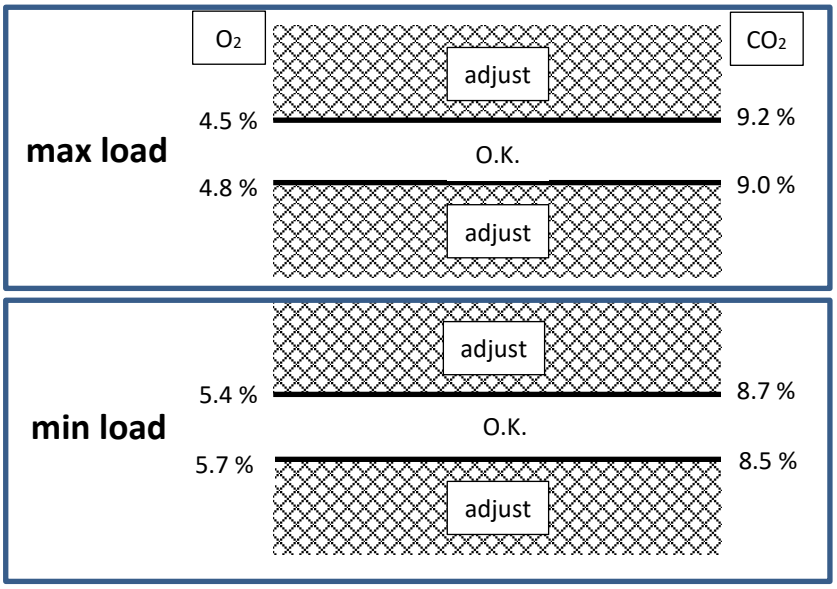
21.2 ADJUSTMENT GRAPHS

To make adjustments easier, values of table 21.1.1 are presented in the following figures.
The O_2 / CO_2 values should always be between the values set in this figure. Nominal values can be found in the Technical specifications datasheet at the beginning of this manual. All values are measured without front door.

21.2.1 Gas type G20

The O_2 level must not be in the hatched area.

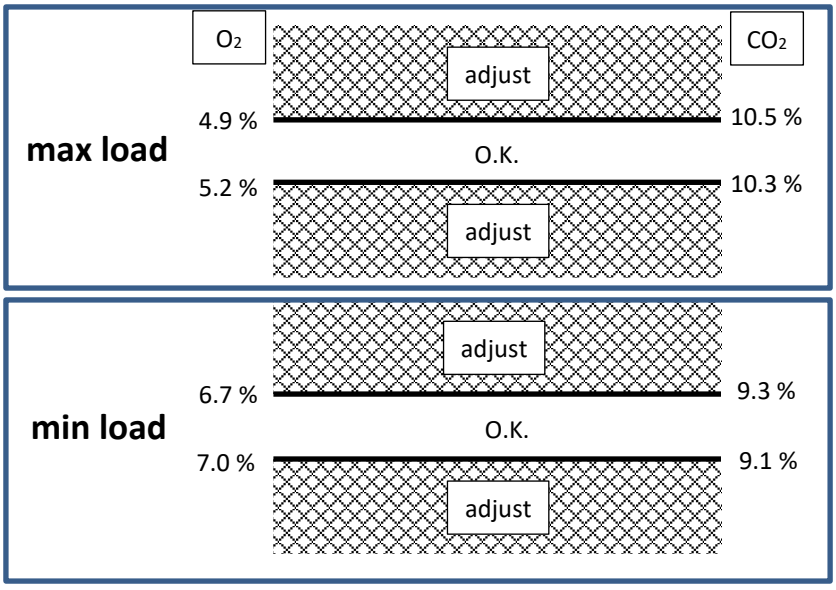
EF80 - EF180



21.2.2 Propane G31:

Fan settings must be changed by altering parameter P4BD (display D8). (Only by a Competent Engineer).
The O_2 level must not be in the hatched area.

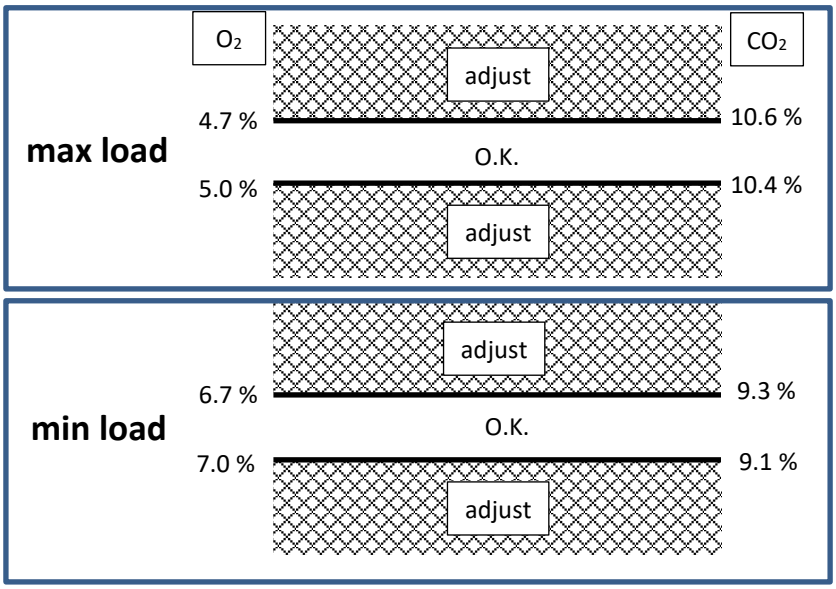
EF80 - EF120



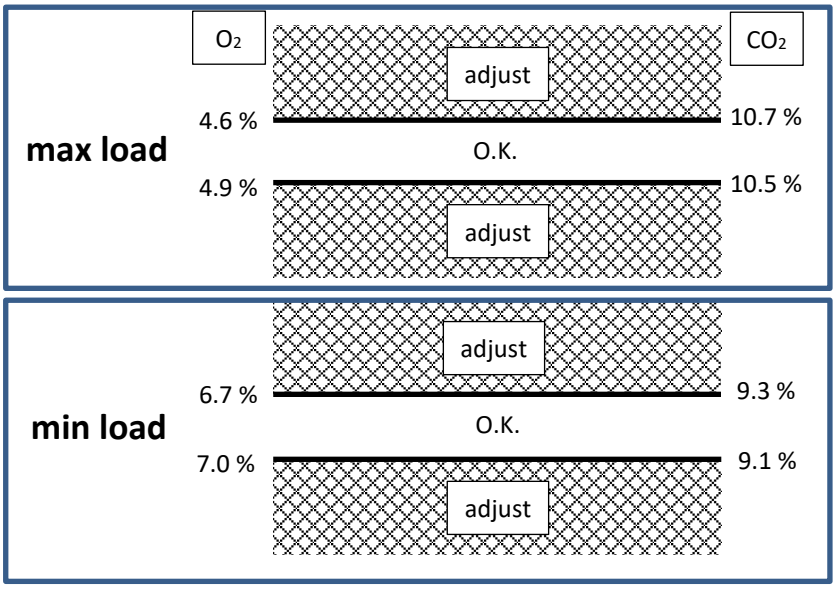
>>> cont. Propane G31:

The O_2 level must not be in the hatched area.

EF150



EF180

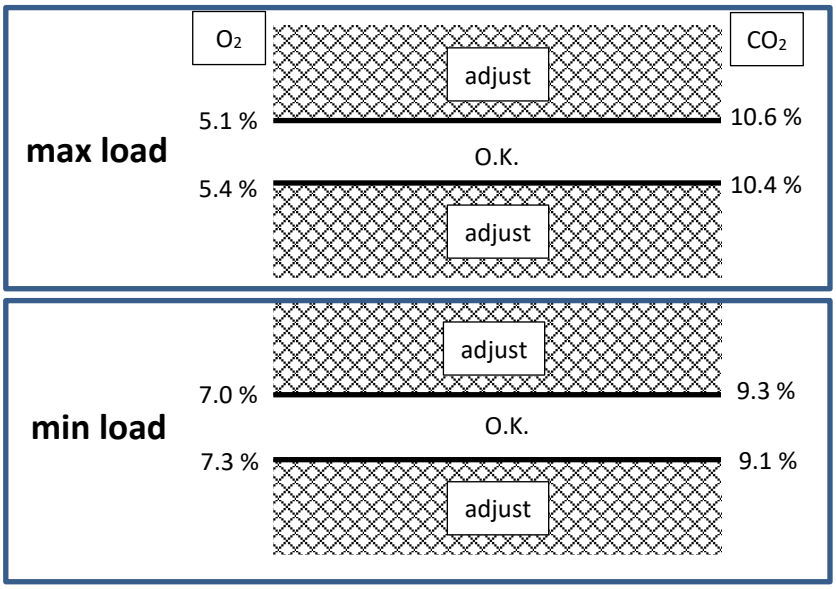


21.2.3 B/P: propane/ butane mixture G30/ G31:

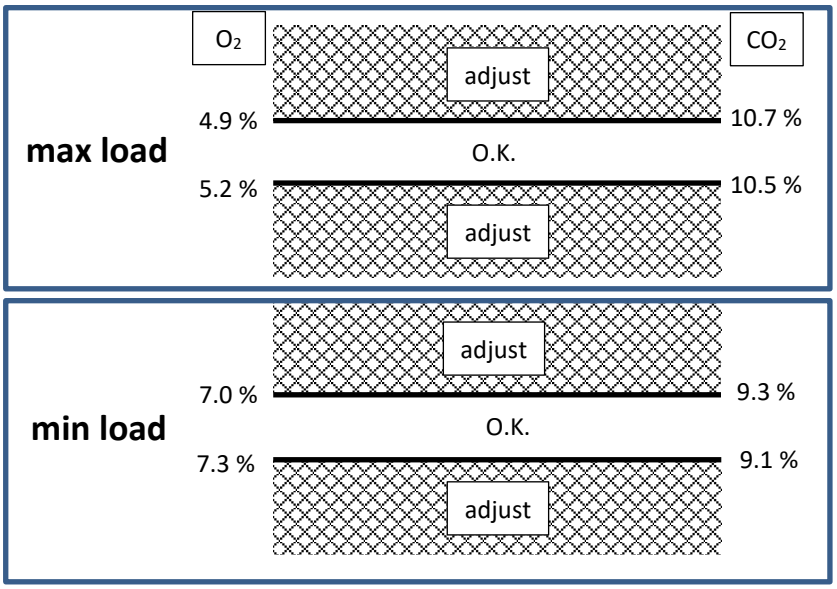
Fan settings must be changed by altering parameter P4BD (display D8). (Only by a Competent Engineer).

The O_2 level must not be in the hatched area.

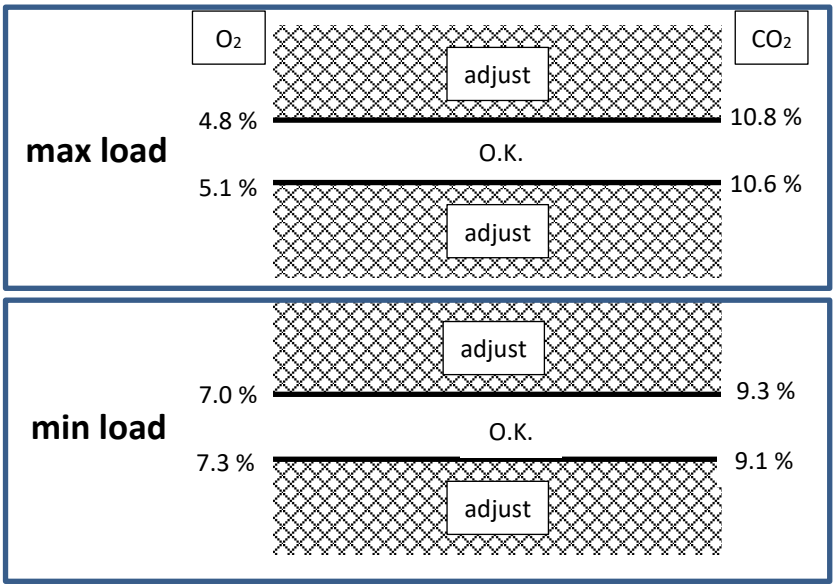
EF80-120



EF150



EF180



21.3 ADDITIONAL SETTINGS CASE B

pre adjustment settings gas valve for Ecoforce water heaters

Water heater Type	Number of turns open (counter clockwise)		
	Nat. Gas G20 / G25	Propane G31	Butane G30
EF 80	1.5	0.75	0.5
EF100	3.5	1.5	1.25
EF120	2.25 *	1 *	0.75 *
EF150	2.25 *	1 *	0.75 *
EF180	4.25 *	2.25 *	2 *

** Both gas valves must be opened this number of turns.*

21.3.1 Table 2

Pressure adjustment settings LEFT gasvalve

Water heater Type	"p-out" pressure at gas valve		
	Nat. Gas G20 / G25	Propane G31	Butane G30
EF120	-2 to 0 Pa	-4 to -2 Pa	-5 to -3 Pa
EF150	-2 to 0 Pa	-7 to -5 Pa	-8 to -6 Pa
EF180	-2 to 0 Pa	-7 to -5 Pa	-8 to -6 Pa

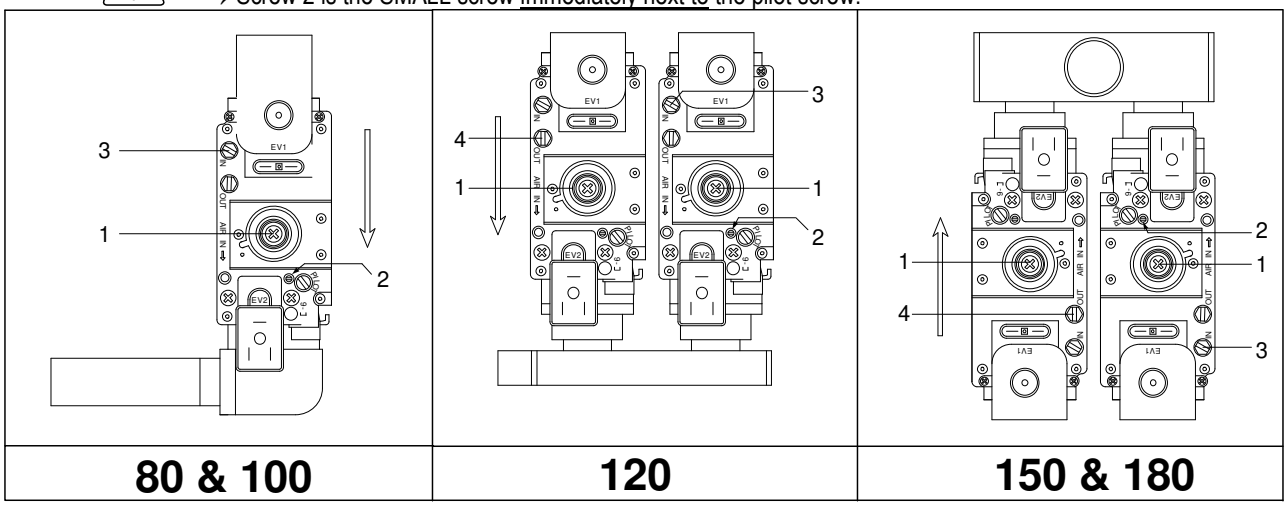
21.3.2 Table 3

Maximum fan speed has to be reduced to convert the boiler into a propane or B/P appliance.
Setting of parameter P4BD.
A sticker has to be pasted after converting the boiler into a propane or B/P appliance.
Mark the used gas and the parameter setting on this sticker.

G31 P	PROPANE PROPAN PROPANO PROPAAN		P4BD = 1
G30/G31 B/P	BUTANE/PROPANE BUTAN/PROPAN BUTANO/PROPANO BUTAAN/PROPAAN		P4BD = 2

21.4 SETTING SCREWS GAS VALVE(S): DRAWINGS

NOTICE: Do NOT mistake the screw marked 'PILOT' for screw 2.
→ Screw 2 is the SMALL screw immediately next to the pilot screw.



80 & 100	120	150 & 180

21.4.1 Adjustments to the gas valve

General scheme for adjustment of gas valve(s). Check this scheme for an overview.
To complete all necessary adjustments in right order, follow case **A** or **B** top-down through the scheme (**B** involves a few extra steps (grey fields)):

	GENERAL SCHEME SETTING STEPS		
	case A	**case B**	
continue ↓		first close (both*) screw(s) [2], then set them in accordance with table 2 (page 92)	
	SWITCH TO SERVICE MODE		
continue ↓		If burner doesn't start, open (RIGHT*) screw[2] ¼ turn extra	
	setting at maximum load		
procedure 1	[▲] set burner at maximum load		
	measure O_2 at flue gas outlet; use (RIGHT*) screw [2] to match value with table 1		
	O_2 ↑	[2]	**CO_2 ↓**
	O_2 ↓	[2]	**CO_2 ↑**
	setting at minimum load		
continue ↓		only → EF120, 150, 180	[▼] set burner at minimum load use LEFT screw [1] to match "p-out" with table 3 (page 92)
procedure 2	[▼] set burner at minimum load		
	measure O_2 at flue gas outlet; use (RIGHT*) screw [1] to match value with table 1		
	O_2 ↑	[1]	**CO_2 ↓**
	O_2 ↓	[1]	**CO_2 ↑**
repeat procedure 1			
repeat procedure 2			
keep repeating until values match table values best			
Water heater returns to NORMAL MODE after 40 min. OR by pressing [SERVICE] button			

* in case of a double valve (EF120, 150 and 180)

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

21.5 ADJUSTMENTS FOR NEW WATER HEATERS OR AFTER A SERVICE (CASE A)

General remark

For all adjusting steps under **A** the following must be applied: as long as measured CO_2 values differ less than 0.3% from the table values, no adjustment is necessary, because this deviation is typical for the process (O_2 values: ± 0.5%). If, however, larger deviations are measured, adjustment now must be made until the table value is reached within max. 0.1% deviation (O_2 values: ± 0.2%).

Adjusting at maximum load

Adjust at maximum load by carrying out procedure 1, 21.9.1

Adjusting at minimum load

Adjust at minimum load by carrying out procedure 2, 21.9.2

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

The maximum fan speed has to be reduced to convert the water heater into a Propane or Propane/Butane (B/P) appliance (set parameter P4BD).

General remarks

In case **B**, a distinction is made between the settings of water heaters containing a single valve (EF80-EF100) and water heaters containing a double valve (EF120-EF180).

All adjustments must result in CO_2 percentages within a bandwidth of max. ± 0.1% deviation from the table values (O_2 values: ± 0.2%).

Adjusting at maximum load EF80 / EF100

The water heaters EF80 and EF100 all have single gas valves.

- First, turn setting screw [2] of the 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 screw [2] counter clockwise (open), according to the number of turns in table 2 for the used water heater and gas type.

After this, adjust at maximum load by carrying out procedure 1, 21.9.1

If the burner doesn't start up in service mode, turn screw [2] a quarter turn counter clockwise further open, and try again.

Adjusting at minimum load EF80 / EF100

Adjust at minimum load by carrying out procedure 2, 21.9.2

IMPORTANT: Toggle between high fire and low fire to make fine-tuning adjustments (adjusting the minimum setting affects the maximum setting and vice-versa).

21.7 CHECKING AND ADJUSTING AT MAXIMUM LOAD EF120 / EF150 / EF180

The water heaters EF120, EF150 and EF180 all have double gas valves.

First connect a manometer to "p-out" = measuring point [4] of the **left** gas valve. Now, turn setting screws [2] of both gas valves clockwise until you feel resistance. This means that the valves are closed; do not try to tighten the screws any further in the closed position.

- After this, turn screws [2] of both left and right hand gas valve counter clockwise (open), according to the number of turns in table 2 for the used water heater and gas type.

From now on **only** use the **right hand** gas valve for adjustments on high fire.

Adjust the right hand valve at maximum load by carrying out procedure 1, 21.9.1.

If the burner doesn't start up in service mode, turn screw [2] a quarter turn counter clockwise further open, and try again.

IMPORTANT: Toggle between high fire and low fire to make fine-tuning adjustments (adjusting the minimum setting affects the maximum setting and vice-versa).

21.8 CHECKING AND ADJUSTING AT MINIMUM LOAD EF120 / EF150 / EF180

Adjusting these water heaters at minimum load in case B involves extra measurements, to get both valves balanced:

Press [▼] button until minimum load is reached. The following screen will appear:

Display message	W	A	T	R	H	T	R	:	S	e	r	v	i	c	e			2	6	%
	>	>	>		1	2	3	.	4	°	C	(	1	2	3	.	4	°	C	)

Water heater is activated and operates at service mode at 26% (minimum).

See 21.3.2 (table 3, page 92) for pressure settings “p-out” gas valve for the used water heater and gas type.
Use screw [1] on the **left hand** gas valve to adjust the measured pressure at “p-out” to the right value according to 21.3.2. Be sure the manometer has been zeroed out prior to making this setting.
Below, the influence of turning screw [1] is described.

Turning counter clockwise	→	less gas	→	a rise in O_2	→	a drop in measured pressure at “p-out”
Turning clockwise	→	more gas	→	a drop in O_2	→	a rise in measured pressure at “p-out”

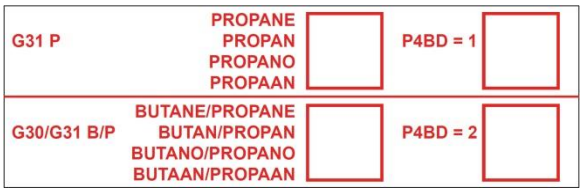
After “p-out” has been set as per 21.3.2, use only the **right hand** screw [1] for setting the O_2 at low fire.

Adjust the **right hand** valve at minimum load by carrying out procedure 2 on page 89.
Again, toggle between high fire and low fire to make fine-tuning adjustments (adjusting the minimum setting affects the maximum setting and vice-versa).

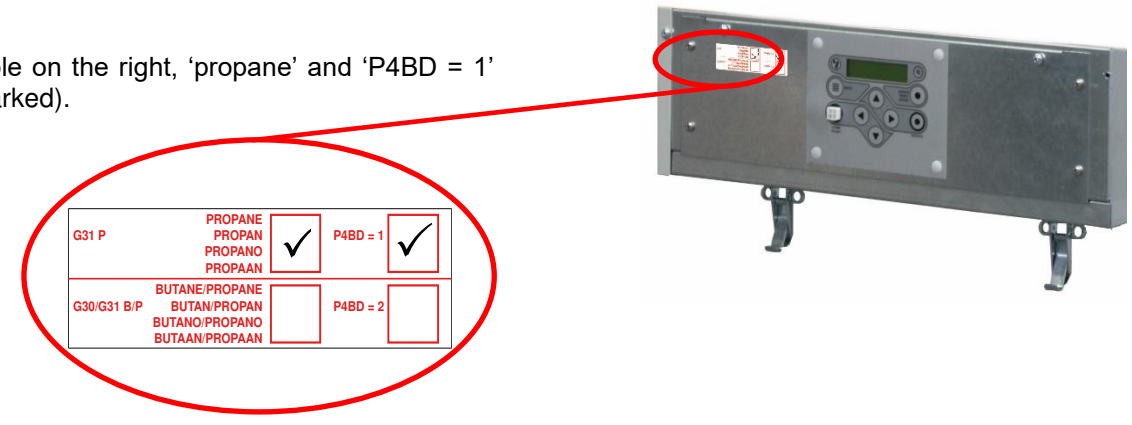
If the valves have been set correctly, “p-out “left should equal “p-out “right. As an additional test, one could check this by measuring “p-out“ at the RIGHT valve, i.e. at measuring point 4 on the right valve (not denoted in the drawings on page 93).
This pressure should be in the same range of pressure as the left valve, so in accordance with 21.3.2 again.

If, after all setting steps have been carried out properly, the values of left and right “p-out “are still very different, contact Lochinvar Technical support.

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.



(In the example on the right, ‘propane’ and ‘P4BD = 1’ have been marked).



21.9 ADJUSTMENT PROCEDURES

Procedures 1 and 2, referred to in the previous sections, are described here:

21.9.1 Procedure 1: adjust at maximum load

*In case **B** (gas conversion or replacement of gas valve): consult § 21.7. before starting procedure 1 below.*

Carry out the next 4 steps:

1. Press [SERVICE] button for about 3 seconds.

Display message	W	A	T	R	H	T	R	:	S	e	r	v	i	c	e			2	6	%
	>	>	>		1	2	3	.	4	°	C	(	1	2	3	.	4	°	C	)

Water heater is activated and operates at service mode at 26% (minimum).

2. 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).

3. Measure the O_2 percentage at the flue gas outlet.
4. By setting screw [2], adjust the gas valve to obtain the O_2 value of table 1.
   NOTICE: For the CD+ 120, 150 and 180 water heaters use only the RIGHT side gas valve for adjusting.

Increase O_2 percentage	$O_2 \uparrow$ [2] $CO_2 \downarrow$	**Turn screw [2] right (clockwise)**
Decrease O_2 percentage	$O_2 \downarrow$ [2] $CO_2 \uparrow$	**Turn screw [2] left (counter clockwise)**

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

21.9.2 Procedure 2: adjust at minimum load

*In case **B** (gas conversion or replacement of gas valve): consult § 21.8 before starting procedure 2 below.*

Carry out the next 3 steps:

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

Display message	W	A	T	R	H	T	R	:	S	e	r	v	i	c	e			2	6	%
	>	>	>		1	2	3	.	4	°	C	(	1	2	3	.	4	°	C	)

Water heater is activated and operates at service mode at 26% (minimum).

2. Measure the O_2 percentage at the flue gas outlet.
3. By setting screw [1], adjust the gas valve to obtain the O_2 value of table 1.
   NOTICE: For the 120, 150 and 180 kW water heaters use only the RIGHT side gas valve for adjusting.

Increase O_2 percentage	$O_2 \uparrow$ [1] $CO_2 \downarrow$	**Turn screw [1] left (counter clockwise)**
Decrease O_2 percentage	$O_2 \downarrow$ [1] $CO_2 \uparrow$	**Turn screw [1] right (clockwise)**

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

22.0 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).

22.1 OUT OF OPERATION: ON/OFF FUNCTION.

To be used when the appliance is to be put out of operation for a long period.

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 (next paragraph).

22.2 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.

Before starting to drain the water heater, first start draining the DHW system and subsequently also the two drains of the water heater.

23.0 FAULT CODES, BLOCKING CODES

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.

23.1.1 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 **F0**	Flow sensor pump 999.5hrs
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 **F1**	Flow high Temp pump 999.5hrs
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:
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 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 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 temp. exceeded 3 times 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 if 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:
Check the igniter/ignition electrode and replace/clean it if necessary. Check the state of the ceramic insulator. A small crack can prevent the spark to form at the end of the electrode. Check the distance between the electrode pin, earth pin and burner. Check the state of the ignition cable and replace it if necessary. Check the state of the earth wire/connection of the igniter and replace it if necessary. Check the state of the sparkplug cap and replace it if necessary. Check power supply. Voltage must be 230 Vac nom. Check for proper electrical grounding of unit. Bad ignition transformer. Change the electronics of the unit.

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

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

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 signal lost during operation.	

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

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:
Check ionisation signal. Check the igniter/ignition electrode and replace/clean it if necessary. Check the state of the ceramic insulator. Check the distance between the electrode pin, earth pin and burner. Check the state of the ignition wire (is also ionisation wire), and replace if necessary Check the state of the igniter earth wire/connection and replace it if necessary. Check for proper electrical grounding of unit.

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

Cause:
External factors.
Corrective action:
Check if there were extreme weather/wind conditions when the fault occurred. 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).

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.

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:
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.

Display message F15	Clixon Fault pump on 999.5 hrs
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 F16	FlowReturn dt fault pump on 999.5 hrs
Reason:	Temperature difference between flow and return exceeds limitation value, or 'Heatexchang at Risk' has occurred 3 times.

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.

For **F16** see also **Flow Monitoring**

Display message F17	Water high limit pump on 999.5 hrs
Reason:	Maximum thermostat exceeds limitation 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 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.

23.1.2 Blocking codes

The display is not blinking, but is light up during the blocking period.
The water heater is blocking an action, because of an extraordinary situation. This action will be continued after eliminating the extraordinary 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:
Systems 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 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 that its resistance gets lower when the temperature rises. A partly shorted sensor will drop resistance and therefore ‘measure’ a higher 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 ended demand.

Cause:
Immediately opening and 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 high.
Corrective action:
Check if the system pressure is too high after (re)filling. Make sure that there is a pressure relief valve and expansion vessel installed in the system, according to the applicable standards. Check if there is an open connection between the unit and the relief valve plus expansion vessel. Be aware that if the unit is installed in the basement of a tall building, only the static pressure of the water column above the units can raise above the maximum allowable limits. Make sure that this is not the case.

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 failing or voltage peaks in the power supply.

Display message	T 1 - T 2 h i g h
	9 9 9 . 5 h r s
Reason	Difference between T1 and T2 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	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	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 during heat demand.

Cause: If used in combination with flow switch:
The water flow through the unit is too low.
Corrective action:
Check functioning of the pump and the flow switch. 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	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 tank 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:
Connect the sensor to the terminals 3 and 4. Check the wires from the sensor to the terminals. Check the sensor on resistance 10K at 25°C.

Display message	F l o w h i g h D H W
	9 9 9 . 5 h r s
Reason:	Setpoint return (tank) temperature DHW (S3) is higher than Setpoint heating = flow temperature (S1)

Cause:
Wrong setting of parameter: P6BA Heating setpoint below P6CA DHW setpoint
Corrective Action:
Adjust the heating setpoint through the display: menu – settings – heating setpoint.

23.1.3 Maintenance attention function

The display shows alternately 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	**Needs Maintenan 0.0** **Ignition cycles hrs**
Reason	Maintenance option of total amount of ignition cycles has been reached.

Display message	**Needs Maintenan 0.0** **Date hrs**
Reason	Maintenance option of the date has been reached.

Display message	**Needs Maintenan 0.0** **Burning hours hrs**
Reason	Maintenance option of total amount of burning hours has been reached.

Display message	**Needs Maintenan 0.0** **All hrs**
Reason	One of the abovementioned maintenance options has been reached.

This Function is factory set to off; it can be activated by the Commissioning Engineer. This function does not overrule the requirements laid out in Maintenance and the requirement for an annual gas safety check

24.0 MAINTENANCE

24.1 GENERAL

Gas appliances should be checked at Maximum intervals of no more than 12 months, this will ensure the safe and reliable operation of the water heater for many years to come.

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.**
- **A full service and gas safety check must be carried out at least every 12 months to ensure safe and efficient operation.**

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

24.2 MAINTENANCE REMINDER FUNCTION.

BE AWARE: This function is OFF as standard. This function is to be used for a general reminder only, it cannot be used to lengthen the periods of Maintenance beyond 12 months and will not be accepted as proof of a suitable Maintenance regime should a warrantable fault occur.
It is and remains the responsibly of the end user to have the unit maintained every twelve months!

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	**l**	**l**														**h**	**r**	**s**	

Reason One of the abovementioned maintenance options has been reached.

24.3 SERVICE INTERVALS

The Maximum 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 the first 6 months. This will determine the frequency of the future service intervals. The maximum interval between two services can be a year.

It is a condition of the water heater warranty that the boiler must be serviced by a competent engineer registered with an HSE approved body every 12 months,

24.4 WATERSIDE

In hard water areas the heat exchanger waterways should be inspected and if necessary a mild descale carried out in order to prevent lime scale build up within the heat exchanger.

Failure to protect and clean the heat exchanger may result in a non-warrantable heat exchanger failure

24.5 INSPECTION AND 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.
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 shut off the gas supply to the water heater

24.5.1 Customer comments

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

24.5.2 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).

24.5.3 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.

24.5.4 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.

24.5.5 Remove complete burner unit

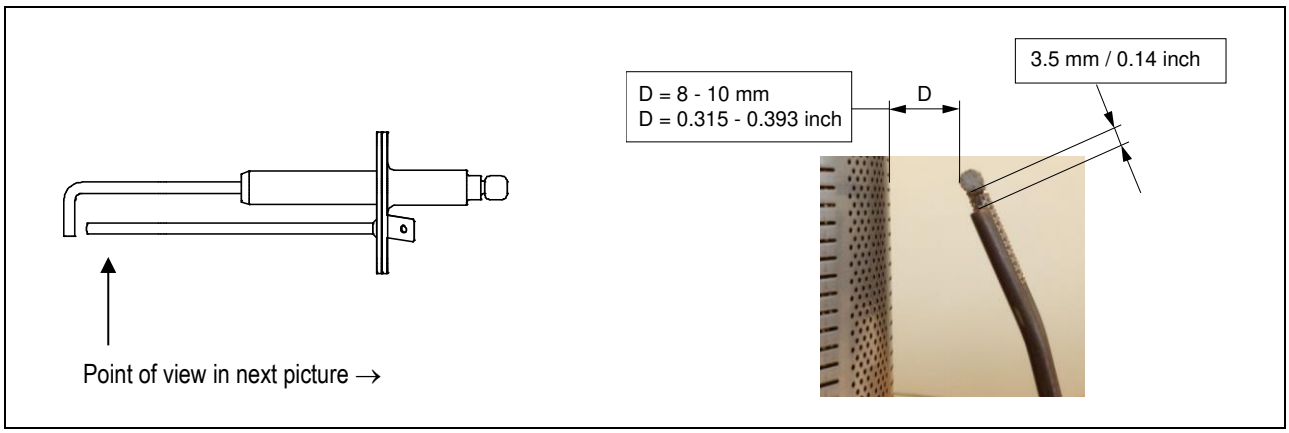
The complete burner unit consists of the fan, the burner plate and the internal burner. To remove this part for an internal heat exchanger check: remove the 6 x M6 nuts and the ignition cable. After this take out the complete burner unit by moving it forward out of the water heater housing. NOTICE: watch out for the burner plate insulation that it won't be damaged during this operation. While removing the complete burner unplug both of the electrical and controlling cables of the fan. After all this dismantle the air/gas mixing box on the suction side of the fan and check the blade wheel of the fan.

24.5.6 Burner

Check the burner surface to see if it has damages, signs of rust and/or is cracked. When the burner surface is damaged the burner must be replaced. The burner can be cleaned by using a soft **non-metallic** brush. The dust can be removed with a vacuum cleaner or pressurized air.

24.5.7 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 being bent, used electrodes 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 to be replaced, also the gasket should be renewed.



24.5.8 Burner door gaskets

When these gaskets have changed colours at some parts, the rubber has cured and/or has damages, these gaskets must be replaced. Notice: only use the gaskets that are supplied by the water heater manufacturer.

24.5.9 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.

24.5.10 Insulation

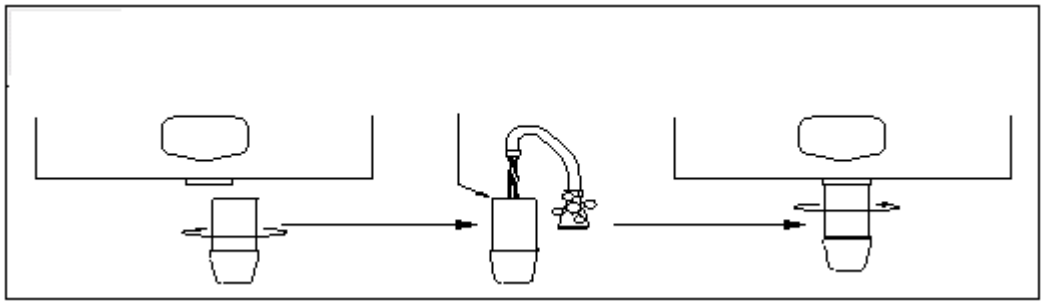
The insulation of the heat exchanger (located on the rear wall inside the heat exchanger and burner door) must be inspected. If this insulation disk shows any signs of (water) damage or degradation it should be exchanged. Also check if there are any indications of a high condensate level in the burner room (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.

24.5.11 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. Notice: Don't wet the rear wall insulation.

When mounting the bottom part of the siphon, before commissioning the boiler and/or after maintenance, the siphon must ALWAYS be FILLED COMPLETELY with water.

This is a safety measure: the water in the siphon keeps the flue gases from leaking out of the heat exchanger via the condensate drain.



24.5.12 Heat exchanger and Combustion chamber

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 Combustion chamber with water. Don't forget afterwards to clean the siphon once again.

Cleaning the combustion chamber with acid or alkali products is prohibited.

24.5.13 Gas/air ratio

With every service check and/or maintenance of the water heater always check the gas/air ratio by measuring the O_2 percentage (flue gas) at the maximum and minimum load of the water heater. If necessary adjust these values, see for information chapter 21**Error! Reference source not found.** "Adjusting and setting the burner".

24.5.14 Pump

Check the electrical parts and the motor of the pump for defects. 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 defects and abnormalities are found by the service engineer during service and maintenance and these are not repairable, this information should be reported to the owner/end-user of the installation. Also these defects should be reported in the service report / log file of the boiler.

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 boiler again.

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

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:

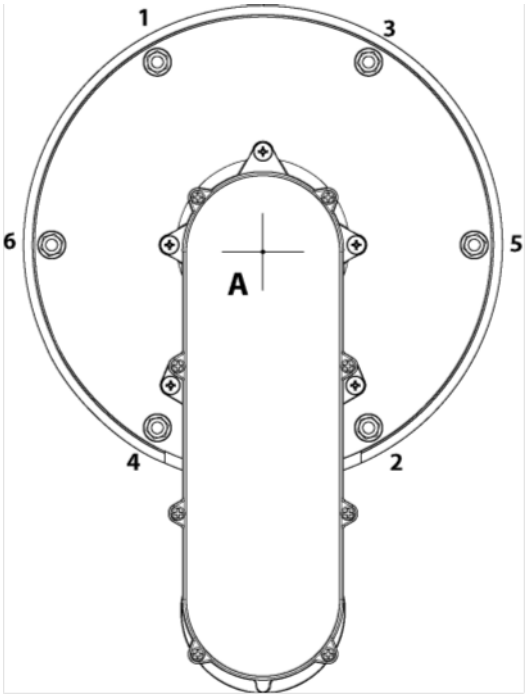
- Place the burner door with its holes over the six threaded studs.
  Careful! When handling too rough or misplacing the holes over the threaded studs, the burner door insulation and/or gaskets can be damaged.
  Assure yourself that the door is well positioned with respect to the threaded studs, before pushing it onto the heat exchanger.
- 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.**

tighten in given order

torque value = 8 Nm



24.7 INSTALLATION NOISE

If care has been taken to follow the manufacturer's instructions there should be no discernible noise from the equipment. The applied pump motor may have a level of sound that could lead to consideration for acoustic insulation, but care must be taken not to impede ventilation or airflow to the pump motor

24.8 DRAINING THE WATER HEATER

The water heater must be drained if it is to be shut down and exposed to freezing temperatures. Maintenance and service procedures may also require draining the water heater.

1. Turn off the water heater electrical disconnect switch.
2. Connect a hose to the drain valve on the storage vessel.
3. Locate hose's discharge in an area where hot water will not cause any damage or injury.
4. Close the cold water inlet valve to the storage vessel.
5. Open a nearby hot water outlet to vent the system.
6. Open the drain valve.
7. Once the system has been drained, the heat exchanger can be purged of water using an air compressor.
8. If the water heating system is being drained for an extended shutdown, it is suggested the drain valve be left open during this period.

24.9 REMOVING SCALE AND SEDIMENT FROM THE STORAGE VESSEL

Refer to installation and maintenance instructions for the direct storage vessel type installed

24.10 REFILLING THE SYSTEM

1. Close the drain valve on the storage vessel.
2. Open a hot water fixture to allow air to escape.
3. Open the cold water supply to water heating system and allow it to fill.
4. Isolate the gas supply to the heater and reinstate the electrical supply.
5. Once there is no air left in the heat exchanger (e.g. no air bleeding from the auto air vent), follow the lighting instructions as detailed in **PROCEDURE FOR INITIAL LIGHTING**.
6. Check for water leakage.

24.11 OTHER CHECKS

24.11.1 Relief valves (if fitted)

At least once a year, the temperature and pressure relief valve and safety valve should be checked to ensure that they are in operating condition. To check each valve, lift the lever or turn the screw cap at the end of the valve several times. The valve should operate freely and seat properly.

If water does not flow, remove and inspect for obstructions or corrosion. Replace with a new valve of the recommended size as necessary.

24.11.2 Flue system

Examine the exhaust and air intake system at least once a year. Points of inspection are as follows:

1. Check for obstructions and/or deterioration of flue piping and terminal. Replace immediately where needed.
2. Check the terminal for any foreign material and remove as necessary.
3. Check all flue system connections for leakage and reseal as required.
4. Check that ventilation grilles comply with current regulations.

25.0 ERP SPECIFICATION DATA SHEET

Water Heater Type:		EF80	EF100	EF120	EF150	EF180
Manufacturer		Lochinvar Limited				
Load Profile		XXL	XXL	XXL	3XL	3XL
Water Heating Energy Efficiency	**%**	**86.0%**	**86.3%**	**85.9%**	**89.0%**	**88.6%**
Daily Electricity Consumption	Qelec	27.9	27.82	27.97	51.92	52.16
Daily Fuel Consumption	Qfuel	0.245	0.242	0.24	0.24	0.235
Mixed water V40 @40°C	litre	*	*	*	*	*
Emissions of Nitrogen Oxides (EN155021:2012+A1:2015))	mg/kwh	39	35	39	36	37
Sound Power Level (EN 15036-1:2006)	LWA(db)	67	65	62	66	69

* EcoForce wall mounted water heaters must be combined with one or more direct storage vessels. The Efficiency and V40 litre is dependent upon:

The number and type of water heaters

the number and size of buffer vessels used

the length of the interconnecting pipework

insulation type used

26.0 USER INSTRUCTIONS

Once the installation and commissioning is complete, the equipment owner or their representative should be made aware of the operation of the appliance and its safety devices. A practical demonstration should be given describing each functional step. Incorrect use may result in injury and will also invalidate the warranty. The installers guide should be handed over and kept in a safe place for easy reference.

26.1 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.

IMPORTANT INFORMATION

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

Lochinvar®
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