EFB

WALL HUNG GAS FIRED CONDENSING BOILERS

Installation, Commissioning, User and Maintenance instructions

MODELS
EFB85
EFB105
EFB125
EFB155

Installation manual_EFB_May 2022
E93.1607.014.A

Lochinvar®
HIGH EFFICIENCY BOILERS & WATER HEATERS

TABLE OF CONTENTS

1 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 boiler 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 must also be in accordance with any requirements of the local gas distributor and local authority. In addition, the installation must 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 boilers 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	
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 boilers
SAFED BG01Guidance on safe operation of boilers
Third edition of the 1956 Clean Air Act Memorandum on Chimney Heights

1.2 ABBREVIATIONS.

EFB = Condensing Boiler
DHW = For Direct Hot Water (drinking water) usage only.
CH = Central Heating (for central heating purposes and/or indirect hot water).
BCU = Burner control unit.
PEFB = Printed circuit board (burner controller).
PB = Pixel button = display board/ control panel.

2 SAFETY GUIDELINES

Keep these instructions near the boiler 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 Lochinvar the internals of the boiler may not be changed. When changes are executed without approval, the boiler 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 must 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 must be supervised to ensure that they do not play with the appliance.

The protection class for gas appliance type B23(P) is IP20.
When fitted with the special air inlet (see Flue section), the protection class is IPX4D.

3 TECHNICAL DATA EFB BOILERS

3.1 FUNCTIONAL INTRODUCTION

EFB boilers are Gas Condensing central heating boilers with a very high efficiency. Such a performance can be reached by, amongst other things, using a special heat exchanger made of stainless steel. This allows the flue gases to cool down below the condensation point, and so release extra heat. This has an immediate positive impact on the efficiency.

The EFB boiler is set for natural gas as standard.
Fuel used must have sulphur rates with a maximum annual peak over a short period of time of 150 mg/m³ and an annual average of 30 mg/m³.

Boiler controller includes:

- Cascade control for up to sixteen boilers
- Remote operation and heat demand indication from each boiler
- Weather compensation control
- Domestic hot water control

Connections for:

- On/Off thermostat or modulating thermostat
- 0-10 VDC remote flow temperature (set point) control.
- 0-10 VDC remote burner input control.
- Outdoor temperature sensor.
- External calorifier pump or diverter valve.
- Boiler pump.
- PWM control for external boiler pump.
- System pump.
- External flow switch or external safety device.
- Modbus.
- External system sensor.
- DHW indirect sensor or aquastat.
- Touchscreen.
- External Ignition transformer.

3.2 LOCATION OF VERSION NUMBERS

Parameter Version
-To be found on the small sticker at the side of the burner controller **v.A** = “Version A” for instance

Burner controller hardware version
– Mentioned at the second line on the white sticker at the side of the burner controller.

957MN25_3Rh4b e.g.

Burner Controller Software Versions
– Press the menu button ☰ , go to Information and then to Software Versions.

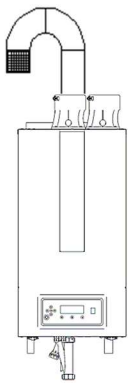
Information	
Software Versions	i
Boiler Status	
Boiler History	
Error Log	

Software Versions	
Display	[63EF 83BC]
Boiler	[5C79 14A9]
Device Group	900MN

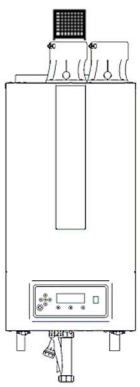
3.2.1 TECHNICAL SPECIFICATIONS DATASHEET

Product I.D. Number		0063CT3633			
Gas Appliance Type		B23(P), C13, C33, C43, C53, C63, C83, C93 C(10)3, C(11)3, C(12)3, C(13)3, C(14)3 ,C(15)3			
Model Number		**EFB85**	**EFB105**	**EFB125**	**EFB155**
Classification		**II2EL3P**	**II2ELL3P**		
GENERAL DATA					
Input (gross) G20 min-max	kW	17.1 - 90.7	20.7 - 108.1	26.2 - 132.6	38.9 - 161.4
Input (gross) G31 min-max	kW	17.4 - 87.4	20.6 - 103.4	26.2 - 131.2	42.7 - 154.4
Input (net) G20 min-max	kW	15.4 - 81.7	18.6 - 97.3	23.6 - 119.4	35 - 145.3
Output (50ºC/30ºC) G20 min-max	kW	16 - 85.1	19.5 - 101.8	24.7 - 124.7	36.4 - 151
Output (80ºC/60ºC) G20 min-max	kW	14.9 - 79.1	18 - 94.2	22.9 - 115.7	33.9 - 140.9
Seasonal Efficiency (Part L)	%	96	96	96	96
Shipping Weight	kg	77	79	83	86
NOx Class According to EN15502-A1 2018		6			
Emissions NO_X According to EN15502-A1 2018	mg/kWh	23.1	21.3	23.9	20.1
GAS DATA – G20					
Nominal gas inlet pressure	mbar	20			
Maximum gas inlet pressure	mbar	25			
Minimum gas inlet pressure	mbar	17.5			
Gas flow rate min-max	m3/hr	1.6 - 8.5	1.9 - 10.2	2.5 - 12.5	3.7 - 15.3
CO_2 flue gas [3] min-max	%	7.9 – 8.4	7.9 – 8.4	7.9 – 8.4	7.9 – 8.4
O_2 flue gas [3] min-max	%	6.9 - 6.0	6.9 - 6.0	6.9 - 6.0	6.9 - 6.0
Gas inlet connection size	"BSP	R¾			R1
GAS DATA – G31					
Nominal gas inlet pressure	mbar	37			
Maximum gas inlet pressure	mbar	57.5			
Minimum gas inlet pressure	mbar	25			
Gas flow rate min-max	m3/hr	0.6 - 3.2	0.8 - 3.9	1 - 4.8	1.6 - 5.7
CO_2 flue gas [3] min-max	%	10.5-9.3	10.3-9.3	10.3-9.5	10.3-9.5
O_2 flue gas [3] min-max	%	4.9 - 6.7	5.2 - 6.7	5.2 - 6.4	5.2 - 6.4
Gas inlet connection size	"BSP	R¾			R1
ELECTRICAL DATA					
Power consumption	W	190	280	280	280
Power supply	V/Hz	Single phase 230/50			
Protection class		IP20 or IPX4D*			
WATER DATA					
Water content	litres	5	6.5	8.3	10.4
Water connections (F & R) Boiler	"BSP	R1			R1¼
Max. water pressure (PMS)	bar	6			
Min. water pressure	bar	1			
Maximum water temperature	°C	90			

[3] O_2 / CO_2 of the boiler measured without the boiler front cover in place



Boiler is IPX4D applying a dust filter or bird screen with two elbows and if necessary, a short straight pipe.



Boiler is IP20 applying a dust filter or bird screen only

3.3 ERP SPECIFICATIONS DATASHEET

Type Boiler:		**EFB85**	**EFB105**	**EFB125**	**EFB155**
Condensing boiler:		Yes	Yes	Yes	Yes
low temperature boiler:		No	No	No	No
B11 boiler:		No	No	No	No
Cogeneration space heater:		No	No	No	No
Combination heater:		No	No	No	No
	Unit:	Value	Value	Value	Value
Rated heat output	**kW**	**78.9**	**94.3**	**115.6**	**140.9**
P-rated (P4) at 58-77°C	kW	78.9	94.3	115.6	140.9
Heat output (p1) 30% at 30-37°C	kW	25.2	31.6	38.8	46.5
Seasonal space heating energy efficiency (ηs).	%	**92.4**	**92.6**	**92.7**	**92.9**
Energy efficiency (η4) at 58-77°C	%	87.2	87.2	87.3	87.3
Energy efficiency (η1) at 30-37°C	%	97.4	97.6	97.7	97.8
Auxiliary electricity consumption					
At full load (elmax)	kW	0.183	0.271	0.28	0.278
At part load (elmin)	kW	0.024	0.023	0.027	0.031
In standby mode (Psb)	kW	0.007	0.007	0.007	0.007
Other					
Standby heat loss (Pstby)	kW	0.066	0.07	0.075	0.083
Ignition burner power consumption	kW	0	0	0	0
Emissions (NOx) of nitrogen oxides (EN15502-1:2012 +A1:2015) [1]	mg/kWh	23.1	21.3	23.9	20.1
Sound power level, indoors (EN 14436-1:2006)	dB	65.8	68	67.8	73

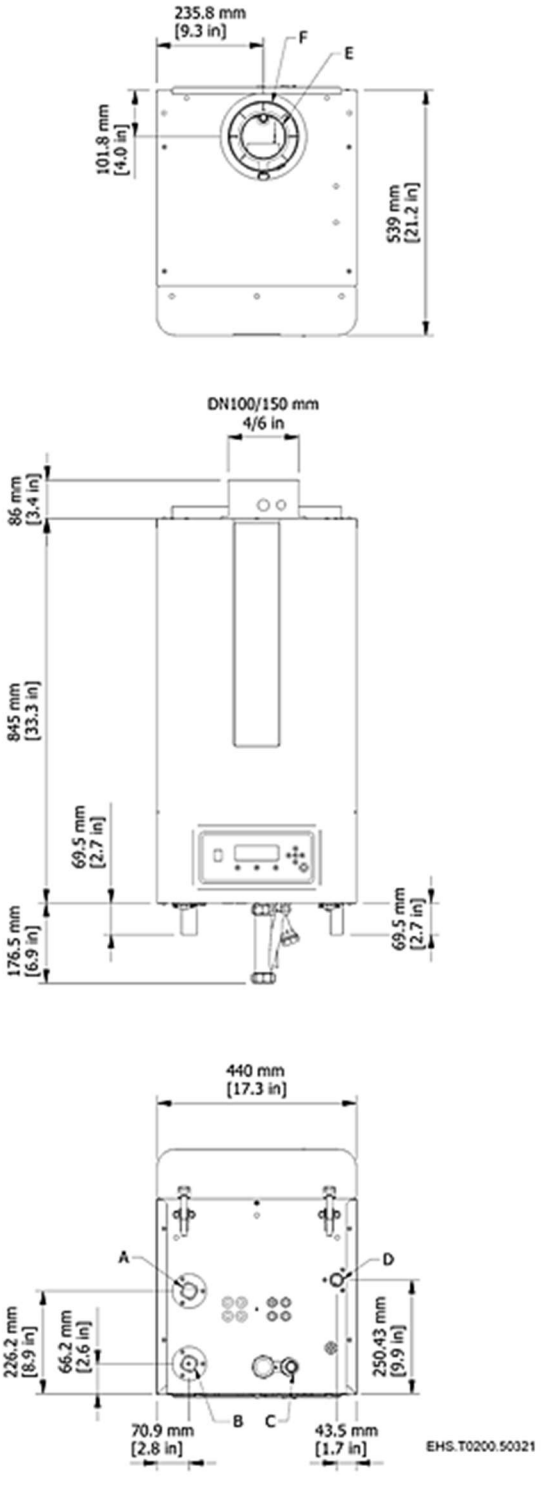
Technical parameters according to the European ERP (Energy Related Products) legislation:

[1] These numbers are used to assign credits according to the BREEAM standards

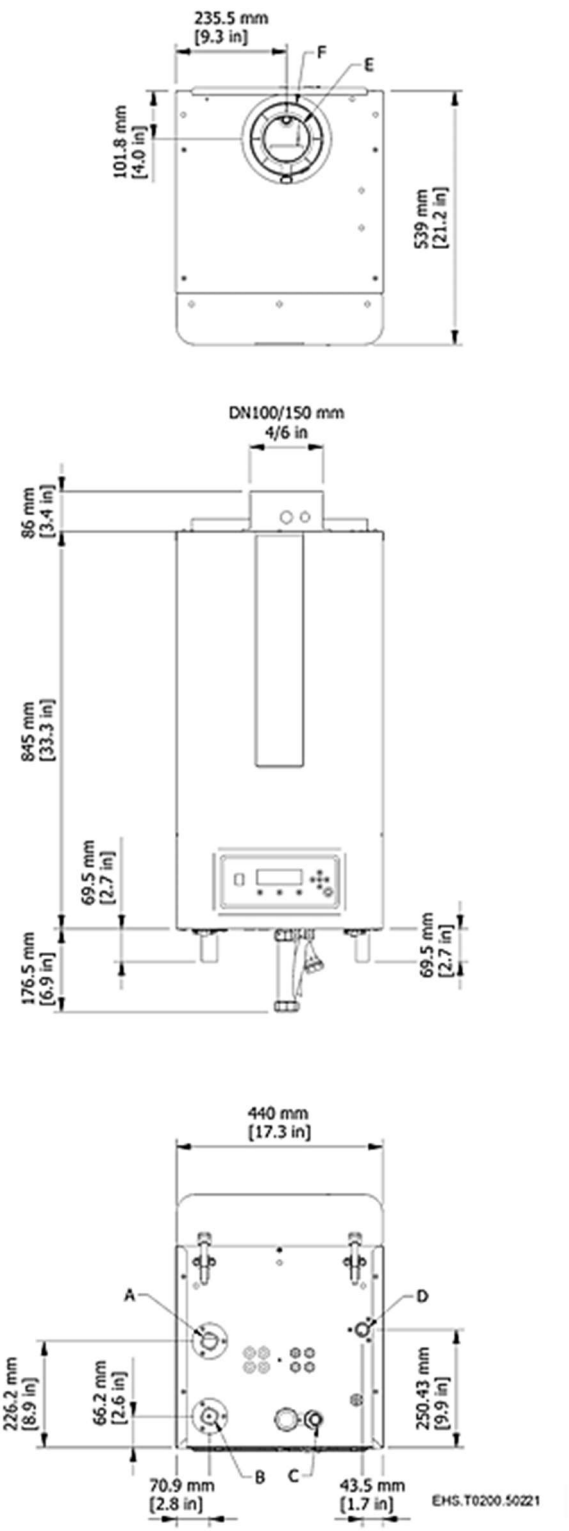
4 DIMENSIONS & CONNECTIONS

4.1 EFB85, EFB105 AND EFB125

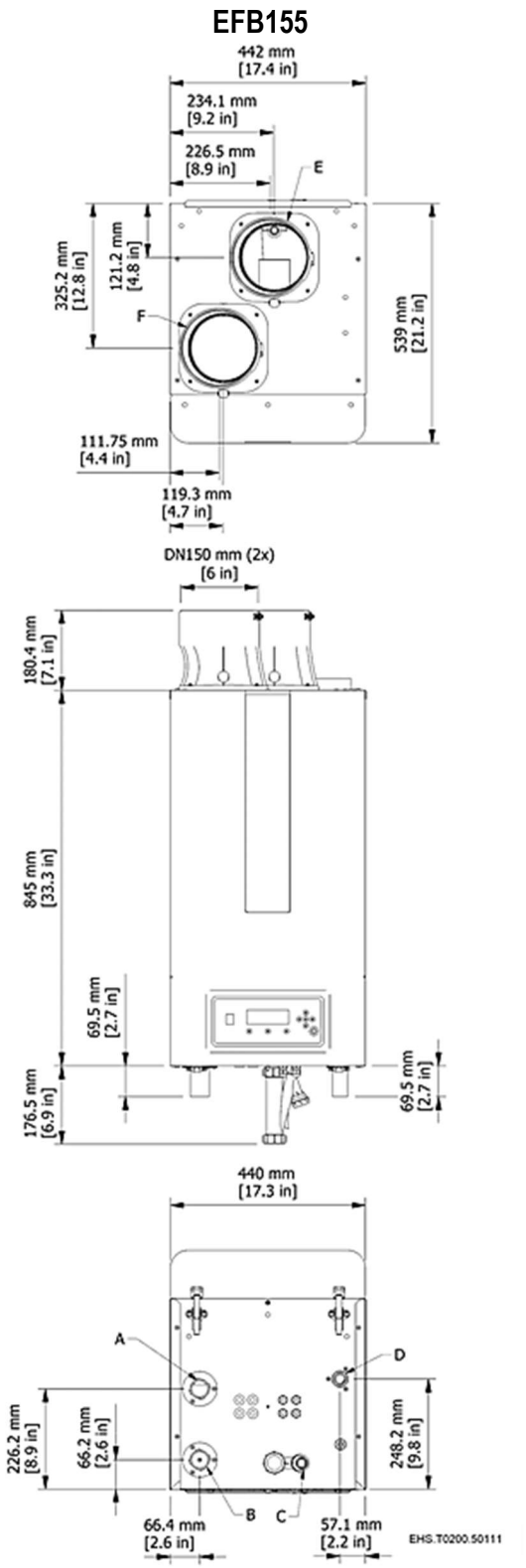
EFB85 & EFB105



EFB125



4.3 EFB155



Connections			Twin pipe			
			EFB85	EFB105	EFB125	EFB155
Flue gas / Air inlet		mm	100-100			150-150
A	flow	Inch	R1"			R1¼"
B	condensate	mm	flexible hose Ø25/21 mm			
C	return	Inch	R1"			R1¼"
D	gas	Inch	R¾"			R1"
Connections			**Concentric**			
			EFB85	**EFB105**	**EFB125**	**EFB155**
Flue gas / Air inlet		mm	100-150			N/A
A	flow	Inch	R1"			R1¼"
B	condensate	mm	flexible hose Ø25/21 mm			
C	return	Inch	R1"			R1¼"
D	gas	Inch	R¾"			R1"

4.3.1 CONNECTION SIZES ALL VERSIONS

5 ACCESSORIES AND UNPACKING

5.1 ACCESSORIES

Depending on the selected controlling behaviour for the central heating system and/or the optional use of a calorifier, the following items can be supplied with the boiler. Contact Lochinvar for prices and further information.

Item	Item Nº.
Outdoor (air) temperature sensor: 10kOhm@25°C -B3977	LE022500020
External flow temperature sensor for behind the low loss header: 10kOhm@25°C - B3977	LE04016304
Calorifier temperature sensor: 10kOhm@25°C - B3977	LE04016303
Pump EFB 85 and EFB 105	LE022500011
Pump EFB 125	LE022500012
Pump EFB 155	LE022500013
IP module	LE022500006
Software + interface cable for programming the boiler with a computer/laptop	LE022500015
Propane orifice EFB 85 and EFB 105	LE022500001
Propane orifice EFB 125	LE022500004
Propane orifice EFB 155	LE022500010
Special air inlet for IPX4D protection on B23(P) boilers EFB 85, EFB 105 and EFB 125	LE022500018
Special air inlet for IPX4D protection on B23(P) boiler EFB 155	LE022500019

5.2 UNPACKING

The EFB boiler will be supplied with the following documents and accessories:

- One set Installation, commissioning, user and maintenance instructions
- One suspension bracket with locking plate and bolts
- Spare fuse for the boiler controller (At the burner controller)
- Spare nuts for mounting the burner plate (in a bag attached to the front of the gas valve)
- Bottom part of the condensate trap.

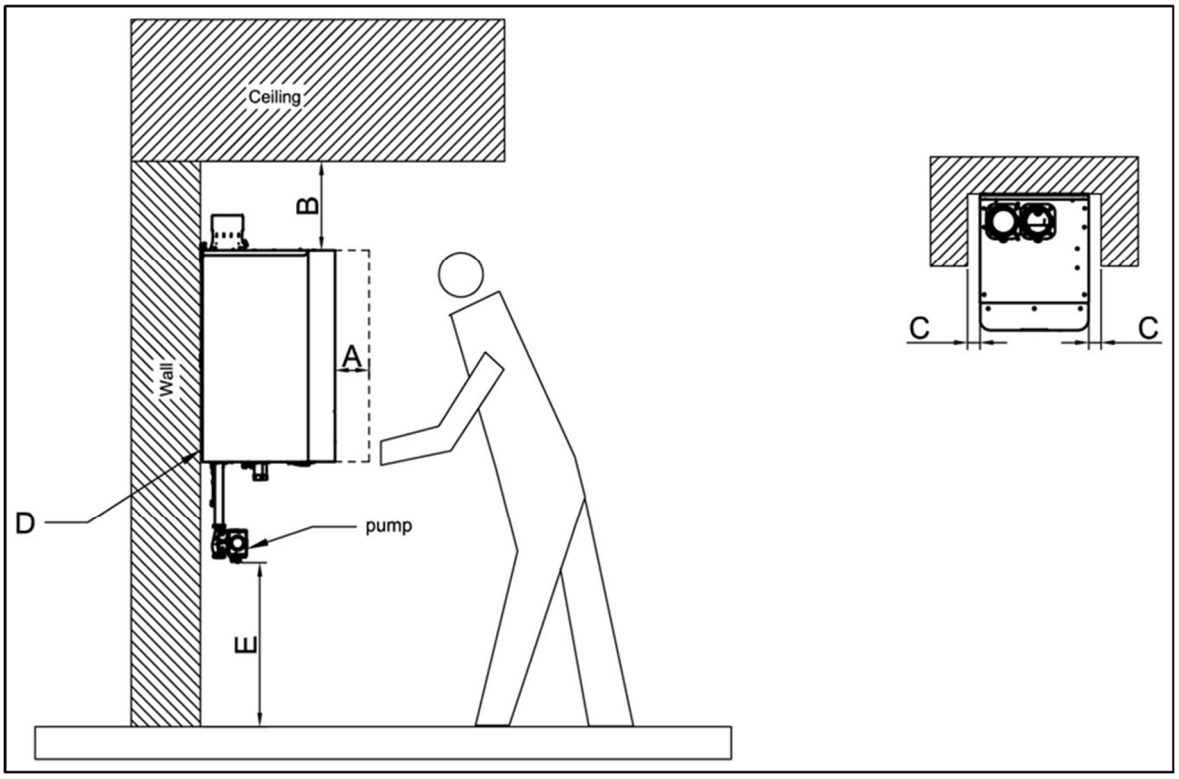
After delivery, always check the boiler package to see if it is complete and without any defects. Report any defects immediately to your supplier.

6 INSTALLATION OF THE EFB

6.1 INSTALLATION CLEARANCES

On all sides of the boiler at least 5 cm of clearance must be applied to walls or wall units, 30 cm above the top side of the boiler and 25 cm from the bottom/pump of the boiler.

Clearances to wall, ceiling and floor in cm					
	A: Front	**B: Top**	**C: Sides**	**D: Back**	**E: Bottom**
Minimum service Clearances	15	30	5	0	25
Recommended Service clearances	64	35	50	0	75
Clearances from combustible materials	1. Hot water pipes—at least 6 mm from combustible materials. 2. Vent pipe – at least 25 mm from combustible materials.				



The installation area/room must have the following provisions:

- 230 V - 50 Hz power supply with ground.
- Open connection to the sewer system for draining condensing water.
- A wall or stand to properly support the weight of the boiler.

The wall used for mounting the boiler must be able to hold the weight of the boiler. If not, it is recommended to mount the boiler by means of a frame available from Lochinvar.

6.2 BOILER INSTALLATION LOCATION REQUIREMENTS

Other considerations related to the boiler location.

- The ventilation of the boiler room must meet local and national standards and regulations, regardless of the selected supply of fresh air to the boiler.
- The flue gas pipes must be connected to the outside wall and/or the outside roof.
- The installation area must be dry and frost-free.
- The boiler has a built-in fan that will generate noise, depending on the total heat demand. The boiler location must minimize any disturbance this might cause. Preferably mount the boiler on a brick wall.
- There must be sufficient lighting available in the boiler room to work safely on the boiler.

When a boiler is positioned at the highest point of the installation, the supply and return pipes must first protrude 0.5 m above the top of the boiler, before these pipes go to the installation side. In other words, the water level must always be 0.5 meters above the top of the boiler and an automatic air vent must be installed in the supply or return pipe.

- Consider the positioning of electrical components in relation to the temperature sensitivity.
- Make sure there is an open connection with the sewer to drain the condensate. This connection must be lower than the condensate drains level of the boiler.

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

6.3 MOUNTING THE BOILER

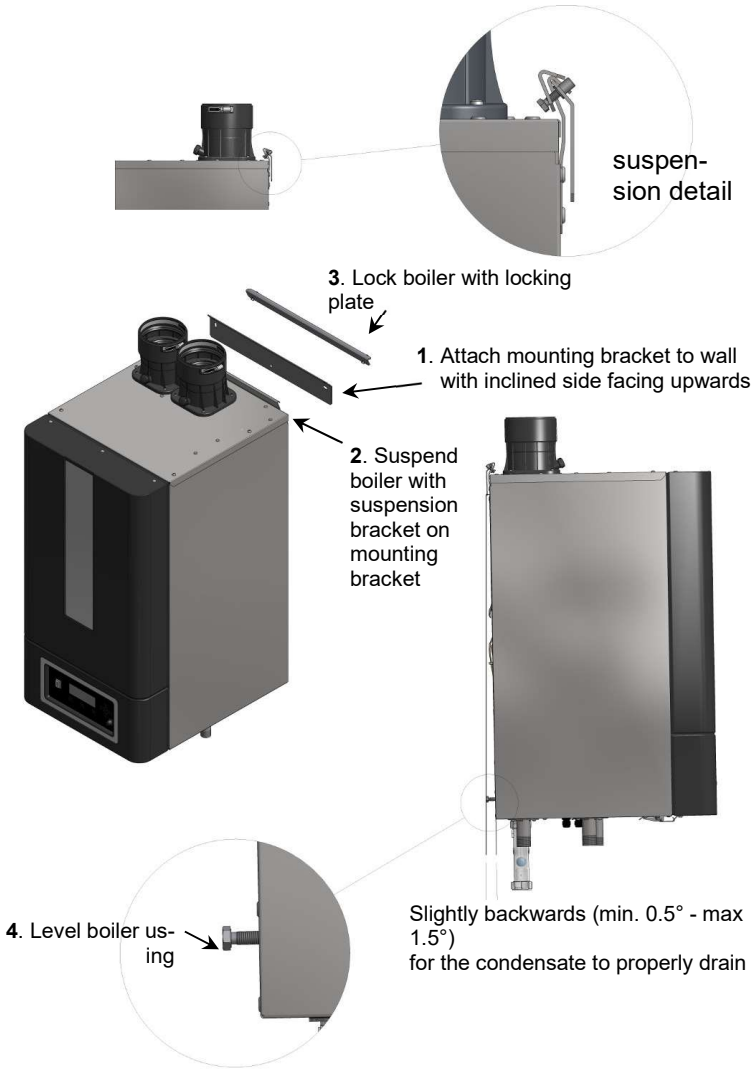
Before mounting and installing the boiler the following connections must be considered:

- Flue gas system and the flue gas pipe connections
- Air supply system and connections
- Flow and return pipe connection
- Condensate and pressure relief valve drainage
- Power supply (preferably the power connection positioned above the boiler)
- Gas pipe.

All lines/piping must be mounted free of tension. The weight of the installation components must be supported separately from the boiler so there will be no standing forces on the connections.
This might influence the mounting position of the boiler.

Determine the position of the boiler by using the included mounting bracket or frame (when supplied). While marking the holes, ensure that the mounting bracket or frame is perpendicular and the boiler 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 aren't sufficient, fill the gap behind the bolts to get the boiler in position. The boiler position lies between the boiler hanging level and hanging slightly backwards (min. 0.5° - max 1.5°).

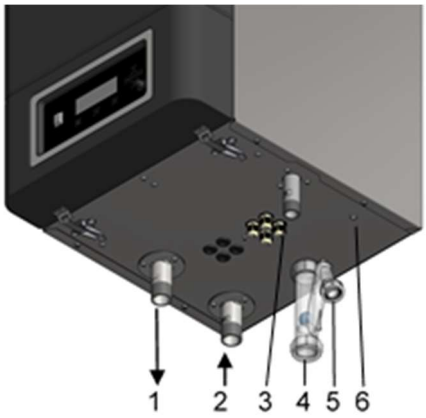
The boiler may not lean forward in the mounted position.



Lock the mounting bracket with the security cover before making any other connections to the boiler. This security cover will prevent the boiler from falling off the bracket. Do not use excessive force during the mounting of the boiler connections.

7 CONNECTIONS

7.1 BOILER CONNECTIONS



1 – Flow (Hot water out)

2 – Return (Cold water in)

3 – Gas

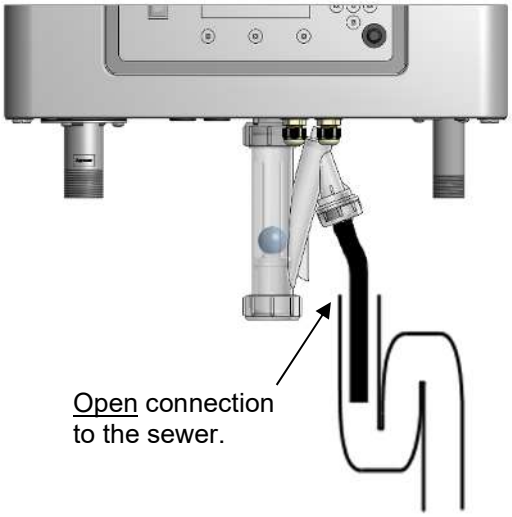
4 – Condensate trap cleaning point

5 – Condensate drain

6 – Automatic air vent.

Strain on the gas valve and fittings may result in vibration, premature component failure and leakage and may result in a fire, explosion, property damage or serious injury. Do not use an open flame to test for gas leaks. Failure to follow these instructions may result in fire.

7.2 CONDENSATE DRAIN CONNECTION



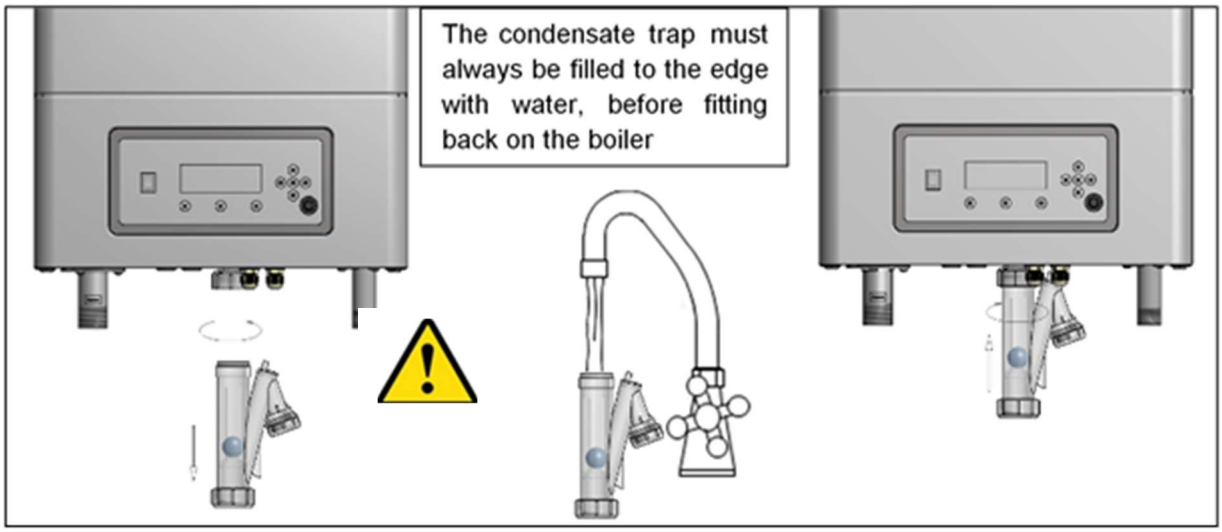
The condensate drain is placed at the centre and at the bottom of the boiler and has a 19 mm hose discharge. Connect this flexible hose to the sewer system.

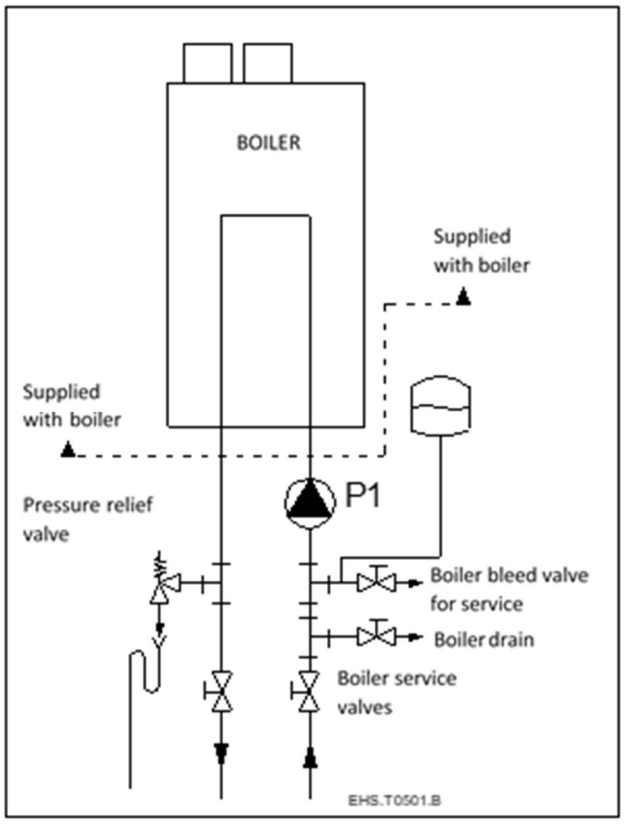
Use only plastic parts with the condensate drain. Metal lines are not allowed.

Blockage of this drain might damage the boiler. The drain connection is correct when the condensate can be seen flowing away, e.g. using a funnel. Any damage that might occur, when the drain is not installed correctly, is not covered by the warranty of the boiler.

There must be an open connection of the condensate hose into the sewage system. A possible vacuum in the sewage system must never give the opportunity to suck on the boiler's condensate drain hose.

When mounting the bottom part of the condensate trap, before commissioning the boiler and/or after maintenance, the condensate trap must ALWAYS be completely filled with water.
This is a safety measure: the water in the condensate trap keeps the flue gases from leaking out of the heat exchanger via the condensate drain.





7.3 FLOW AND RETURN CONNECTIONS

Use T-pieces for externally mounting the pressure relief valve and the boiler bleed valve for servicing the boiler. Isolation valves must also be fitted to allow disconnection if required

When using a system pump, this pump must always be mounted in the return pipe of the heating system.
Do not use chloride-based fluxes for soldering any pipes of the water system.

7.4 THE EXPANSION VESSEL

The capacity of the expansion vessel must be selected and based on the capacity of the central heating system and the static pressure. Suggested is to fit the expansion vessel in the return pipe of the central heating system. It can be combined with the drain valve for service. See the drawing.

7.5 REQUIREMENTS FOR BS6699

If isolation valves are fitted then in accordance with BS6699 a safety valve and small expansion vessel must be fitted to each boiler to protect the boiler must the isolation valves be closed whilst the boiler is still firing. A suitable kit of components is available from Lochinvar.

7.6 PRESSURE RELIEF VALVE

The boiler has no internal pressure relief valve. This must be installed close to the boiler in the flow pipe of the heating system. When having cascaded boilers, each boiler must have its own pressure relief valve.
It is recommended to install service valves, so the boiler can be isolated from the heating system, when needed. Make sure that the pressure relief valve is mounted between the boiler and the service valves.
The specifications and size of the relief valve must be determined by the installer and must comply with all applicable regulations and boiler capacity.

7.7 NON-RETURN VALVE.

All EFB boilers have a non-return valve installed in the gas-air mixing pipe just before the burner. Flue gas recirculation is prevented by the non-return valve. The prevention of recirculation also reduces standby losses through the flue of the boiler. This creates a higher thermal efficiency.

7.8 BYPASS

The boiler has no internal bypass. When thermostatic valves are being used, the system must have a bypass to allow an adequate flow when all thermostatic valves are closed. Instead of a bypass also a low-loss header can be used for this function.
The boiler flow will also be influenced when a pipe of the heating system is frozen / blocked. Make sure all heating pipes are free from the risk of frost. If there is the risk of freezing of the heating system, all the pipe section must be insulated and/or protected with the help of trace heating.

7.9 PUMP FUNCTIONALITY

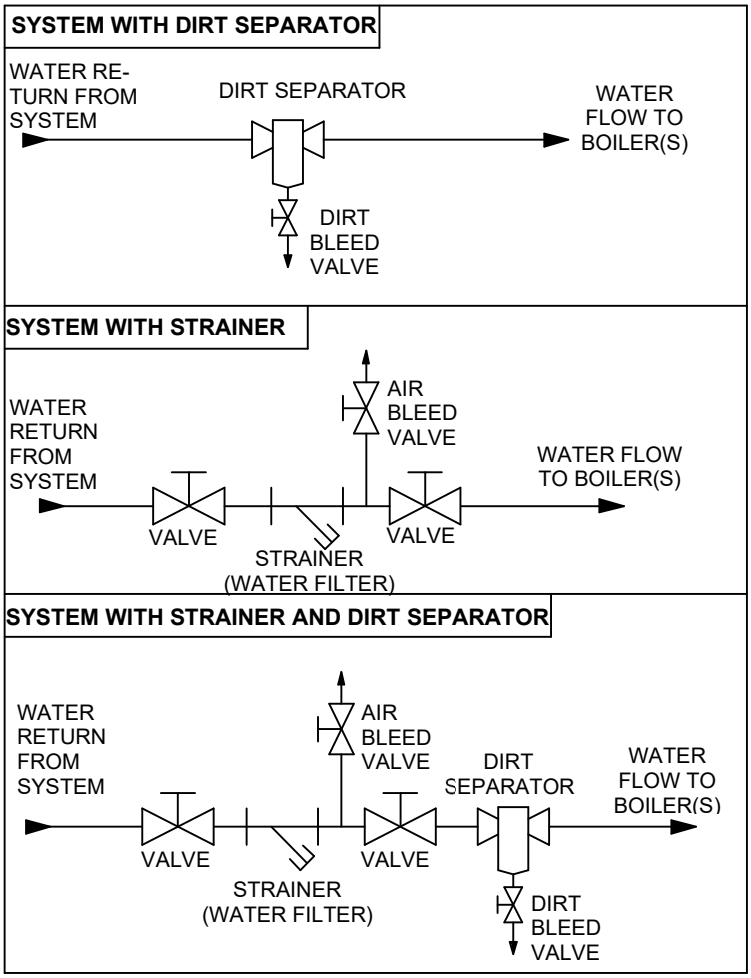
Delta T monitoring:
A high temperature difference between supply and return of the boiler can indicate a clogged heat exchanger or filter, or a defective pump. The burner load automatically decreases when the supply and return temperature differential increases too much. See 13 "Temperature protection".

7.10 FROST PROTECTION

The boiler has a built-in frost protection that is automatically activating the central heating pump when the boiler return (water) temperature drops below 10 °C (programmable). When the boiler return temperature drops below 5 °C (programmable), the burner is also ignited. The pump and/or burner will shut down as soon as the return temperature has reached 15 °C (programmable). The mentioned temperatures are related to the temperatures measured by the return sensor of the boiler. This frost protection function will not fire up the boiler in case of a “general blocking” of the burner demand.

This “Frost Protection” function only protects the boiler and not the whole heating system. Because it concerns a programmable setting, a boiler damaged by frost is not covered under warranty.

7.11 INSTALLING A STRAINER AND/OR DIRT SEPARATOR



Always install a strainer (water filter) and/or a dirt separator in the return pipe of the boiler; in such a way that the water going to the boiler is free of any debris/particles. When using a water filter always check a week after installation to determine the strainer cleaning interval. Advice is to mount valves before and after the strainer, including an air bleed valve, so the strainer can be isolated from the heating circuit for service operations. Clean water is very important, blocked and/or polluted heat exchangers, including failures and/or damages caused by this blockage are not covered by the warranty.

7.12 WATER QUALITY

Contaminant	Maximum allowable level	Units
pH	7.5 to 9.5	
Total hardness	5 to 15	°fH
	3.5 to 10.5	°e (Clark)
	2.8 to 8.4	°dH
Aluminium particles	< 0.2	mg/L
Chlorides	150	Ppm
TDS	350	Ppm

The pH value is reached with steady conditions. These steady conditions will occur, when after filling the heating system (pH around 7) with fresh water, the water will lose any air due to the air bleeding operation and heating up (dead water conditions).

If there is the risk of contamination of the water by any kind of debris/chemicals in the period after installing, a plate heat exchanger must be used to separate the boiler circuit from the heating circuit (see7.15.1).

Introduction of fresh water due to leaks must be minimised or eliminated altogether. Fresh oxygenated water might damage the heat exchanger of the boiler and must therefore be prevented. Usual spots where air is most likely to seep in are: suction gaskets, pumps, air valve working as a venting pipe, O-rings / gaskets in stuffing box, under floor heating pipes.
When a boiler is installed in a new system or an existing installation the system must be cleaned before the boiler is installed. The system is required to be cleaned using a system cleaner from the table at 7.13 or an equivalent hydronic system cleaner. Follow the instructions provided by the system cleaner manufacturer. The system must then be drained and thoroughly flushed with clean water to remove any residual cleaner.

The system cleaner must never be run through the boiler.

For recommended cleaners see 7.13

Do not use petroleum-based cleaning and sealing compounds in the boilers system as they could damage gaskets. When using antifreeze in the system always use an inhibited mono propylene glycol antifreeze approved for use in heating systems. Never use Ethylene glycol in a heating system as it is toxic and can damage gaskets.
A micro bubble air elimination device is required to be installed in all heating systems. An air scoop is not an acceptable substitute for a micro bubble air elimination device and may not be used in the installation. A few examples of acceptable devices are
* Spirovent
* Caleffi Discal
If an automatic feed valve is installed in the system, it may not be left open indefinitely. A continuous feed of fresh water could damage the system. It is recommended that after a short period of time following the installation of the boiler into a heating system that the automatic feed valve be closed.
If the boiler is used in a system with snow melt where antifreeze percentages are above the supplier's specified values, it must be isolated from the snow melt with a plate heat exchanger.

7.13 CHEMICAL WATER TREATMENT

The chemical compatibility of several products for treatment of the central heating equipment has been tested on the heat exchangers and the boilers. See below for the list with the corrosion inhibitors in preventative and curative treatment for gas fired central heating boilers. If water treatment is required when filling the system or preforming maintenance an inhibitor must be used. Follow the instructions provided by the inhibitor manufacturer when adding it to the system. The following is a list of approved inhibitors.

Corrosion-/ Scale inhibitors and recommended suppliers				
Manufacturer	**Fernox**	**Sentinel**	**Sotin**	**ADEY**
Inhibitors	Protector F1 / Alphi 11	X100, X500	Sotin 212	MC1+
Noise reducer		X200		
Universal cleaner	Restorer	X300		
Sludge remover	Protector F1, Cleaner F3	X400	Sotin 212	
Antifreeze	Alphi 11	X500		
Tightness		Leak Sealer F4		

Treatment type	Preventive	Curative
Protector F1	X	
Cleaner F3	X	X
X100	X	
X200	X	
X300		X
X400		X
X500	X	
Alphi 11	X	
Leaker Sealer F4	X	
Stin 212		X
MC1+	x	

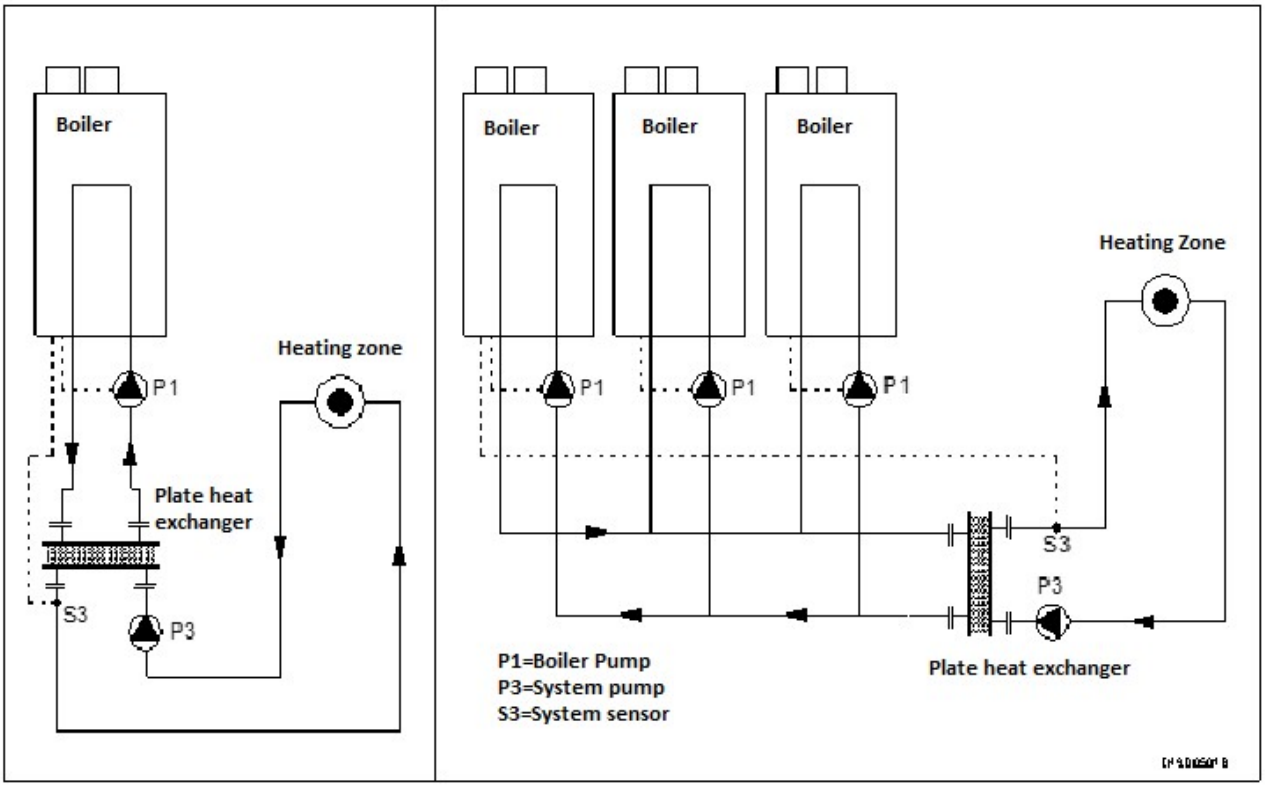
When using chemicals or any kind of additives: Follow the instructions provided by the manufacturer, read the suppliers manual for the maximum allowable level/mixing ratio that can be used with the boiler. Warranty will be void if these instructions are not followed exactly. Record the used products and mixing ratio in the log book, start-up-, check- and maintenance list.

7.14 FLUSH THE SYSTEM WITH FRESH WATER

The water of the boiler and heating circuit must be free of any particles, debris and pollution. Therefore, the complete installation must always be thoroughly flushed with clean water before installing and using the boiler(s).

7.15 PLASTIC PIPING IN THE HEATING SYSTEM

When plastic pipes with no oxygen barrier are used in the central heating system, these must be separated from the boiler system by using a plate heat exchanger. Diffusion (through the plastic) can cause air to enter the heating system. This could damage the boiler, pumps and other components in the system. Be aware that plastic piping is often used in under floor heating systems. When no measures have been taken to prevent the entrance of air into the boiler system, the warranty of the boiler and any boiler part may be deemed invalid.



7.15.1 BOILER FITTED WITH PLATE HEAT EXCHANGER SIMPLE SCHEMATIC SHOWING CONCEPT

7.16 DE-AIR SEQUENCE.

The De-Air sequence it is a safety function starting at every power ON and is used to remove the air from the heat-exchanger. The De-Air sequence also starts after a general reset (such as the locking error reset or 24 hours reset)
The display will show 'dAir' indicating that the controller is performing the De-Air sequence to purge the heat exchanger of air, by sequencing the pump OFF and ON. The user can cancel the De-Air sequence by pressing a specific key-button combination from the display. By default "De-Air" sequence takes around 14 minutes.

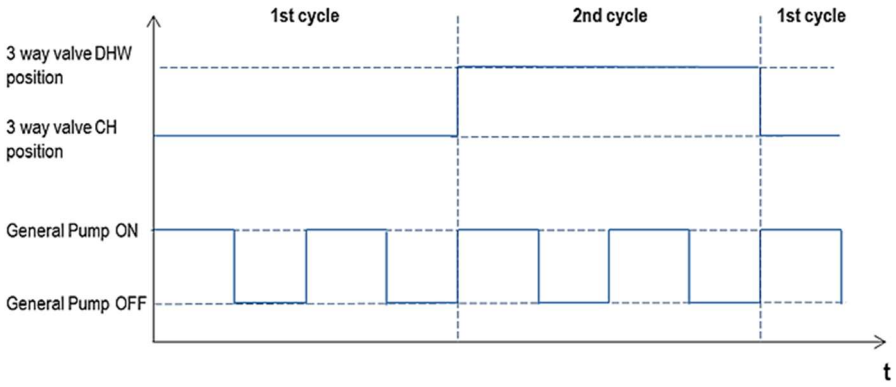
• 1st cycle:The 3 ways valve moves to CH position and the general pump is activated for 10 seconds, deactivated for 10 seconds, activated again for 10 seconds and then deactivated again for 10 seconds (DAir_Repeation_OnOff, which means ON/OFF/ON/OFF each time for 10 seconds = 40 seconds in total).

• 2nd cycle:it starts when 1st cycle is ended. The 3 ways valve is moved to DHW position and repeats the same cycling of the pump (DAir_Repeation_OnOff, which means ON/OFF/ON/OFF each time for 10 seconds = 40 second in total).

This sequence (1st cycles + 2nd cycles) is performed DAir_Number_Cycles times (if DAir_Number_Cycles is 3 'De-air' sequence lasts (3 x 40) x 2 = 240 seconds).

During De-Air sequence no demand will be served. When the water pressure is too low or pressure sensor is in error, the De-Air sequence will be suspended until water pressure / sensor pressure is stable again. In that case the De-Air sequence will last longer than the estimated minutes.

The following scheme below shows the behaviour of the 3-way valve and general pump during one whole cycle of De-Air sequence with a DAir_Repeation_OnOff set to 2.



7.16.1 RELEVANT VARIABLES:

Specific Parameters	Level	(Default)	Range
De-Air Config Configuration for the De-Air function	2: Installer	1	0: 24 hr pump 1: De-Air 2: Disabled
De-Air State	1: User	-	-
Current state of the De-Air function.			
De-Air Repetition Cnt On/Off repetition count for a De-Air cycle.	2: Installer	2	0…255
De-Air Cycles Number of De-Air cycles.	2: Installer	3	0…255

7.17 PRESSURE MAKE UP SYSTEMS

If an automatic feed valve is installed in the system, it may not be left open indefinitely. A continuous feed of fresh water could damage the system (fresh water is bringing fresh oxygen into the system). It is recommended that after a short period of time following the installation of the boiler into a heating system that the automatic feed valve be closed

When using an automatic water refill system some precautions must be taken (fresh water is bringing fresh oxygen into the system), like installing a water meter to measure and evaluate the total water volume that is added to the system. This is to detect and eliminate any water leakage as soon as possible.

When an automatic water refill system is used, some form of logging must take place to prevent continuously filling of the system with large amounts of oxygenated fresh water. This can happen when a leak in the system is not detected and the total added water amount is not being logged.

7.18 WATER PRESSURE

The installation must be designed and built to conform to all applicable regulations and standards, including the correct safety valves. IMPORTANT: Always keep the pressure in the boiler lower than the value at which its safety relief valve opens.

7.18.1 SENSOR

A water pressure sensor has been built into the boiler. With this sensor, the minimum water pressure in the boiler is 1.0 bar and the maximum pressure is 6.0 bar (sensor values). The normal water pressure is supposed to be between 1.5 and 2.0 bar.

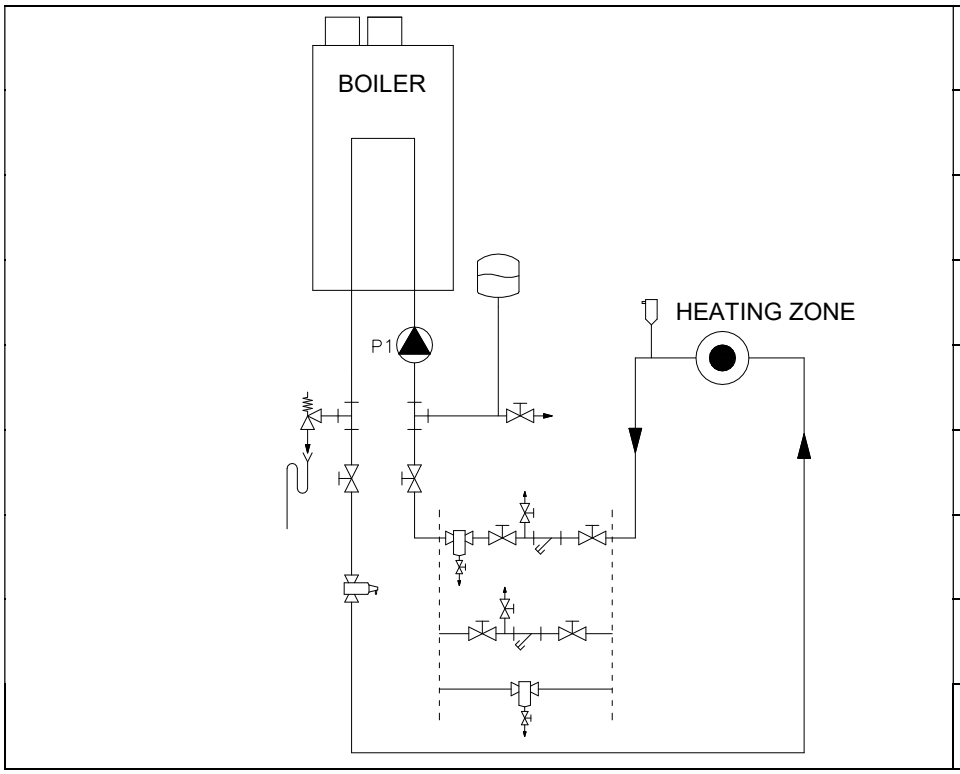
The pressure sensor will stop the boiler from firing when the water pressure drops below 0.7 bar, and start the boiler firing again when the water pressure reaches above 1.0 bar.

7.18.2 HIGHER PRESSURE SYSTEMS (E.G. IN HIGH BUILDINGS)

If pressures higher than 6.0 bar occurs in the heating system, the best solution is to separate the system from the boiler by means of a plate heat exchanger.

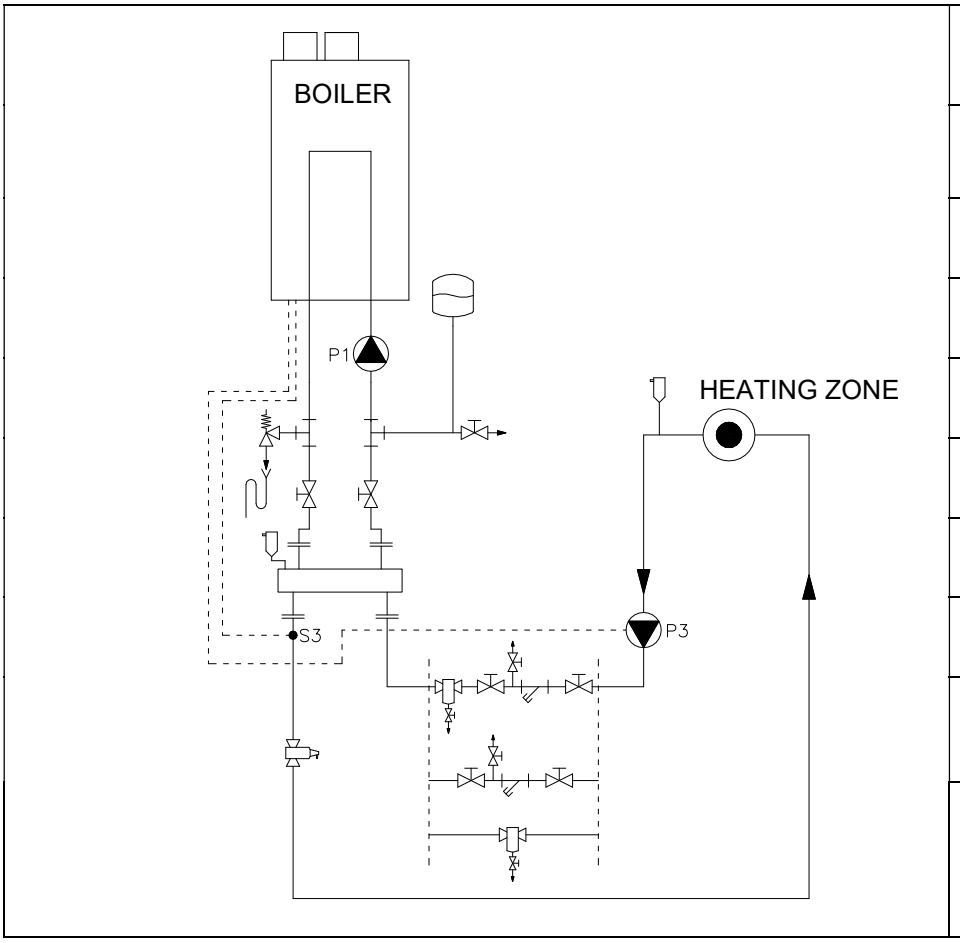
7.19 INSTALLATION EXAMPLES

7.19.1 EXAMPLE OF A LOW-RESISTANCE HEATING CIRCUIT



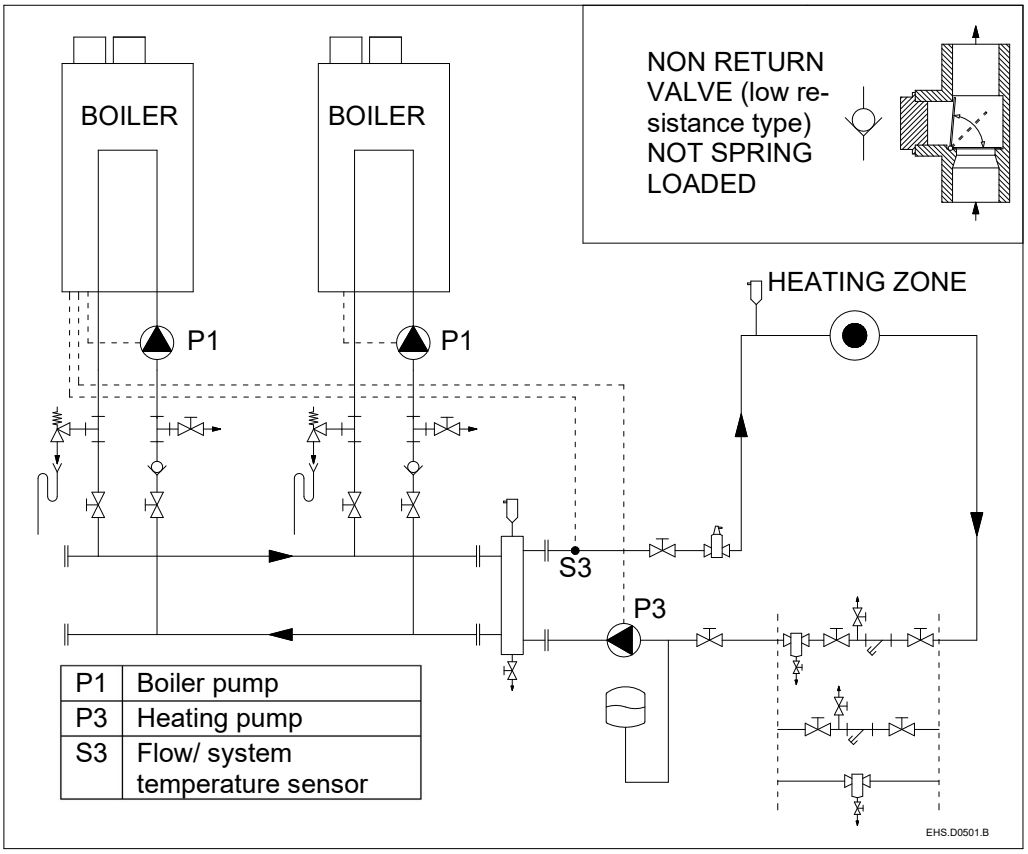
	valve
	air separator
	dirt separator
	strainer (water filter)
	pressure relief valve
	condensate trap
	pump
	automatic air vent
	expansion vessel

7.19.2 EXAMPLE OF A NORMAL SINGLE BOILER HEATING CIRCUIT WITH LOW LOSS HEADER (PREFERABLE)



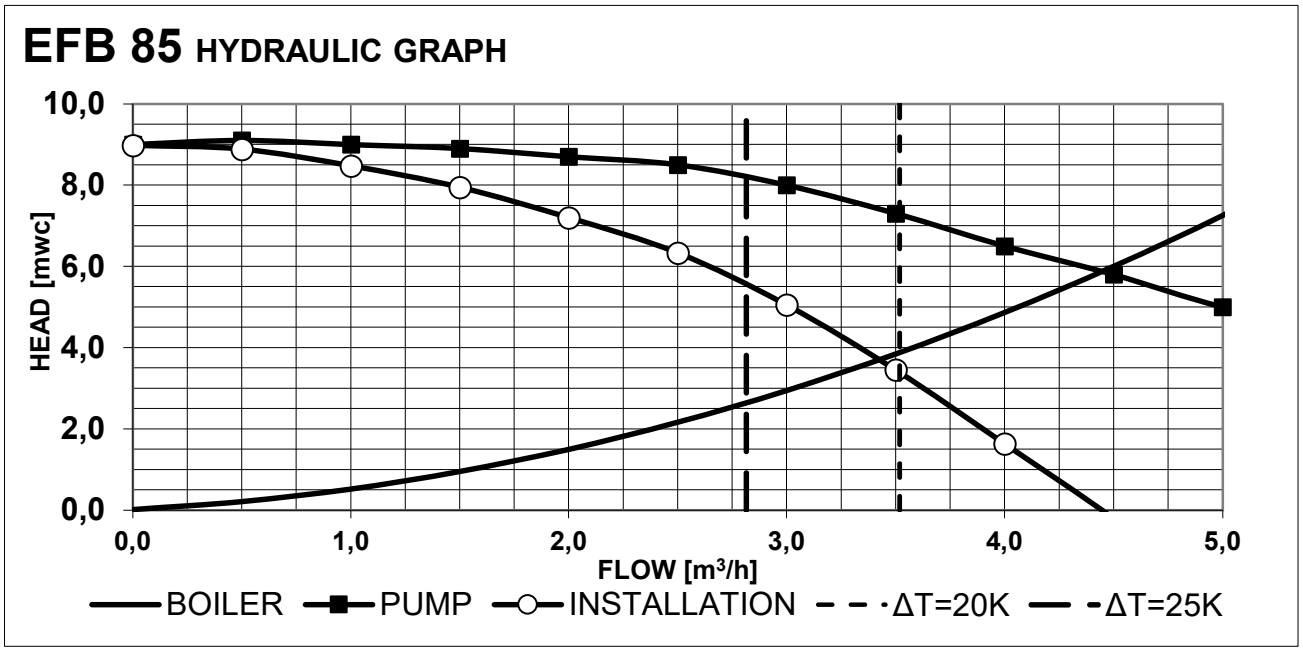
	valve
	air separator
	dirt separator
	strainer (water filter)
	pressure relief valve
	condensate trap
	pump
	automatic air vent
	expansion vessel
	low loss header

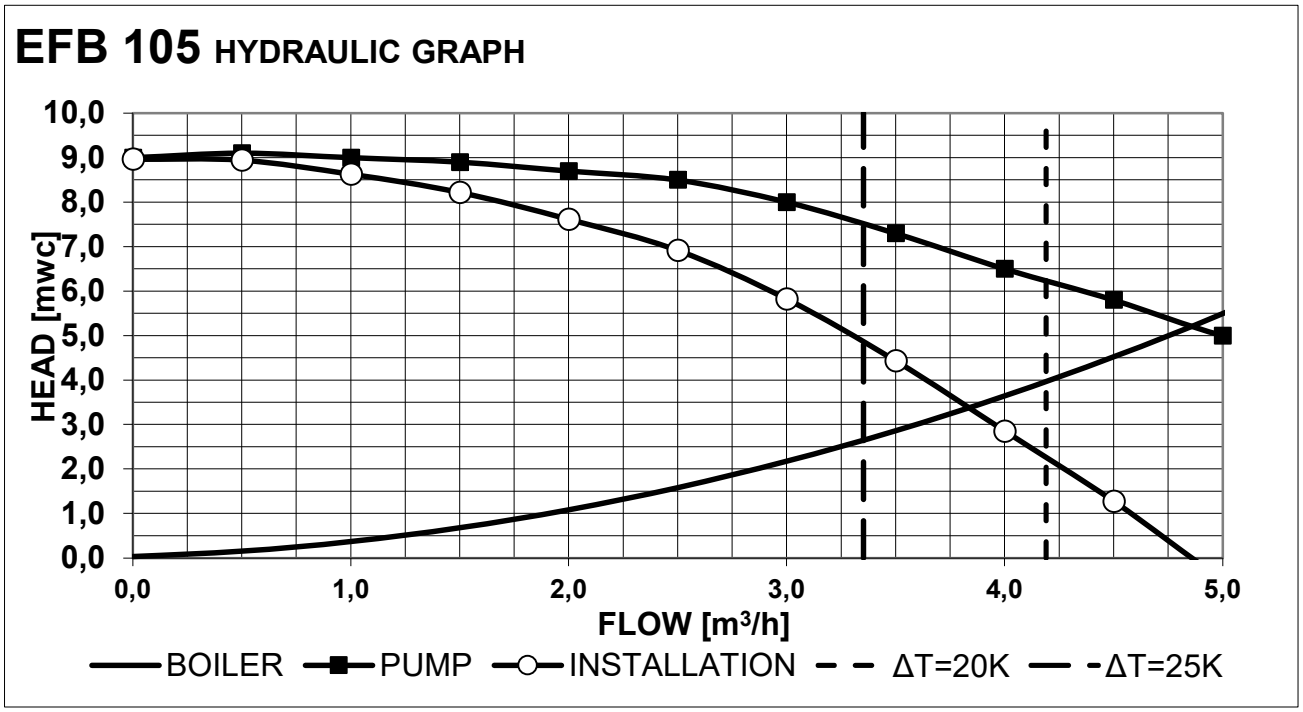
7.19.3 EXAMPLE OF A MULTIPLE BOILER HEATING CIRCUIT WITH LOW LOSS HEADER



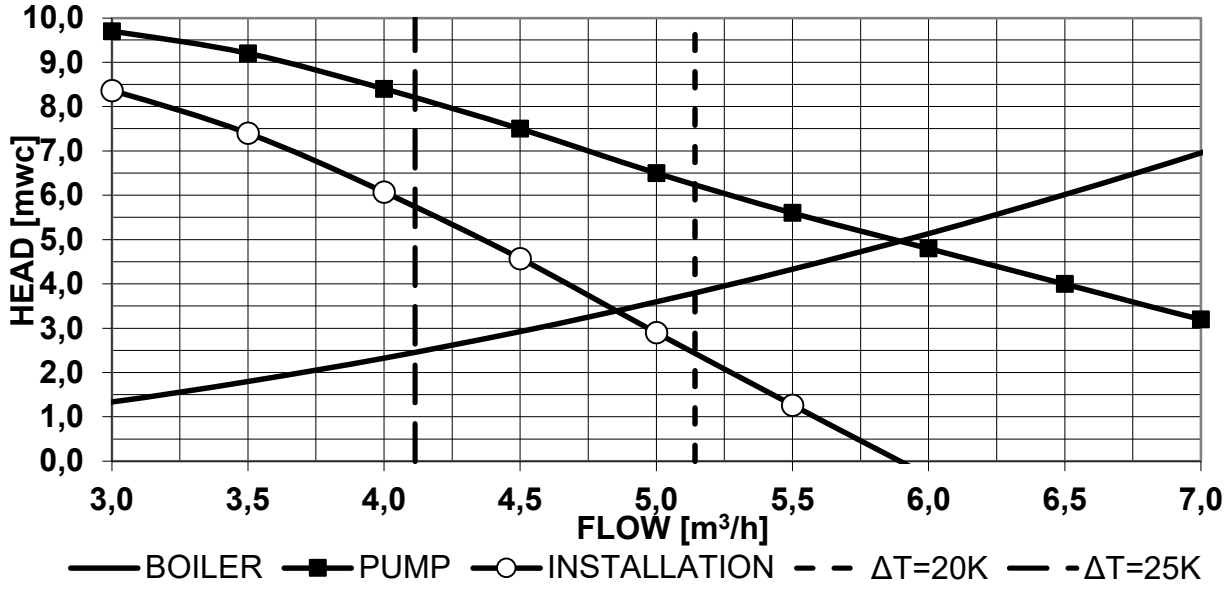
8 PUMP CHARACTERISTICS

8.1 HYDRAULIC GRAPHS

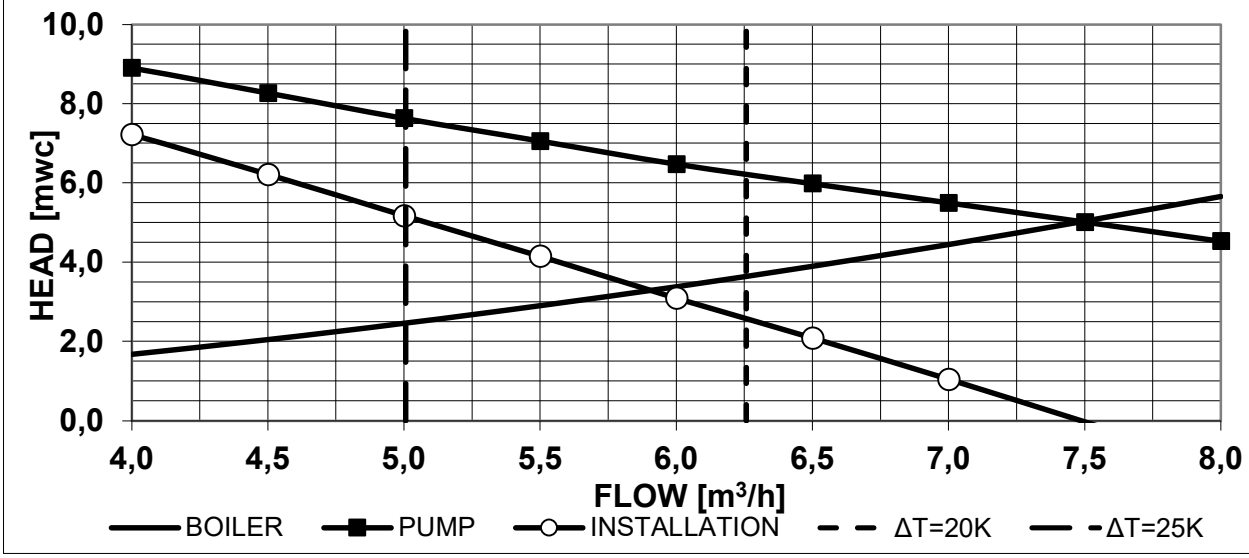




EFB 125 HYDRAULIC GRAPH



EFB 155 HYDRAULIC GRAPH



8.2 MODULATING PUMP FOR CH DEMAND

The controller supports PWM modulation for the general pump.
The boiler pump is modulated when there is a demand for CH.
During any other demand, the PWM pump will run at a fixed speed set by the Default Duty cycle parameter. How the pump is modulated is controlled with the Modulating_Pump_Mode setting.

8.3 MODULATING PUMP MODES

There are several modulating pump modes implemented in the software. By selecting a different modulating pump mode, the pump behaviour can be changed. The following modulating pump modes are available.

	Modulating pump mode	Details
0:	Disabled	No pump modulation; the PWM duty cycle is always 0%.
1:	Delta temperature modulation	Calculated duty cycle to create a delta temperature between the T_Supply and T_Return sensor.
2:	Fixed 20% speed	Fixed duty cycle of 20%.
3:	Fixed 30% speed	Fixed duty cycle of 30%.
4:	Fixed 40% speed	Fixed duty cycle of 40%.
5:	Fixed 50% speed	Fixed duty cycle of 50%.
6:	Fixed 60% speed	Fixed duty cycle of 60%.
7:	Fixed 70% speed	Fixed duty cycle of 70%.
8:	Fixed 80% speed	Fixed duty cycle of 80%.
9:	Fixed 90% speed	Fixed duty cycle of 90%.
10:	Fixed 100% speed	Fixed duty cycle of 100%.

8.3.1 DELTA TEMPERATURE MODULATION

When the modulating pump mode 1 Delta temperature modulation is selected the pump modulates to create a delta of T_Delta between the T_Supply and T_Return sensors. This modulation is only done when the boiler is burning.
When the burner starts the duty cycle is kept at the Default Duty cycle setting for the time set by Burn Stabilize Time. After this time, the PID calculated duty cycle is used.

During modulation, the duty cycle output changed according to the following logic:
• Actual delta temperature is greater than the selected T_Delta
• The pump speed increases so there is less time to cool down the heated water. This results in the T_Return temperature increasing.
• Actual delta temperature is smaller than the selected T_Delta
• The pump speed decreases so there is more time to cool down the heated water. This results in the T_Return temperature decreasing.

8.4 PUMP: MAXIMUM ELECTRICAL POWER

General
- The inrush current of a conventional pump is approximately 2½ x its nominal current.
- The maximum allowed switch current of the burner controller is 4 A.
- The total current of burner controller and gas valve is approx. 0.5 A, so the total current of additional pumps and valves should not exceed 3.5 A. Use separate relays if higher currents are needed.

Pump P1 - boiler pump.
This pump is NOT part of the appliance. The maximum nominal current for it is 2 A, so its maximum electrical power is 230 VAC x 2 A = 460 W.

Pump P2 - calorifier pump.
Pump P2 is a DHW pump, meaning it's not part of the appliance, is also used for heating of an indirect calorifier.
The maximum nominal current of pump P2 must also be < 2 A.

3-way valve.
The combined nominal current of pump P1 and the 3-way valve must be smaller than 2 A.

Pump P3 - system pump.
The nominal current of pump P3 and the other connected pumps must be equal to or lower than 2 A.

Warning (EC pumps):
In case of using an electronic commutating pump with a higher inrush current than 8 A, the boiler controller should not be used for the power connection, because of the inrush current of the electronics of the pump. Directly connect the pump to an external power supply.

WARNING: Use an external relay if pump current exceeds 2A.

9 FLUE GAS AND AIR SUPPLY SYSTEM

9.1 GENERAL

The boiler has a positive pressure flue system. The available combined pressure drop for the inlet and outlet system **is 200 Pa for the complete boiler range.**
The EFB boiler is an appliance with sealed combustion requiring certain venting systems. All combustion air is drawn from outdoors or indoor. All products of combustion are vented directly outdoors. The exhaust and if applicable air-Intake piping, must be piped to the outdoors. The internal safety system shuts down the boiler in case the flue gas temperature becomes too high, after which the appliance will not run until re-started. Installations must comply with local requirements.
When considering the flue route and termination point please take the following points into account:

If the total combined net input of the installation is > 333kW then approval of the height and position of any termination must be obtained from the local authority BEFORE installation to satisfy the requirements of the clean air act.

Under no circumstances may this appliance exhaust gases into a masonry chimney.

Install the horizontal flue components with an angle of 3° back in the direction of the boiler (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 must be taken into account during the design phase of the heating installation.

EFB Boilers 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 EFB boiler 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.

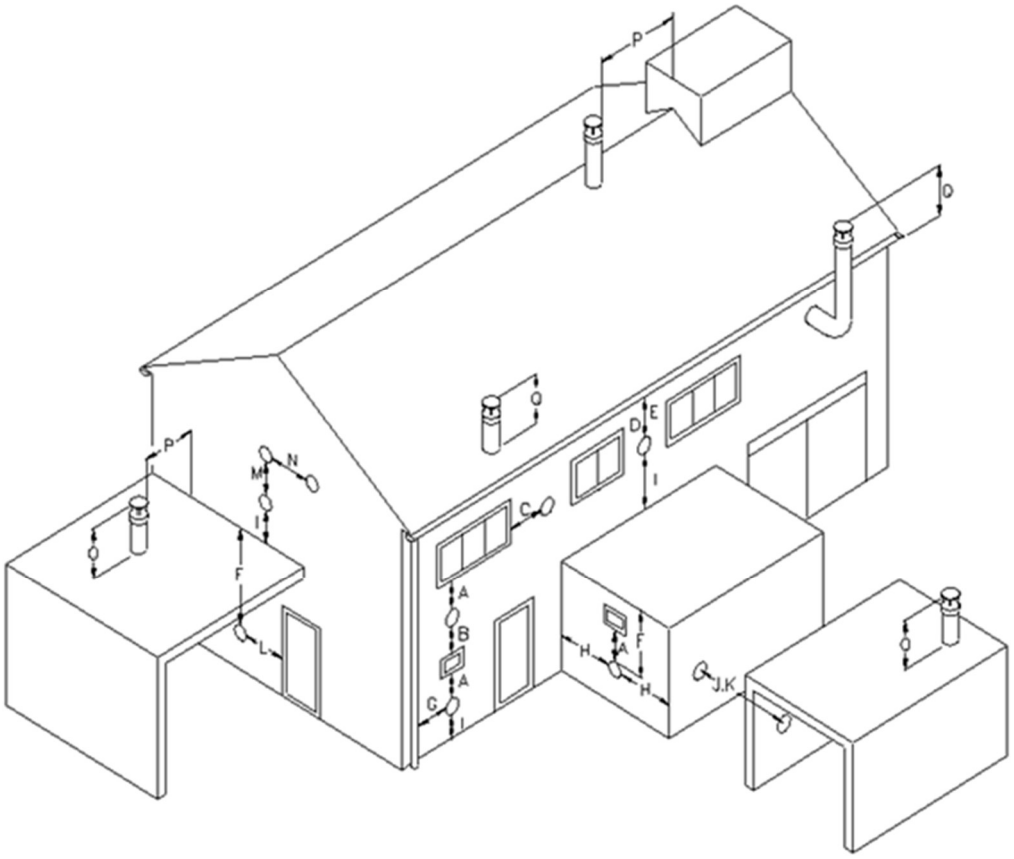
Before installation of any flue system read the installation manual carefully for both the appliance and flue system to be used. Information on the flue system Supplied by Lochinvar can be found within this manual.

9.2 FLUE SYSTEM TECHNICAL DETAILS

Model Number		EFB85	EFB105	EFB125	EFB155
FLUE DATA TYPE B_{23}					
Nominal flue diameter	mm	100			150
Maximum flue gas temp	°C	90			
Flue gas temperature	°C	60-90			
Flue draught requirements	mbar	-0.03 to -0.1			
Available pressure for the flue system	Pa	200			
Maximum flue gas volume	g/s	28.9	38.6	71.7	86.2
FLUE DATA TYPE C_{13} & C_{33}					
Nominal flue diameter	mm	100/150			N/A
Flue gas temperature	°C	60-90			
FLUE DATA TYPE C_{43} & C_{53}					
Nominal flue diameter	mm	100			150
Flue gas temperature	°C	60-90			

9.3 FLUE TERMINAL LOCATION

Flue terminal positions must comply with the requirements of the latest edition of IGEM/UP/10, including a risk assessment as laid out in Appendix 9 of the document if the total nett input is less than 333 kW, or the requirements of the Clean Air Act if the total net input is above 333 kW.



9.3.1 FLUE TERMINAL POSITIONS

Use in conjunction with table 9.3.2

Location	Description		EFB85	EFB105	EFB125	EFB155
A	Directly below an opening, air brick, opening windows etc.#	mm	2500	2500	2500	2500
B	Above an opening, air brick, opening windows etc.	mm	685	797	957	1145
C	Horizontally to an opening, air brick, opening windows etc.#	mm	685	797	957	1145
D	Below a gutter or sanitary pipework	mm	200	200	200	200
E	Below the eaves	mm	200	200	200	200
F	Below a balcony or car port roof	mm	Not recommended see UP10 risk assessment			
G	From a vertical drain or soil pipe	mm	150	150	150	150
H	From an internal or external corner	mm	1271	1631	2142	2741
I	Above ground, roof or balcony level	mm	300	300	300	300
J	From a surface facing the terminal	mm	1271	1632	2143	2742
K	From a terminal facing the terminal	mm	2226	2527	2954	3455
L	From an opening in the car port (e.g. door, window) into the dwelling	mm	Not recommended see UP10 risk assessment			
M	Vertically from a terminal on the same wall	mm	2500	2500	2500	2500
N	Horizontally from a terminal on the same wall*	mm	600	600	900	900
P	From a vertical structure on the roof	mm	1500	1500	1500	1500
Q	Above intersection with the roof	mm	331	373	432	501

Table 9.3.2

9.3.2 FLUE TERMINAL MINIMUM DISTANCES

*Figures shown are to guarantee problem free operation in most circumstances, these figures could be reduced in certain circumstances contact Lochinvar Technical support for help and advice
see UP10 figure 7 for full clarification

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.

In general, boilers are certified with their own flue gas material. The boiler must be provided with high efficiency PP flue gas components available from the M&G group. The parts have to be rated for a overpressure class P1 or H1 and a temperature class of T120 minimum

For flue gas type B23, C13, C33, C43 systems, use only flue gas and air supply parts of the approved supplier M&G group (Muelink & Grol) and only the parts mentioned in the DoP (declaration of performance): "No 001-MG-PP DoP" and No 001-MG-RVS DoP". (With exception of O4 and O5) The concerning DoP's can be found at the website of Muelink & Grol https://www.mg-flues.com/certifications

The following Manuals for parts supplied by Muelink & Grol are applicable:
- Regulations regarding flue gas systems PP(s)
- Installation instructions clamps: Checklist
- Installation instructions Skyline 3000
- Installation instruction Multiline PP (Cascade)

9.4 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 boiler 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 boiler, long external runs must be avoided to prevent the condensate freezing within the flue system.
- During assembly of the flue system, precaution must 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 must be used.

Multiple boilers can be connected to a common flue. See EFB flue guide and seek assistance from Lochinvar Technical support before installing on common flue systems.

Read the manual provided by the vent gas and air system supplier carefully

9.5 POLYPROPYLENE

This product has been approved for use with polypropylene vent with the manufacturers listed.
All terminations must comply with listed options in this manual and be a single-wall vent offering.
For support and special connections required, see the manufacturer's instructions.
All vent is to conform to standard diameter and equivalent length requirements established.

9.5.1 FLEXIBLE POLYPROPYLENE

When using flexible PP Chimney liners, it is recommended to have the vent material at 0 °C (32°F) or higher ambient space before bending at installation. No bends must be made to greater than 45° and ONLY installed in vertical or near vertical installations.

9.6 AIR SUPPLY

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)
EFB85	90.7	81.7	163	327	245	409	327	490	409	817	490	899	572	980
EFB105	108.1	97.3	195	389	292	487	389	584	487	973	584	1070	681	1168
EFB125	132.6	119.4	239	478	358	597	478	716	597	1194	716	1313	836	1433
EFB155	161.4	145.3	291	581	436	727	581	872	727	1453	872	1598	1017	1744

9.6.1 FREE AIR REQUIREMENTS IN A PLANT ROOM OR ENCLOSURE

9.6.2 COMBUSTION AIR QUALITY

Combustion air must be free of contaminants. For example: chlorine, ammonia and/or alkali agents, dust, sand and pollen. Note that installing a boiler near a swimming pool, a washing machine, laundry or chemical plants will expose combustion air to these contaminants.

9.6.3 AIR SUPPLY THROUGH HUMID AREAS

When the supply duct will be placed in a boiler room with moist air (for example: greenhouses), a double walled supply duct or an insulated duct must be used to prevent the possible condensation at the outside of the duct. It is not possible to insulate the internal air pipes of the boiler and therefore condensation at the internal air canals must be prevented. When roof mounted, the air supply duct needs to be protected against rain, so no water will enter the boiler.

9.6.4 AIR INLET PIPE MATERIALS

The air inlet pipe(s) must be sealed. Choose acceptable combustion air inlet pipe materials from the following list:
- PVC or PP
- Flexible propylene air intake
- Galvanized steel vent pipe with joints and seams sealed as specified in this section.

9.6.5 AIR FROM THE PLANT ROOM

Commercial applications utilising the boiler may be installed with a single pipe carrying the flue products to the outside while using combustion air from the equipment room. In order to use this option, the following conditions and considerations must be followed.
• The unit MUST be installed in a positive or neutral pressure room.
• The equipment room MUST be provided with properly sized openings to assure adequate combustion air. These vents must be open and may not be closed or blocked. Requirements in accordance with national and local standards, e.g. NEN 3028 and BS 6644.
• There will be a noticeable increase in the noise level during normal operation from the inlet air opening.
• Vent system and terminations must comply with the standard venting instructions in this manual.

The installation room MUST have sufficient air supply vents. These vents must be open and may not be closed or blocked. The air vents must be sized according to 9.6.1

9.6.6 AIR CONTAMINATION

Pool and laundry products and common household and hobby products often contain fluorine or chlorine compounds. When these chemicals pass through the boiler, they can form strong acids. The acid can eat through the boiler wall, causing serious damage and presenting a possible threat of flue gas spillage or boiler water leakage into the building.
Please read the information given in the list below, with contaminants and areas likely to contain them. If contaminating chemicals will be present near the location of the boiler combustion air inlet, have your installer pipe the boiler combustion air and vent to another location, per this manual.

The boiler may never be located in a laundry room or pool facility, for example, these areas will always contain hazardous contaminants. To prevent the potential of severe personal injury or death, check for areas and products in the list below with contaminants before installing the boiler or air inlet piping.
If contaminants are found, you MUST remove contaminants permanently or relocate air inlet and vent terminations to other areas.

9.6.7 CORROSIVE CONTAMINANTS AND SOURCES

Products to avoid:	Spray cans containing chloro/fluorocarbons
	Permanent wave solutions
	Chlorinated waxes/cleaners
	Chlorine-based swimming pool chemicals
	Calcium chloride used for thawing
	Sodium chloride used for water softening
	Refrigerant leaks
	Paint or varnish removers
	Hydrochloric acid/muriatic acid
	Cements and glues
	Antistatic fabric softeners used in clothes dryers
	Chlorine-type bleaches, detergents, and cleaning solvents found in household laundry rooms
	Adhesives used to fasten building products and other similar products

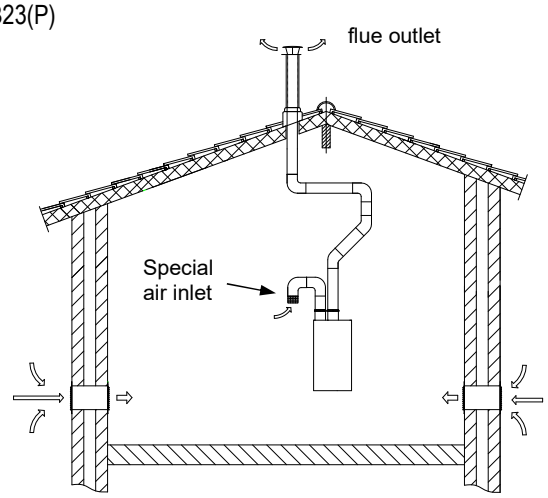
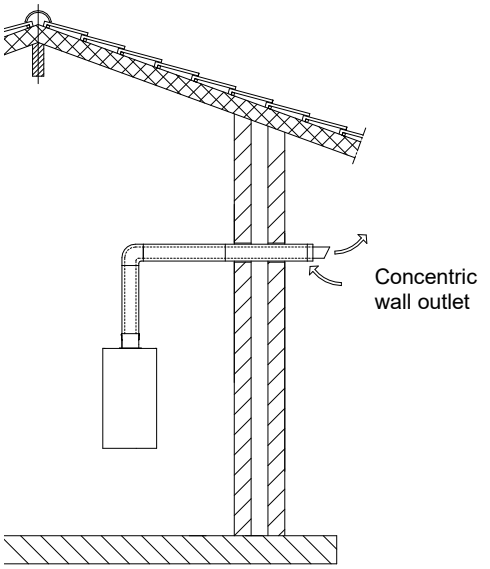
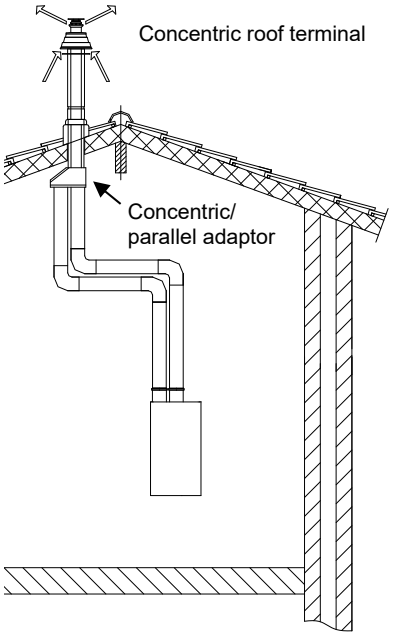
Areas likely to have contaminants:	Dry cleaning/laundry areas and establishments
	Swimming pools
	Metal fabrication plants
	Beauty shops
	Refrigeration repair shops
	Photo processing plants
	Auto body shops
	Plastic manufacturing plants
	Furniture refinishing areas and establishments
	New building construction
	Remodelling areas
	Garages with workshops.

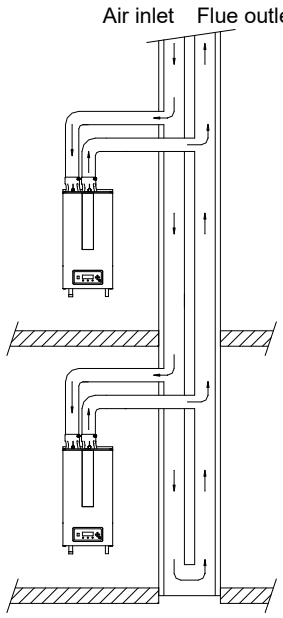
Vent connectors serving appliances vented by natural draft shall not be connected into any mechanical draft systems operating under positive pressure.

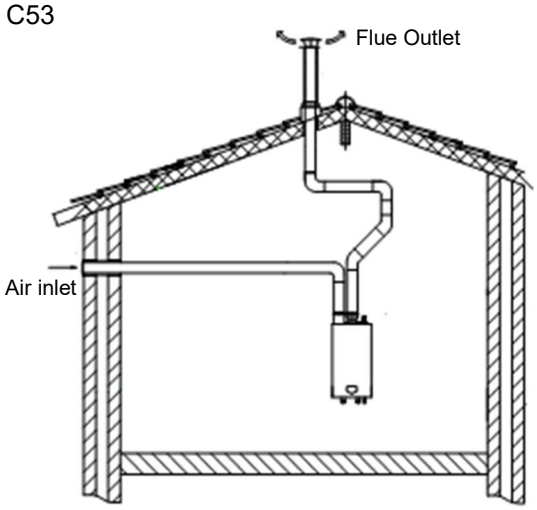
The vent for this appliance shall not terminate:

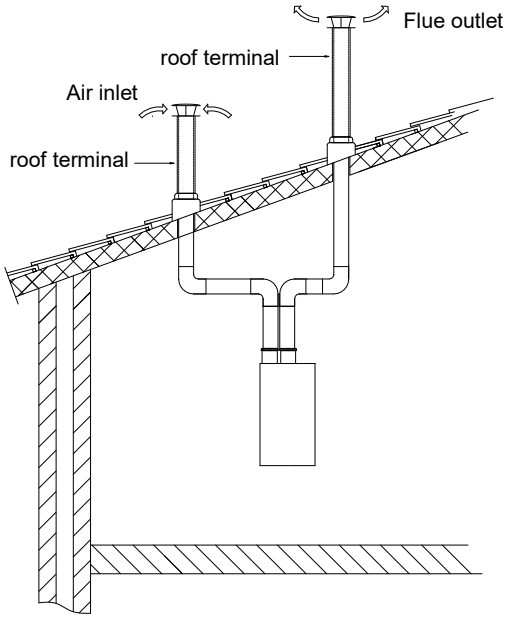
1. over public walkways;
2. near soffit vents or crawl space vents or other areas where condensate or vapor could create a nuisance or hazard or cause property damage;
3. where condensate vaper could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.

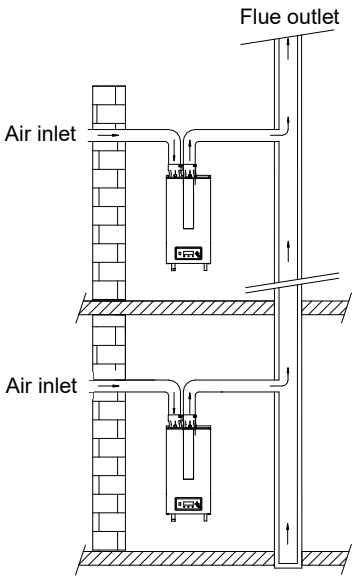
9.7 BOILER CATEGORIES - TYPES OF FLUE GAS SYSTEMS

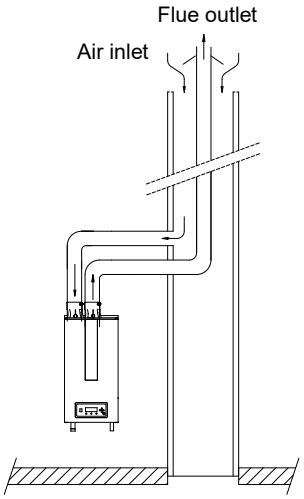
Type according EN 15502-2-1: 2012	Performance	Description
B23(P) 	Open Air supply from room	* Roof terminal * Without draught diverter * Boiler room air supply. * P = overpressure systems See: Typical examples - example C **Be aware:** The installation room has to have sufficient air supply vents. These vents must be open and may not be closed or blocked. Requirements at NEN 3028 paragraph 6.5 Note: Special air inlet needed for IPX4D protection class (accessory, see § 5.1).
C13 	Closed Air supply from outside	* Wall outlet. * Air supply inlet and flue gas outlet at the same air pressure zone. (a combined wall outlet e.g.). See: Typical examples - example E **Not Applicable for use with EFB155**
C33 	Closed Air supply from outside	* Flue terminal at the roof. * Air supply inlet and flue gas outlet located at the same air pressure zone (a combined roof terminal e.g.). See: Typical examples - example B

<table>
<tr>
<td>C43
 

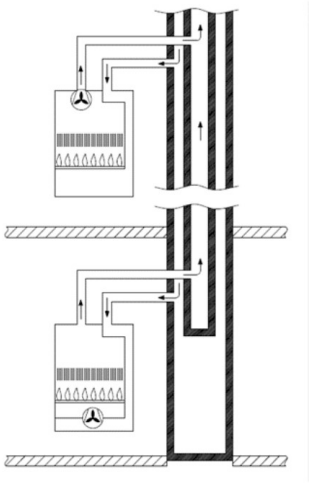
EHS.D0500.5010.400</td>
<td>Closed
Air supply from outside</td>
<td>Type C43. A type C4 appliance incorporating a fan upstream of the combustion chamber/heat exchanger.</td>
</tr>
<tr>
<td>C53
 
</td>
<td>Closed
Air supply from outside</td>
<td>*Separate air supply duct
*Separate flue gas discharge duct.
* Air supply inlet and flue gas outlet at different air pressure zones. But not at opposite walls.

See: Typical examples - example F</td>
</tr>
<tr>
<td>C63 - example
 
</td>
<td>Closed
Air supply from outside</td>
<td>* Appliance sold without flue/air-inlet ducts
* The flue gas parts are not part of the boiler. The boiler is intended to be connected to a separately approved and marketed system for the supply of combustion air and discharge of combustion products.
Condensate is allowed to go to the boiler.
* Air supply inlet and flue gas outlet not at opposite walls
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
<tr><td>max. allowed draft</td><td>70 Pa</td></tr>
<tr><td>max. pressure drop inlet-outlet</td><td>200 Pa</td></tr>
<tr><td>max $T_{air\ supply}$</td><td>40 °C</td></tr>
<tr><td>max recirculation</td><td>10 %</td></tr>
</table>
1) technical specifications datasheet
See: Typical examples - example A</td>
</tr>
</table>

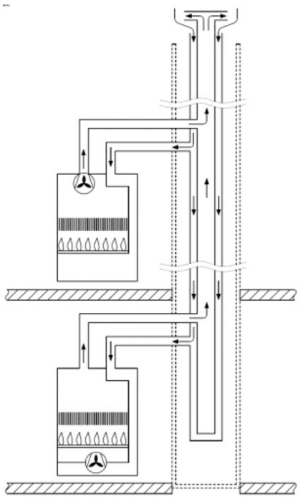
<table>
<tr>
<td>C83
 

EHS.D0500.5010</td>
<td>Closed
Air supply from outside</td>
<td>* Separate air supply duct from external wall.
* Flue gas discharge through individual or shared flue ducting built into the building.
* Air supply inlet and flue gas outlet at different air pressure zones.
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1 1)</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1 1)</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1 1)</td></tr>
</table>
1) technical specifications datasheet
* Flue ducting: Material: PP or SS
CE approved</td>
</tr>
<tr>
<td>C93
 
</td>
<td>Closed
Air supply from outside</td>
<td>Type C93 . A type C9 appliance incorporating a fan upstream of the combustion chamber/ heat exchanger.

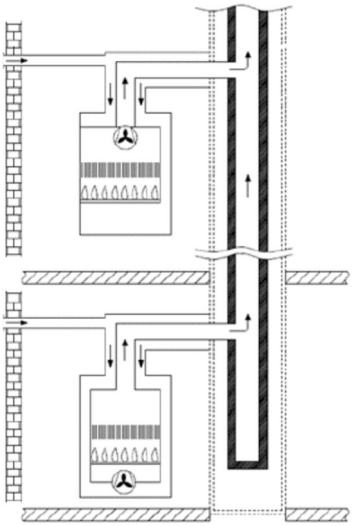
Minimum required diameter/ cross section area, for both air supply as flue discharge.
<table>
<tr><th>boiler</th><th>diameter</th><th>area</th></tr>
<tr><td>EFB 85, 105, 125</td><td>100 mm</td><td>7854 mm^2</td></tr>
<tr><td>EFB 155</td><td>150 mm</td><td>17671 mm^2</td></tr>
</table></td>
</tr>
</table>

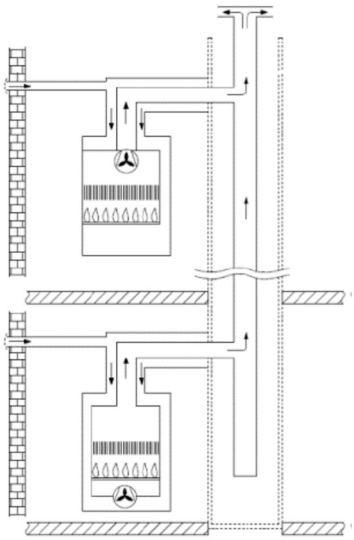
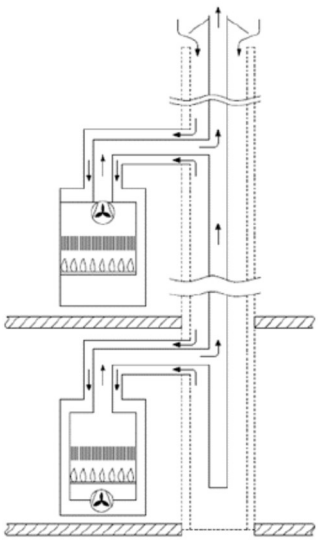
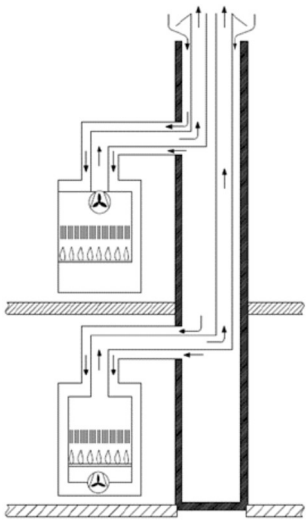
<table>
<tr>
<td>C10(3)
  </td>
<td>Closed or open
Air supply from out-side or room</td>
<td>Over pressure common flue system:
* Flue gas discharge through individual or shared flue ducting built into the building.
* Air supply inlet and flue gas outlet
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
</table>
1) technical specifications datasheet

* Flue ducting: Material: PP or SS, CE approved
* max. collector flue pressure 25pa

WARNING:
If other than M&G flue gas materials are used, please contact your boiler supplier.</td>
</tr>
<tr>
<td>C11(3)
  </td>
<td>Closed or open
Air supply from out-side or room</td>
<td>Over pressure common flue system:
* Flue gas discharge through individual or shared flue ducting built into the building.
* Air supply inlet and flue gas outlet
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
</table>
1) technical specifications datasheet

* Flue ducting: Only M&G multi PP and SS according to the C11 flue gas manual.
* max. collector flue pressure 85pa

Check the C11 Common Flue gas manual to calculate the flue gas system.</td>
</tr>
<tr>
<td>C(12)3
  </td>
<td>Closed
Air supply from out-side</td>
<td>Over pressure common flue system:
* Flue gas discharge through individual or shared flue ducting built into the building.
* Air supply inlet and flue gas outlet
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
</table>
1) technical specifications datasheet
* Flue ducting: Material: PP or SS, CE approved
* max. collector flue pressure 25pa</td>
</tr>
</table>

<table>
<tr>
<td>C(13)3
  </td>
<td>Closed
Air supply from out-side</td>
<td>Over pressure common flue system:
* Flue gas discharge through individual or shared flue ducting built into the building.
* Air supply inlet and flue gas outlet
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
</table>
1) technical specifications datasheet
* Flue ducting: Only M&G multi PP and SS according to the C11 flue gas manual.
* max. collector flue pressure 85pa</td>
</tr>
<tr>
<td>C(14)3
  </td>
<td>Closed
Air supply from out-side</td>
<td>Over pressure common flue system:
* Flue gas discharge through individual or shared flue ducting built into the building.
* Air supply inlet and flue gas outlet
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
</table>
1) technical specifications datasheet
* Flue ducting: Only M&G multi PP and SS according to the flue gas manual.
* max. collector flue pressure 85pa</td>
</tr>
<tr>
<td>C(15)3
  </td>
<td>Closed
Air supply from out-side</td>
<td>Over pressure common flue system:
* Flue gas discharge through individual ducting built into the building.
* Air supply inlet and flue gas outlet
* Condensate is not allowed to go to the boiler.
* Technical data:
<table>
<tr><td>nominal $T_{flue\ gas}$</td><td>85 °C</td></tr>
<tr><td>nominal $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>maximum $T_{fluegas}$</td><td>90 °C</td></tr>
<tr><td>min. load $T_{fluegas}$</td><td>35 °C</td></tr>
<tr><td>min. load $Q_{fluegas}$</td><td>see 3.2.1[1)]</td></tr>
<tr><td>nominal % CO_2</td><td>see 3.2.1[1)]</td></tr>
</table>
1) technical specifications datasheet
* Flue ducting: Only M&G multi PP and SS according to the C11 flue gas manual.</td>
</tr>
</table>

9.8 C_{13}, C_{33} CONCENTRIC FLUE SYSTEMS

Model	Description	Flue Assembly Item number
EFB85	Horizontal Concentric flue kit 100/150mm	CPMH003
EFB105	Horizontal Concentric flue kit 100/150mm	CPMH003
EFB125	Horizontal Concentric flue kit 100/150mm	CPMH003
EFB155	Not available	

9.8.1 C_{13} HORIZONTAL CONCENTRIC FLUE ASSEMBLIES

9.8.2 HORIZONTAL TERMINAL INSTALLATION

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

1. Determine the location of the flue terminal, taking into account minimum distances as detailed in **Section** 9.3 IGEM/UP/10 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 must 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.

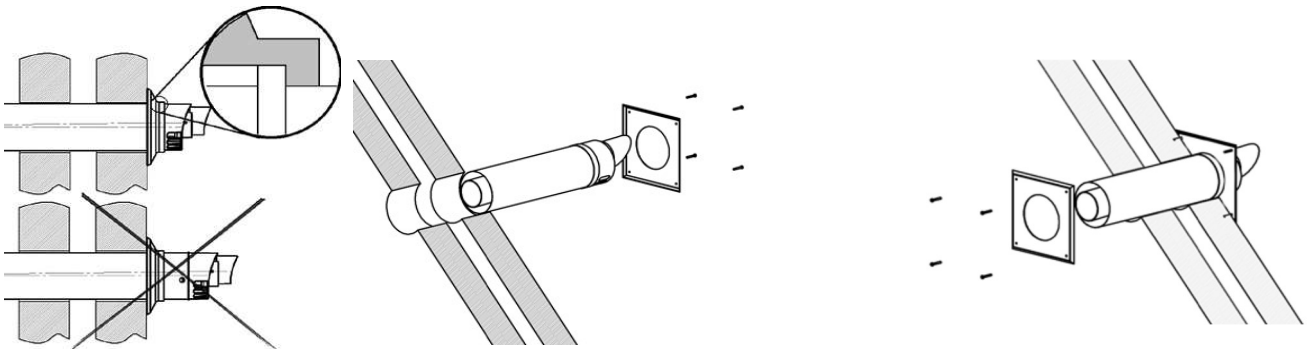
NOTE: When determining the required length for the flue terminal, the outer wall plate or rosette must be flush to the wall. See drawing below

NOTE: Once cut; remove all burrs and sharp edges

4. Insert the terminal into the drilled hole. The terminal section must 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

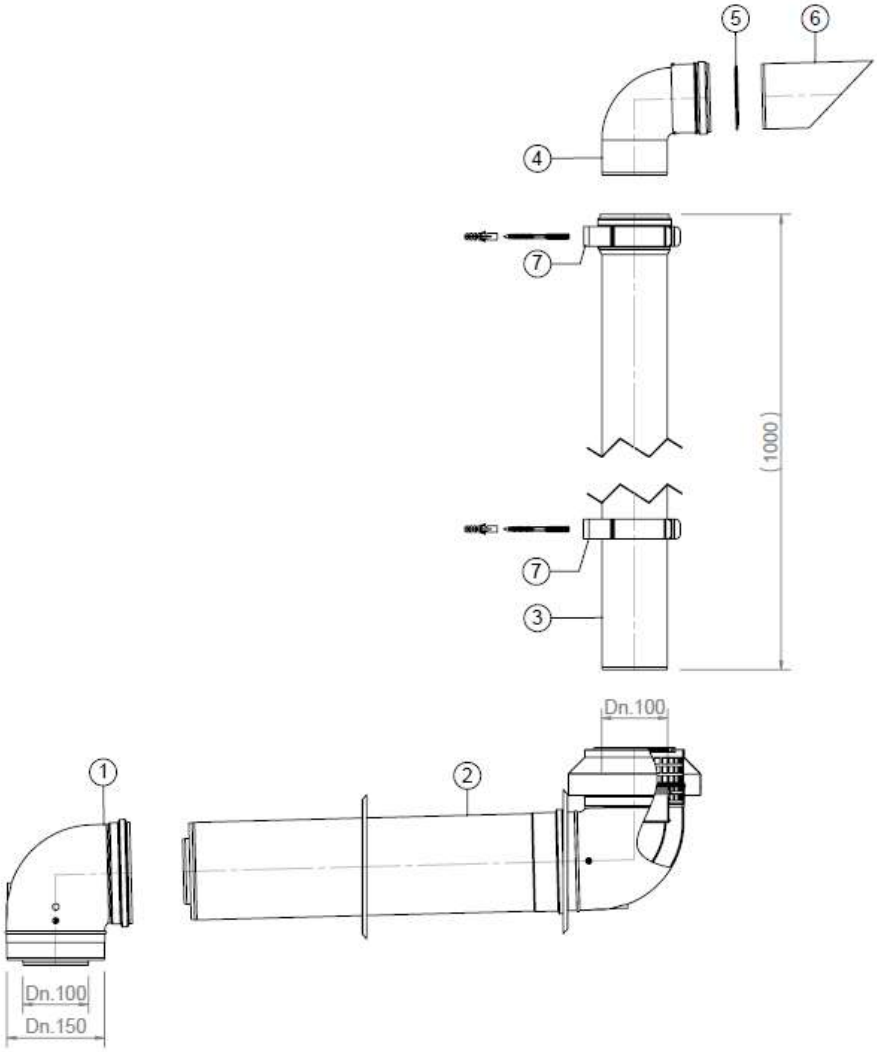
5. Fill the void between the terminal and wall with water resistant sealant.
6. Fit the wall plates or rosette using appropriate fixings.
7. Install the remainder of the flue system working progressively away from the boiler supporting the pipes as necessary.



9.8.3 HORIZONTAL CONCENTRIC FLUE TERMINAL

9.9 PLUME MANAGEMENT KITS FOR EFB85-EFB105

For installations where the flue exhaust may present a nuisance pluming problem but is installed as per IGEM/UP/10 then Lochinvar can offer a plume management kit as below for models EFB85 and EFB105 only.



Item No	QTY	Description
1	1	Elbow 100/150
2	1	High level flue terminal
3	1	Extension
4	1	Elbow 100
5	1	Spring
6	1	High level flue terminal 100
7	2	Wall bracket

The flue terminal location before the Plume kit is fitted must comply with the guidance shown within the EFB Installation manual and the requirements of IGEM/UP/10.

The plume kit cannot be used with models EFB125-EFB155

9.9.1 C_{33} Vertical Concentric Flue Assembly

Model	Description	Flue Assembly Item number
EFB85	Vertical Concentric flue kit 100/150mm	CPMV003
EFB105	Vertical Concentric flue kit 100/150mm	CPMV003
EFB125	Vertical Concentric flue kit 100/150mm	CPMV003
EFB155	Not available	

9.9.2 Vertical Terminal Installation

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

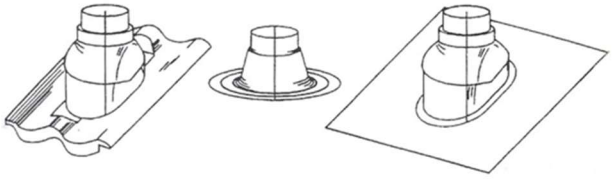
1. Confirm that the roof flashing is correct for the type of roof through which the terminal is to be installed. (See 9.3)
2. Determine the desired location for the flue terminal, taking into account minimum distances as detailed in See 9.3 and IGEM/UP/10 and the relevant British Standards.
3. Taking care to protect the appliance from debris and dust, drill a hole in the desired location. The diameter of the hole must be no more than 10mm greater than the diameter of the air supply pipe of the terminal.

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

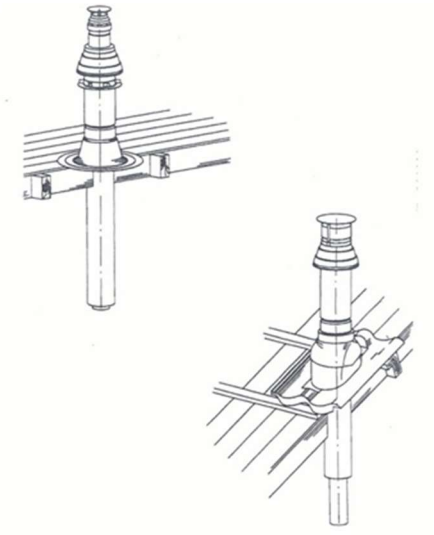
4. Install the roof flashing and secure as appropriate.
5. Carefully insert the roof terminal through the roof flashing and hole in the roof.

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 boiler supporting the pipes as necessary.
9. Once the flue system is fully installed, tighten the clamp to secure the terminal in place.

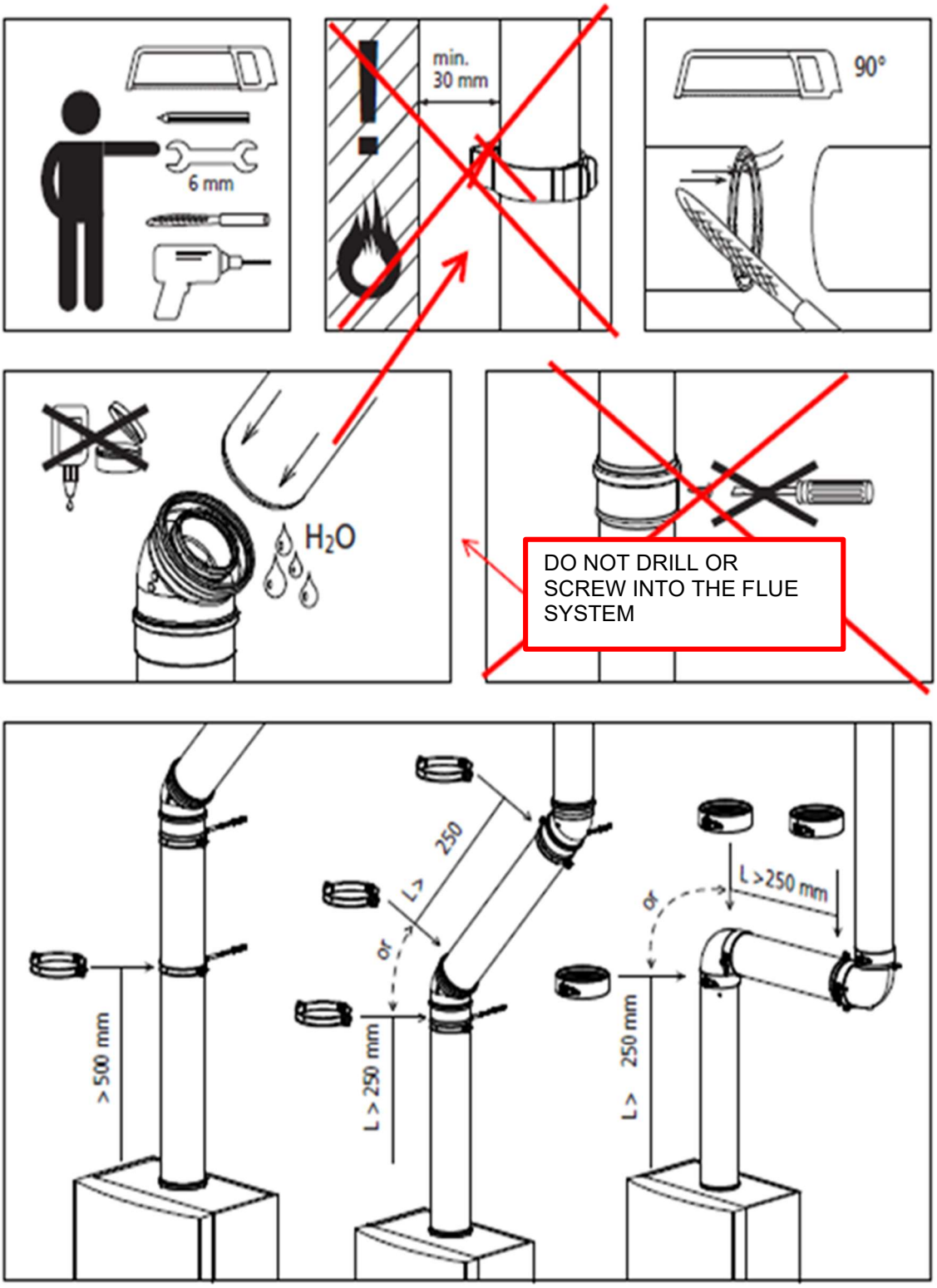


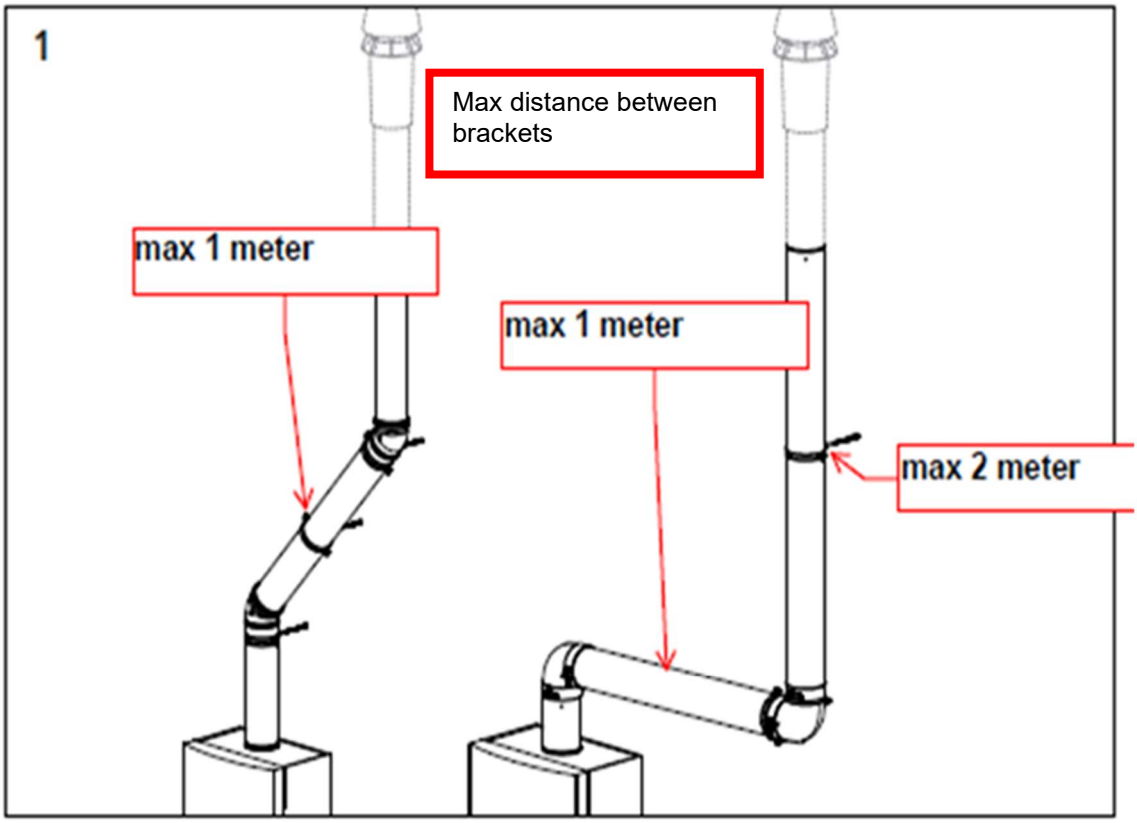
9.9.3 Vertical Terminal Roof Flashings For Synthetic, Flat And Tiled Roofs

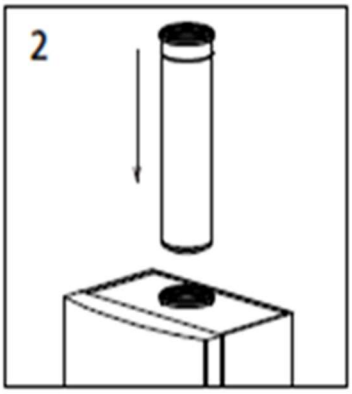


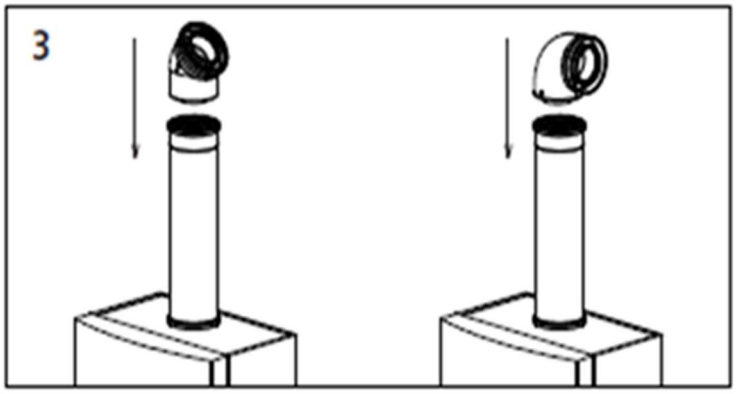
9.9.4 Installing Terminal Through Roof Flashing

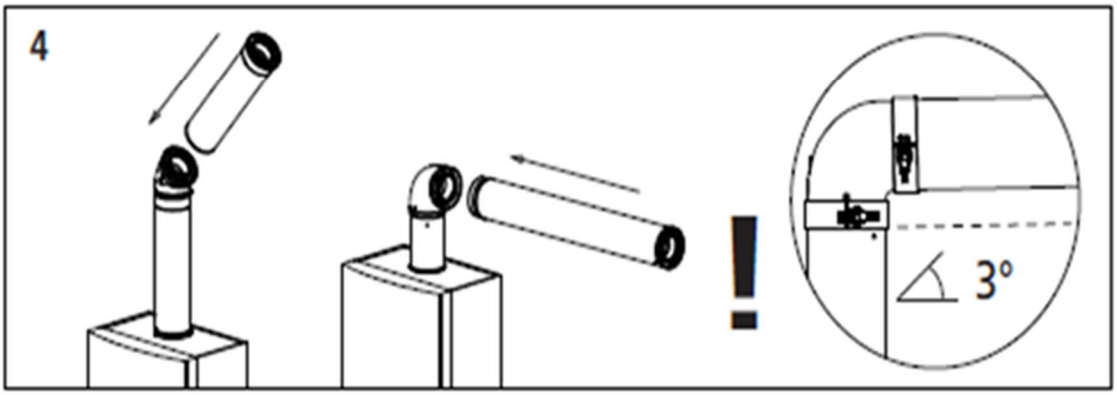
9.9.5 General Concentric Flue System Installation Guidelines



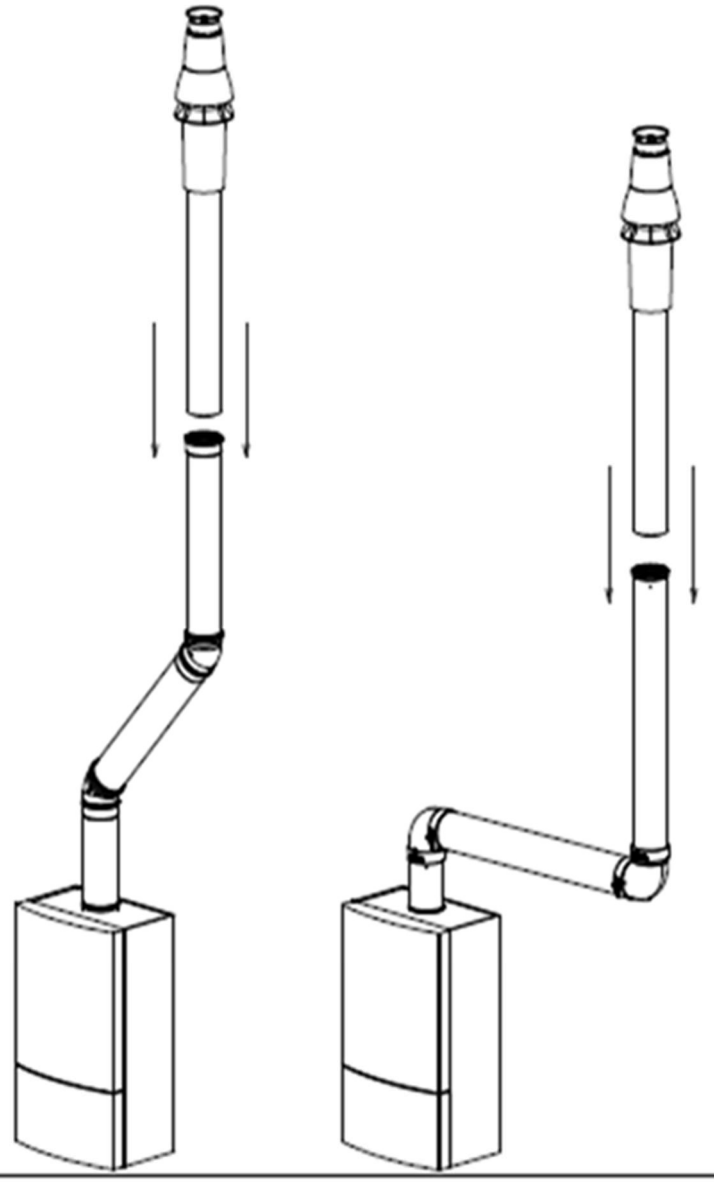

1
Max distance between brackets
max 1 meter
max 1 meter
max 2 meter


2

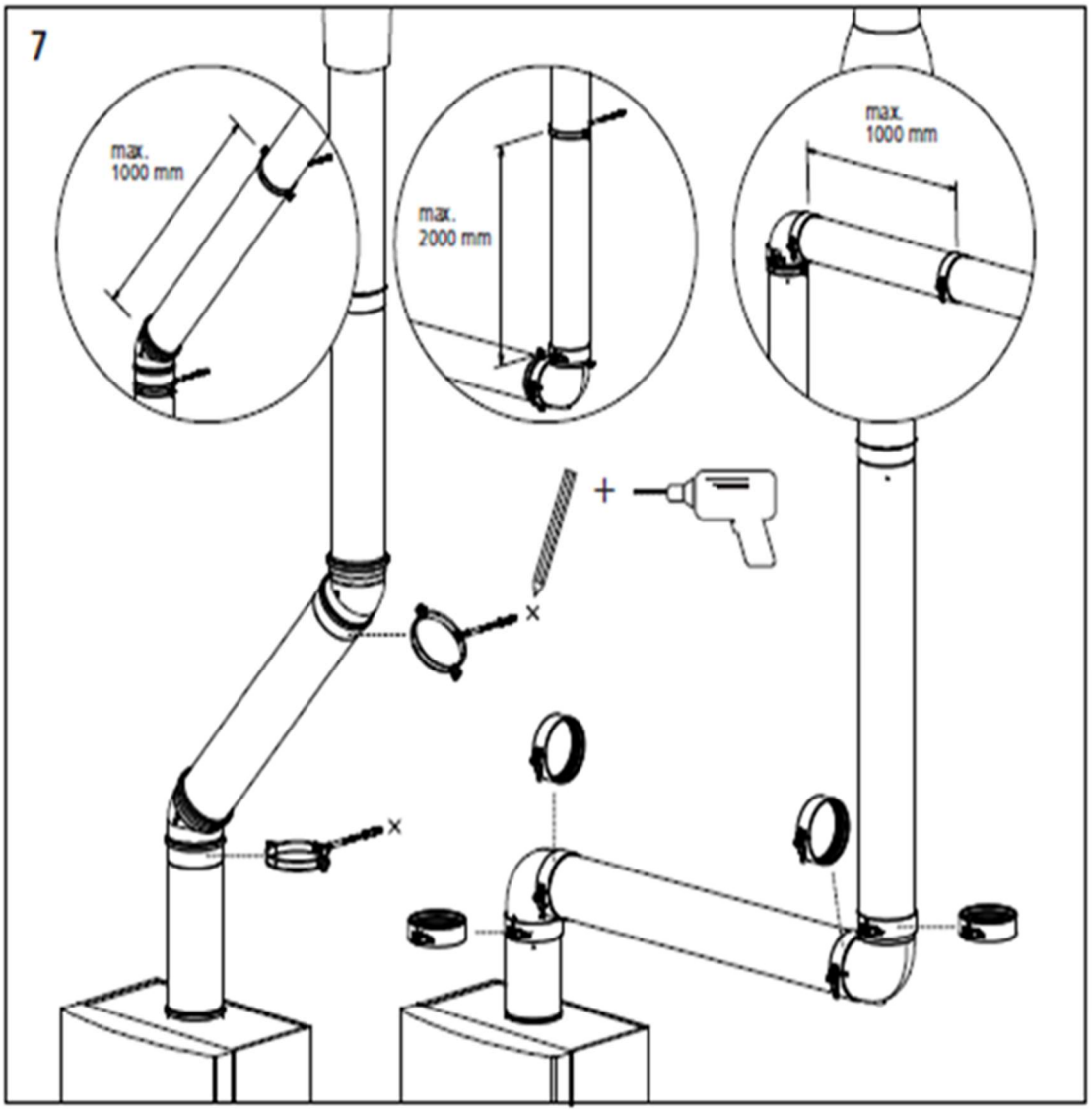

3

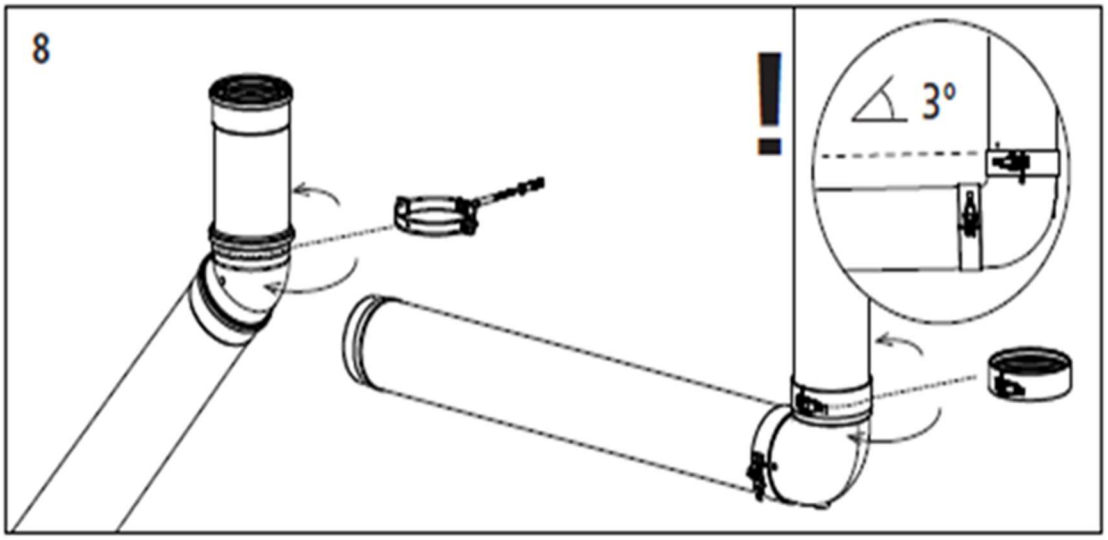

4
!
3°

5



6


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


8
!
3°

9.10 C_{53} TWIN PIPE FLUE SYSTEMS

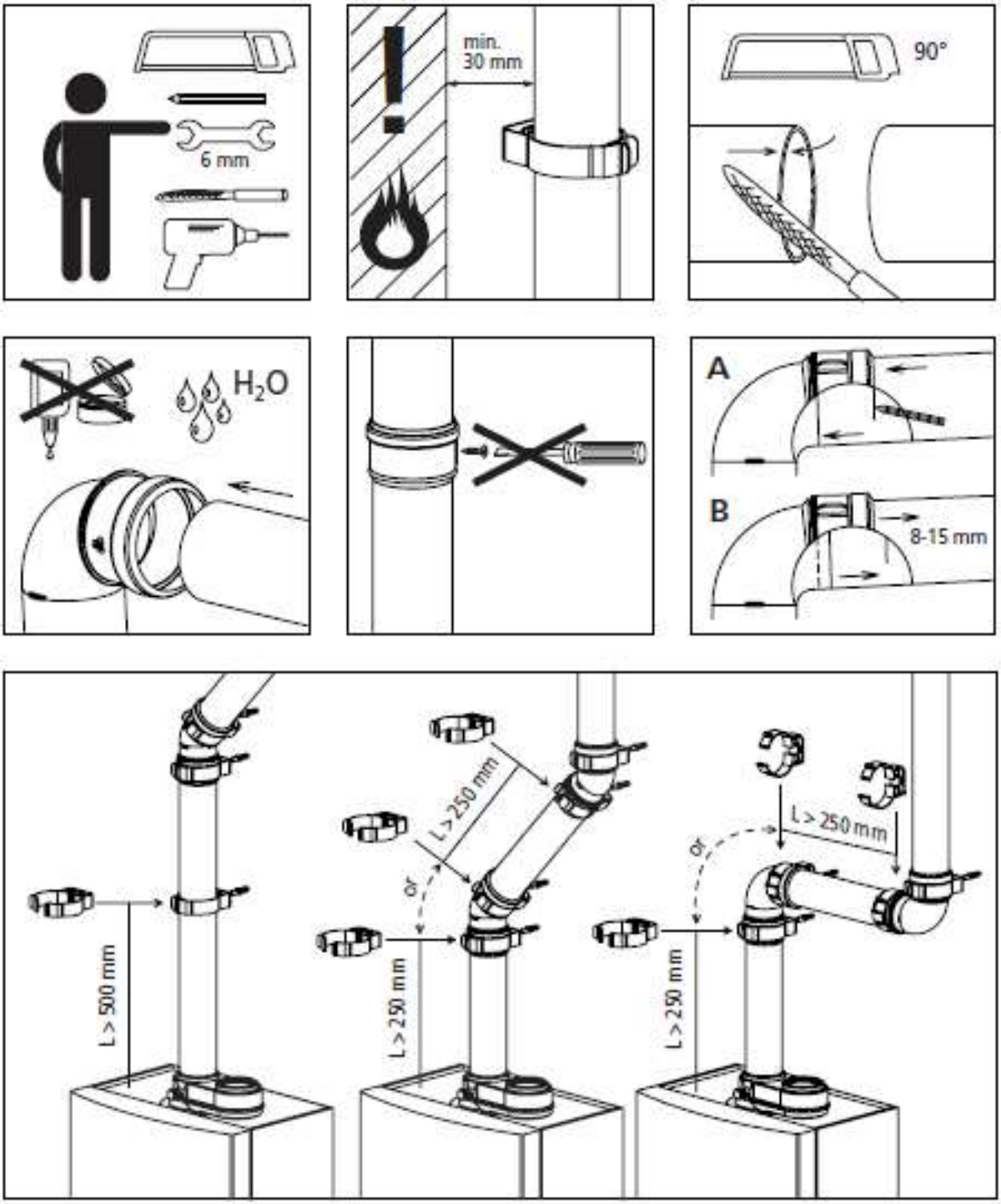
Model	Conversion kit Item number
EFB85	LE04018220
EFB105	LE04018220
EFB125	LE04018220
EFB155	Boiler is supplied in Twin-pipe configuration

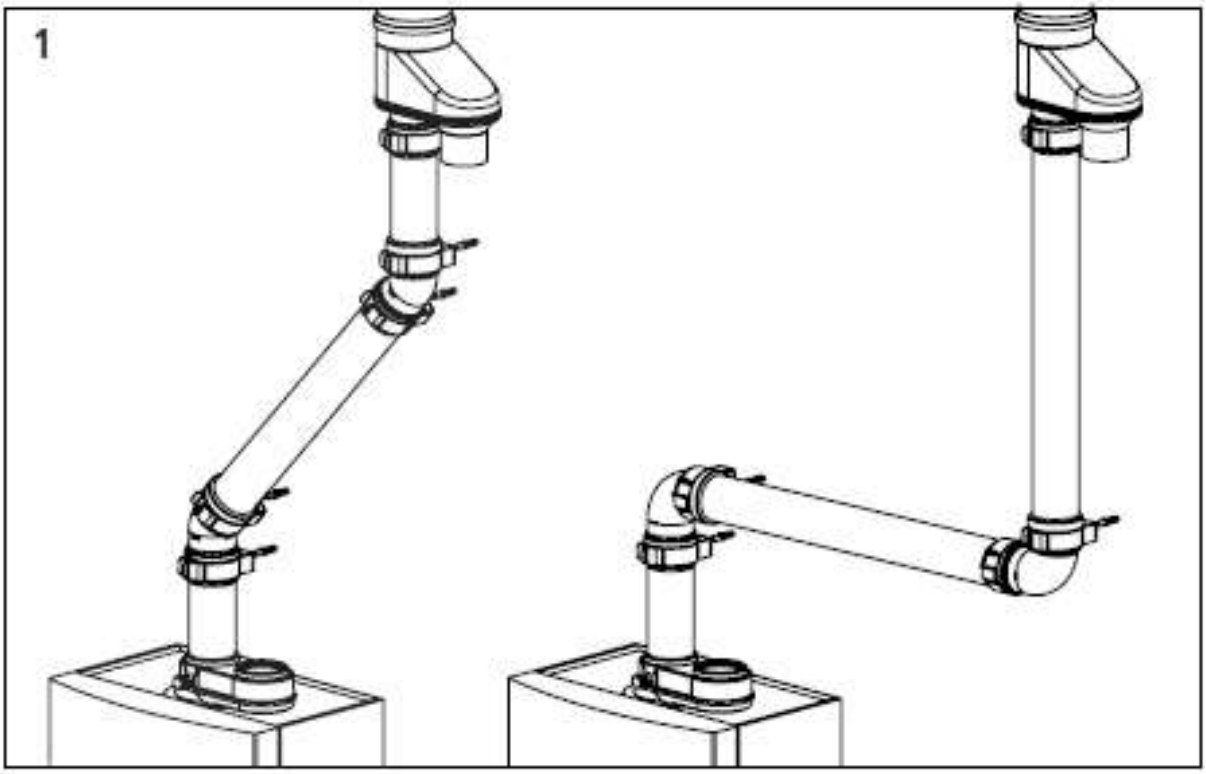
When ordering the EFB boiler with a standard twin-pipe flue kit the above conversion kit will be included.

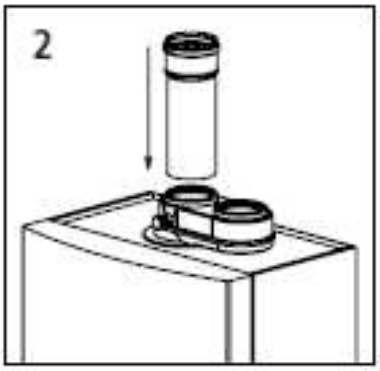
When installing the boiler as a type C_{53} appliance, it must be noted that the terminals must not be installed on opposite sides of the building.

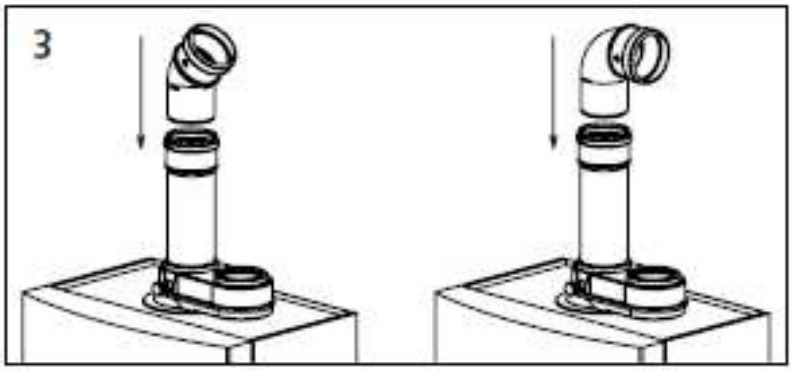
Due to the large Flue pipe size required Lochinvar does not supply Twin-Pipe flue components for models EFB155. For this installation type a flue system designer/installer must be consulted.

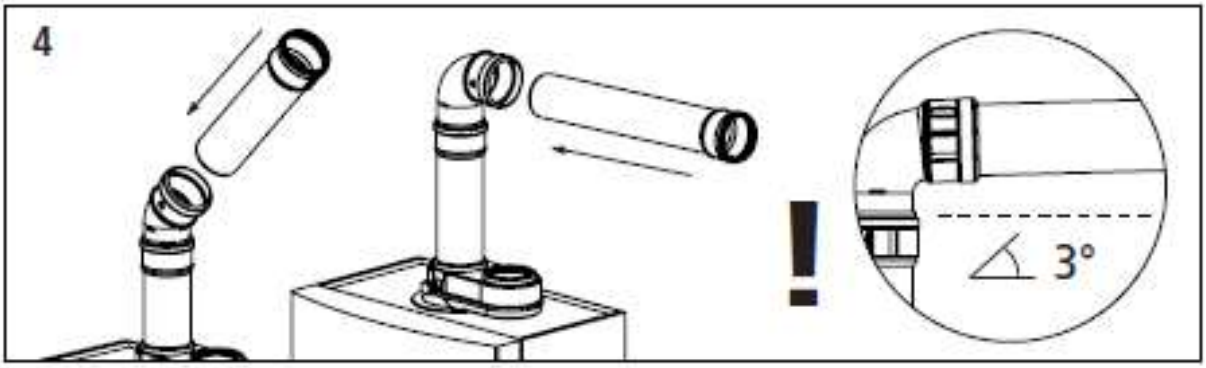
9.10.1 General Twin-Pipe Installation Guidelines

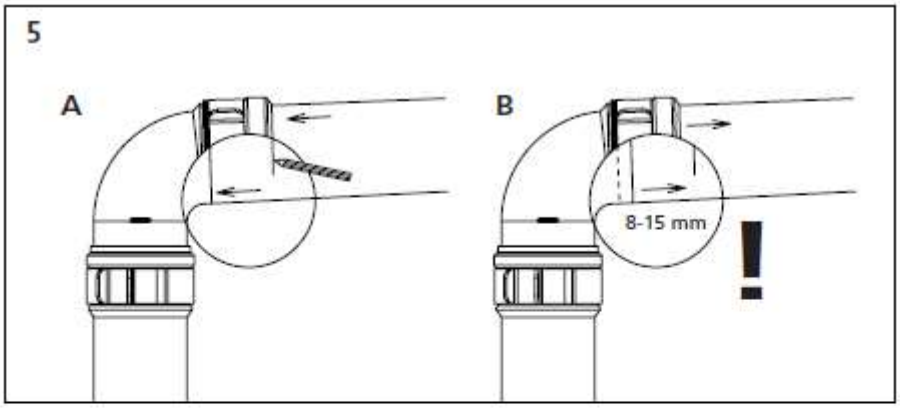


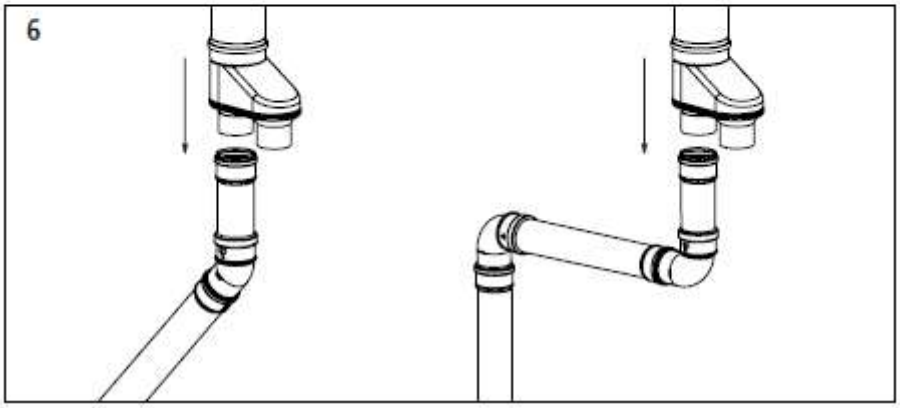

1

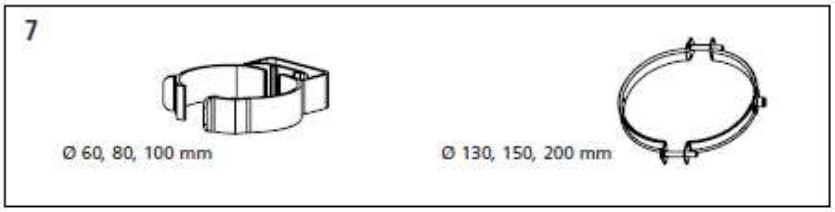

2

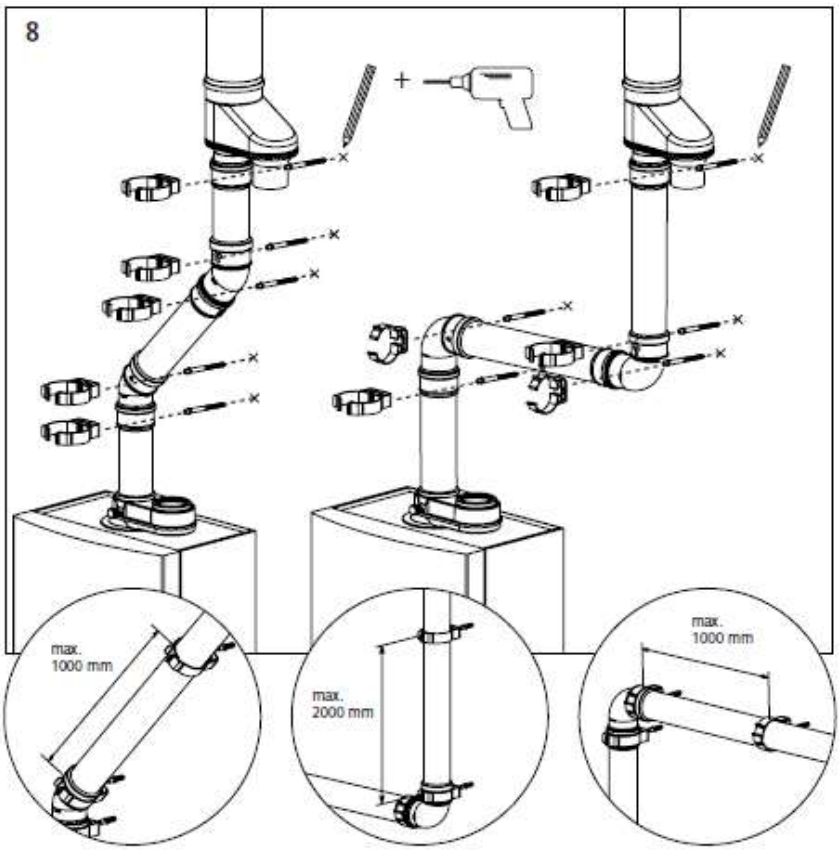

3

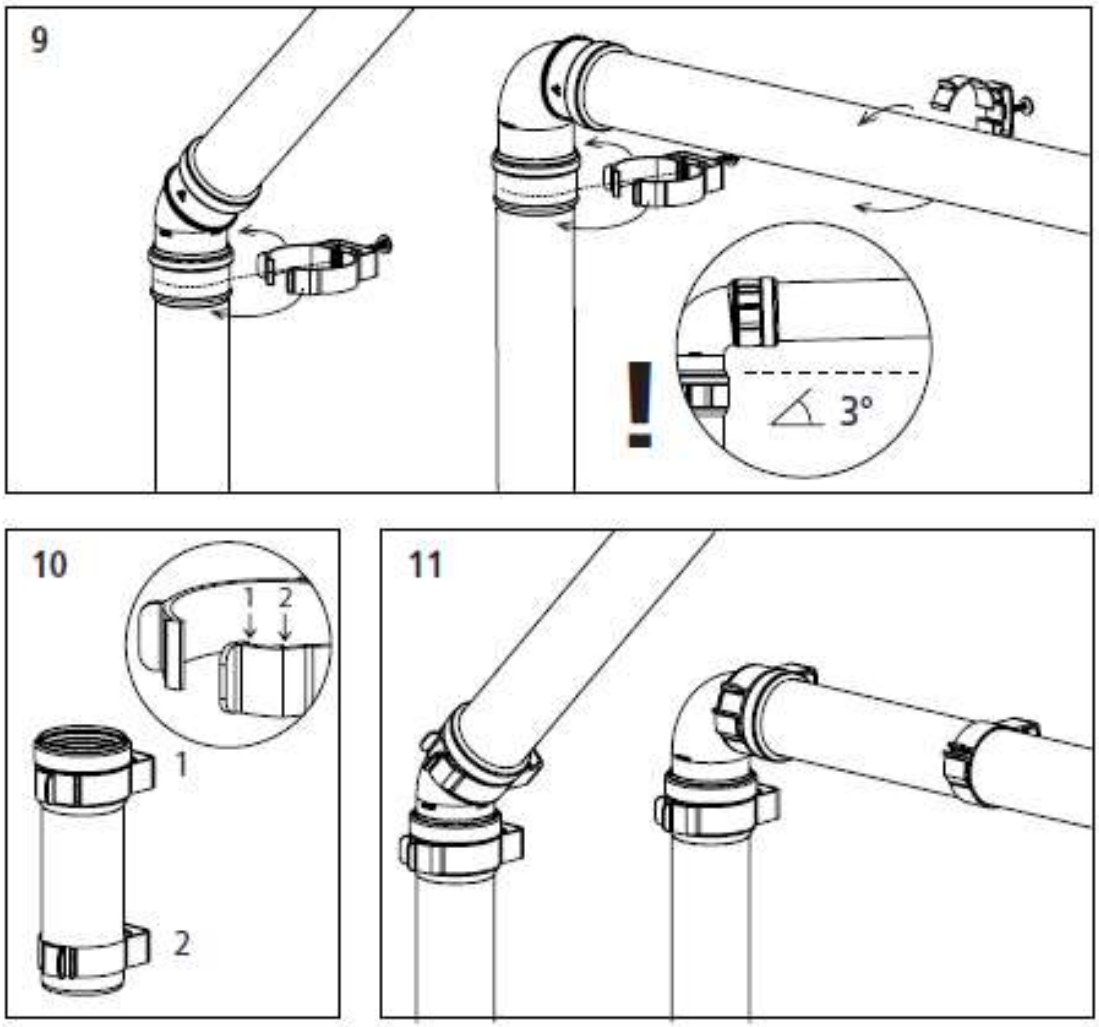

4
!
3°


5
A
B
8-15 mm
!


6


7
Ø 60, 80, 100 mm
Ø 130, 150, 200 mm


8
max.
1000 mm
max.
2000 mm
max.
1000 mm

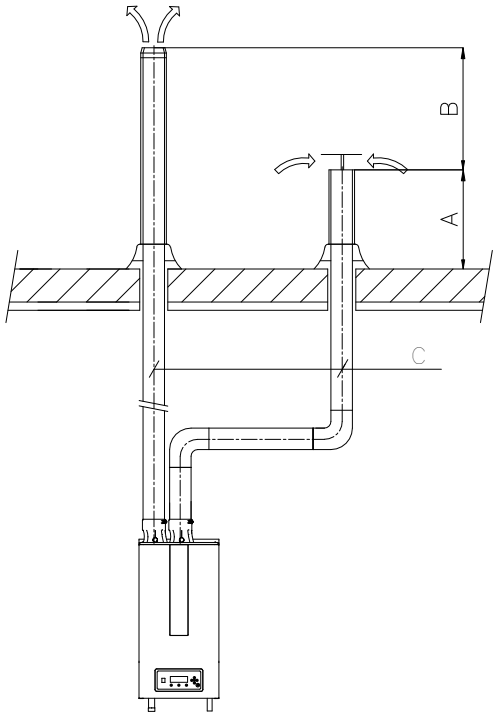


9.11 C63 CERTIFIED

If a heater is C63 certified, the flue gas and air supply parts must have a separate CE marking according to the building products regulations.
The parts must be able to handle the condensate forming (W) and transport, overpressure (P1) and must have a minimum temperature class of **T120**. Also it has to meet the requirements in the chapters 6.4 and 6.5.

CE string flue gas material	European standard	Temperature 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. req. PP	EN 14471	T120	P1	W	1		O	30	I of E	C/E	L
min. req. SS	EN 1856-1	T120	P1	W	1	L20040	O	40			

9.12 PIPE HEIGHTS AND MUTUAL DISTANCES ON A FLAT ROOF



Height A

This is the height of the air inlet. A rain hood must prevent rainwater entering the air supply system.
When the inlet and outlet are mounted on a flat roof, the inlet must be at least 60 cm (23.5 inch) above the roof surface and at least 30 cm (12 inch) above the maximum snow level.

Example 1:

If the maximum snow level on the roof surface is 45 cm, then the air inlet would be at 45 + 30 = 75 cm. This 75 cm is more than the minimum 60 cm, so the height must be 75 cm.

Example 2:

If the maximum snow level on the roof surface is 15 cm, then the air inlet would be at 15 + 30 = 45 cm. This 45 cm is less then the minimum 60 cm, so the height must be 60 cm.

Height difference B

This is the distance between the flue outlet and the air inlet.
The flue gas outlet must be at least 70 cm (27.5 inch) above the air inlet. It is advised to apply a conical outlet.
If no air inlet is used on the roof, the flue outlet must be situated at least 100 cm above the roof surface.

Distance C

The horizontal mutual distance at roof level.
This distance must be at least 70 cm.

9.13 FLUE GAS AND AIR SUPPLY RESISTANCE TABLE

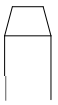
In the next section, for five typical flue gas outlet & air inlet configurations the maximum lengths of the straight pipes will be calculated. First all component resistance values are given in the next table:

		BOILER	EFB 85	EFB 105	EFB 125	EFB 155
	Ø	PARALLEL	RESISTANCE [Pa]			
FLUE GAS	100	straight tube/m	**2.8**	**4.0**	**6.0**	**-**
		45° bend	**6.4**	**9.0**	**13.6**	**-**
		90° bend	**10.2**	**14.5**	**21.9**	**-**
		Flue outlet zeta=0.05	**0.5**	**0.8**	**1.2**	**-**
		Flue outlet zeta=1.0	**10.8**	**15.3**	**23.0**	**-**
		Flue outlet zeta=1.5	**16.2**	**22.9**	**34.5**	**-**
	130	straight tube/m	0.7	1.0	1.5	2.2
		45° bend	1.3	1.8	2.7	4.0
		90° bend	3.0	4.3	6.4	9.5
		Flue outlet zeta=0.05	0.2	0.3	0.4	0.6
		Flue outlet zeta=1.0	3.6	5.1	7.7	11.4
		Flue outlet zeta=1.5	5.4	7.7	11.6	17.2
	150	straight tube/m	0.4	0.6	0.9	**1.3**
		45° bend	0.7	0.9	1.4	**2.1**
		90° bend	1.6	2.2	3.3	**4.9**
		Flue outlet zeta=0.05	0.1	0.1	0.2	**0.3**
		Flue outlet zeta=1.0	2.0	2.8	4.3	**6.3**
		Flue outlet zeta=1.5	3.0	4.3	6.4	**9.5**
		Roof terminal	3.4	4.8	7.3	**10.8**
		reducer 150 to 130	2.1	3.0	4.5	**6.6**
AIR SUPPLY	100	straight tube/m	3.2	4.6	6.9	**-**
		45° bend	7.4	10.5	15.7	**-**
		90° bend	11.9	16.8	25.3	**-**
		air inlet zeta=1.0	12.5	17.7	26.7	**-**
	130	straight tube/m	0.8	1.1	1.7	2.5
		45° bend	1.5	2.1	3.1	4.6
		90° bend	3.5	4.9	7.4	11.0
		air inlet zeta=1.0	4.2	5.9	9.0	13.3
	150	straight tube/m	0.5	0.7	1.0	**1.5**
		45° bend	0.8	1.1	1.6	**2.4**
		90° bend	1.8	2.6	3.9	**5.7**
		air inlet zeta=1.0	2.3	3.3	5.0	**7.3**

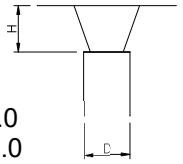
FLUE GAS OUTLET

zeta=0
open outlet

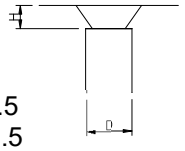
zeta=0.05
conical outlet



H/D=1.0
zeta=1.0

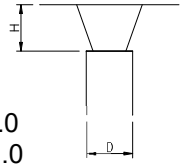


H/D=0.5
zeta=1.5



AIR INLET

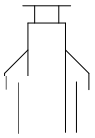
H/D=1.0
zeta=1.0



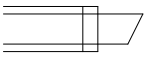
		BOILER	EFB 85	EFB 105	EFB 125	EFB 155
	Ø mm	CONCENTRIC	RESISTANCE [Pa]			
FLUE GAS	100/150	straight tube/m	**2.9**	**4.1**	**6.2**	**-**
		45° bend	**6.4**	**9.0**	**13.6**	**-**
		90° bend	**10.2**	**14.5**	**21.9**	**-**
		roof terminal	**31.2**	**44.3**	**66.7**	**-**
		wall terminal	**10.8**	**15.3**	**23.0**	**-**
		Plume kit	**0.4**	**0.6**	**0.9**	**-**
		adaptor				**-**
AIR SUPPLY	100/150	straight tube/m	**9.2**	**13.1**	**19.7**	**-**
		45° bend	**8.1**	**11.4**	**17.2**	**-**
		90° bend	**11.7**	**16.6**	**25.1**	**-**
		roof terminal	**43.3**	**61.4**	**92.4**	**-**
		wall terminal	**43.3**	**61.4**	**92.4**	**-**
		adaptor	**39.2**	**55.6**	**83.8**	**-**

CONCENTRIC
FLUE GAS OUTLET
AIR INLET

ROOF



WALL



*** Never reduce pipe diameters relative to boiler connections**

Values printed in grey applicable for larger pipe diameters than boiler connection

This table may only be used for a single flue/air system for one boiler

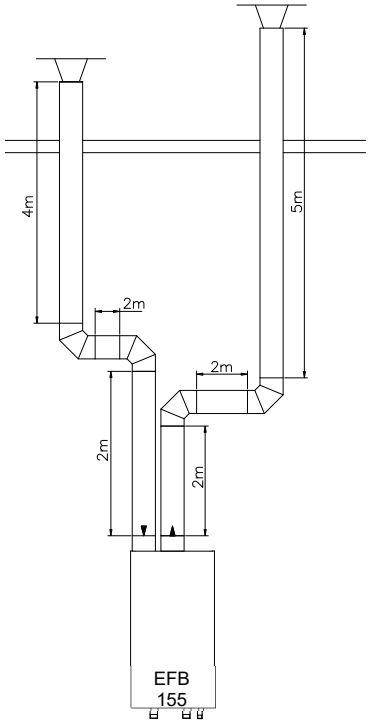
Do NOT use this table for common flue systems with cascaded boilers.

9.14 TYPICAL EXAMPLES

A:	Twin pipe system with separate pipes for flue gas and air supply	**C63**
B:	Twin pipe system with separate pipes and concentric roof terminal	**C33**
C:	Single pipe for flue gas outlet only (air supply from boiler room)	**B23**
D:	Concentric pipe for flue gas/air supply (roof-mounted)	**C33**
E:	Concentric pipe for flue gas/air supply (wall-mounted)	**C13**
F:	Separate air supply duct & flue duct in different pressure zone	**C53**

Specific resistance values of Lochinvar supplied flue gas and air intake parts are used for these examples. Do not use for other flue systems

9.14.1 EXAMPLE A: TWIN PIPE SYSTEM WITH SEPARATE PIPES FOR FLUE OUTLET AND AIR SUPPLY



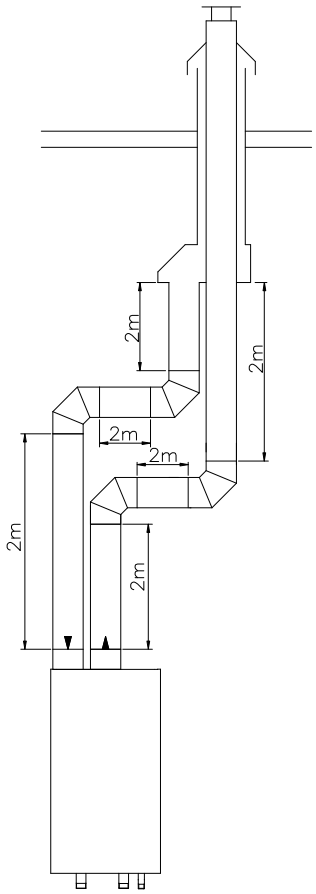
Calculation example with given lengths: checking resistance

Boiler type:		EFB 155		
Flue gas	**Diameter: 150 mm**	**quantity**	**Pa**	**Pa total**
	Straight tube /m total	9	1.3	11.7
	Bend 90°	2	4.9	9.8
	Flue outlet zeta=1.0	1	6.3	6.3
	Total resistance flue gas outlet:			**27.8**
Air supply	**Diameter: 150 mm**	**quantity**	**Pa**	**Pa total**
	Straight tube /m total	8	1.5	12.0
	Bend 90°	2	5.7	11.4
	Air inlet zeta=1.0	1	7.3	7.3
	Total resistance air supply:			**30.7**
Total resistance flue gas outlet and air supply:				**58.5**

The total resistance is less than 200 Pa.
This flue gas / air supply system is OK.

NOTE: Specific resistance values are used in this example.
Flue and air pipes of other suppliers can have other values

9.14.2 EXAMPLE B: TWIN PIPE SYSTEM WITH CONCENTRIC ROOF TERMINAL



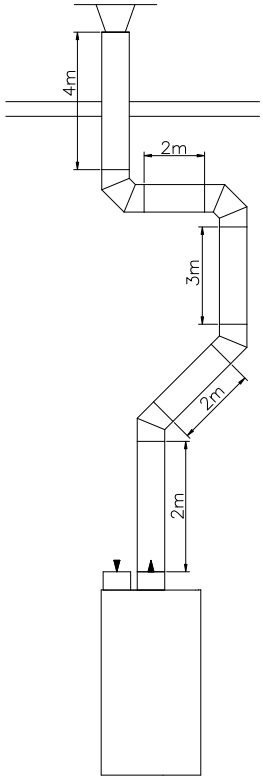
Calculation example with given lengths: checking resistance

Boiler type:		EFB 125			
Flue gas	Diameter: 100 mm		Number	Pa	Pa total
	Straight tube /m	total	6	6.0	36.0
	Bend	90°	2	21.9	43.8
	Roof terminal	concentric 100/150	1	66.7	66.7
	Adaptor conc./par.	100-100 > 100/150	1	0.9	0.9
	Total resistance flue gas outlet:				**147.4**
Air supply	**Diameter: 100 mm**		**Number**	**Pa**	**Pa total**
	Straight tube /m	total	6	6.9	41.4
	Bend	90°	2	25.3	50.6
	Roof terminal	concentric 100/150	1	92.4	92.4
	Adaptor conc./par.	100-100 > 100/150	1	83.8	83.8
	Total resistance air supply:				**268.2**
Total resistance flue gas outlet and air supply:					**415.6**

The total resistance is more than 200 Pa.
This flue gas / air supply system CANNOT BE USED.

NOTE: Specific resistance values are used in this example.
Flue and air pipes of other suppliers can have other values

9.14.3 EXAMPLE C: SINGLE FLUE GAS OUTLET. AIR SUPPLY FROM BOILER ROOM

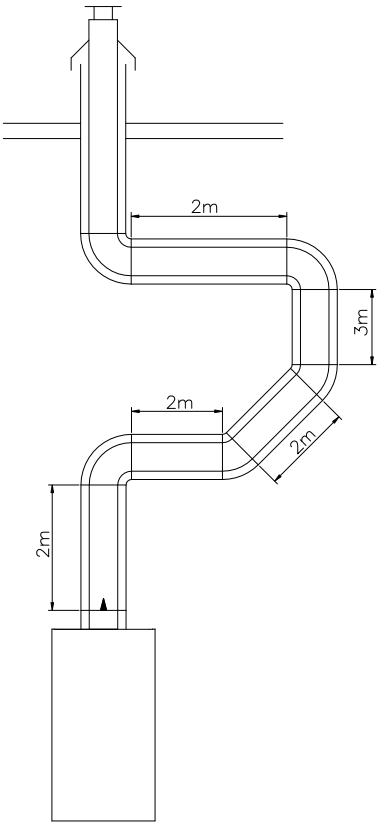


Calculation example with given lengths: checking resistance

Boiler type:		EFB 105			
FLUE GAS	Diameter: 100 mm		Number	Pa	Pa total
	Straight tube m¹	total	13	4.0	52.0
	Bend	90°	2	9.0	18.0
	Bend	45°	2	14.5	29.0
	Flue outlet	zeta = 1.0	1	15.3	15.3
	Total resistance flue gas:				**114.3**

The total resistance is less than 200 Pa.
This flue gas / air supply system is OK.

9.14.4 EXAMPLE D: CONCENTRIC FLUE GAS/AIR SUPPLY PIPE (ROOF-MOUNTED)



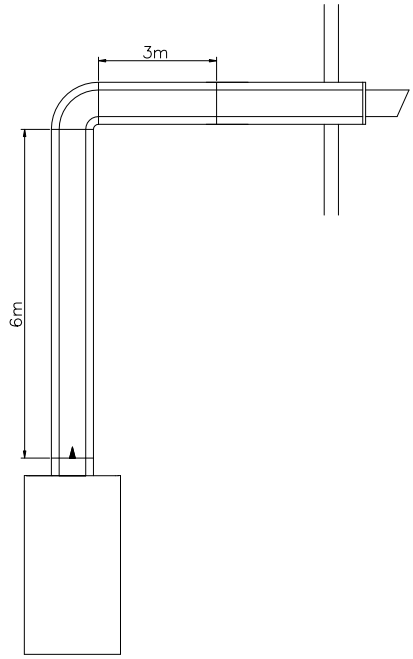
Calculation example with given lengths: checking resistance

Boiler type:			EFB 85		
FLUE GAS	**Diameter: 100/150 mm.**		**quantity**	**Pa**	**Pa total**
	Straight tube m	total	11	2.9	31.9
	Bend	45°	2	6.4	12.8
	Bend	90°	3	10.2	30.6
	Concentric terminal	roof	1	**31.2**	**31.2**
	resistance flue gas:				**106.2**
AIR SUPPLY	**Diameter: 100/150 mm.**		**quantity**	**Pa**	**Pa total**
	Straight tube m	total	11	9.2	101.2
	Bend	45°	2	9.1	16.2
	Bend	90°	3	11.7	35.1
	Concentric terminal	roof	1	**43.3**	43.3
	resistance air supply:				**195.8**
	Total resistance flue gas and air supply:				**302.3**

The total resistance is more than 200 Pa.
This flue gas / air supply system CANNOT BE USED.

NOTE: Specific resistance values are used in this example.
Flue and air pipes of other suppliers can have other values

9.14.5 EXAMPLE E: CONCENTRIC SYSTEM WALL OUTLET C13 (WALL-MOUNTED)



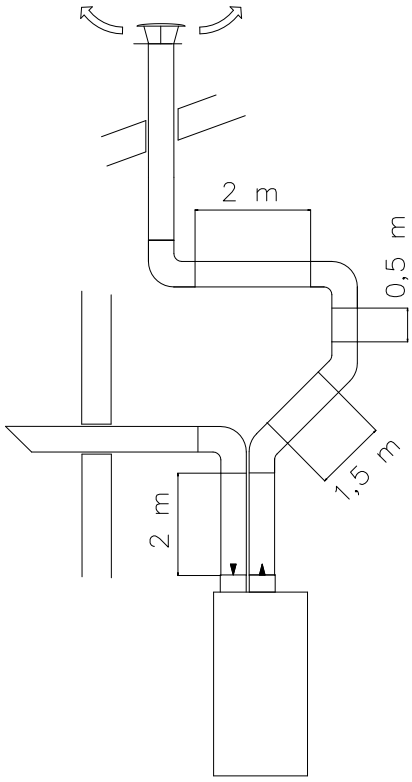
Calculation example with given lengths: checking resistance

Boiler type:			EFB 85		
FLUE GAS	**Diameter: 100/150 mm.**		**quantity**	**Pa**	**Pa total**
	Straight tube m	total	9	2.9	26.1
	Bend	90°	1	10.2	10.2
	Concentric terminal	wall	1	10.8	10.8
	resistance flue gas outlet:				**47.1**
AIR SUPPLY	**Diameter: 100/150 mm.**		**quantity**	**Pa**	**Pa total**
	Straight tube m	total	9	9.2	82.8
	Bend	90°	1	11.7	11.7
	Concentric terminal	wall	1	43.3	43.3
	resistance air supply:				**137.8**
	Total resistance flue gas outlet and air supply:				**184.9**

The total resistance is less than 200 Pa.
This flue gas / air supply system is OK.

NOTE: Specific resistance values are used in this example.
Flue and air pipes of other suppliers can have other values

9.14.6 EXAMPLE F: SEPARATE AIR SUPPLY DUCT & FLUE DUCT IN DIFFERENT PRESSURE ZONE (C53)



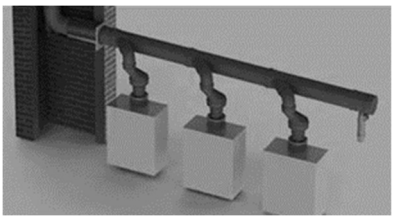
Calculation example with given lengths: checking resistance

Boiler type:		EFB 105			
FLUE	Diameter: 100 mm.		quantity	Pa	Pa total
	Straight tube m	total	6	4.0	24.0
	Bend	45°	2	9.0	18.0
	Bend	90°	2	14.5	29.0
	Flue outlet zeta = 1.0	roof	1	15.3	15.3
	resistance flue gas outlet:				**86.3**
AIR	**Diameter: 100 mm.**		**quantity**	**Pa**	**Pa total**
	Straight tube m	total	2	4.6	9.2
	Bend	90°	1	16.8	16.8
	Air inlet zeta = 1.0	wall	1	17.7	17.7
	resistance air supply:				**43.7**
	Total resistance flue gas outlet and air supply:				**130.0**

The total resistance is less than 200 Pa.
This flue gas / air supply system is OK.

NOTE: Specific resistance values are used in this example.
Flue and air pipes of other suppliers can have other values

10 COMMON FLUE CASCADING



C10 Common flue gas systems.

WARNING:

If other than M&G flue gas materials are used, please contact your boiler supplier.

If using C10 flue gas system for so called "CLV" system than the following must be applied:
A data plate shall be present on the connection interface to the common flue duct. It shall contain the following information:
a) the common duct system is for C(10) boilers;
b) the maximum allowable combustion products mass flow rate;
c) the dimensions of the connection to the common ducts;
d) a warning when the boiler is disconnected the air outlet and the combustion product inlet openings shall be closed and checked on tightness.
e) the name of the manufacturer of the common flue duct or his identifying symbol.

C11 Common flue gas systems.

A special common flue gas calculation manual for C11 flue gas systems is available on request at your supplier.

10.1 SAFETY MEASURES COMMON FLUE SYSTEMS

In case EFB boilers are installed with a common flue system and the combustion air is drawn directly from the room, safety measures have to be taken

Indicated hazard
The EFB boilers are equipped with a Non-return valve to prevent recirculation of flue gas of a running boiler through one or more boilers which are not running and are connected with a common flue system. This Non-return valve might leak over time by pollution, incorrect maintenance or other unexpected cause. In case the combustion air is drawn from the room, flue gas might enter the room, which could lead to Carbon Monoxide (CO) poisoning.

Safety measures:
To cover this risk of Carbon Monoxide (CO) poisoning in combination with combustion air drawn directly from the room, two safety measures have to be taken:

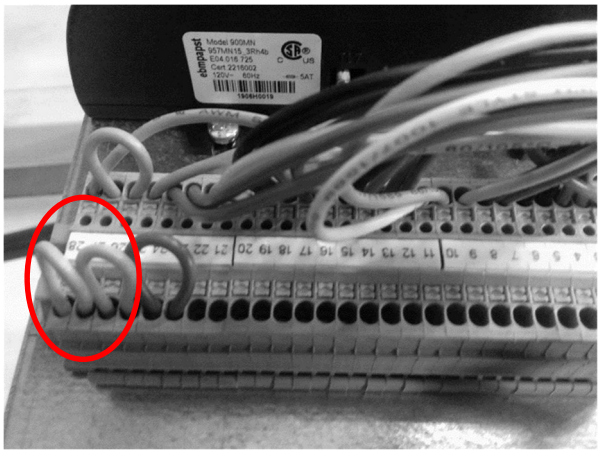
1. Guaranteed sufficient outside air supply for combustion and ventilation according local standards, codes and regulations.
2. Use an CO detector for alarm and switching module to switch off all the boilers. The CO alarm system must be according national and local standards.

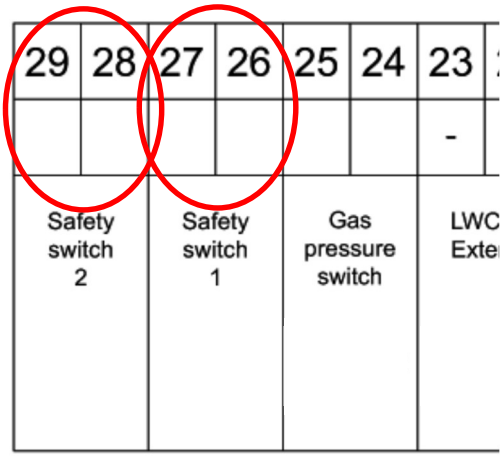
Additional Safety Advice

3. Use always the cascade manager of the boiler and check if power mode 2 is switched on. Power mode 2 is selected at parameter 148.
4. Combine all air intake terminals of the boilers, which do not necessarily have to be connected to the outside.

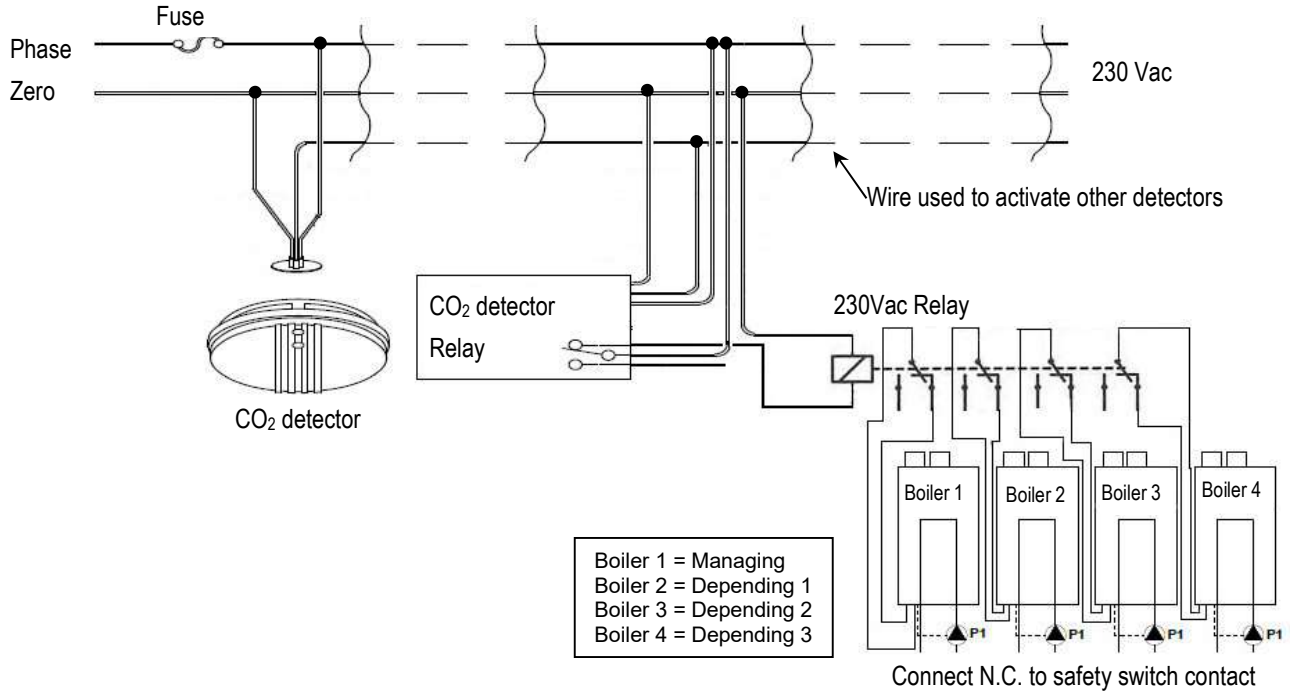
Ad 1. Guaranteed sufficient outside air supply for combustion and ventilation according local standards, codes and regulations.
The boiler-room must have sufficient outside air supply for combustion and ventilation. There are many ways of creating sufficient outside air supply, depending on location of the boiler-room in the building. The demands for the (size of the) boiler-room and required ventilation is prescribed in local standards, codes and regulations.
The execution and size of the outside air supply must be engineered and calculated by engineers thoroughly familiar with all aspects of the subject.
The outside air supply must be guaranteed during the lifetime of the installation. Risks of blocking or reducing the outside air supply, should be assessed and covered by this engineer and its design. Common obstacles in the outside air supply are eg. Venting opening closed/reduced by pollution, a cupboard, a parked truck / car, closed for heat loss arguments, etc, etc.

Ad 2. CO detection and switch off module:
Use a CO detection system which has an alarming and switching module. Use a switching module that has an Normally Closed (N.C.) contact. The boiler safety loop will be extended with the CO detectors by connecting the N.C. contacts in series to the safety switch terminal connections 26/27 or 28/29 on the boiler to switch off the boiler in case of an alarm.
Remove the yellow wiring bridge and connect the N.C. contacts in series to the relay(s).





Low voltage connections EFB boiler.



Use an extra 230V multipole relay (number of poles equal to number of boilers). In case of power failure on the CO alarm system and modules the boilers will shut down. Mount, install, test and maintain the CO detector according to the manufacturer's instructions. Test the system at least monthly, to ensure the boilers will switch off in case of a CO alarm.

In case of an CO alarm, the display of the boiler will mention: '*Max. thermostat lock error*'.

Ad 3. Use always the cascade manager of the boiler and check if power mode 2 is switched on (parameter 148)

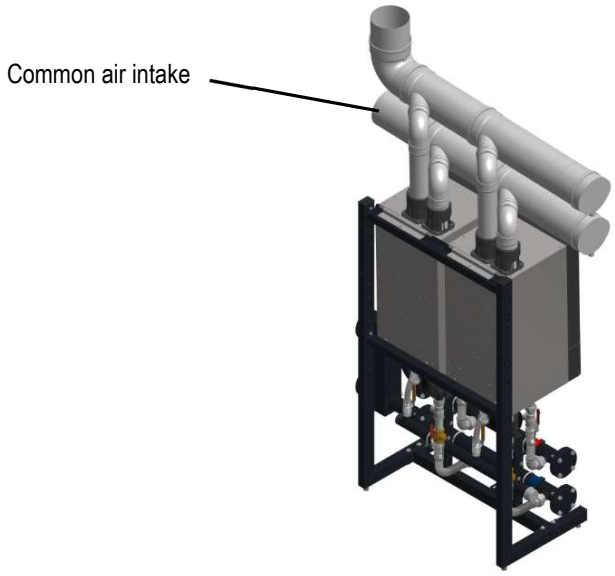
Check parameter setting 148. This setting must be '*Power mode 2*'. Change the parameter 148 to '*Power mode 2*' in case the current setting is different.

See manual §: CASCADE – POWER BALANCE MODE

Several different power control modes can be selected to operate the cascade system.

- Power mode 0: Power control disabled; each boiler modulates based on the system setpoint.
- Power mode 1: Power control algorithm to have a minimum number of boilers/boilers active.
- Power mode 2: Power control algorithm to have a maximum number of boilers/boilers active.
- Power mode 3: Power control algorithm to have a balanced number of boilers/boilers active.

Ad 4. Combine all air intake terminals of the boilers
Combine all air intake terminals of the boiler, which do not necessarily have to be connected to the outside of the room. The purpose of a combined air intake is to have a controlled airflow towards the boilers and improve the air exchange in the room.



10.2 EXISTING COMMON VENTING GUIDELINES

Do not common vent the EFB boiler with the vent pipe of any other boiler or appliance. However, when an existing boiler is removed from an existing common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it. At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation:

1) Seal any unused openings in the common venting system.
2) Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3) Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4) Place in operation the appliance being inspected. Follow the lighting instructions. Adjust thermostat so appliance will operate continuously.
5) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar, or pipe.
6) After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas-burning appliance to their previous condition of use.

Any improper operation of the common venting system must be corrected so the installation conforms with the National standards.

When resizing any portion of the common venting system, the common venting system must be resized to approach the minimum size as determined using the appropriate tables in the Standards and this manual.

11 ELECTRICAL INSTALLATION

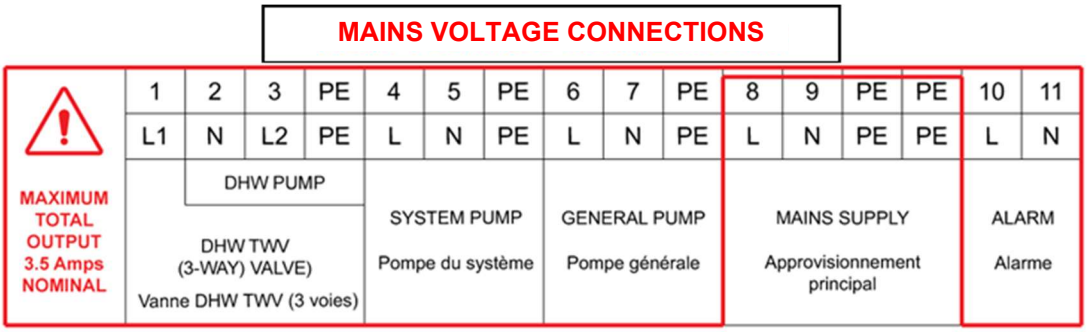
11.1 GENERAL

- For operation, the boiler needs a power supply of 230 VAC 50Hz.
- The boiler main supply connection is phase/neutral sensitive.
- The wiring for the connections can be entered at the bottom of the boiler through the cable glands.
- NOTICE: Before starting to work on the boiler, it must be switched off and the power supply to the boiler must be disconnected.
- Electrical wiring must be installed according to all applicable standards and regulations.
- Working on the boiler may only be done by a qualified service engineer that is skilled in working on electrical installations and according to all applicable standards.
- It is not allowed to change the internal wiring fitted by the manufacturer.
- A spare fuse is mounted on the casing of the burner controller.

11.2 CONNECTION MAINS SUPPLY

- It is advised to use a flexible cable between the cabinet entry (at the bottom) and the connection terminal.
- The earth wire has to be longer than the phase and neutral wire.
- The power supply cable must be secured by tightening the cable gland at the bottom of the boiler casing.
- In case of a flexible cable: use crimp ferrules on each wire end for the terminal connections.
- On the mains voltage terminal, connect to numbers: 8 = Phase; 9 = Neutral; PE = Earth.
- The minimum cross section of the wires in the power supply cable is 3 x 1.0 mm^2.
- As it is a stationary appliance without means for disconnection from the supply a contact separation in all poles that provide full disconnection under voltage category III must be provided.

11.3 MAINS VOLTAGE CONNECTIONS



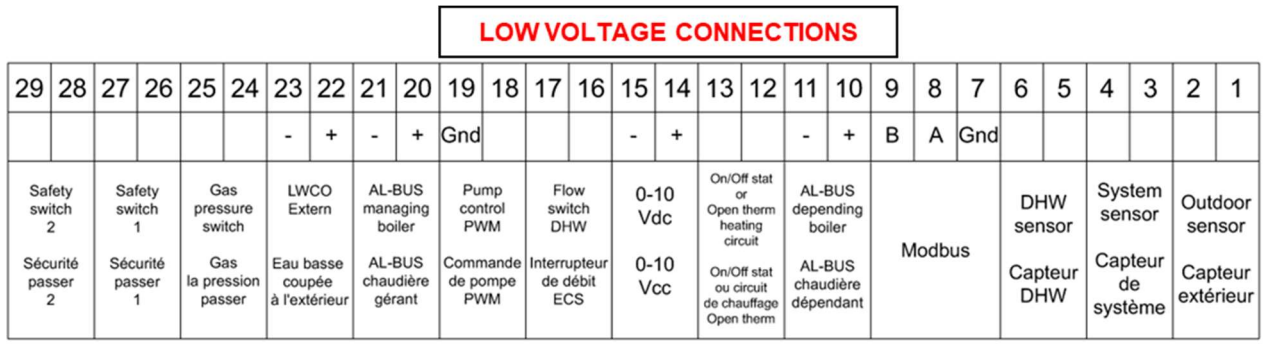
11.3.1 EXPLANATION OF THE MAINS VOLTAGE CONNECTIONS.

1-2-3-PE	DIVERTER VALVE DHW indirect tank
If an indirect domestic hot water tank is installed, a 3-way valve or a pump (P2) can be used to divert hot water to the heating coil of the tank. This 3-way valve will open, or pump will power on, when the indirect tank has a heat demand. PARAMETER: boiler parameter 128, see § 11.9 "programmable in- and outputs" 1 = L1 wire (heating position); 2 = Neutral wire; 3 = L2 (hot water position); PE = Ground. The inrush current of the 3-way valve or pump may not exceed 8 Amps, see § 8.4 for detailed electrical specifications.	
4-PE-5	**SYSTEM PUMP**
Connections for the power supply of a central heating system pump (P3, see chapter 8.4 for detailed electrical specifications). 4 = Phase wire; 5 = Neutral wire; PE = Ground PARAMETER: boiler parameter 125, see § 11.9 "programmable in- and outputs"	
6-PE-7	**BOILER PUMP**
Connections for the power supply of a boiler pump. (P1, see chapter 8.4 for detailed electrical specifications).	
8-9-PE-PE	**MAINS SUPPLY**
The power supply connection of the unit. 8 = Line voltage wire; 9 = Neutral wire, PE = Ground wire	
10-11	**ALARM RELAY**
A semiconductor alarm output. This is a triac output with an active voltage of 230 VAC, it can only handle resistive loads between 5 and 50 Watt. E.g. an incandescent light bulb of 10-50 Watt can be used. This alarm will be activated 60 seconds after an error has occurred. There are a few exceptions: - Alarm output will not be activated for a service warning; - Alarm output will not be activated for warning 202 (Appliance selection). 10 = Phase wire; 11 = Neutral wire PARAMETER: boiler parameter 127, see § 11.9 "programmable in- and outputs"	

X1-X2-X3	HIGH POWER IGNITER (external igniter)
A separate connector for an external igniter is located on the cable tree, near the boiler controller and labelled "High power ignitor". This is a connection for an external ignition transformer. Instead of the internal igniter, an external igniter can be connected. Available as an accessory, see 5.1 "Accessories". X1 = Neutral wire; X2 = Ionization; X3 = Phase wire. PARAMETER: boiler parameter 126, see § 11.9 "programmable in- and outputs".	

To all outputs following applies:
Maximum current 2A each output.
Total output of all currents combined maximum 3.5 A.
The inrush current of the 3-way valve and/or pumps is maximum 8 A.

11.4 LOW VOLTAGE CONNECTIONS

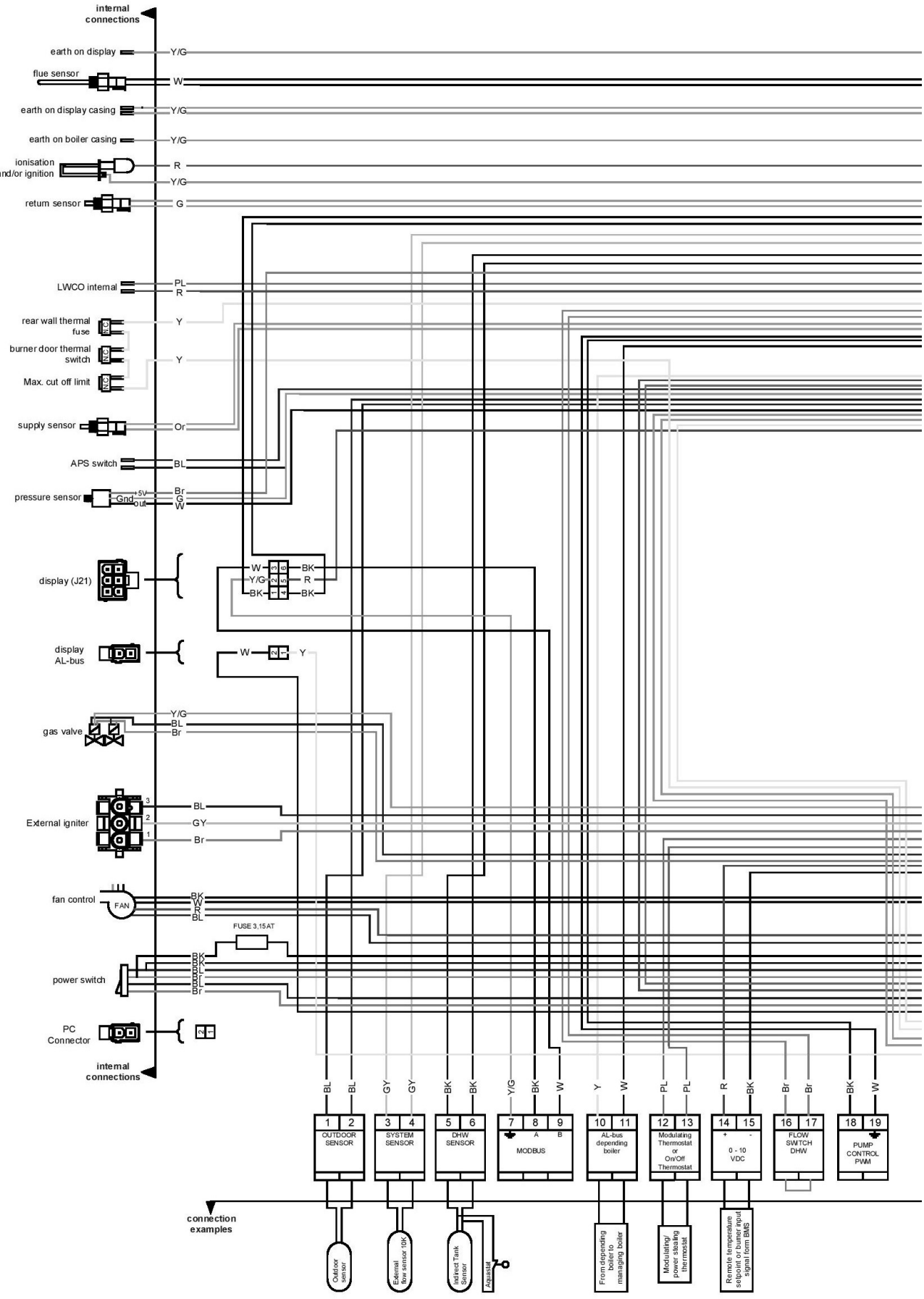


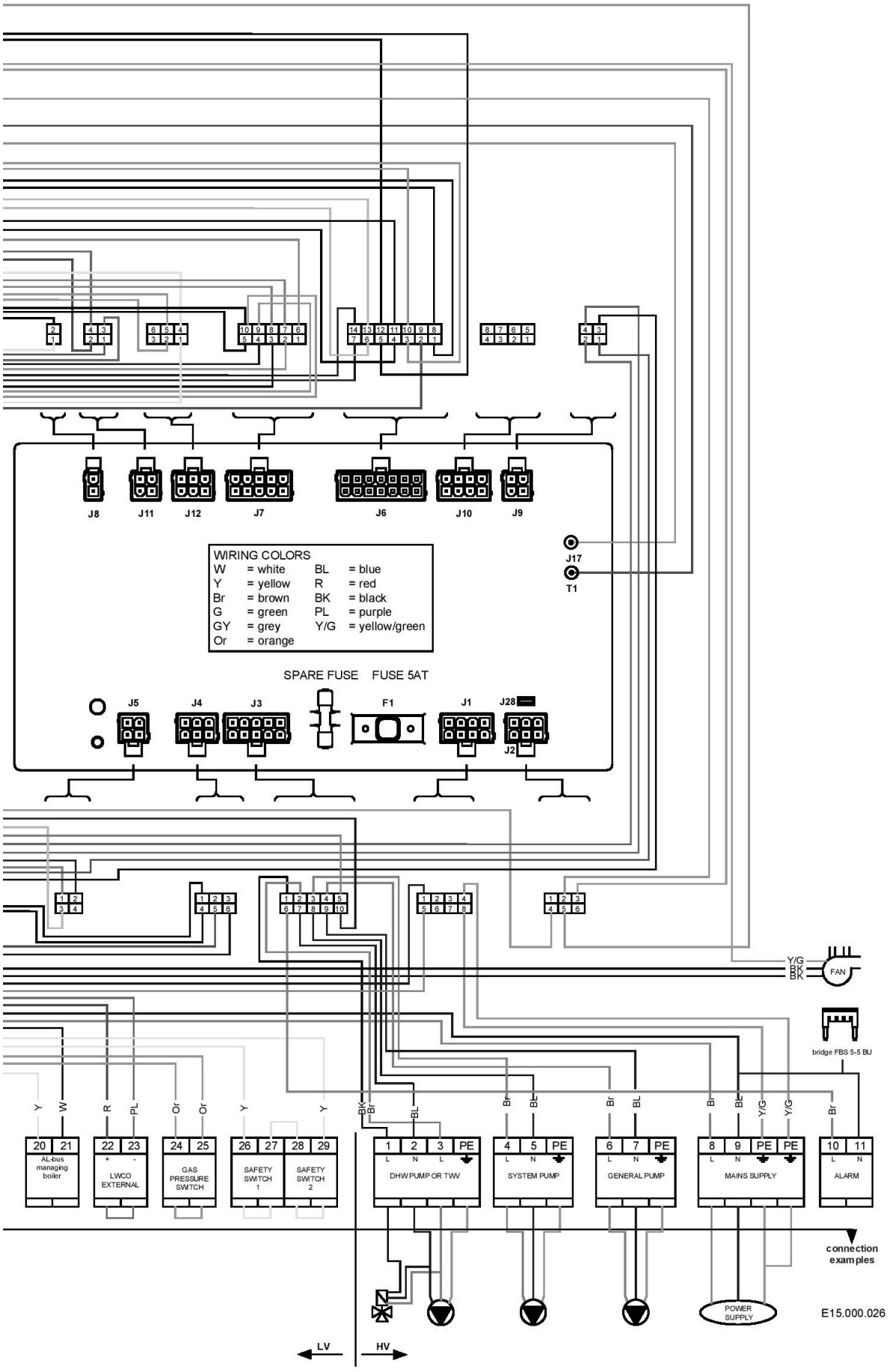
11.4.1 EXPLANATION OF THE LOW VOLTAGE CONNECTIONS.

1-2	OUTDOOR SENSOR
If an outdoor temperature sensor is connected, the boiler will control the supply water temperature by using a calculated setting based on outdoor reset curve, which is related to the outdoor temperature.	
3-4	**SYSTEM SENSOR**
If a low loss header is used, this sensor measures the flow temperature at the system side. The sensor must be mounted on the supply pipe or in a sensor well at the system side, close to the low loss header. NOTICE: This sensor (see 15.1 "Cascading - system setup") must be used when boilers are cascaded with the internal cascade manager. PARAMETER: boiler parameter 122, see § 11.9 "programmable in- and outputs"	
5-6	**DHW SENSOR**
When an indirect hot water tank is installed, the DHW mode must be set to 1 or 2. When the DHW mode is set to 1, a sensor can be connected. This sensor must be mounted in a well in the tank. The boiler will now modulate towards the hot water setpoint. When the DHW mode is set to 2, an aquastat can be connected. When the set temperature is reached, the aquastat will switch off and the boiler will stop serving hot water.	
7-8-9	**MODBUS**
Connections for a MODBUS communication signal. 7 = ground, 8 = A, 9 = B (A detailed Modbus bulletin is available at your supplier on request)	
10-11	**AL-BUS DEPENDING**
Cascade connections for the dependent boilers, must be parallel linked together. NOTICE: link all connections 10 to 10 and all connections 11 to 11, do not mix these. Link connections 10 of the dependent boilers to 20 of the managing boiler, and connections 11 of the dependent boilers to 21 of the managing boiler.	
12-13	**ON/OFF STAT OR MODULATING THERMOSTAT**
OPTION 1: An ON/OFF thermostat can be connected. If these terminals are bridged, the set/ programmed flow temperature of the boiler will be used. OPTION 2: A Modulating controller can be connected to these terminals. The boiler software will detect and use this Modulating signal automatically. Not all Modulating thermostats will work with the EFB boiler control, please check with the thermostat supplier before purchasing. PARAMETER: boiler parameter 124, see § 11.9 "programmable in- and outputs"	

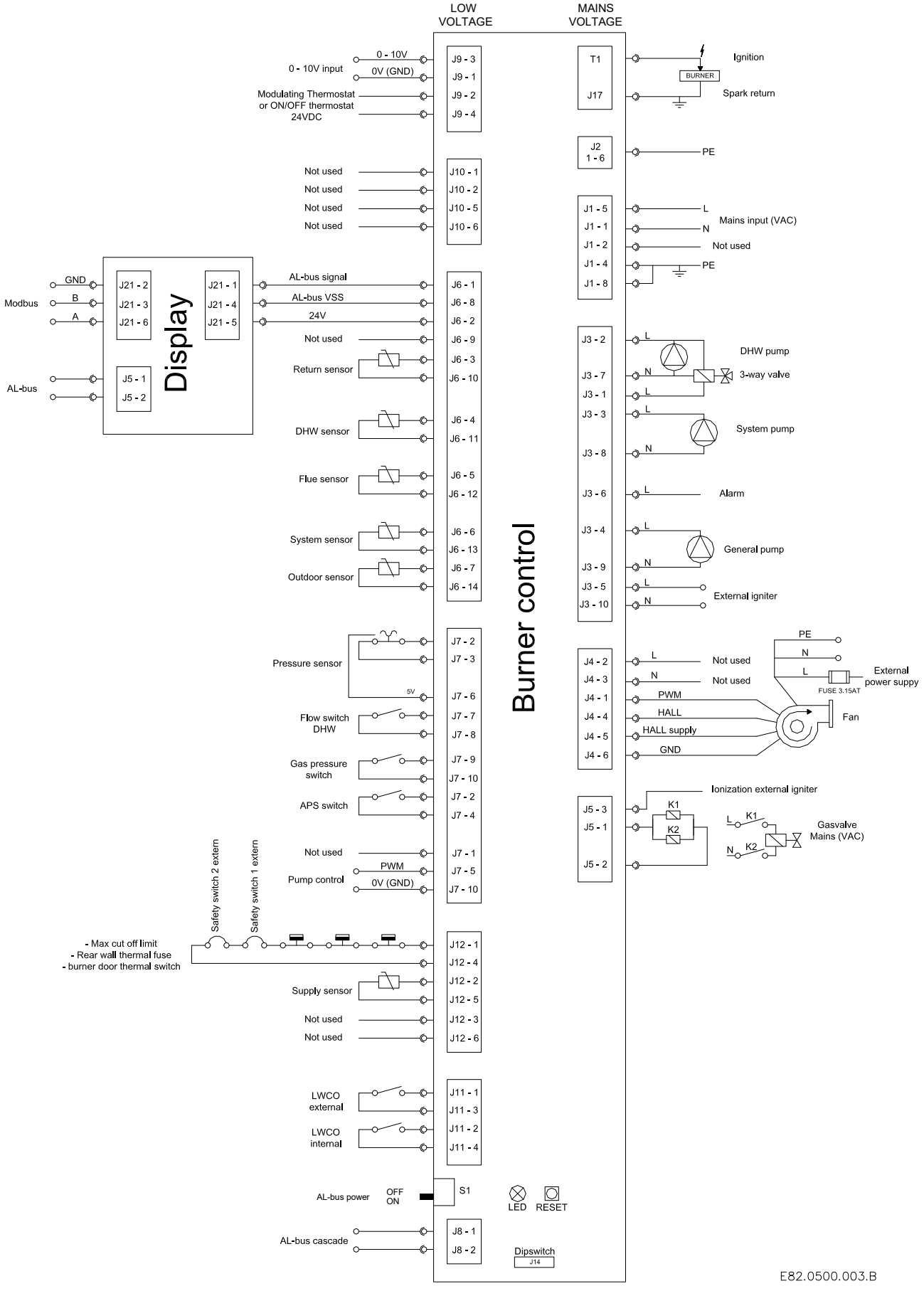
14-15	0-10 VDC CONTROL SIGNAL
These terminals are used for an external 0-10 VDC control input signal. NOTICE: Terminal 14 [+] (positive) and terminal 15 [-] (negative).	
16-17	**DHW - FLOW SWITCH**
For DHW_Mode 3 a flow switch can be connected. If a water flow is present, the switch closes, and the DHW pump is started. The temperature of the DHW is set with DHW_Setpoint. PARAMETER: boiler parameter 117, see § 11.9 "programmable in- and outputs"	
18-19	**PWM – PUMP CONTROL**
These connections are used to control the boiler pump. The PWM signal determines the speed of the pump, when there is a heat demand. 18 = Signal, 19 = Ground Parameter 136 is factory set to modulating pump.	
20-21	**AL-BUS MANAGING**
Cascade connection for the managing boiler. Link connection 20 of the managing boiler to connections 10 of the depending boilers, and connection 21 of the managing boiler to connections 11 of the depending boilers.	
22-23	**LWCO EXTERN**
To be used for an extra external Low Water Cut Off. The boiler goes into a lockout when this contact opens	
24-25	**GAS PRESSURE SWITCH**
To be used for an extra external gas pressure switch. The boiler goes into a lockout when this contact opens PARAMETER: boiler parameter 118, see § 11.9 "programmable in- and outputs"	
26-27	**SAFETY SWITCH 1**
To be used for an extra external safety switch. The boiler goes into a lockout when this contact opens	
28-29	**SAFETY SWITCH 2**
To be used for an extra external safety switch. The boiler goes into a lockout when this contact opens	

11.5 ELECTRICAL SCHEMATICS




J8
J11
J12
J7
J6
J10
J9
J17
T1
WIRING COLORS
W = white
Y = yellow
Br = brown
G = green
GY = grey
Or = orange
BL = blue
R = red
BK = black
PL = purple
Y/G = yellow/green
SPARE FUSE FUSE 5AT
J5
J4
J3
F1
J1
J28
J2
FAN
bridge FBS 5-5 BU
20 21 AL-bus managing boiler
22 23 LWCO EXTERNAL
24 25 GAS PRESSURE SWITCH
26 27 SAFETY SWITCH 1
28 29 SAFETY SWITCH 2
1 2 3 PE DHW PUMP OR TWV
4 5 PE SYSTEM PUMP
6 7 PE GENERAL PUMP
8 9 PE PE MAINS SUPPLY
10 11 ALARM
connection examples
POWER SUPPLY
E15.000.026
LV
HV

11.6 LADDER/LOGIC DIAGRAM



11.7 SENSOR AVAILABILITY

The following table shows the sensor availability for all CH and DHW control modes. Sensors not mentioned in the table are optionally available for other functions

	CH Mode					
	0	1	2	3	4	5
T_Supply	M	M	M	M	M	M
T_Return	O	O	O	O	O	O
T_DHW	O	O	O	O	O	O
T_Outdoor	---	M	M	O	O	
0-10 Volt	O	O	O	O	M	M
Water Flow DHW	O	O	O	O	O	---
RT Switch	M	M	M	M	M	---
M = Mandatory, O = Optional, --- = Disabled.						

CH mode 0 – Central Heating demand with thermostat control
CH mode 1 – CH with an outdoor temperature reset and thermostat control
CH mode 2 – Central Heating with full outdoor temperature reset
CH mode 3 – Central Heating with permanent heat demand
CH mode 4 – Central Heating with analogue input control of set point
CH mode 5 – Central Heating with analogue input control of power output

	DHW Mode								
	0	1	2	3	4 N.A.	5 N.A.	6 N.A.	7 N.A.	8 N.A.
T_Supply	O	M	M	O	M	O	M	M	M
T_Return	O	O	O	O	M	O	---	O	M
T_DHW	---	M	---	M	M	M	M	---	M
T_Outdoor	O	O	O	O	O	O	---	---	O
0-10 Volt	O	O	O	O	O	O	O	O	O
Water Flow DHW	O	O	O	O	O	M	O	M	M
RT Switch	O	O	M	O	O	O	O	O	O
M = Mandatory, O = Optional, --- = Disabled, N.A. = Not Available.									

DHW mode 0 – No Domestic Hot Water
DHW mode 1 – Storage with sensor
DHW mode 2 – Storage with thermostat
DHW mode 3 – Instantaneous water heating with plated heat exchanger, flow switch and DHW-out sensor.
DHW mode 4 to 8 N.A.

11.8 NTC SENSOR CURVE

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

All NTC sensors are according to this characteristic: NTC 10K@25°C B3977k

11.9 PROGRAMMABLE IN- AND OUTPUTS

It is possible to re-program some in- and outputs to other functions. To do this use the list below and go to:
Menu\settings\boiler settings\"1122" (installer password)\boiler parameters

boiler parameter	name	default	description	terminal
(117)	Prog. Input 2.	2	DHW flow switch	LV 16-17
(118)	Prog. Input 3.	2	Gas pressure switch	LV 24-25
(122)	Prog. Input 7.	3	Cascade sensor	LV 3-4
(124)	Prog. Input RT.	1	room thermostat on	LV 12-13
(125)	Prog. Output 1.	4	System pump	HV 4-5
(126)	Prog. Output 2.	0	External igniter	separate connector
(127)	Prog. Output 3.	6	Alarm relay	HV 10-11
(128)	Prog. Output 4.	18	3-way Valve DHW	HV 3-2-1

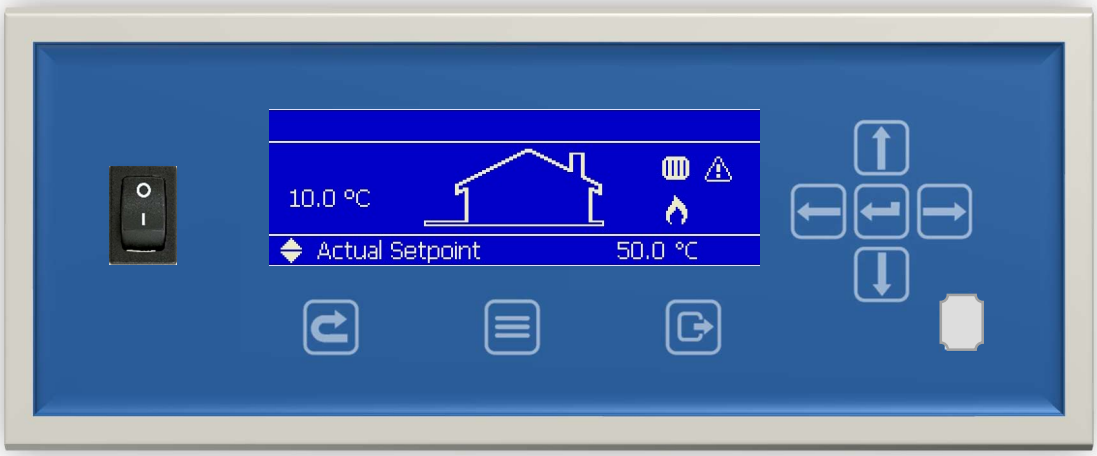
To all outputs following applies:
Maximum current 2 A each output.
Total output of all currents combined maximum 3.5 A.
The inrush current of the 3-way valve and/or pumps is maximum 8 A.

para-meter	Display:	**INPUTS:**	remark
(117)	Prog. Input 2.	0 Disabled	
		1 DHW flow sensor	N.A.
		2 DHW flow switch	
		3 CH flow sensor	N.A.
		4 CH flow switch	
(118)	Prog. Input 3.	0 Disabled	
		1 Drain switch	
		2 Gas pressure switch	
(122)	Prog. Input 7.	0 Disabled	
		1 T_Flue_2 sensor	N.A.
		2 T_Flue_2 with blocked flue	N.A.
		3 Cascade sensor	
		4 Blocked Flue switch	N.A.
		5 CH Sensor	
(124)	Prog. Input RT.	0 room thermostat off	
		1 room thermostat on	
	Display:	**OUTPUTS**:	
(125)	Prog. Output 1.	0 Disabled	
		1 Module pump	
		2 CH pump	
		3 DHW pump	
		4 System pump	
		5 Cascade pump	
		6 Alarm relay	
		7 Filling valve	
		8 LPG tank	
		9 Ext. Igniter	
		10 Air damper	
(126)	Prog. Output 2.	0 Disabled	
		1 Module pump	1)
		2 CH pump	1)
		3 DHW pump	1)
		4 System pump	1)
		5 Cascade pump	1)
		6 Alarm relay	1)
		7 Filling valve	1)
		8 LPG tank	1)
		9 External igniter	1)
		10 Air damper	1)

parameter	Display:	**OUTPUTS**:	re-mark
(127)	Prog. Output 3.	0 Disabled	
		1 Module pump	N.A.
		2 CH pump	N.A.
		3 DHW pump	N.A.
		4 System pump	N.A.
		5 Cascade pump	N.A.
		6 Alarm relay	2)
		7 Filling valve	2)
		8 LPG tank	2)
		9 Ext. Igniter	2)
		10 Air damper	2)
(128)	Prog. Output 4.	0 Disabled	
		1 Module pump	
		2 CH pump	
		3 DHW pump	
		4 System pump	
		5 Cascade pump	
		6 Alarm relay	
		7 Filling valve	
		8 LPG tank	
		9 Ext. Igniter	
		10 Air damper	
		11 empty	
		12 empty	
		13 empty	
		14 empty	
		15 empty	
		16 empty	
		17 3-way Valve CH	
		18 3-way Valve DHW	
		19 3-way Valve CH (power when idle)	
		20 3-way Valve DHW (power when idle)	

Remarks:
1) Prog. Output 2: (external igniter); this is a separate connector, the pin in the middle is for ionization, it has no PE connection. If earth is needed, it must be connected to the main earth terminal.
2) Prog. Output 3: (alarm relay); this is a triac output with an active voltage of 230 VAC, it can only handle resistive loads between 5 and 50 Watt.

12 DISPLAY AND BUTTONS



12.1 EXPLANATION OF THE BUTTONS

	On / off switch. Switches electrical power to the boiler
	Connector for computer cable
	Reset lockout error
	Main Menu
	Escape / Return to the status overview
	**Right** Enter a menu item or confirm selection in Status overview (when directly setting Actual setpoint or DHW setpoint)
	**Left** Return to previous menu item or Status overview
	**Up** Directly select Actual setpoint of DHW setpoint in the Status overview, push RIGHT to confirm and use UP or DOWN to adjust value.
	**Down** Directly select Actual setpoint of DHW setpoint in the Status overview, push RIGHT to confirm and use UP or DOWN to adjust value.
	**Enter** Confirm a setting or enter a menu item

12.2 DISPLAY CONFIGURATION.

The Status overview has three different sections that show specific information:

Header

- Left: For cascade systems the cascade icon is shown, with the cascade manager indication (M) or the dependent number.
- Centre: Shows the CH and/or DHW disabled icons when CH and/or DHW is disabled
- Right: Shows the time (only if the real-time clock is available).

Icon	Description
	Cascade icon CH
	Disabled
	DHW Disabled

Middle section

- Left: Shows user-configured information (by default only the outside temperature):

Line	Info
Top	Burner state (when enabled)
Middle	Configured/selected temperature (one of the following): ▪ Outside temperature ▪ Demand based (Flow or DHW temperature based on active demand) ▪ Flow temperature ▪ DHW temperature ▪ System temperature (module cascade flow/supply temperature) ▪ Cascade temperature (boiler cascade flow/supply temperature)
Bottom	CH water pressure (when enabled)

- Centre: The house icon is always displayed.

- Right side: Shows several status icons:

Icon	Description
	CH demand
	DHW demand
	Emergency mode is active (for cascade systems only) Burner is
	on (and flame is detected)
	Frost protection is active
	Anti-legionella program is active.
	Error is set in the Main Control (see footer for error description)

Footer

Shows Error/Warning messages when an Error or Warning is set in the Main Control, otherwise a quick menu is displayed where the user can quickly edit setpoints and enable/disable CH or DHW.

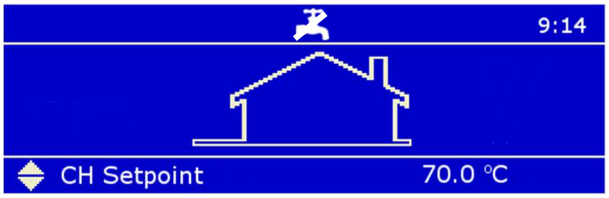
12.3 STARTING THE BOILER

If the boiler is not on make sure the gas switch beneath the boiler is open and the power cord is connected to the mains, use the on/off button to switch the boiler on. The following screen will appear:

This Status screen is active during power up and will remain active until communication with the Main Control has been established.

After communication has been established the Dair mode is running and the following screen appears:

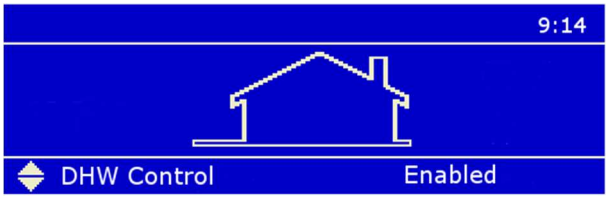
The "De-Air" sequence is a safety function that starts at every power-up and is used to remove the air from the heat exchanger. The De-Air sequence takes around 14 minutes to complete. It can be cancelled by pressing the Enter button for over 5 seconds.
After completion or manual ending the "De-Air" sequence one of the following Status overview screens appears:



Central Heating only

Note: Cascade dependents will only have the 'Calculated Setpoint' available

OR



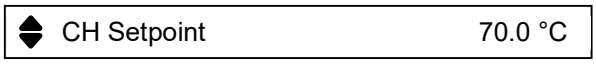
Central Heating
AND
Domestic Hot Water

12.3.1 SET CH/DHW SETPOINT AND/OR ENABLING CH/DHW

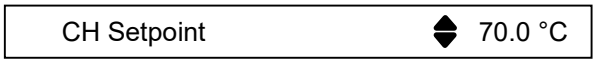
Setting can be done directly via the Status overview or via the MENU.
When CH is active, you can adjust the Actual setpoint directly on the bottom of the Status overview. When DHW is active, you can adjust the DHW setpoint directly on the bottom of the Status overview.
This means that when CH is active, you cannot set the DHW setpoint directly via the Status overview. When DHW is active, you also cannot set the Actual setpoint (CH setpoint) directly via the Status overview.

12.3.2 CHANGING THE CENTRAL HEATING SETPOINT DIRECTLY

Press the UP or DOWN button to select the mode:



70.0 °C is just an example of a possible temperature value.
Use the left/right buttons to move the ▲▼ sign to the front of the temperature digits.

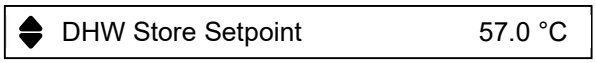


Use UP/DOWN buttons to increase/decrease the setpoint.
Press the ENTER or RIGHT button to confirm your alteration or press the BACK or LEFT button to cancel

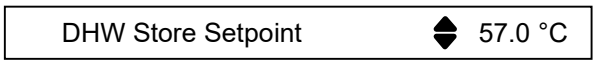
12.3.3 CHANGING THE DHW SETPOINT DIRECTLY

Only applicable if this function is available.

Press the UP or DOWN button to select the mode:



57.0 °C is just an example of a possible temperature value.
Use the left/right buttons to move the ▲▼ sign to the front of the temperature digits.

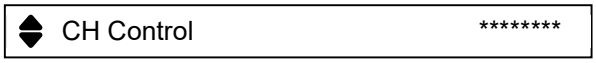


Use UP/DOWN buttons to increase/decrease the setpoint.
Press the ENTER or RIGHT button to confirm your alteration or press the BACK or LEFT button to cancel.

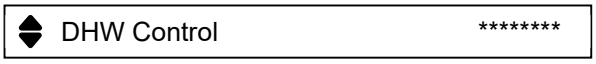
A setpoint is only visible on the main screen when no error or alert is active. In case of an active error or alert, the bottom right part of the PB screen is used to display the error or alert

12.3.4 ENABLE/DISABLE CH OR DHW CONTROL

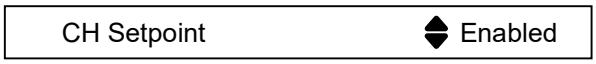
The CH or DHW Enable/Disable option is available when its set-up in the software (by the installer) only.
Press the UP or DOWN button to select the mode:



OR



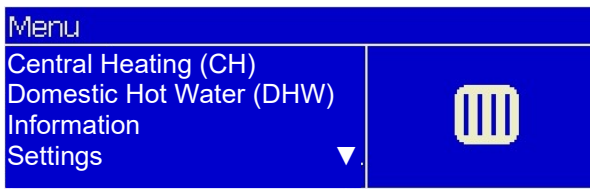
Use the left/right buttons to move the ▲▼ sign to the front of Enable/Disable text.



Use UP/DOWN buttons to change from Enabled to Disabled or vice versa
Press the ENTER or RIGHT button to confirm your alteration or press the BACK or LEFT button to cancel

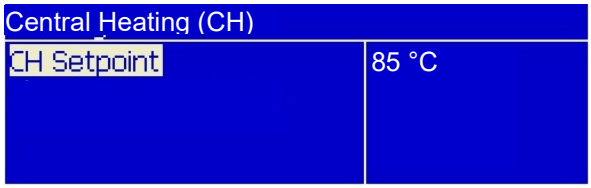
12.3.5 SET ACTUAL CH SETPOINT/DHW SETPOINT BY THE MENU

Enter the menu by pressing the MENU ☰ button once. The header in the display shows you are inside the main menu. While scrolling through the menu you will see that the selected menu item is shown in a white rectangle.

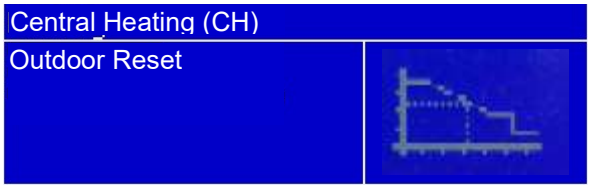


Enter a menu item by pressing CONFIRM ↵ or RIGHT →.
The header shows your location inside the menu, as seen in the following image:

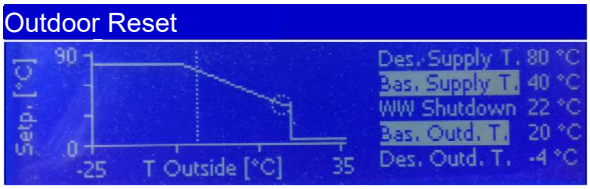
If you are inside the menu (or a menu item) and want to return directly to the Status overview press MENU ☰ or ESC ⎋ If you want to go back one step in the menu press BACK/LEFT ←.



If CH-mode is set to:
CH mode 1 – CH with an outdoor temperature reset and thermostat control
Or
CH mode 2 – Central Heating with full outdoor temperature reset
The following display will appear:



Enter a menu item by pressing CONFIRM ↵ or RIGHT →
The header shows your location inside the menu, as seen in the following image:



It now is possible to set the Outdoor reset curve by changing the parameters on the right hand of the screen.

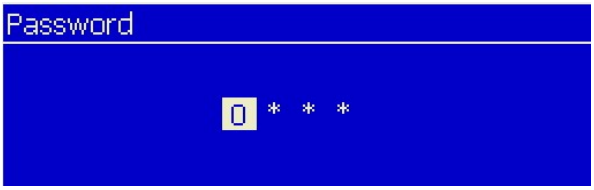
If you are inside the menu (or a menu item) and want to return directly to the Status overview press MENU ☰ or ESC ⎋ if you want to go back one step in the menu press BACK/LEFT ←.

12.3.6 PROTECTED MENU ITEMS

The display supports 3 different access levels; each with its own set of available menu items/parameters:

Level	Description
0: User	Basic info and settings only that are accessible for everyone.
1: Installer	Advanced information and settings; only to be accessed by an experienced installer/person.
2: Factory	Highest level information and settings, only available/relevant for factory Engineers.

Access the Installer and Factory user level by entering the correct access code (password) for the desired user level. If a certain menu item has been selected, the following password screen will appear where a specific password has to be entered:



Changing protected/safety parameters may only be carried out by Lochinvar service engineers or agents. Hazardous burner conditions can happen with improper operations that may result in property loss, physical injury, or death.

Enter the password with the following steps:

1. Use the UP/DOWN ↑↓ button to adjust the first number
2. Press CONFIRM ↵ or RIGHT → to confirm and to go to the following number

Repeat this action for all numbers to enter the password.
During this action, if you want to return to the previous screen, just press MENU ☰ or ESC ⎋ to cancel. After the password is entered in correctly press ENTER/RIGHT to confirm and access the menu item.
When a correct password is entered the selected user-level is unlocked. This is displayed by an icon (padlock or key) in the top bar, the associated number indicates which user-level is unlocked (1:Installer, 2:Factory).
In the main menu an extra choice appears: Log out. With this option you leave the protected menu.

The following menu items also require a password*:

(Sub) Menu item	Location inside menu
Startup Settings	Settings / General Settings / Other Settings / Startup Settings
Boiler Parameters	Settings / Boiler Settings / Boiler Parameters
Module Cascade Settings	Settings / Boiler Settings / Module Cascade Settings
Boiler Cascade Settings	Settings / Boiler Settings / Boiler Cascade Settings

12.3.7 DE-AERATION SEQUENCE

The “De-Aeration” sequence is a safety function that starts at every power ON and after reset of the boiler and is used to remove the air from the heat-exchanger.

The display will show the following string during DAir sequence:
• “Dair Running”
• “Dair Error Water Pressure”

The DAir sequence can be cancelled by the user by pressing the Enter button for over 5 seconds.

12.3.8 LANGUAGE SETTINGS

The display supports the following languages:

- Chinese
- Croatian
- Czech
- Dutch
- English
- French
- German
- Greek
- Hungarian
- Italian
- Polish
- Portuguese
- Romanian
- Russian
- Slovak
- Slovene
- Spanish
- Turkish

The following paragraph describes how to change the display language. No matter which language you have set, the menu icons will always remain universal

12.3.9 CHANGE THE LANGUAGE VIA THE MENU

Please follow the next steps, which describe how to set the display to a specific language:

1. From the Status Overview, press the MENU button once
2. Select “Settings” (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button
3. Select “General Settings” (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button
4. Select “Language” (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button
5. Select the desired language (press UP/DOWN ↑↓ to highlight/select) and press the CONFIRM button

- For Chinese select ‘中文’.
- For Croatian select ‘Hrvatski’.
- For Czech select ‘Česky’.
- For Dutch select ‘Nederlands’
- For English select ‘English’.
- For French select ‘Français’.
- For German select ‘Deutsch’
- For Greek select ‘Ελληνικά’.
- For Hungarian select ‘magyar’
- For Italian select ‘Italiano’
- For Polish select ‘Polski’.
- For Portuguese select ‘Português’.
- For Romanian select ’Românesc’.
- For Russian select ‘Русский’
- For Slovak select ‘Slovenský’.
- For Slovene select ’Slovenščina’.
- For Spanish select ‘Español’.
- For Turkish select ‘Türkçe’.

Press ESC to go back in the menu and return to the Status overview.

12.3.10 CHANGE THE LANGUAGE VIA THE MENU ICONS

The next steps describe how to change the display language via the icons displayed inside the menu, which can be useful if a foreign language is set, causing the user not able to understand the menu.

1. From the Status overview, press the MENU button once.
   Scroll down until the SETTINGS icon appears on the right-side of the display (and press ENTER):
2. In the following menu, press the SETTINGS icon again (and press ENTER):
3. In the following menu screen, select the LANGUAGE icon (and press ENTER to access the Language menu):
4. Select the desired language by scrolling through the list of available languages.
   Press ENTER to set the desired language, after you will automatically return to the General settings menu. Press ESC a few times until you have reached the Status Overview again.

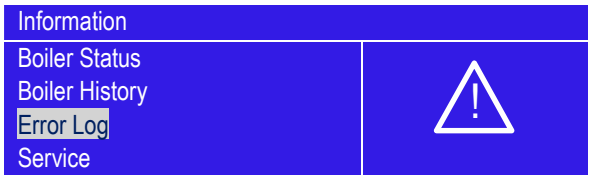
12.4 BOILER HISTORY

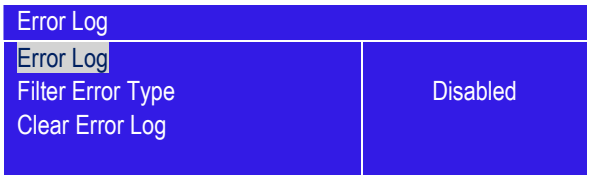
The boiler history found in the information menu displays several history counters that keep track of the boiler usage. The history cannot be erased and will continue for the burner controller life cycle. The following boiler history data is available:

(Sub) Menu item	Description
Successful Ignitions	Number of successful ignitions.
Failed Ignitions	Number of failed ignitions.
Flame Failures	Number of flame failures (loss of flame).
Total system run time	Total hours that the appliance is operational (powered ON).
CH Burner Hours	Number of hours that the appliance has burned for Central Heating.
DHW Burner Hours	Number of hours that the appliance has burned for Domestic Hot Water.
Anti-Legionella count	Total number of completed anti-legionella cycles

12.5 ERROR LOGGING.

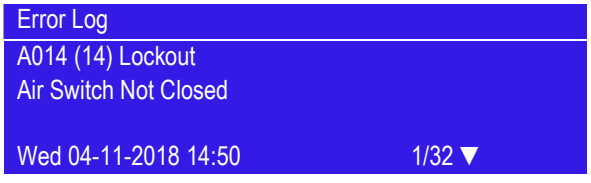
Error logging is available. This functionality is linked to the Real-Time Clock functionality.
Errors will be logged for a stand-alone system or for a complete cascade system (based on the cascade settings).
The PB display will monitor the error codes it receives from the boiler(s) and if an error code is a new error code the error will be stored in the error log. An error will be logged with a (real-time clock) time stamp (date and time) when the error was detected and a boiler ID of the boiler on which the error was detected.
The error log can be viewed from the error log menu, which is located in the information menu.





(Sub) Menu item	Description
Error Log	Show the error log (based on the selected filter options)
Filter Error Type	Filter errors based on the Error Type (Lockout/Blocking)
Filter Boiler ID (Cascade System only)	Filter errors based on Boiler ID (Managing, Dep 1, Dep 2, etc.)
Clear Error Log	Clear the error log (protected by password)

When no filtering option is selected (Disabled) the error log will show all errors for that category. So, if both filters are disabled, the error log will show all the errors in the log.



The error log screen will show on the first line: Boiler ID for which boiler the error was detected (cascade system only), Error Code, (internal) Error Number, Error Type (Lockout/Blocking).
The second line will show the Error Description.
The bottom line will show the Time Stamp (date and time) when the error was detected (in the format as configured in the Date Time Settings menu), and also the selected error index from the total number of errors in the (filtered) error log. Only Time Stamp, Code and Description is displayed.

Example, see picture. On page previous page
A014 = Error code.
(14) = Error Number (tracking number, 1-15 errors are stored maximum).
Lockout = Error type.
Air Switch Not Closed = Error description.
Wed 04-11-2018 14:50 = Time stamp when the error occurred.

12.6 SERVICE REMINDER

The Service reminder will remind the owner/user of the appliance to service the appliance at a specified "Service Interval", factory set on 2000 burn hours. When service is not done within this time, a service reminder will be shown on the screen: "Service is required!" alternating with the normal status display.

NOTE: with the message "Service is required" the boiler keeps running, but maintenance must be done before resetting this message.

12.6.1 SERVICE OVERDUE LOGGING

Menu/ Information/ Service/ Service history.
When the Service reminder has become active, the time (in hours) it takes before service is actually done is being logged. This time is called the Service Overdue Time.
A maximum of 15 service moments can be logged by the system. When the log is full it will overwrite the oldest log entry. Each time the Service reminder is reset, a new service moment is logged (counted) and the Service Overdue counter will be stored in the log/history.

12.6.2 RESET THE SERVICE REMINDER

It is possible to reset the Service reminder counters before the Service reminder was actually active. This must be done when the appliance was serviced before the Service reminder was active.
This means an overdue counter of 0 hours will be stored on the log (which makes sense because the service was not overdue but ahead of schedule).

To remove the message "Service is required": menu/ Information/ Service/ "Reset service reminder".
Enter the installer password, the "Reset service reminder" can be set to "YES" for resetting the service reminder. The overdue time is recorded in the service history.

12.6.3 MENU'S AND PARAMETERS

Service status information can be viewed: Menu/ Information/ Service.
Here the installer can also reset the Service reminder (accessible at installer level).

(Sub) Menu item	Description
Service history	View the Service history (log). For each service moment the Service overdue counter is stored. When the overdue counter is 0 hrs., it means service was done before the Service reminder was active. The log is ordered so the most recent service moment is shown first (on top of the list).
Hours since last service	Shows the number of hours (or burn hours) since the last service moment
Burn hours since last service	Shows the number of burn hours since the last service moment.
Hours till service	Shows the number of hours (or burn hours) until service is required
Burn hours till service	Shows the number of burn hours until service is required.
Hours till shutdown	When the Service shutdown function is enabled and the Service reminder is active, the number of hours until the appliance is shut down will be shown
Reset service reminder	Reset the Service reminder (and store Service overdue counter in the service history). Installer must enter the installer password first before it can be reset.

12.7 GENERAL

The burner controller is designed to function as a standalone control unit for intermittent operation on heating appliances with a premix (modulating) burner and a pneumatic air-gas system.

Fuses	Mains input 1 x 5AT, 230V
Flame establishing period	2 seconds
Safety time	5 seconds
Ignition attempts	3
Pre-purge time	≥ 2…60 seconds (not safety critical)
Pre-ignition time	2 seconds (not safety critical)
Flame failure response time	< 1.0 second
Flame-current	Minimum 1.0 µA Start-detection 1.5 µA
Cable length AL-BUS[1]	mm² (AWG) Cable length m (ft)
	0.25 (23) 100 (328.1 ft)
	0.5 (20) 200 (656.2 ft)
	0.75 (18) 300 (984.3 ft)
	1.0 (17) 400 (1312.3 ft)
	1.5 (15) 600 (1968.5 ft)
1) This is the total length of the cable, not the length between two boilers. The length differs with the diameter of the cable.	

12.7.1 PUMP START EVERY 24 HOURS

To protect the pump from getting stuck at a certain position it is forced to run for 10 seconds every 24 hours. This is done only for the boiler loop pump at the start-up of the board.

12.7.2 FROST PROTECTION

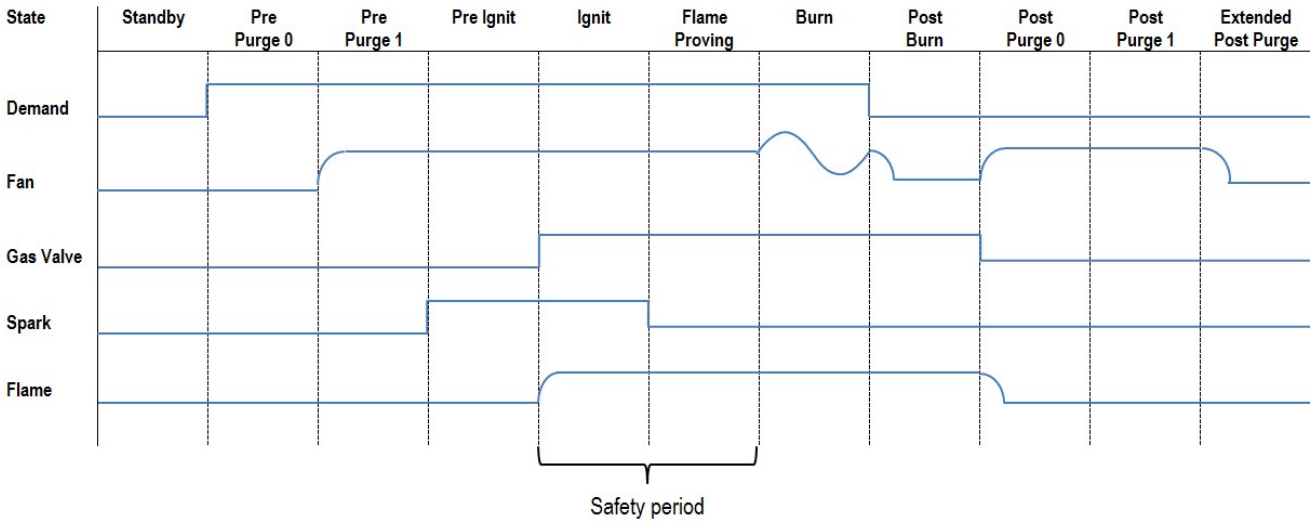
The Frost protection function protects the boiler and boiler loop from freezing.
The T_Supply, T_Supply_2 and T_Return sensors are checked for generating a Frost protection demand.

- When any of the sensors drop below FP_Start_Pump the boiler loop pump is switched ON for CH.
- When any of the sensors drop below FP_Start_Burn the boiler is fired.
- When all of the sensors measure above FP_Stop the Frost protection demand is ended.

When the demand for Frost protection is ended the pumps will post-circulate for CH_Post_Pump_Period.
Parameters are factory set

12.8 IGNITION CYCLE

During the ignition cycle multiple safety checks are active



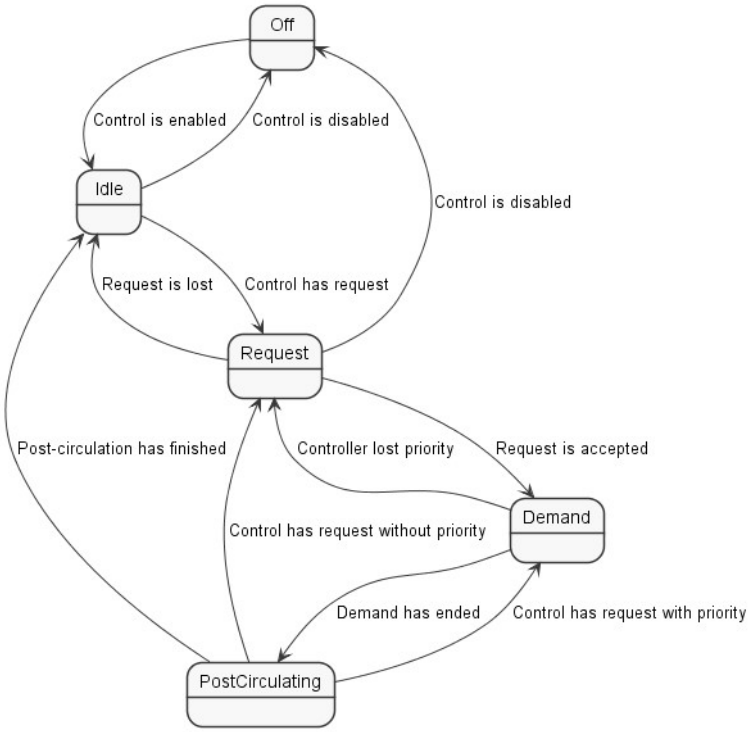
The table below shows the states of the burner ignition cycle, as shown in the diagram above:

#	Burner state	Actions
0	INIT	▪ Controller initialization
1	RESET	▪ Software reset (and initialization)
2	STANDBY	▪ Standby (waiting for demand)
3	PRE_PURGE_0	▪ Fan is not running ▪ When an APS is enabled the APS position is checked
4	PRE_PURGE_1	▪ Fan starts at ignition speed ▪ When an APS is enabled the APS position is checked
5	PRE_IGNIT	▪ Fan stays at ignition speed ▪ Igniter is started ▪ When a LPG tank is selected, the tank valve is opened
6	IGNIT	▪ Fan stays at ignition speed ▪ The gas valve is opened ▪ Igniter stays on ▪ When a LPG tank is selected, the tank valve stays opened
7	FLAME_PROVING	▪ Fan stays at ignition speed ▪ The gas valve stays opened ▪ The igniter is stopped ▪ When a LPG tank is selected, the tank valve stays opened
8	BURN	▪ The fan is modulating ▪ The gas valve stays opened ▪ When a LPG tank is selected, the tank valve stays opened ▪ When an APS is enabled the APS position is checked
9	POST_BURN	▪ Fan is set to minimum speed ▪ The gas valve stays opened
10	POST_PURGE_0	▪ The fan is set at ignition speed ▪ The gas valve is closed ▪ When a LPG tank is selected, the tank valve is closed
11	POST_PURGE_1	▪ Fan stays at ignition speed ▪ When an APS is enabled the APS position is checked
12	ERROR_CHECK	▪ Blocking error is set ▪ Checking if blocking error can be removed (error situation is solved)
13	ALARM	▪ Lockout error is set ▪ User must reset the lockout error (and the controller will reboot)
14	BURNER_BOOT	▪ Finalise processes and reboot the control

During the ignition cycle multiple safety checks are active:

False flame detection	If flame is detected at the end of the pre-spark period (*Pre_Ignit*) a lockout error will occur.
Re-ignition	If at the end of the safety period no flame is detected the control will go to *Post_Purge* to remove any unburned gas. After this a re-ignition attempt is started following the same cycle. The number of re-ignition attempts is limited to *Max_Ignit_Trials* after which a lockout occurs.
Flame establishing time	Sparking stops in the *Flame_Proving* state to allow for ionization detection. The *Flame_Proving* state takes *Safety_Period - Ignit_Period*.
Flame out too late	If at the end of the *Post_Purge* 0 state the flame is still detected a lockout follows.
Flame loss	When a flame is lost during a burn cycle the control will restart the burner. The number of restarts is limited by the *Max_Flame_Trials* setting.
Fan supervision	The fan speed is continuously monitored. The following conditions for the fan speed are checked: ▪ The actual fan speed must be within 300RPM of the target fan speed ▪ When the fan speed duty cycle is within the lower/upper 5% of the PWM duty cycle range no errors will be generated since the fan is in the limits of its working range.

12.8.1 CONTROL FUNCTIONS



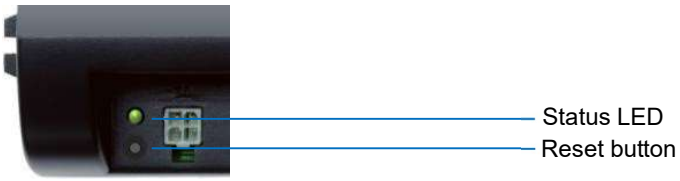
Dependent on the required functions of the appliance and connected sensors and components, several operation modes for Central Heating (CH) and Domestic Hot Water (DHW) can be selected, which are described hereafter.
The demand controls all work according to a defined state machine. The diagram below shows how the controller states are implemented

Each state has a specific meaning for the controller. Below the various states are explained in more detail.

Controller State	Description
Off	The controller is disabled. The controller cannot generate request from this state. When the controller is enabled the controller state will move to the Idle state.
Idle	The controller is enabled. There is no request present. When a request becomes present the controller will move to the Request state. In case the controller is disabled the controller will move to the Off state.
Request	The controller is enabled. There is an active request present. The active request is not yet accepted by the demand controller. Once the active request is accepted the controller state moves to the Demand state. When the request is lost the controller state moves back to the Idle state. In case the controller is disabled the controller will move to the Off state.
Demand	The controller is enabled. There is an active request that has been accepted by the demand controller. The control is actively handling its heat-request. This state does not mean that the burner is on. The burner state can be monitored using the Burner State variable. When the active request is lost the controller will move to the post-circulating state. When the priority for the active request is lost the controller falls back to the Request state. In case the controller is disabled the controller moves to the Post-circulating state.
Post-circulating	The control is post-circulating. During this state the pumps continue to run for a short while. When the post-circulation time has finished the control moves to the Idle state. When the post-circulation time has finished and the control is no longer enabled the control moves to the Off state. When a higher priority demand becomes active the post-circulation is ended and the controller moves to the Idle state.

12.8.2 ON BOARD HMI AND LED COLOURS

On the burner controller a basic on-board Human Interface (HMI) is available which consists of a push button and a 2 colour (red/green) LED. These are used to indicate basic status information about the control.



900MN

Control operational
When the control is operational and there are no errors present the LED will show as a constant green colour.

Control locked
When the control is locked the LED will show as a constant red colour. When the control is locked the control can be reset by using the push button. When the reset has been accepted the control is reset and the status LED will return to show the green colour

Control blocked
When the control is blocked the LED will alternate between green and red with a 1 second interval. When the blocking error is solved the LED will return to show only the green colour.

Exceptions
In case the communication between the main and watchdog processor cannot be established the LED will not follow the status from the control. In this situation the watchdog processor will reset in an attempt to restore the communication. When this occurs the LED will appear as green with short pulses in which the LED is off.

12.8.3 FLAME DETECTION

When the boiler is firing, and the flame is not detected anymore, the gas valve will be closed, and the controller will perform a post-purge, after which a restart will take place.
When the flame disappears three times within one heat demand, the controller will lockout.
The presence of a flame is measured through the flame rod that points into the flame. Between this pen and earth an electromagnetic field is present. When a flame is present, the free electrons in the flame flow from the pen to the earth. This flow of electrons is the flame current. The flame current is measured by the controller as ionization in micro amps (µA).

When the flame current is above Flamerod_Setpoint + Flamerod_Hysterese (1.0 µA + 0.5 µA) a flame will be present. When the flame current is below Flamerod_Setpoint (1.0 µA) the flame will not be present.

12.8.4 FLAME RECOVERY

When the ionization current is too low, the system responds by increasing the minimal fan speed, in order to keep the flame present.

Whenever the ionization current is high enough, the minimal fan speed will be decreased again. When the flame still disappears the minimal fan speed will be increased for the next burn cycle.

- When the flame current is below Flamerod_Setpoint + Flamerod_Delta (1.0 µA + 0.2 µA) the minimal fan speed will be increased.
- When the flame current is above Flamerod_Setpoint + Flamerod_Delta + Flamerod_Delta * 2 (1.0 µA + 0.2 µA + 0.4 µA) the minimal fan speed will be decreased.

When the flame still disappears the minimal fan speed will be increased for the next burn cycle.

No. of flame losses	Description
0	Minimal fan speed as set in the system
1	In between minimal and ignition fan speed
2	Ignition fan speed

When the system successfully completes a burn cycle, the minimal fan speed will be reset to the set minimal fan speed in the system.

12.9 CONTROL FUNCTIONS

Dependent on the required functions of the appliance and connected sensors and components, several operation modes for Central Heating (CH) and Domestic Hot Water (DHW) can be selected.

12.9.1 CH WITH ROOM THERMOSTAT ONLY; CH MODE 0 (DEFAULT SETTING)

For this mode the CH mode must be set to 0 and no outdoor sensor is needed. A room thermostat (on/off or modulating) must be connected to inputs 12 and 13 of the low voltage connection terminal.

If the room thermostat closes, the boiler and system pumps are switched ON. When the supply temperature drops CH_Hysterese_Down below the CH_Setpoint (settable via the menu) the boiler is switched ON. The power for the boiler is PID regulated between T_Supply and the CH_Setpoint using the PID parameters for Central Heating.
If the supply temperature reaches a temperature CH_Hysterese_Up above the CH_Setpoint the boiler is switched OFF. However, if CH_Setpoint + CH_Hysterese_Up is greater than maximum setpoint the boiler switches OFF at the maximum setpoint.
If the room thermostat opens the boiler is switched OFF (if this was not already happening) and the boiler and system keep running for CH_Post_Pump_Time.

Anti-cycling time
(This function is also applicable to all other CH modes) When the boiler is switched OFF because the supply temperature reaches CH_Set-point + CH_Hysterese_Up, the controller will wait a period of time (Anti_Cycle_Period →180 sec. settable) before it is allowed to be switched ON again.
This function is to prevent short cycling ON and OFF of the boiler. However, when during the anti-cycle wait time the differential between setpoint and supply temperature gets greater than Anti_Cycle_T_Diff, anti-cycle will be aborted, and the boiler is allowed to start.

Maximum CH power
(This function is also applicable to all other CH modes)
The maximum boiler power during CH operation can be limited with parameter P_CH_Max.

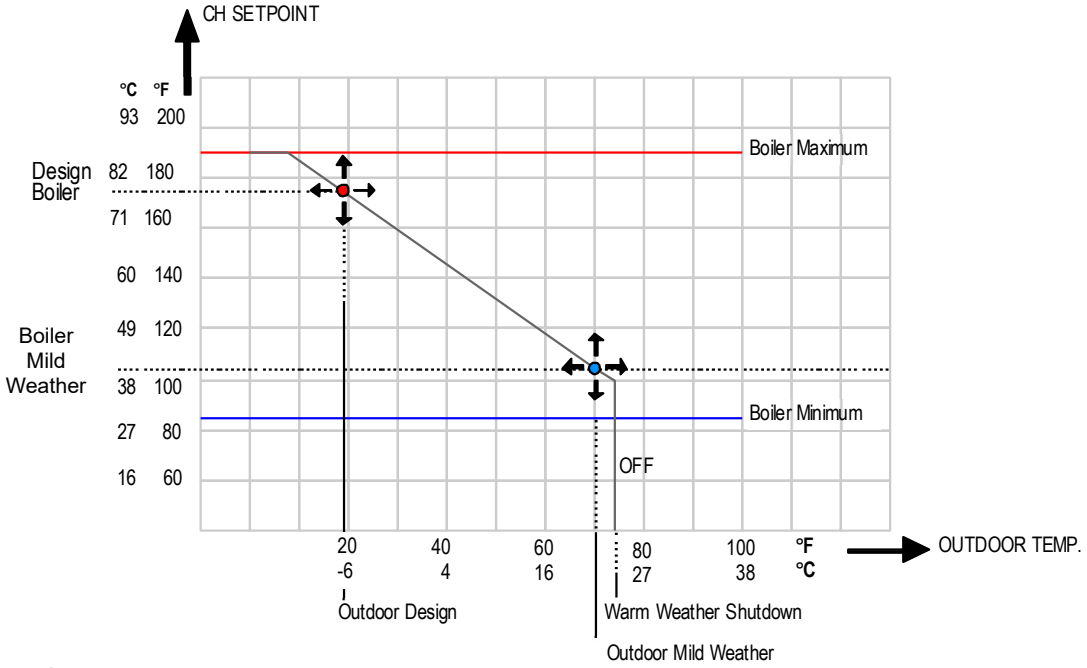
Minimum CH power
(This function is also applicable to all other CH and DHW modes)
The minimum boiler power during operation can be limited with parameter P_CH_Min.

Adjustable Set Point Heating Parameters

Specific Parameters	Level	Default Value	Range
CH_Mode	2: Installer	0	Mode 0-5
CH Setpoint Sets the required supply temperature.	2: Installer	85 ºC (185 ºF)	20…..90 ºC (68…..194 ºF)
CH_Post_Pump_Time	2: Installer	120 sec.	10…..900 sec
Anti_Cycle_Period	2: Installer	180 sec	10…..900 sec
Anti_Cycle_T_Diff Aborts anti-cycle time when setpoint – actual supply temp >*Anti_Cycle_T_Diff.*	2: Installer	16 ºC (29 ºF)	0…..20 ºC (0…..36 ºF)
P_CH_Max Maximum boiler power for CH operation	2: Installer	100 %	1…..100 %
P_CH_Min Minimum boiler power for CH operation	2: Installer	1 %	1…..50 %

12.9.2 CH WITH OUTDOOR TEMPERATURE RESET AND THERMOSTAT; CH MODE 1

If the parameter CH_Mode is set to 1, the “Outdoor temperature reset with room thermostat” mode is selected.
This mode will only function when an outdoor temperature sensor is connected to inputs 1 and 2 of the low voltage connection terminal. If no outdoor temperature sensor is connected, the boiler automatically uses Reset_Curve_Design_Boiler as the setpoint.
The setpoint is calculated depending on the outdoor temperature as indicated in the following graph and the boiler will react on the room thermostat (as described in 12.9.1 "CH with room thermostat only...").



CH outdoor reset curve

The outdoor reset curve can be changed by adjusting the design and mild weather reference temperatures. The calculated CH-setpoint is always limited between parameters Reset_Curve_Boiler_Minimum and Reset_Curve_Boiler_Maximum.
The outdoor temperature used for the CH_Setpoint calculation is measured once a minute and averaged with the previous measurement. This is to avoid commuting when the outside temperature changes rapidly.
If an “open” outdoor sensor is detected the CH_Setpoint will be equal to the Reset_Curve_Design_Boiler.

Shutdown temperature

When the outdoor temperature rises above Warm_Weather_Shutdown, the call for heat is blocked and the pumps are stopped. There is a fixed hysteresis of 1 °C (1.8 °F) around the Warm_Weather_Shutdown setting.
This means that the demand is stopped when the outdoor temperature has risen above Warm_Weather_Shutdown plus 1 °C (1.8 °F). When the outdoor temperature drops below Warm_Weather_Shutdown minus 1 °C (1.8 °F) again, the demand will also start again.

Boost function

The outdoor reset boost function increases the CH_Setpoint by a prescribed increment (Boost_Temperature_Incr) if a call for heat continues beyond the pre-set time limit (Boost_Time_Delay).

Boiler Parameters		
(25) Warm Weather Shutdn	22 °C	▲
(26) Boost Temp increment	0 °C	
(27) Boost Time Delay	20 min	
(28) Night Setback Temp.	4 °C	▼

These are parameters 26 Boost Temp Increment and 27 Boost Time Delay.
And have a default value of 0 °C (0 °F) and 20 min, so the function is switched off and can be activated by the installer by increasing parameter 26 by a number of degrees. Also, the time can be set when this parameter will be active in parameter 27 now set on 20 min.
CH_Setpoint increases again if the call for heat still is not satisfied in another time increment.

Setpoint adjustment

It is possible to adjust the calculated setpoint with parameter CH_Setpoint_Diff. The calculated setpoint can be increased or decreased with a maximum of 10 ºC (18 °F). The CH setpoint limits (Reset_Curve_Boiler_Minimum and Reset_Curve_Boiler_Maximum) are respected while adjusting the setpoint.
Apart from the calculated setpoint the functionality is the same as described in 12.9.1 "Room thermostat only...”

Adjustable Outdoor Reset parameters

Parameters	Level	Default Value	Range
CH_Mode	2: Installer	0	Mode 0-5
Reset_Curve_Design_Boiler Sets high boiler CH setpoint when outdoor temp. is equal to *Reset_Curve_Outdoor_Design.*	2: Installer	80 ºC (176 ºF)	0…..80 ºC (32…..176 ºF)
Reset_Curve_Outdoor_Design Sets the outdoor temp at which the boiler setpoint must be high as set by *Reset_Curve_Design_Boiler.*	2: Installer	-5 ºC (23 ºF)	-20…..5 ºC (-4…..41 ºF)
Reset_Curve_Boiler_Mild_Weather Sets low boiler CH setpoint when outdoor temp. is equal to *Reset_Curve_Outdoor_Mild_Weather.*	2: Installer	40 ºC (104 ºF)	0…..40 ºC (32…..104 ºF)
Reset_Curve_Outdoor_Mild_Weather Sets the outdoor temp at which the boiler setpoint must be low as set by *Reset_Curve_Mild_Weather.*	2: Installer	20 ºC (68 ºF)	0…..30 ºC (32…..86 ºF)
Reset_Curve_Boiler_Minimum Sets the lower limit for the CH setpoint (minimum).	2: Installer	30 ºC (86 ºF)	20…..90 ºC (68…..194 ºF)
Reset_Curve_Boiler_Maximum Sets the upper limit for the CH setpoint (maximum).	2: Installer	90 ºC (194 ºF)	20…..90 ºC (68…..194 ºF)
Warm_Weather_Shutdown Set max. outdoor temp. Above this temperature heat demand is blocked.	2: Installer	22 ºC (72 ºF)	0…..35 ºC (32…..95 ºF)
Boost_Temperature_Incr CH setpoint increment when heat demand remains beyond *Boost_Time_Delay.*	2: Installer	0 ºC (0 ºF)	0…..20 ºC (0…..36 ºF)
Boost_Time_Delay	2: Installer	20 min.	1 – 120 min.
CH_Setpoint_Diff Adjusts the calculated CH setpoint.	1: User	0 ºC (0 ºF)	-10…..10 ºC (-18…..18 ºF)

Status variables	Range
Actual_CH_Setpoint Calculated CH setpoint, based on outdoor reset curve.	20.....90 ºC (68...194 ºF)

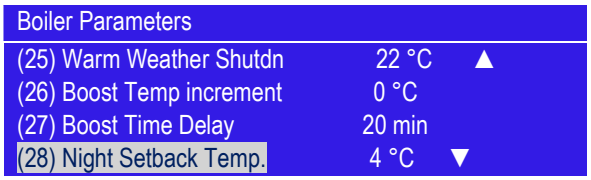
12.9.3 CH WITH FULL OUTDOOR TEMPERATURE RESET; CH MODE 2

When CH_Mode is set to 2, full weather compensator is chosen. For this mode an outdoor sensor has to be connected. The CH_Setpoint is calculated on the same way as described in 12.9.2 "CH with an outdoor temperature reset and thermostat; CH mode 1"

However, the demand does not depend on the Room Thermostat input but on the outdoor temperature and the outdoor reset setpoint. When the outdoor temperature is below Warm_Weather_Shutdown (settable) CH demand is created.

During the night an input signal from an external clock can lower the CH_Setpoint. When the RT input opens CH_Setpoint will be decreased with Night_Setback_Temp. The RT input does not influence the CH demand directly!

This can be done by connecting a relay contact or clock thermostat to terminal 12 and 13 on the low voltage connection terminal. The room thermostat is only being used in this function to switch between a night setback temperature and a daytime temperature, there is always a constant demand for heat in CH mode 2.
The Night Setback temperature can be set by using the installer password and changing parameter 28 in the boiler parameters, default value is setpoint 4 ºC.



Adjustable full weather compensation Parameters

Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0 - 5
Warm_Weather_Shutdown Set max. outdoor temp. Above this temperature heat demand is blocked.	2: installer	22 ºC (72 ºF)	0...35 ºC (32...95 ºF)
CH_Setpoint_Diff Adjusts the calculated CH setpoint.	1: User	0 ºC (0 ºF)	-10...10 ºC (-18...18 ºF)

12.9.4 CH WITH CONSTANT CIRCULATION AND PERMANENT HEAT DEMAND; CH MODE 3

For this mode no outdoor sensor is needed. The supply temperature is kept constantly at the setpoint temperature. The boiler is controlled in a similar way as described in 12.9.1 "CH with room thermostat only...".

When the room thermostat contact opens CH_Setpoint will be decreased with Night_Setback_Temp. In this condition the pump is always ON.

Please note that the pump starts every 24 hours function is not performed during this mode. In this mode the pump will be running continuously.

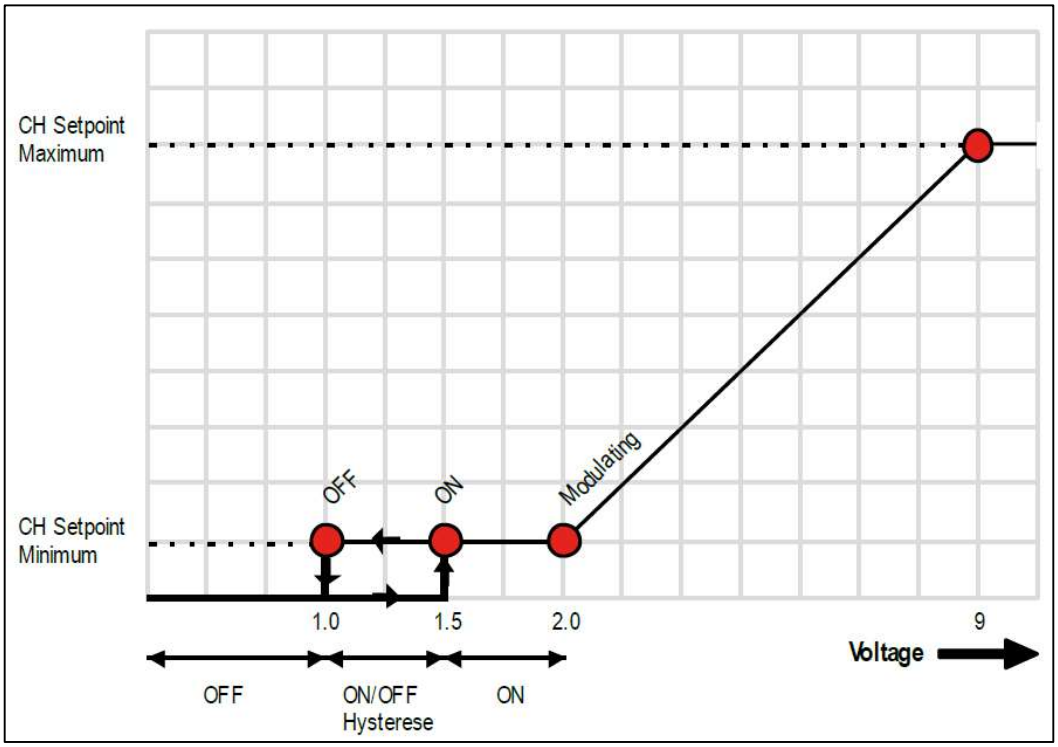
Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0 - 5
CH_Setpoint	2: Installer	85 ºC (185 ºF)	20…..90 ºC (68…..194 ºF)

12.9.5 CH WITH ANALOGUE INPUT CONTROL OF SETPOINT; CH MODE 4

In this mode of operation, the boiler CH setpoint is controlled by an analogue input signal provided by a remote means such as a Building Management System or a system controller. The analogue input 0-10 VDC is used to adjust the boiler setpoint between the CH_Setpoint_Min and the CH_Setpoint_Max settings.

The minimum analogue input signal will correspond to the CH_Setpoint_Min parameter and the maximum analogue input signal will correspond to the CH setpoint maximum parameter. All other safety and control functions associated with the boiler will react normally to adverse condition and override control of the analogue signal to prevent an upset condition. This means for example that when signal is going up faster than the boiler can regulate that the boiler will slow down to prevent overshoot in temperature.

The CH_Setpoint_Min and CH_Setpoint_Max parameters can be adjusted to provide the desired temperature adjustment band. A heat request will be generated by an input of 1.5 volts or higher. The setpoint modulation will occur between 2 and 9 volts. The request for heat will be removed when the voltage drops below 1 volt.



- The room thermostat connection needs to be bridged (low voltage connections 12 and 13) to activate the 0-10V signal
- Min/Max CH setpoint is limiting 0-10V range.

Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0, 1, 2, 3, 4, 5
CH_Setpoint_Minimum (par. 110)	2: Installer	20 ºC (68 ºF)	20...90 ºC (68...194 ºF)
CH_Setpoint_Maximum (par. 111)	2: Installer	85 ºC (185 ºF)	20...90 ºC (68...194 ºF)

12.9.6 CH WITH ANALOGUE INPUT CONTROL OF POWER OUTPUT; CH MODE 5

In this mode of operation, the boiler power (boiler input) is controlled by an analogue input signal provided by a remote means such as a Building Management System or a system controller. The analogue input 0-10 VDC is used to adjust the boiler power output between the minimum boiler input and the maximum boiler input settings.

The minimum analogue input signal value will correspond to the minimum modulation rate and the maximum modulation analogue input signal value will correspond to the maximum modulation rate.
All other safety and control functions associated with the boiler will react normally to adverse condition and override control of the analogue signal to prevent an upset condition.

A heat request will be generated by an input of 1.5 volts or higher. The fan speed modulation will occur between 2.0 and 9.0 volts. The request for heat will stop when the voltage drops below 1 volt.

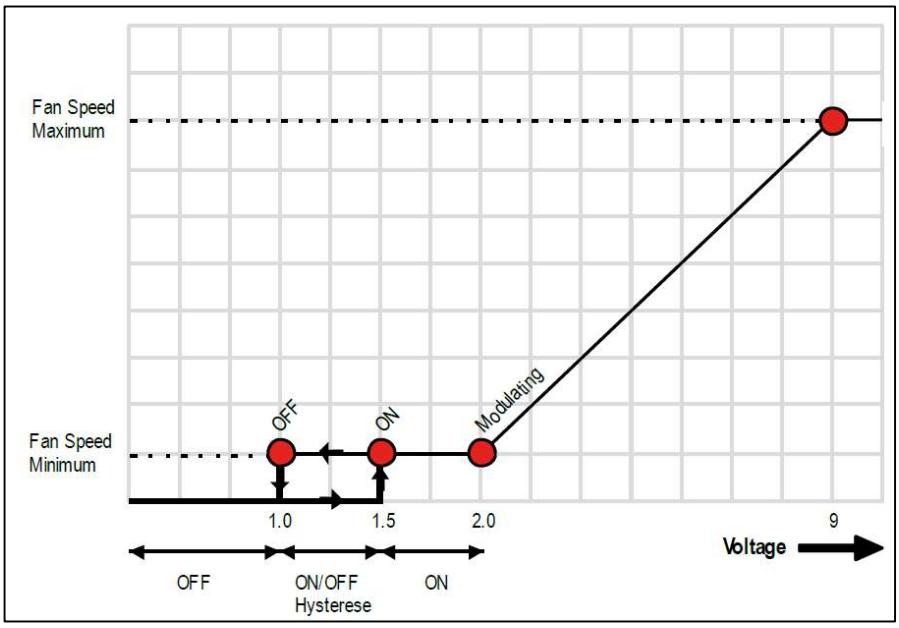


Figure 12. 1

- CH mode 5 will work without sensors.
- The room thermostat connection needs to be bridged (low voltage connections 12 and 13) to activate the 0-10V signal

Parameters	Level	(Default) Value	Settable
CH_Mode	2: Installer	0	Mode 0, 1, 2, 3, 4, 5

When using CH mode 5 the temperature needs to be controlled by an external temperature controller. When boiler has a supply temperature of 95ºC (203ºF) the boiler switches off and gives a blocking code “High Temp Error” (105) wait until temperature has dropped to 90ºC (194ºF) now the boiler will start again. So the external controller needs to reduce the 0-10V signal or switch the boiler off before it reaches 95ºC (203ºF).

When using a modulating pump on pwm signal the pump will only run on the fixed pwm signal. This signal can be changed in parameter (136) Mod. Pump Mode. The pump will not modulate on delta T setpoint. When you want to use a delta T controlled setpoint of the pump use CH-mode 4.

12.10 DEMAND FOR DOMESTIC HOT WATER

12.10.1 NO DOMESTIC HOT WATER; DHW MODE 0

No domestic hot water is available. The T_DHW_Out sensor does not need to be connected.

12.10.2 DHW STORAGE WITH SENSOR; DHW MODE 1

Mode 1: DHW is prepared by warming up a store. Either a DHW pump or 3-way valve can be used to switch to DHW mode. A tank sensor must be connected to inputs 5 and 6 of the low voltage connection terminal.

The DHW temperature in the tank is measured with sensor T_Store and set with parameter DHW_Store_Setpoint.
When this sensor drops below DHW_Store_Setpoint minus DHW_Store_Hyst_Down the controller detects a demand for the store and starts the general and DHW pump.
If the supply temperature T_Supply is below DHW_Store_Setpoint plus DHW_Store_Supply_Extra – DHW_Supp_Hyst_Down the boiler is started as well.

When the boiler is ON the power is PID-modulated so T_Supply is regulated towards
DHW_Setpoint + DHW_Store_Supply_Extra.

The boiler is stopped when the supply temperature rises above
DHW_Store_Setpoint + DHW_Store_Supply_Extra + DHW_Supp_Hyst_Up.

The demand for the tank is ended when the tank-sensor rises above
DHW_Store_Setpoint + DHW_Store_Hyst_Up. The pump continues DHW_Post_Pump_Period.

DHW Priority
Standard DHW demand has priority over CH demand but the priority period is limited up to
DHW_Max_Priority_Time. The priority timer starts when both CH and DHW demand are present. After the DHW_Max_Priority_Time is achieved, the controller will switch from DHW to CH operation. CH has priority now for a maximum period of DHW_Max_Priority_Time.

Different DHW Priority types can be chosen:

DHW priority	Description
0 = Time	DHW has priority to CH during *DHW_Max_Priority_Time*
1 = OFF	CH always has priority to DHW
2 = ON	DHW always has priority to CH

Default *DHW_Priority* is set to 2.

Store warm hold function
Because of the presence of the indirect tank sensor (*T_Store*) the controller can detect demand for holding the indirect tank hot. If *T_Store* drops below *DHW_Store_Setpoint - DHW_Store_Hyst_down* the boiler starts.
The boiler stops if *T_Store* is higher than *DHW_Store_Setpoint + DHW_Store_Hyst_Up*.

Relevant variables

Specific Parameters	Level	(Default) Value	Range
DHW_Mode	2: Installer	0	0, 1, 2, 3, 5, 6, 7, 8
DHW_Store_Setpoint Sets the desired DHW temperature.	1: User	65 ºC (149 ºF)	40...71 ºC (104...160 ºF)
DHW_Store_Supply_Extra Increases the supply temperature to the store until *DHW_Store_Setpoint + DHW_Store_Supply_Extra.*	2: Installer	15 ºC (59ºF)	0...30 ºC (0...86 ºF)

Status Variables	Value
DHW control state Central Heating controller state	0 = Idle
	1 = Request
	2 = Demand
	3 = Post circulation
	4 = Off

12.10.3 DHW STORAGE WITH THERMOSTAT; DHW MODE 2

In this mode DHW is prepared by warming up an indirect tank. Either a DHW pump or 3-way valve can be used to switch to DHW mode. The temperature of the DHW in the indirect tank is regulated by a thermostat/aquastat (instead of a sensor), which must provide only an open/closed signal to the controller.

When the thermostat/aquastat closes the controller detects a demand from the DHW indirect tank and starts the DHW pump.
If the supply temperature T_Supply drops below DHW_Store_Setpoint minus DHW_Supp_Hyst_Down the boiler starts. When the boiler is ON the power is PID-controlled based on T_Supply toward DHW_Store_Setpoint.

The boiler is stopped when the supply temperature rises above DHW_Store_Setpoint plus DHW_Supp_Hyst_Up.
The demand for DHW ends when the indirect tank thermostat/aquastat opens. The pump continues DHW_Post_Pump_Period after the DHW demand has stopped.

DHW priority
See 12.10.2 "DHW Storage with sensor; DHW Mode 1"

Relevant variables

Specific Parameters	Level	(Default) Value	Range
DHW_Mode	2: Installer	0	0, 1, 2,3, 4, 5, 6, 7, 8
DHW_Store_Setpoint Sets the supply temperature from the boiler to prepare DHW in the indirect tank	2: User	65 ºC (149 ºF)	40…85 ºC (104…185 ºF)
DHW_Priority	[-]	2	0=Time, 1=OFF, 2=ON
DHW_Max_Priority_Time Sets the maximum time for either DHW or CH priority.	2: Installer	60 min.	
DHW_ Pump_Overrun	2: Installer	120 sec.	10...900

12.10.4 INSTANTANEOUS WATER HEATING WITH PLATED HEAT EXCHANGER; DHW MODE 3

In DHW mode 3 the water flow through a plated heat exchanger is checked with a flow switch. If the switch closes a water flow is detected, and either a DHW pump or a 3-way valve can be used to switch to DHW mode. The temperature of the DHW is set with *DHW_Setpoint*.

If the *T_DHW_Out* sensor drops below *DHW_Setpoint* minus *DHW_Hyst_Down* the burner starts. When the burner is on, the power is PID-controlled based on *T_DHW_Out* toward *DHW_Setpoint*. The burner stops when the *T_DHW_Out* temperature rises above *DHW_Setpoint* plus *DHW_Hyst_Up*. When the flow switch opens the demand for the tapping is ended and the burner stops. The pump continues *DHW_Post_Pump_Period.*

Based on a DHW temperature rise of 50 °C (90 °F) following minimum and maximum DHW flows are advised:

Boiler model	Minimum flow (litre/ min)	Maximum flow (litre/ min)
EFB 85	4.4	23.5
EFB 105	5.3	27.9
EFB 125	6.8	34.3
EFB 155	10.0	41.7

Specific Parameters	Level	(Default) Value	Range
DHW_Mode	2: Installer	0	0, 1, 2,3, 4, 5, 6, 7, 8
DHW_Setpoint Sets the desired DHW temperature	2: User	60 ºC (140 ºF)	30…80 ºC (86…176 ºF)
DHW_Pump_Overrun	2: Installer	20 s	10…900 s

12.10.5 ANTI-LEGIONELLA PROTECTION

Anti-Legionella protection is enabled for DHW modes with an external tank with a sensor (DHW Mode 1) and when DHW is not switched OFF.

To prevent legionella a special function is implemented in the software.

When DHW Mode 1 is selected the Anti-Legionella protection will be checked on the T_DHW_Out sensor.
At least once every 168 hours (7 days) the Anti_Legionella_Sensor must reach a temperature above Anti_Legionella_Setpoint for a time specified by Anti_Legionella_Burn_Time.

If 7 days have passed and these conditions are not met, the boiler is forced to heat-up the system for Anti-Legionella. When the Anti_Legionella_Sensor temperature is below Anti_Legionella_Setpoint the controller switches ON the pumps, when the Anti_Legionella_Sensor temperature is above Anti_Legionella_Setpoint 5 °C (41 °F) the controller stops the pumps.

When DHW Mode 1 is selected the boiler setpoint will be at Anti_Legionella_Setpoint + DHW_Store_Supply_Extra

If the supply temperature drops below the Boiler_Setpoint the boiler is started as well. The boiler is PID controlled towards the Boiler_Setpoint. When the supply temperature rises above boiler setpoint + DHW_Supp_Hysterese_Up the boiler is switched OFF.

When the Anti_Legionella_Sensor is above Anti_Legionella_Setpoint minus 3 °C (minus 5.4 °F) for Anti_Legionella_Burn_Time the controller goes into post circulation and ends the Anti-Legionella demand. When the controller has powered up, the Anti_Legionella_Sensor temperature must reach a temperature of Anti_Legionella_Setpoint (for Anti_Legionella_Burn_Time) within 2 hours, otherwise the boiler is forced into Anti-Legionella demand.

Every time an Anti-Legionella demand has ended the Anti_Legionella_Active_Counter is incremented to indicate how many Anti- Legionella actions have been performed. Also the Anti Legionella wait time is started to delay the next anti legionella cycle.

The anti-legionella demand has priority over any DHW and CH demand. However, when the anti-legionella protection is active and there is no heat or burn demand because the Anti_Legionella_Sensor is already at a high enough temperature CH/DHW demand will be accepted as normal.

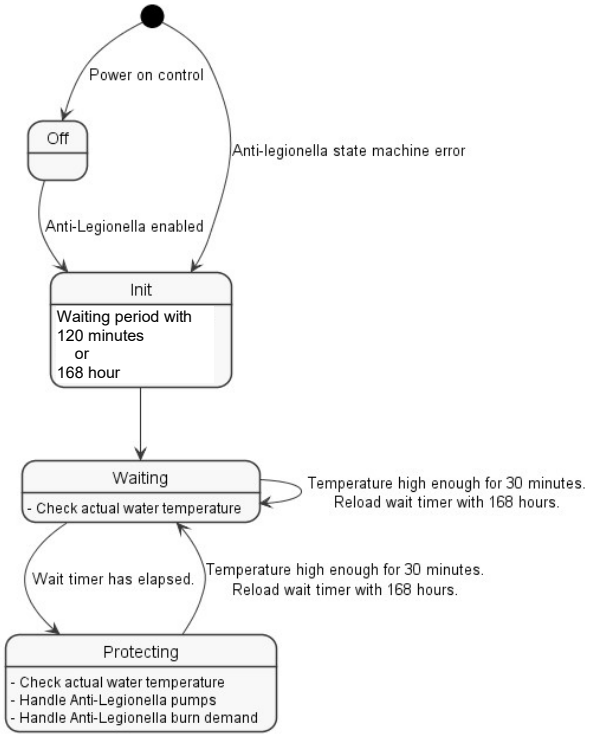
Below parameters can be set by the installer(DHW Modus 1 only)

Parameter	Installer.
(107) Anti Legionella Day	Sunday
(108) Anti Legionella hour	0 Hours

Below Parameters are factory set

Parameter	Factory Setting.
Anti_Legionella_Setpoint Setpoint for Anti-Legionella demand	60 ºC (140 ºF)
Anti_Legionella_Burn_Time	30 Min.
Anti_Legionella_Wait_Time Wait time for Anti-Legionella demand.	120 min after cold start, 168 h after first successful Anti-Legionella demand

After a cold boot of the control the Anti-legionella cycle is forced to start after 120 minutes.
When the Anti-legionella request is active the measured sensor temperature must stay above *Anti_Legionella_Setpoint – 3°C* for at least *Anti_Legionella_Burn_Time*. When the measured sensor temp. drops below this level the *Anti_Legionella_Burn_Time* is reloaded
The diagram below shows how the state machine for Anti-Legionella is implemented.



Burn demand generation

When the anti-legionella control has an active request a burn demand can be generated. The burn demand is generated according to the following rules

Start demand

- The demand is started when the measured sensor temperature is below the burner setpoint

Stop demand

- The demand is stopped when the measured sensor temperature is above the burner setpoint + 5°C

Status information

Every time an anti-legionella demand ends the Anti_Legionella_Active_Counter is incremented to indicate how many anti-legionella actions have been performed. This counter can be found in the 'Boiler History' screen in LabVision PC software.

12.10.6 DISPLAY MENU STRUCTURE SUMMARY.

Be aware: some parameters (min, max and default) are influenced by the setting of other parameters, so the value in the table can deviate from the value and available settings in the burner controller/display.

Menu structure Display:	**Access level**	**Description:**
1. Central Heating (CH)	User	Enter the Central Heating (CH) menu
2. Domestic Hot Water (DHW)	User	Enter the Domestic Hot Water (DHW) menu
3. Information	User	Enter the Information menu
4. Settings	User	Enter the Settings menu
5. System Test	User	Enter the System Test menu
6. Logout	Installer	Reset the user-level back to 0: User.

1. Central Heating (CH)	**min.**	**max.**	**Default**	**unit**	**Access level**	**Description:**
1.1 CH Setpoint	20	90	85	°C	Installer	Set the CH setpoint if CH mode is 0
1.2 Outdoor Reset					User	Enter the Outdoor Reset menu if CH mode is 1

1.2 Outdoor reset	**min.**	**max.**	**Default**	**unit**	**Access level**	**Description:**
Des. Supply T.	20	90	85	°C	Installer	Set CH setpoint when outdoor temperature equals Des. Outd. T.
Bas. Supply T.	20	90	40	°C	Installer	Set CH setpoint when outdoor temperature equals Bas. Outd. T.
WW Shutdown	0	35	22	°C	Installer	Set outdoor temperature above which CH demand is locked.
Bas. Outd. T.	0	30	20	°C	Installer	Set the outdoor temperature at which CH setpoint is set to Bas. Supply T.
Des. Outd. T.	-25	25	-5	°C	Installer	Set the outdoor temperature at which CH setpoint is set to Des. Supply T.

2. Domestic Hot Water (DHW)	**min.**	**max.**	**Default**	**unit**	**Access level**	**Description:**
DHW Setpoint	39	70	60	°C	Installer	Set the DHW setpoint
DHW Store Setpoint	0	90	65	°C	Installer	Set the DHW store setpoint for DHW mode 1 and 2

3. Information	**min.**	**max.**	**Default**	**unit**	**Access level**	**Description:**
3.1 Software versions					User	Enter the Software Versions menu
3.2 Boiler Status					User	Enter the Boiler Status menu
3.3 Boiler History					User	Enter the Boiler History menu
3.4 Error Log					User	Enter the Error Log menu
3.5 Service					User	Enter the Service menu

3.1 Software versions	**min.**	**max.**	**Default**	**unit**	**Access level**	**Description:**
Display				xxxx xxxx	User	Display the software checksum
Boiler				xxxx xxxx	User	Display the boiler software checksum
Device Group				xxxMN	User	Display the boiler group ID

3.2 Boiler status	min.	max.	Default	unit	Access level	Description:
Flow Temperature				°C	User	Actual supply flow temperature
Flow 2 Temperature				°C	User	Actual supply 2 flow temperature
Return Temperature						
DHW Temperature				°C	User	Actual DHW temperature
DCW Temperature				°C	User	Actual DCW temperature
Outside Temperature				°C	User	Actual outside temperature
Flue Temp				°C	User	Actual flue gas temperature
Flue 2 Temp				°C	User	Actual flue gas 2 temperature
System Temperature				°C	User	Actual system temperature
0-10 V Input						
Flowrate				l/min	User	Actual DHW flowrate
RT Input				open/close	User	Actual RT input status
Gas Pr Sw				open/close	User	Gas pressure switch input
Flow Switch				open/close	User	CH/DHW) Flow switch input
Air Fl Sw				open/close	User	Air pressure switch input
Water Pressure				Bar	User	Actual CH water pressure
Fan Speed						
Ionization				uA	User	Actual ionization current
State					User	Actual burner state
Error				#	User	Actual internal error code
Calculated Setpoint				°C	User	Actual CH setpoint
Module Setpoint				°C	User	Actual Module/dependent/burner set-point (Only for module cascade.)

3.3 Boiler history	min.	max.	Default	unit	Access level	Description:
Successful Ignitions				#	User	Display the number of successful ignitions
Failed Ignitions				#	User	Display the number of failed ignitions
Flame Failures				#	User	Display the number of flame losses
Operation Days				days.	User	Display the total time in operation
CH Burner Hours				hrs.	User	Display the amount of burn hours for CH
DHW Burner Hours				hrs.	User	Display the amount of burn hours for DHW

3.4 Error Log	min.	max.	Default	unit	Access level	Description:
Error Log					User	Display the complete error log
Filter Error Type					User	Set the error log filter
Clear Error Log					Installer	Clear the complete error log

3.5 Service	min.	max.	Default	unit	Access level	Description:
Service history					User	Display the service history
Burn hours since last service				hrs.	User	Display the burn hours since last service
Burn hours till service				hrs.	User	Display the hours remaining until next service
Reset Service Reminder	no	yes			Installer	Reset the service reminder

4 Settings	min.	max.	Default	unit	Access level	Description:
4.1 General Settings					User	Enter the General Settings menu
4.2 Boiler Settings					User	Enter the Boiler Settings menu

4.1 General settings	min.	max.	Default	unit	Access level	Description:
4.1.1 Language					User	Enter the Language menu
4.1.2 Unit Type					User	Enter the Unit Type menu
4.1.3 Date & Time					User	Enter the Date & Time menu
4.1.4 Cascade Mode					User	Enter the Cascade Mode menu
4.1.5 Other Settings					User	Enter the Other Settings menu

4.1.1 Language	min.	max.	Default	unit	Access level	Description:
English			Eng		User	Select the English language
Italiano					User	Select the Italian language
Русский					User	Select the Russian language
Hrvatski					User	Select the Croatian language
中文					User	Select the Chinese language
Français					User	Select the French language
Español					User	Select the Spanish language
Türkçe					User	Select the Turkish language
Deutsch					User	Select the German language
Slovenský					User	Select the Slovak language
Nederlands					User	Select the Dutch language
Polski					User	Select the Polish language
Česky					User	Select the Czech language
Ελληνικά					User	Select the Greek language
magyar					User	Select the Hungarian language
Português					User	Select the Portuguese language
Românesc					User	Select the Romanian language
Slovenščina					User	Select the Slovene language

4.1.2 unit type	min.	max.	Default	unit	Access level	Description:
Metric (˚C, bar)			˚C/bar	˚C/bar	User	Select Metric units
Imperial (˚F, psi)			x	˚F/psi	User	Select Imperial units

4.1.3 Date & Time	min.	max.	Default	unit	Access level	Description:
Date				dd-mm-yy	User	Set the current date
Time				hh:mm	User	Set the current time
A. Time Zone Settings					User	Enter the time zone settings menu
B. Display Settings					User	Enter the display settings menu

A Time zone settings	min.	max.	Default	unit	Access level	Description:
Time Zone Correction					User	Set the time zone correction
Daylight Savings Time					User	Select the daylight savings time mode

B Display settings	min.	max.	Default	unit	Access level	Description:
Time Notation			24h	24h/12h	User	Select 24h or 12h time notation
Date Order			DMY		User	Select the date-format
Day of Month			2	1 or 2 digits	User	Select how the day of month is displayed
Month			short text		User	Select how the month is displayed
Year			4	2 or 4 digits	User	Select how the year is displayed
Date Separation Character			“_”		User	Select the date separation character
Day of Week			Short text		User	Select how the day of week is displayed
Seconds			no	yes/no	User	Select if seconds are displayed

4.1.4 Cascade mode	min.	max.	Default	unit	Access level	Description:
Full			Full	Full	Installer	Select full cascade mode for more data for max 8 boilers
Basic					Installer	Select basic cascade mode for 9 to 16 boilers

4.1.5 Other settings	min.	max.	Default	unit	Access level	Description:
Status overview settings					User	Configure which information is shown on the Status overview
Modbus Address	0	255	1	0…255	User	Select the Modbus communication address
Modbus Stop bits	1	2	2	1 – 2	User	Select the number of Modbus communication stop bits

4.1.5.1 Status Overview Settings	min.	max.	Default	unit	Access level	Description:
Water Pressure				Off/On	User	Enable/disable the CH water pressure
State				Off/On	User	Enable/disable the burner state
Temperature selection ID					User	Enable/disable the temp. selection ID[Tx] where x is the number of the selection.
Temperature selection					User	Select which temperature is displayed: Outside temperature [T0] Demand based [T1] (Flow or DHW temperature based on active demand) Flow temperature [T2] ; DHW temperature [T3] ; System temperature [T4] (module cascade flow/supply temp.) Cascade temperature [T5] (boiler cascade flow / supply temp.)

4.2 Boiler settings	min.	max.	Default	unit	Access level	Description:
4.2.1 Boiler Parameters					installer	Enter the Boiler Parameters menu
4.2.2 Module Cascade Settings					installer	Enter the Module Cascade Settings menu
4.2.3 Boiler Cascade Settings					installer	Enter the Boiler Cascade Settings menu

4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Display no:
CH mode	0	5	0	#	Installer	Set the CH mode	1
CH Setpoint	20	90	85	ºC	Installer	Set the CH setpoint	3
Calc. Setp. Offset	-10	10	0	ºC	Installer	Set the offset for CH mode 1 / 2 calculated setpoint	109
CH Min Setpoint	20	50	20		Installer	Set the minimum CH setpoint (0-10V modes	110
CH Max Setpoint	50	90	85		Installer	Set the maximum CH setpoint (0-10V modes)	111
Boiler Pump Overrun	0	900	120	sec.	Installer	Set the post-circulation time for the boiler/CH pump	5
CH Hysteresis Up	2	40	3	ºC	Installer	Set the CH hysteresis up	7
CH Hysteresis Down	2	20	5	ºC	Installer	Set the CH hysteresis down	112
Anti-Cycle Period	10	900	180	sec.	Installer	Set the burner anti-cycling period	9
Anti-Cycle Temp. Diff.	0	20	16	ºC	Installer	Set the burner anti-cycling differentia	10
Max. Power CH	1	100	100	%	Installer	Set the maximum CH burner power	14
Min. Power CH	1	100	1	%	Installer	Set the minimum CH burner power	15
CH PID P	0	1275	20		Installer	Set the PID P factor for CH	16
CH PID I	0	1275	1000		Installer	Set the PID I factor for CH	17
Design Supply Temp.	4	90	85	ºC	Installer	Set CH setpoint when outdoor temperature equals Des. Outd. T.	19
Design Outdoor Temp.	-25	25	-5	ºC	Installer	Set the outdoor temperature at which CH setpoint is set to Des. Supply T.	20
Baseline Supply Temp	4	90	40	ºC	Installer	Set CH setpoint when outdoor temperature equals Bas. Outd. T.	21
Baseline Outdoor Temp	0	30	20	ºC	Installer	Set the outdoor temperature at which CH setpoint is set to Bas. Supply T.	22
Design Supply Min. Limit	4	82	20	ºC	Installer	Set the outdoor reset curve minimum setpoint	23
Design Supply Max. Limit	27	90	90	ºC	Installer	Set the outdoor reset curve maximum setpoint	24
Warm Weather Shutdn	0	35	22	ºC	Installer	Set outdoor temperature above which CH demand is blocked	25
Boost Temp Increment	0	30	0	ºC	Installer	Set the setpoint boost function temperature increment	26
Boost Time Delay	0	120	20	min.	Installer	Set the setpoint boost function delay time	27
Night Setback Temp.	0	30	10	ºC	Installer	Set the CH setpoint night setback temperature	28
DHW Mode	0	8	0	#	Installer	Set the DHW mode	35
DHW Tank Hyst. Down	0	10	5	ºC	Installer	Set the DHW tank hysteresis down	36
DHW Tank Hyst. Up	0	10	5	ºC	Installer	Set the DHW tank hysteresis up	37
DHW Tank Supply Extra	0	30	15	ºC	Installer	Set the DHW tank supply setpoint offset	38
DHW Tank Supp Hyst Dn	0	20	5	ºC	Installer	Set the DHW tank supply hysteresis down	39
DHW Tank Supp Hyst Up	0	20	5	ºC	Installer	Set the DHW tank supply hysteresis up	40
DHW Priority	0	2	on	0-2	Installer	Set the DHW priority mode	42
DHW Max. Priority Time	1	255	60	min.	Installer	Set the maximum DHW priority time	43
DHW Pump Overrun	0	900	20	sec.	Installer	Set the DHW post-circulation time	44
DHW Tank PID P	0	1275	100		Installer	Set the DHW tank PID P factor	45
DHW Tank PID I	0	1275	300		Installer	Set the DHW tank PID I factor	46

cont.: 4.2.1 Boiler parameters	min.	max.	Default	unit	Access level	Description:	Dis-play no:
DHW/Tank Setpoint	30	80	60	ºC	Installer	Set the DHW setpoint	48
DHW Store Setpoint	0	90	65	ºC	Installer	Set the DHW storage setpoint	115
DHW Hysteresis Down	0	20	4	ºC	Installer	Set the DHW hysteresis down	49
DHW Hysteresis Up	2	20	4	ºC	Installer	Set the DHW hysteresis up	50
DHW Instant PID P	0	1275	100	-	Installer	Set the DHW instantaneous PID P factor	51
DHW Instant PID I	0	1275	160	-	Installer	Set the DHW instantaneous PID I factor	52
DHW On Off Period	10	60	30	sec.	Installer	Set the on/off modulation period	63
PreHeat mode	on	off	off	-	Installer	Set the PreHeat Eco mode	64
PreHeat Eco Setpoint	0	80	30	ºC	Installer	Set the PreHeat Eco setpoint	65
DHW Max. Limit	0	90	80	ºC	Installer	Limiting DHW setpoint max.	91
DHW Min. Limit	20	50	30	ºC	Installer	Limiting DHW setpoint min.	96
Fan Speed Maximum	0	12750	dep unit	rpm	Installer	Set the maximum fan speed	92
Fan Speed Minimum	0	12750	dep unit	rpm	Installer	Set the minimum fan speed	93
Fan Speed Ignition	0	12750	dep unit	rpm	Installer	Set the ignition fan speed	94
Prog. Input 1.	0	3	1	#	Installer	Select the function for programmable input 1	116
Prog. Input 2.	0	4	2	#	Installer	Select the function for programmable input 2	117
Prog. Input 3.	0	2	2	#	Installer	Select the function for programmable input 3	118
Prog. Input 7.	0	5	3	#	Installer	Select the function for programmable input 7	122
Prog. Input RT.	0	1	1	#	Installer	Select the function for the programmable RT input	124
Prog. Output 1.	0	10	4	#	Installer	Select the function for programmable output 1	125
Prog. Output 2.	0	10	0	#	Installer	Select the function for programmable output 2	126
Prog. Output 3.	0	10	6	#	Installer	Select the function for programmable output 3	127
Prog. Output 4.	0	20	18	#	Installer	Select the function for programmable output 4	128
Mod. Pump dT	5	40	20	ºC	Installer	Set the modulating pump target delta temperature	133
Mod. Pump Start Time	0	255	120	sec.	Installer	Set the modulating pump start up time	134
Mod. Pump Type			Linear Inv		Installer	Set the modulating pump model	135
Mod. Pump Mode	20	100	mod.	o/f or mod.	Installer	Set the modulating pump mode	136
Mod. Pump Min Pwr			30	%	Installer	Set the modulating pump minimum duty cycle	137
Appliance Type	50	55	Dep. unit	#	Installer	Set the appliance type	138
Dair active	0	1	yes	Yes/No	Installer	Enable/disable the De-Air function	139
Nominal Flow	0	10	0	l/min	Installer	Sets the nominal flow	141
Anti Legionella Day	mon	sun	Sunday		Installer	Select the day for the anti-legionella cycle	107
Anti Legionella Hour	0	23	0	hrs.	Installer	Select the time for the anti-legionella cycle	108
Frost Protection			Enabled	Ena/Dis	Installer	Switch Frost protection on/off	205
Anti Legionella			Enabled	Ena/Dis	Installer	Anti Legionella protection on/off	206
DHW Detection Delay	0	255	0		Installer	Sets the detection delay.	207

4.2.2 Module Cascade Settings	min.	max.	Default	unit	Access level	Description:	Display no:
Burner Address			Stand alone		Installer	Set the cascade burner address	184
Permit Emergency Mode			Yes	Yes/No	Installer	Enable/disable the cascade emergency mode	72
Emergency Setpoint	20	90	70	°C	Installer	Set the emergency mode setpoint	74
Delay Per Start Next Mod.	0	1275	90	sec.	Installer	Set the delay time before the next module is started	75
Delay Per Stop Next Mod.	0	1275	60	sec.	Installer	Set the delay time before the next module is stopped	76
Delay Quick Start Next	0	1275	20	sec.	Installer	Set the fast delay time before the next module is started	142
Delay Quick Stop Next	0	1275	10	sec.	Installer	Set the fast delay time before the next module is stopped	143
Hyst. Down Start Module	0	40	8	°C	Installer	Set the hysteresis down after which a module is started	77
Hyst. Up Stop Module	0	40	5	°C	Installer	Set the hysteresis up after which a module is stopped	78
Hyst. Down Quick Start	0	40	12	°C	Installer	Set the fast hysteresis down after which a module is started	144
Hyst. Up Quick Stop	0	40	7	°C	Installer	Set the fast hysteresis up after which a module is stopped	145
Hyst. Up Stop All	0	60	10	°C	Installer	Set the hysteresis up at which all modules are stopped	146
Number of Units	0	16	1	#	Installer	Set the no. of modules expected in the cascade system	147
Power Mode	0	3	2	#	Installer	Set the power mode	148
Max. Setp. Offset Down	0	20	2	°C	Installer	Set the maximum setpoint offset down	79
Max. Setp. Offset Up	0	20	10	°C	Installer	Set the max. setpoint offset up	80
Start Mod. Delay Fact.	0	60	0	min.	Installer	Set the setpoint modulation delay time	81
Next Module Start Rate	10	100	80	%	Installer	Set the next module start rate	82
Next Module Stop Rate	10	100	25	%	Installer	Set the next module stop rate	83
Module Rotation Interval	0	30	5	days	Installer	Set the rotation interval	84
First Module to Start	0	17	1	#	Installer	Set the first module to start in the rotation cycle	149
PwrMode2 Min Power	0	100	15	%	Installer	Set the power mode 2 minimum power	152
PwrMode2 Hysteresis	0	100	35	%	Installer	Set the power mode 2 hysteresis	153
Post-Pump Period	0	255	30	sec.	Installer	Set the cascade post-circulation period	154
Frost Protection	10	30	15	°C	Installer	Set the frost-protection setpoint	155

NOTICE	Parameters for cascade operation are found in the Module cascade settings menu, located in the Boiler settings menu. Parameters in the **Boiler cascade settings** menu must not be used.

4.2.3 Boiler Cascade Settings	min.	max.	Default	unit	Access level	Description:	Display no:
Boiler Address			stand-alone		Installer	Set the cascade boiler address	73
Permit Emergency Mode	No	Yes	yes		Installer	Enable/disable the cascade emergency mode	156
Emergency Setpoint	20	90	70	°C	Installer	Set the emergency mode setpoint	157
Delay Per Start Next Blr	0	1275	1275	sec.	Installer	Set the delay time before the next boiler is started	158
Delay Per Stop Next Blr.	0	1275	1275	sec.	Installer	Set the delay time before the next boiler is stopped	159
Delay Quick Start Next	0	1275	400	sec.	Installer	Set the fast delay time before the next boiler is started	160
Delay Quick Stop Next	0	1275	240	sec.	Installer	Set the fast delay time before the next boiler is stopped	161
Hyst. Down Start Boiler	0	40	5	°C	Installer	Set the hysteresis down after which a boiler is started	162
Hyst. Up Stop Boiler	0	40	2	°C	Installer	Set the hysteresis up after which a boiler is stopped	163
Hyst. Down Quick Start	0	40	10	°C	Installer	Set the fast hysteresis down after which a boiler is started	164
Hyst. Up Quick Stop	0	40	4	°C	Installer	Set the fast hysteresis up after which a boiler is stopped	165
Hyst. Up Stop All	0	60	8	°C	Installer	Set the hysteresis up at which all boilers are stopped	166
Number of boilers	0	16	1	#	Installer	Set the number of boilers expected in the cascade system	167
Power Mode	0	3	2	#	Installer	Set the power mode	168
Max. Setp. Offset Down	0	20	0	°C	Installer	Set the maximum setpoint offset down	169
Max. Setp. Offset Up	0	20	20	°C	Installer	Set the maximum setpoint offset up	170
Start Mod. Delay Fact.	0	255	20	min.	Installer	Set the setpoint modulation delay time	171
Next Boiler Start Rate	10	100	80	%	Installer	Set the next boiler start rate	172
Next Boiler Stop Rate	10	100	25	%	Installer	Set the next boiler stop rate	173
Boiler Rotation Interval	0	30	5	days	Installer	Set the rotation interval	174
First Boiler to Start	1	17	1	#	Installer	Set the first boiler to start in the rotation cycle	175
PwrMode2 Min Power	0	100	20	%	Installer	Set the power mode to min. power	180
PwrMode2 Hysteresis	0	100	40	%	Installer	Set the power mode 2 hysteresis	181
Post-Pump period	0	255	30	sec.	Installer	Set the cascade post-circulation period	182

5 System test	min.	max.	Default	unit	Access level	Description:
Test State			off		Installer	Set test state (for adjusting CO2 level's)
Fan speed			xxxx	rpm	Installer	Read out fan speed
Ionization			x.x	µA	Installer	Read out flame signal

Service	min.	max.	Default	unit	Access level	Description:
Reset Service Reminder	no	yes	no	yes/no	Installer	Reset the service history

13 TEMPERATURE PROTECTION

The difference between supply temperature and return temperature is continuously monitored (ΔT). If this becomes too high it can indicate a defective pump or a clogged heat exchanger. To protect the boiler, the burner controller reduces the input when the temperature difference ΔT becomes too high:

At maximum boiler input ΔT is limited to 35°C (63 °F) - (*Hx_Diff_DeltaT_Min)*

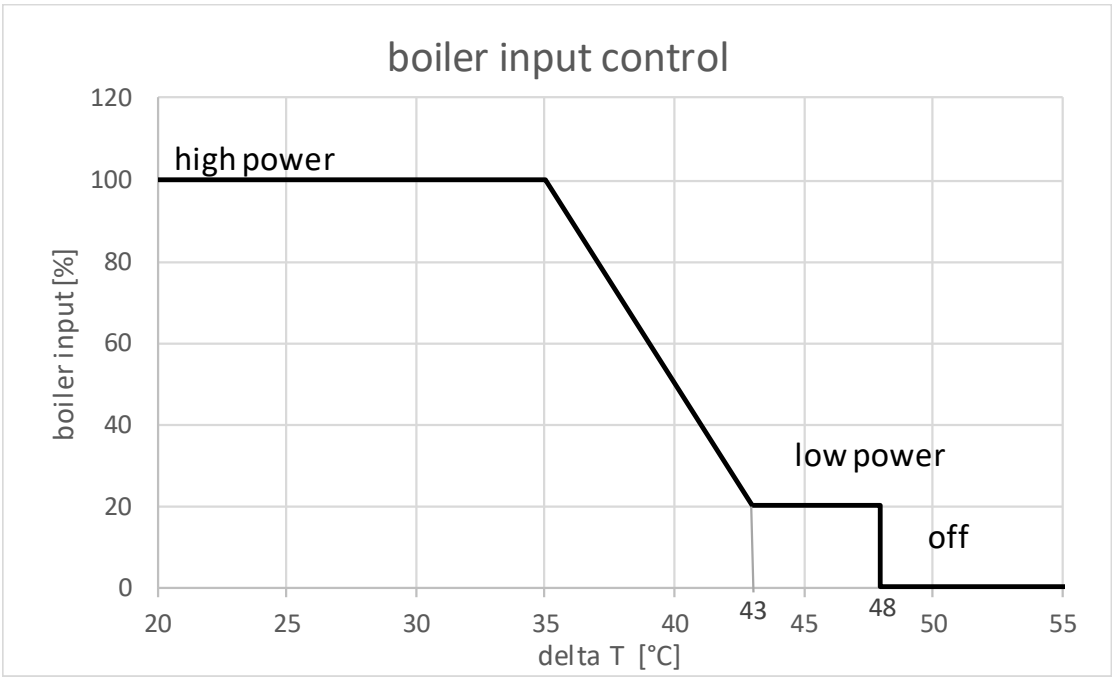
In between 35°C (63 °F) and 43 °C (77 °F) boiler input modulates between minimum and maximum.

At min. boiler input ΔT above 43 °C (77 °F) is allowed ((*Hx_Diff_DeltaT_Min)+8 °C (+14.4 °F)*

Above ΔT = 48 °C (86 °F), the boiler is switched OFF during *HX_Diff_Max_Wait_Time*.

Relevant factory set variables

Parameter	Level	Factory Setting.	Range
HX Diff DeltaT Min	3: Factory	35 °C (63 °F)	10 ….80 °C (18….144 °F)
HX Diff Max Wait Time Wait time after upper limit primary heat exchanger differential has been exceeded.	3: Factory	180 Sec.	1….255 Sec.



14 ERROR INFORMATION.

Errors can be divided in three groups:

•Manual reset locking errors (can only be reset by the reset button).
•Blocking errors (will disappear when error is gone)
•Warnings (will disappear when the warning is gone, not stored in the controls e2prom)

The boiler pump will continue to run during most locking and blocking error codes. This is to prevent the freezing of the Central Heating circuit when the boiler is in error during the winter period. For some non-volatile lockouts the pump will not be running, also see the error tables in this chapter for more details.

14.1 BOILER HISTORY.

The last 15 lockouts and 15 blocking errors are stored in the boiler controller. This boiler history can be shown via the Boiler History screen via the installer boiler status menu in one of the advanced displays.

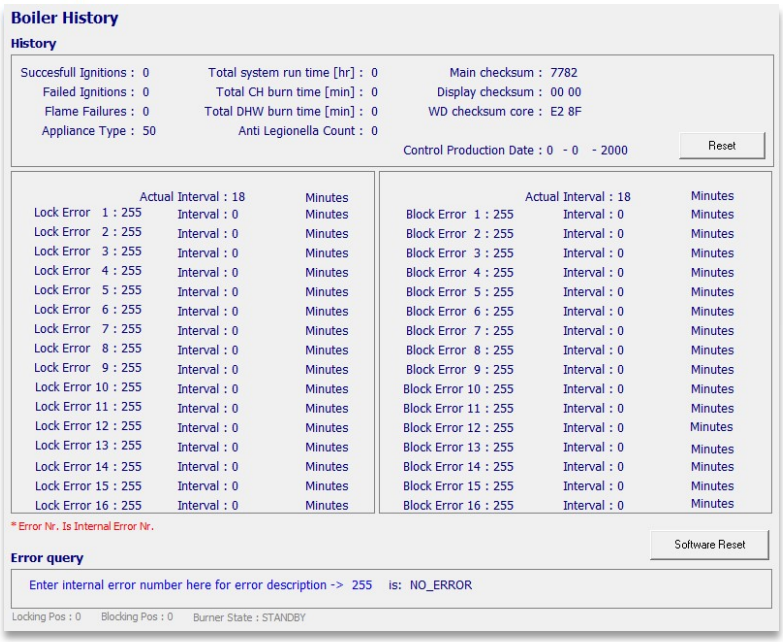
- Successful ignitions
- Failed Ignitions
- Flame Failures
- Operation days
- CH Burner Hours
- DHW Burner Hours

14.2 BOILER HISTORY AND TIME STAMPS BOILER HISTORY

Via the 'boiler history' screen in the LabVision PC software the following history data is shown:

Only available to authorised service partners

• Successful ignitions
• Failed Ignitions
• Flame Failures
• Anti-Legionella count
• Total system run time [hr]
• Total CH burn time [min]
• Total DHW burn time [min]



The last 15 lockout and 15 blocking errors are stored in the boiler controller. This boiler history can be shown via the Boiler History screen via the installer boiler status menu in one of the advanced displays.

Time Stamp
A time stamp will be added to an error at the moment the error occurs. The time between this error and a new error will be counted. The interval between an error and the previous error is shown as interval time in minutes, hours, days or weeks.

Successful ignitions
To prevent wear on the e2prom of the boiler controller, the successful ignitions are only saved after 16 successful ignitions. When a power cycle is performed after 15 successful ignitions, these 15 ignitions are not counted.

14.3 LOCKOUT CODES

Lockout code	Error	Description	Cause	Solving
0	E2PROM_READ_ ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
1	IGNIT_ERROR	Five unsuccessful ignition attempts in a row	no gas, wrongly adjusted gas valve	check gas supply and adjust gas valve, reset BCU
2	GV_RELAY_ERROR	Failure detected in the gas valve relay, GV and safety relay both switches the gas valve	short circuit in coil of the gas valve, water on wiring or gas valve	reset BCU replace gas valve or wiring harness
3	SAFETY_RELAY_ ERROR	Failure detected in the safety relay GV and safety relay both switches the gas valve	short circuit in coil of the gas valve, water on wiring or gas valve	reset BCU replace gas valve or wiring harness
4	BLOCKING_ TOO_LONG	Controller had a blocking error for more than 20 hours	blocking code active for more than 20 hours	reset and check blocking code
5	FAN_ERROR_ NOT_RUNNING	Fan is not running for more than 60 seconds	electrical wiring not correctly connected, or Fan is malfunctioning	Check wiring or replace Fan if not solved check fuse on BCU or replace BCU
6	FAN_ERROR_ TOO_SLOW	Fan runs too slow for more than 60 seconds	electrical wiring not correctly connected, or Fan is malfunctioning	Check wiring or replace Fan if not solved check fuse on BCU or replace BCU
7	FAN_ERROR_ TOO_FAST	Fan runs too fast for more than 60 seconds	electrical wiring not correctly connected, or Fan is malfunctioning	Check wiring or replace Fan if not solved check fuse on BCU or replace BCU
8	RAM_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
9	WRONG_EEPROM_ SIGNATURE	Contents of E2prom is not up to date	out dated E2prom	reset BCU or replace BCU
10	E2PROM_ERROR	Wrong safety parameters in E2prom	wrongly programmed BCU or PB	reset BCU or replace BCU
11	STATE_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU
12	ROM_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU
13	APS_NOT_OPEN	Air pressure switch not opening during pre-purge 0	electrical circuit is short circuited or APS is jammed	check wiring or replace APS
14	APS_NOT_CLOSED_IN_ PRE_PURGE	Air pressure switch not closing during pre-purge 1	no air transport to the burner; flue or air inlet is blocked or APS is jammed or air signal hose not connected to the air intake pipe or water in hose	Check if there are any obstructions in the flue or air intake, replace APS if jammed, connect air hose to the air intake pipe, and remove any water from the hose.
15	MAX_TEMP_ERROR	The external overheat protection is enabled or the T_Supply sensor measures a temp. of over Prot_Overheat_Temp - SGOverheat_Duplex_Tolerance for a period of Max_Value_Period	Burner door clixon tripped because of overheating of the burner door or the water flow is restricted or rear wall thermal fuse has tripped because rear wall insulation disc (combustion chamber) is damaged or broken.	Check burnerdoor gasket and replace burner door gasket and reset clixon on burner door or check pump and waterflow and replace pump or increase water flow. Check also if valves are closed or check if rear wall fuse is broken, if so replace and also replace rear wall insulation disc (combustion chamber).
16	FLUE_GAS_ERROR	Flue temperature exceeded the maximum flue temperature	There is no water in the heat exchanger or flue gas sensor is malfunctioning or heat exchanger is overheated.	Check if flue sensor is working correctly, if not, replace flue sensor. Check waterflow if too low increase waterflow.

Lockout code	Error	Description	Cause	Solving
17	STACK_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
18	INSTRUCTION_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
19	ION_CHECK_FAILED	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
20	FLAME_OUT_ TOO_LATE	Flame still present 10 seconds after closing the gas valve	wrong earthing of BCU and boiler	Check earthing of BCU and boiler
21	FLAME_BEFORE_IGNIT	Flame is detected before ignition	wrong earthing of BCU and boiler	Check earthing of BCU and boiler
22	TOO_MANY_ FLAME_LOSS	Three time flame lost during 1 demand	bad gas supply or CO2 level is not correct or bad ignition rod	check gas supply pressure, check CO2 level and adjust if necessary, replace ignition rod or replace ignition cable.
23	CORRUPTED_ ERROR_NR	Error code RAM byte was corrupted to an unknown error code.	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
27	FILLING_TOO_MUCH	Too many automated filling attempts in a short time period	If output is programmed as filing valve and there are to many filing attempts	Check if there is a leak in the central heating system or if the boiler it self is leaking also check expansion vessel on internal leak
28	FILL_TIME_ERROR	Filling takes too long	If output is programmed as filing valve and filling takes more than 10 minutes	Check if there is a leak in the central heating system or if the boiler it self is leaking also check expansion vessel on internal leak
29	PSM_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
30	REGISTER_ERROR	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
32	T_EXCHANGE_ DIFF_ERROR	The 2 exchange sensors deviate too much for more than 60 seconds	There is not not enough water flow through the heat exchanger	Check if the general pump is running and if all valves are open to make enough flow
33	LWCO_1_ERROR	Low water cut off 1 error	There is no water in the heat exchanger or not electrically connected	Check if there is enough water in the heat exchanger if not so fill up the system
34	LWCO_2_ERROR	Low water cut off 2 error	There is no water in the heat exchanger or not electrically connected	Check if there is enough water in the heat exchanger if not so fill up the system
35	APS_NOT_CLOSED_IN_ POST_PURGE	Air pressure switch not closing during post-purge 1	no air transport to the burner after heat demand; flue or air inlet is blocked or APS is jammed or air signal hose not connected to the air intake pipe or water in hose	Check if there are any obstructions in the flue or air intake, replace APS if jammed, connect air hose to the air intake pipe, and remove any water from the hose.
36	GAS_PRESSURE_ ERROR	Gas pressure switch open for more than E2_GPS_Timeout	wrong gas pressure on gas supply	Check if gas pressure is in limits of the gas pressure switch.

14.4 BLOCKING CODES

Blocking code	Error	Description	Cause	Solving
100	WD_ERROR_RAM	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
101	WD_ERROR_ROM	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
102	WD_ERROR_STACK	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
103	WD_ERROR_REGISTER	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
104	WD_ERROR_XRL	Internal software error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
105	HIGH_TEMP_ERROR	T_Supply sensor measures over Stay_Burning_Temp for a period of Max_Value_Period.	not enough waterflow over heat exchanger	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.
106	REFHI_TOO_HIGH	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
107	REFHI_TOO_LOW	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
108	REFLO_TOO_HIGH	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
109	REFLO_TOO_LOW	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
110	REFHI2_TOO_HIGH	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
111	REFHI2_TOO_LOW	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
112	REFLO2_TOO_HIGH	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
113	REFLO2_TOO_LOW	Internal hardware error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
114	FALSE_FLAME	Flame is detected in a state in which no flame is allowed to be seen	wrong earthing of BCU and boiler	Check earthing of BCU and boiler

Blocking code	Error	Description	Cause	Solving
116	LOW_WATER_PRES-SURE_SENSOR	Low water pressure, generated when the pressure drops below Minimal_Pressure, or when the pressure drops below 0.3 bar (4.5 PSI)	Not enough water pres-sure	Fill up the system and check if there are any water leakages
118	WD_COMM_ERROR	Watchdog communication error	wrong program-med BCU or PB	reset BCU or replace BCU and or display unit
119	RETURN_OPEN	Return sensor open	malfunctioning return sen-sor or not connected	check connection to BCU or check resistance NTC sen-sor
120	SUPPLY_OPEN	Supply sensor open	malfunctioning supply sensor or not connected	check connection to BCU or check resistance NTC sen-sor
122	DHW_OPEN	DHW sensor open	malfunctioning DHW sen-sor or not connected	check connection to BCU or check resistance NTC sen-sor
123	FLUE_OPEN	Flue sensor open	malfunctioning flue sensor or not connected	check connection to BCU or check resistance NTC sen-sor
125	OUTDOOR_OPEN	Outdoor sensor open	malfunctioning outdoor sensor or not connected or wrong CH-mode pro-grammed	check connection to BCU or check resistance NTC sen-sor or change CH-mode
126	RETURN_SHORTED	Return sensor shorted	malfunctioning return sen-sor or short circuiting	check connection to BCU or check resistance NTC sen-sor
127	SUPPLY_SHORTED	Supply sensor shorted	malfunctioning supply sensor or short circuiting	check connection to BCU or check resistance NTC sen-sor
129	DHW_SHORTED	DHW sensor shorted	malfunctioning DHW sen-sor or short circuiting	check connection to BCU or check resistance NTC sen-sor
130	FLUE_SHORTED	Flue sensor shorted	malfunctioning Flue sen-sor or short circuiting	check connection to BCU or check resistance NTC sen-sor
132	OUTDOOR_SHORTED	Outdoor sensor shorted	malfunctioning Outdoor sensor or short circuiting	check connection to BCU or check resistance NTC sen-sor
134	RESET_BUTTON_ ERROR	Too many resets in a short time period	Reset many times by user or installer	wait, or disconnect and re-connect power supply
136	T_EXCHANGE_ BLOCK_ERROR	Exchange temperature ex-ceeded 90 ºC (194 ºF).	water temperature is above 90 ºC (194 ºF).	Check pump functioning. Check/open all valves that might restrict water flow through the unit. Check ex-ternal system pump(s) that influences flow through the unit. Check if the system re-sistance exceeds the spare capacity of the unit pump.

Blocking-code	Error	Description	Cause	Solving
155	WD_CONFIG_ ERROR	Watchdog fan configuration setting error	wrongly programmed BCU or PB	reset BCU or replace BCU and or display unit
162	FILL_WARNING	Error is generated immediately when the pressure drops below Minimal_Pressure. Demand has stopped, but no error needs to be stored at this time.	The water pressure is below the minimum pressure level	refill the system until the pressure is above 1 Bar or 14.5 PSI
164	LOWEXFLOW_ PROTECTION	Flow is too low, demand needs to be stopped with fan at ignition speed*, but no error needed to be stored at this time	not enough water flow through heat exchanger	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.

14.5 WARNINGS

Error no.	Error	Description	Cause	Solving
200	CC_LOSS_COM-MUNICATION	Cascade System: Managing cascade controller lost communication with one of the depending.	connection between cascaded boilers is interrupted or wiring is broken or wrong setting parameter 147 on the managing boiler	Check wiring between boiler or distance between boilers is to big or check setting parameter 147 on the managing boiler
202	APP_SELECTION_ ERROR	Unknown appliance model selected	wrongly programmed parameters	replace BCU
203	CC_LOSS_BOILER _COMM	Dual Cascade System: Managing cascade controller lost communication with one of the depending.	connection between cascaded boilers is interrupted or wiring is broken	Check wiring between boiler or distance between boilers is to big
204	OUTDOOR_ WRONG	T_Outdoor sensor measures open/shorted	malfunctioning outdoor sensor or not connected or wrong CH-mode programmed	check connection to BCU or check resistance NTC sensor or change CH-mode
205	T_SYSTEM_ WRONG	T_System sensor measures open/shorted	malfunctioning system sensor or not connected	check connection to BCU or check resistance NTC sensor
206	T_CASCADE_ WRONG	T_Cascade sensor measures open/shorted	malfunctioning cascade sensor or not connected	check connection to BCU or check resistance NTC sensor Or wrong cascade settings (boiler cascade settings) used, set para 73 to standalone and use MODULE cascade settings for cascading
207	HEAT_EX_ PROTECTION	The heat-exchanger protection function is actively blocking the burn demand		

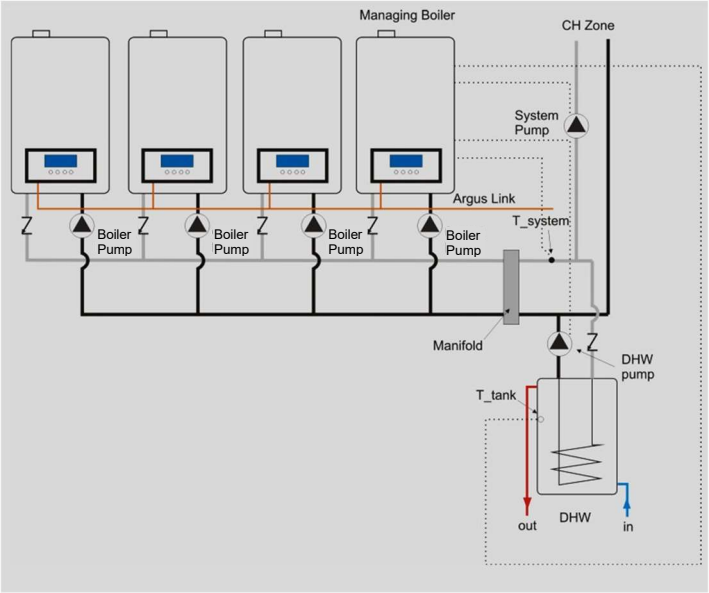
15 CASCADING

15.1 SYSTEM SETUP

NOTE: for the system to function correctly, some settings have to be changed, see 15.4.1"Emergency mode".

The boiler controller can control multiple boilers in a cascade setup.
A system sensor is necessary to measure the cascade system supply temperature. The sensor is connected to the boiler controller. A pump output is also available to run the system pump, as well as an output for the DHW pump.
When the CH supply temperature is calculated based on an outdoor sensor, only one outdoor sensor is needed. This sensor is connected to the managing boiler and calculates the CH setpoint for the cascade system.
A cascade system can be used with a DHW indirect tank. A DHW pump and sensor can be connected to the managing boiler.

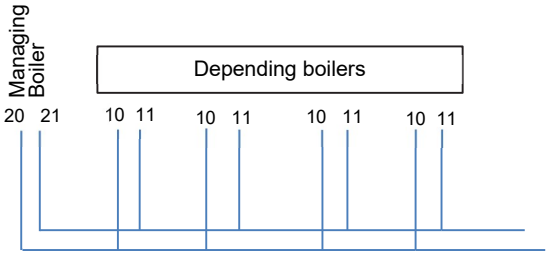
Cascade boiler pump connections for system configuration 1.
System configuration for handling DHW indirect tank or Central Heating demand.
All boilers handle **either** indirect tank **or** Central Heating demand at one time.

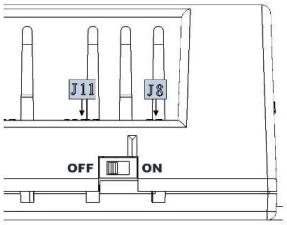


15.2 QUICK-GUIDE CASCADE SET-UP.

Below a quick set-up, all settings are described in detail in the successive chapters

1. **Link the boilers with a 2-wire cable in parallel.**
   Connect 20 on the managing boiler to 10 on the dependent boilers and connect 21 on the managing boiler to 11 on the dependent boilers.





2. **Set the switch “bus power on” at the side of the boiler control to the off position, on all boilers.**
   Note the line of the bottom of the boiler control on above picture to determine the off position.

3. **Change the burner address on every boiler that is part of the cascade**
   Parameter: Menu - Settings - Boiler settings - **Module Cascade Settings** - Parameter 184 (Burner Address)
   On managing boiler: set as manager. (**DO NOT USE Boiler Cascade Settings)**
   On dependent boilers: set as dep 1, dep 2, etc.

4. **Changer number of units on manager boiler only**
   Parameter: Menu - Settings - Boiler settings - **Module Cascade Settings** - Parameter 147 (Number of units)
   On managing boiler: set at total amount of units that are part of the cascade (= managing + number of dependents)
   On dependent boilers: set at 1 (= default setting)

5. **Select correct CH mode on managing boiler only**
   Parameter: Menu - Settings - Boiler settings - Boiler parameters - Parameter 1 (CH mode)
   CH mode 0 – Central Heating demand with thermostat control
   CH mode 1 – Central Heating with an outdoor temperature reset and thermostat control
   CH mode 2 – Central Heating with full outdoor temperature reset
   CH mode 3 – Central Heating with permanent heat demand
   CH mode 4 – Central Heating with analog input control (0-10V) of setpoint

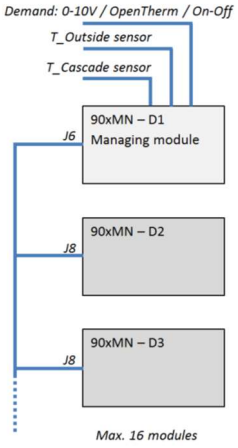
   (CH mode 5 – Central Heating with analog input control (0-10V) of power output is not possible in cascade)

6. **Connect required sensors to the managing boiler only**
   DHW temperature sensor required (for DHW mode 1) at Low voltage connections 5 and 6.
   System temperature sensor required at Low voltage connections 3 and 4.
   Thermostat (wire bridge) required (for CH mode 4) at Low voltage connections 12 and 13

7. **Deactivate de-air on managing boiler only after de-airing the boilers and system**
   Parameter: Menu - Settings - Boiler settings - Boiler parameters - Parameter 139 (Dair active)
   On managing boiler: set to No

15.3 BOILER CASCADE COMMUNICATION SETUP.

In order for the system to work for cascade the communication busses must be parallel linked together. The managing boiler uses the AL-bus connection 20-21 for the cascade. For details, 11.4.1 "Explanation of the low voltage connections".
It is important that the power on the 10-11 connection terminals on all dependent boilers is switched to the OFF position
All boilers in the cascade system must have a unique address selected (see also 15.3.2 "Setting up the cascade parameters").
Before commissioning a cascade installation, a number of parameters have to be changed.
These parameters can be programmed on the unit itself.



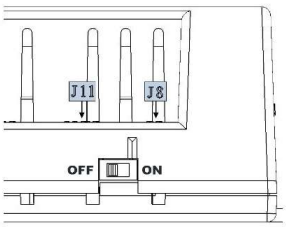
Changes in parameter should only be carried out by a skilled commissioning/service engineer, who has had specific training for setting up the EFB range boilers. He will be able to check whether the installation functions correctly after the parameter change has been done.

Parameters for cascade operation are found in the Module cascade settings menu, located in the Boiler settings menu. Parameters in the Boiler cascade settings menu must not be used

15.3.1 SET THE BOILER ADDRESS

Address rules
The cascade managing address (parameter 184) must be set to 'Managing' on the managing boiler.
The cascade depending addresses (parameter 184) must be set in a logical numbered order from 2: Dep. 2, Dep. 3 etc. on the depending boilers.
The total number of boilers in the cascade must be stored in parameter 147 on the managing boiler.

When the number of boilers is set to 4, the first three depending controls are expected to be available for the cascade. In this case depending controls 2, 3 and 4 must be selected. When any of these 3 are not present on the communication bus the managing controller detects the loss of a depending controller and generates the warning: Comm. Lost with module.



The managing boiler of the cascade system is connected to the AL-BUS connection on terminals 20-21. This connection also provides the power for the communication bus. The depending boilers are all parallel connected to the managing boiler communication bus.

The bus power is provided by the managing boiler on terminals 20-21, switch S1 must be set in the OFF position (all controls).

Each boiler must be configured with its own unique address.

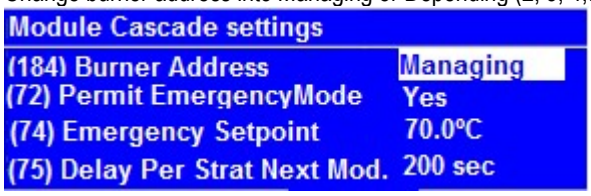
15.3.2 SETTING OF THE CASCADE PARAMETERS:

Enter the main menu by pushing the menu button, now select settings by toggling the up and down arrow and enter settings by pushing the enter button.

Now select Boiler Settings

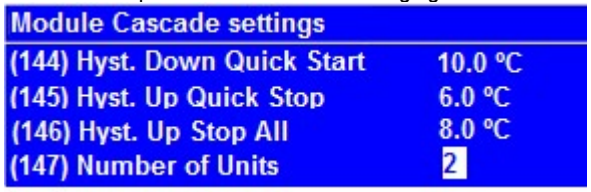
Select the Module Cascade Settings

Change burner address into Managing or Depending (2, 3, 4,…)



Boiler address	Boiler Operation	Function of sensor input terminal 3-4
0 (default)	Standalone burner	No function
1	1st boiler (**managing**)	System sensor
2	2nd boiler (depending)	No function
3	3rd boiler (depending)	No function
4	4th boiler (depending)	No function
↓	↓	
16	16th boiler (depending)	No function

Now select in parameter 147 of the managing boiler how many boilers (units) are in the cascade.



15.3.3 CASCADE – CENTRAL HEATING SETTINGS

When a boiler is set as "Managing" (parameter 184: "Burner address"), the controller of this boiler will drive the cascade. The CH mode of this managing boiler applies to all other boilers. It is only required to set the CH mode on the managing boiler.

- The outdoor temperature sensor connected to the managing boiler will be the outdoor sensor for the cascade operation
- The system sensor (T_System) connected to the managing boiler will be the control sensor for the cascade supply temperature.
- The (modulating) thermostat connected to the managing boiler will be the CH heat demand input for the cascade system.

Based on the system temperature (T_System) and the requested Cascade_Setpoint the managing boiler calculates a required boiler setpoint, to achieve the requested Cascade_Setpoint.
The managing boiler provides the calculated setpoint to all dependent boilers. The modulating power of the dependent boilers is PID controlled based on the calculated setpoint and dependent boiler supply temperature.

Cascade CH setpoint adaption
When the system temperature is not high enough the setpoint for all boilers will be adjusted.
The boiler setpoint will be increased when the system temperature drops below Cascade_Setpoint and decreased when it rises above Cascade_Setpoint temperature.

Dependent Boiler
The CH mode for the cascade is defined by the setting of the managing boiler. CH mode settings on dependents are ignored. In case a boiler is set as "Dependent" (parameter 184: "Burner address") the setpoint is always provided by the managing boiler.
The modulating power of the ALL boilers is PID controlled by the boiler itself by comparing the calculated setpoint from the managing boiler and T_Supply. The managing boiler itself will be controlled in the cascade system as it would as if it was a dependent boiler. Only the pumps and sensor inputs are used.

Boiler input Rates
A cascade system operates most effective and efficiently when all of the boilers in the system are the same size.

15.3.4 CASCADE – DOMESTIC HOT WATER SETTINGS

In the installer DHW menu of the managing boiler controller the DHW_Mode must be set.
Available DHW modes in cascade are mode 1 = sensor or 2 = aquastat (see 12.10 "Demand for Domestic Hot Water").

Dependent Boiler
In case a boiler is set as dependent (parameter 184: "Burner address") the DHW setpoint is always provided by the managing boiler, the internal control of the setpoint functions are disabled.

Managing Boiler
If there is a request for a “Store Warm Hold” for the tank and no central heating request the managing boiler is going to burn for the DHW tank. This (the heating of the DHW tank) is interrupted when there comes a central heating request and the managing boiler and cascade are burning for the central heating system.

15.3.5 CASCADE – DHW PRIORITY

The boiler cascade system has multiple options for priority and parallel DHW and heating.
The following levels of priority are configurable (and possible):

Priority level		Description
0)	Switch Priority	When both CH and DHW demand have to be served, the priority it is given to the DHW demand for a given interval (indicated with parameter Minute_Switch_Priority). As soon as the interval has expired the priority switches to CH demand. The interval time will be reloaded and priority will switch again after the interval is over.
1)	CH	The priority is permanently given to CH Demand
2)	DHW	The priority is permanently given to DHW Demand

Relevant variables

Specific Parameters	Level	(Default) Value	Range
DHW Priority Both, CH or DHW priority, Parallel	2: Installer	2	0, 1, 2
DHW Max Priority Timer Interval time for switching the priority	2: Installer	60 min.	1..60 min.

15.3.6 CASCADE – BOILER ROTATION

The boiler rotation function can change the start/stop sequence for the cascade boilers.
The parameter Module_Rotation_Interval sets the number of days after which the sequence is updated. When Module_Rotation_Interval is set to 0 boiler rotation is disabled.
When the parameter Module_Rotation_Interval is updated the boiler rotation days left will be initialized to the new Module_Rotation_Interval setting.

When for example *Module_Rotation_Interval* = 5 the start sequence is as following (x is the last boiler):

Days	Start/Stop sequence
Day 0-5	1-2-3-4-5-6..x
Day 5-10	2-3-4-5-6..x-1
Day 10-15	3-4-5-6..x-1-2
Day 15-20	4-5-6..x-1-2-3
Day 20-25	5-6..x-1-2-3-4

With parameter First_Module_To_Start the current depending that is first to start in the sequence is selected.
When the boilers are rotated the parameter First_Module_To_Start is automatically updated to the next depending. When boiler rotation is disabled the parameter First_Module_To_Start is reset to 0.
When the First_Module_To_Start is manually changed the control will clear all demand of the cascade control. After this is will start cascade demand generation with the new selection for First_Module_To_Start.

15.3.7 NEXT DEPENDING TO START SELECTION

When the cascade Module_Rotation_Interval has passed the control will perform the cascade rotation. At this moment the next available control based on the current First_Module_To_Start is selected.
A depending control is available when the control is present on the communication bus and the control is not blocked by an error.

When the control is not available the control is skipped as the next First_Module_To_Start.

Relevant variables

Specific Parameters	Level	(Default) Value	Range
Module_Rotation_Interval (84)	2: Installer	5	0…30 (0: Disabled)
First_Module_To_Start (149)	2: Installer	1	1…8/16

15.4 CASCADE ERROR HANDLING

15.4.1 CASCADE FROST PROTECTION

1. Frost protection for burner cascade

The 'frost protection' function for a burner cascade is related to the boiler sensor temperatures.
Reactions on the supply / return temperatures of the managing boiler are as follows:

Cascade_Frost_Protection:	Below this temperature the cascade CH/system pump and the general pump of the managing boiler start running.	Default: 15 °C (59 °F)
Cascade_Frost_Protection minus 9 °F (minus 5 °C):	Below this temperature the cascade heat demand is activated; the general pumps of all the cascaded boilers will be started and the boilers start burning.	15 minus 5 = 10 °C (59 minus 9 = 50 °F)
Cascade_Frost_Protection plus 9 °F (plus 5 °C):	Above this temperature, the boilers stop burning.	15 plus 5 = 20 °C (59 plus 9 = 68 °F)

2. Frost protection on boiler

As last protection the controllers for the boilers can force themselves to burn.

If the boiler supply/return temperature drops below 41 °F (5 °C) the boiler starts at minimum power and continues burning until the lowest of both supply and return temperatures are above 59 °F (15 °C).

Specific Parameters	Level	(Default) Value	Range
Cascade frost protection Temperature for frost protection	2: Installer	15 ºC (59 ºF)	10...30 ºC (50...86 ºF)

15.4.1 EMERGENCY MODE

When the managing boiler is in error mode, the depending boilers can go into "Emergency Mode", if enabled.
In emergency mode the system setpoint is set to the temperature of the Emergency_Setpoint and all cascaded boilers start burning on this setpoint.

NOTE: the default setting is 70 °C (158 °F)! Make sure the correct temperature is set for your installation.

Specific Parameters	Level	(Default) Value	Range	Parameter
Permit Emergency Mode	Installer	Yes	Yes/No	Module Cascade parameter 72
Emergency Setpoint	Installer	70 ºC (158 ºF)	20 - 90 °C (68 - 194 °F)	Module Cascade parameter 74
Dair active	Installer	Yes	Yes/No	Boiler parameter 139

For proper functioning of this emergency mode, the following settings are necessary in the managing boiler (installer password required):
- Module Cascade parameter no. 72: "Permit_Emergency_Mode" has to be set on "yes".
- Module Cascade parameter no. 74: "Emergency_Setpoint" has to be set on the right temperature.
- Boiler parameter no. 139: "Dair active" has to be set on "No".

NOTE: do not de-activate the Dair function before commissioning the system and adjusting the boilers!

When the managing unit is reset from lockout state, the cascade controllers are re-initialized.

Loss of cascade communication
The burner controller of the managing boiler is aware of how many dependents must be present in the system. The total number of boilers is stored in the BCU (in parameter 147). When powering on the system the leading boiler has to detect all depending boilers within 60 seconds. When not all dependent boilers are detected, the controller will show the CC_Loss_Communication warning. When the communication with any of the depending boilers is lost during operation, the controller will show the CC_Loss_Communication warning after 60 seconds, which is purely informative and will not block the controller.

15.4.2 MANAGING BOILER ERROR

When the managing boiler is in error mode this boiler is not used anymore for the cascade system.
However depending on the error code, the pumps connected to the managing boiler still can be active for the cascade system. When the managing unit is reset from lockout state, the cascade controllers are re-initialized.

16 SYSTEM TEST.

For testing the system at fixed power rates, a system test can be activated via the Installer menu. Via the system test the boiler can be started without CH or DHW demand being present. The system test has priority.

The following modes are available:

System test mode		Description
0	Not active	System test mode not active
1	Fan only	The fan is forced to run at maximum speed without starting the boiler
2	Low power	The boiler starts and after the ignition period has finished the boiler stays at low power
3	Ignition power	The boiler starts and stays at ignition power
4	High power	The boiler starts and after the ignition period has finished the boiler stays at high power
5	High power limited	The boiler starts and after the ignition period has finished the boiler stays at high power limited by the parameter *CH_ max_power*
6	High limit error test	Simulates the *Max_Temp_Error*
7	Low water cut off 1 error test	Simulates the *LWCO_1_Error*
8	Low water cut off 2 error test	Simulates the *LWCO_2_Error*

Before running the system test modes first check if the heat can also be dissipated. Note that during this mode the supply temperature can be raised above 95 ºC (203 ºF). When this temperature is reached the boiler will switch OFF.
When the supply temperature cools down to 90 ºC (194 ºF) the boiler will start again.

During the system test the boiler and system pump will be ON. As the boiler will run at fixed power rates there is no setpoint control active. Also the flame recovery is not active during system test demand. All other safety functions remain active.

The system test automatically stops after 10 minutes, after which the system continues with normal demand handling. When the system test mode is changed during an active system test, the 10-minute timer is restarted.

17 COMMISSIONING THE BOILER

17.1 FIRST: FLUSHING THE BOILER WITH WATER

After installation of the boiler the first step, before commissioning, is to flush the boiler and the whole heating installation with fresh water to remove pollution, debris and other materials that might cause a blocking. This must also be done with heating installations, where only the boiler is replaced.
Existing and new heating systems must be cleaned with a hydronic system cleaner; see 7.14 "Flush the system with fresh water". System cleaner must be drained and thoroughly flushed with clean water to remove any residual cleaner, prior to installing a new boiler. NEVER leave system cleaner in the heating system for longer than recommended by the manufacturer of the cleaner. Never put system cleaner inside the boilers heat exchanger.

17.2 SECOND: FILLING & VENTING THE BOILER AND THE SYSTEM

After flushing the boiler and the installation the system can be filled with fresh water. Fill the boiler and the heating system by using the appropriate filling valve. The water pressure of the system normally lies between 1.5 and 2.0 bar (21.8 and 40 psi) – see 7.18 'Water pressure'

NOTICE: Use the following aspects to prevent corrosion of the central heating system:

- Filling water: Do not use any additives for the water of the central heating system except those shown in section 7.13. The pH value of the water must be more than 5 (If this pH value is less, please contact the supplier).
- Ensure that any used "plastic" pipes are oxygen diffusion-proof in accordance with DIN 4726/4729. If not, make sure that the boiler circuit is separated from the heating circuit by a plate heat exchanger. This way no oxygen that entered the heating system through these pipes can reach the boiler.

Check the total heating system for any leaks. This to prevent oxygen entering the system through these leaks.

The boiler has an automatic air vent situated inside the boiler. This vent is always open and the venting outlet goes via a plastic tube through the bottom to the outside. Shortly after putting the boiler into operation, check the water pressure and add or remove some water to obtain the required pressure.

During the commissioning, make sure that no water can enter the boiler and make contact with the electrical parts.

17.3 THIRD: CHECK THE WATER FLOW

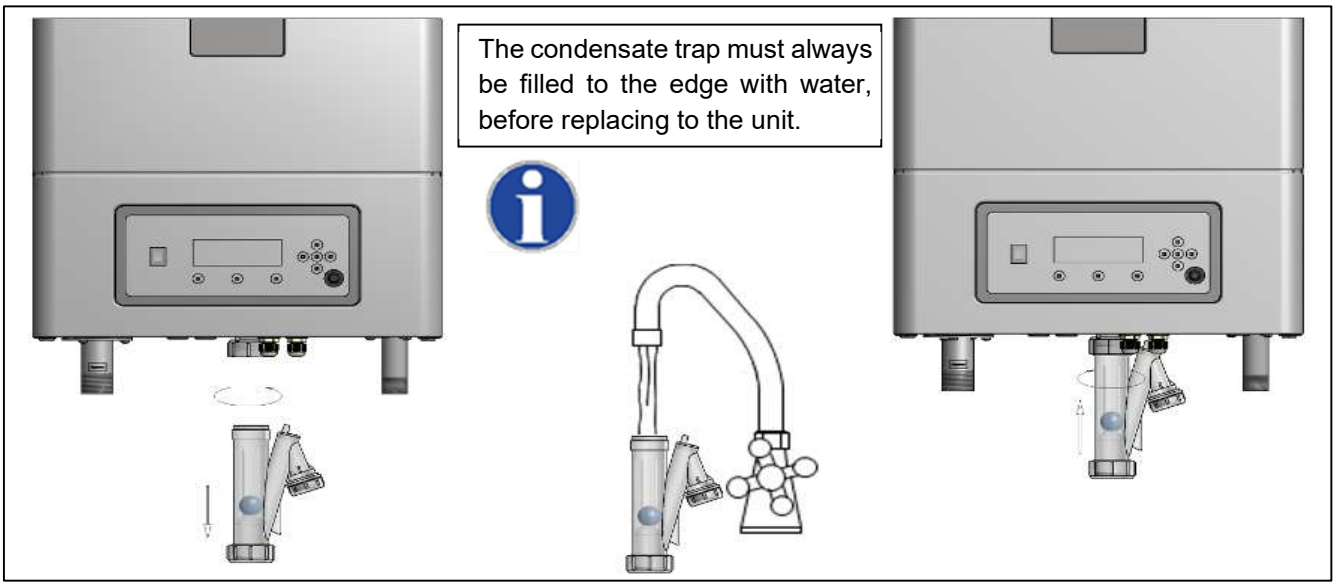
Before starting the boiler ensure the pump is installed and operating correctly and that there are no obstructions or closed valves that could prevent water flow through the heat exchanger.

Always ensure the boiler pump is functioning correctly and that there is flow through the heat exchanger after working on the boiler or system.

17.4 MOUNTING CONDENSATE TRAP

When mounting the bottom part of the condensate trap, 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 condensate trap keeps the flue gases from leaking out of the heat exchanger via the condensate drain.



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

17.5 CHECKING GAS PRESSURE

Check the gas pressure available at the gas connection pipe of the boiler. Use the pressure nipple [3] of the gas safety valve for this measurement. In 18.1.2 "Setting screws ..." the position of the pressure nipple [3] is shown.

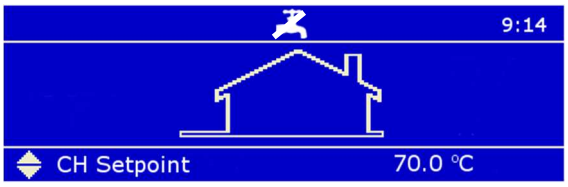
Min. and max. gas supply pressures:

Type of Gas	p nom [mbar]	p min [mbar]	p max [mbar]
G20	20	17	25
G31	37	25	45

17.6 FIRING FOR THE FIRST TIME

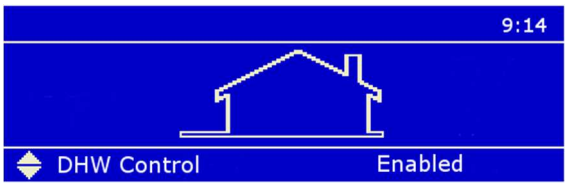
After the commissioning of the boiler and the described previous actions, the boiler display will show this screen.

This screen is active during power up and will remain active until communication with the main Controller has been established. After communication has been established one of the following status overview screens appears:



Central Heating only

OR



Central Heating AND Domestic Hot Water

The display describes:

- The actual operation for heating or hot water
- The temperature setting

18 ADJUSTING AND SETTING THE BOILER

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

The initial lighting of the appliance must be performed by a fully trained competent Engineer. Failure to follow these instructions may result in property damage, serious injury or death.
As soon as the appliance has been fully installed (with regard to hydraulics, filling and de-aeration of installation, gas, flue gas, air intake, wiring etc.) according to the preliminary installation instructions, the boiler may then be wired to an electrically grounded power supply source. A suitably competent person MUST check the 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 must be sited close to the equipment and must only serve that equipment. The double pole switch must be readily accessible under all conditions.
WARNING: THIS APPLIANCE MUST BE EARTHED

18.1 INTRODUCTION

The boiler must always be adjusted in the next situations:

- A new boiler is installed
- As part of a service/maintenance check, in case the O_2 values turns out to be incorrect.
- The gas valve has been replaced.
- Gas conversion to propane. Prior to adjustments, follow the procedure in 18.4
- The venturi has been replaced. Prior to adjustments, follow the procedure in 18.3
- The fan has been replaced
- The flue gas check valve has been replaced

In any of the cases described, always check the gas/air ratio of the combustion figure (O_2) at maximum and minimum input. First set the boiler at maximum load and subsequently at minimum load, and repeat if necessary (adjustments at maximum load influence values at minimum load and vice versa).

Chapter overview:
First, all necessary values are given in adjustment table below. A drawing of the gas valve(s) and setting screws is given in 18.1.2. In 18.2 a general procedure, conform which the adjustments must be carried out, is presented. § 18.3 describes the specific adjustments to be made when the venturi is replaced, and 18.4 describes the changes needed when the gas type is set to propane.

18.1.1 COMBUSTION TABLE

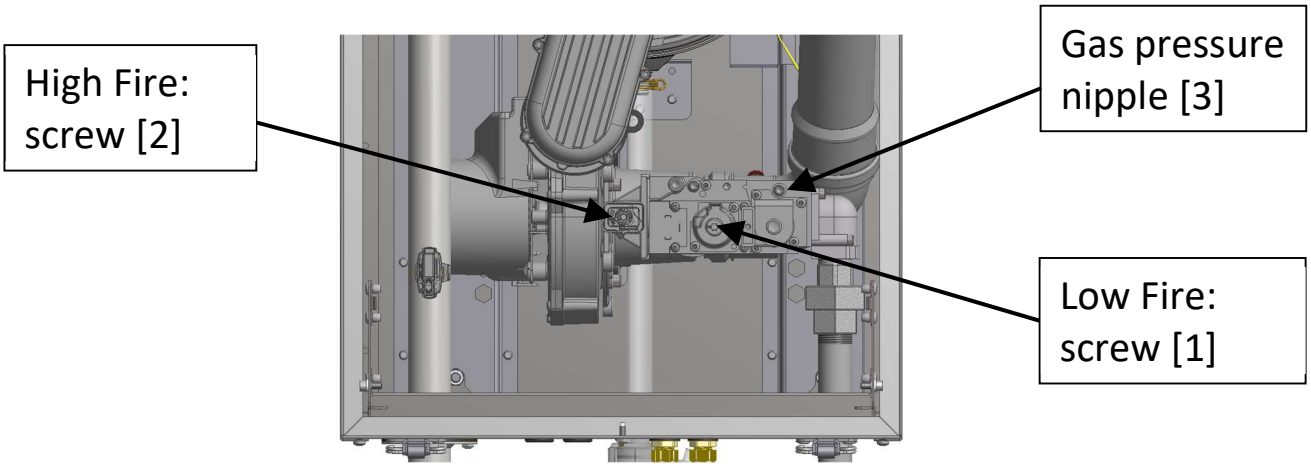
Table: O_2 and CO_2 values for maximum and minimum load. [1)]

Gas type:	Natural gas G20		Propane G31 [2) 3)]	
	O_2 / CO_2 [%]		O_2 / CO_2 [%]	
Boiler type	max load	min load	max load	min load
EFB85	6.0 / 8.4	6.9 / 7.9	4.9 / 10.5	6.7 / 9.3
EFB105			5.2 / 10.3	
EFB125				6.4 / 9.5
EFB155				

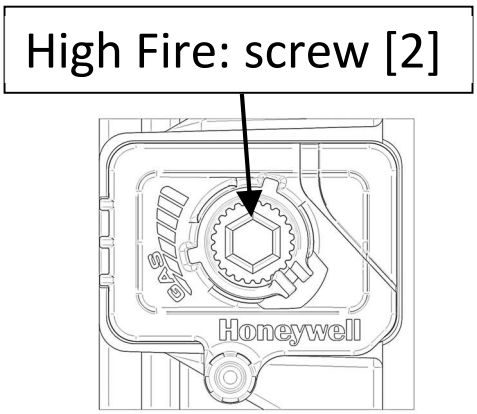
Allowed tolerances are: O_2 ± 0.2 and CO_2 ± 0.1

18.1.2 SETTING SCREWS VENTURI- AND GAS VALVES: DRAWINGS

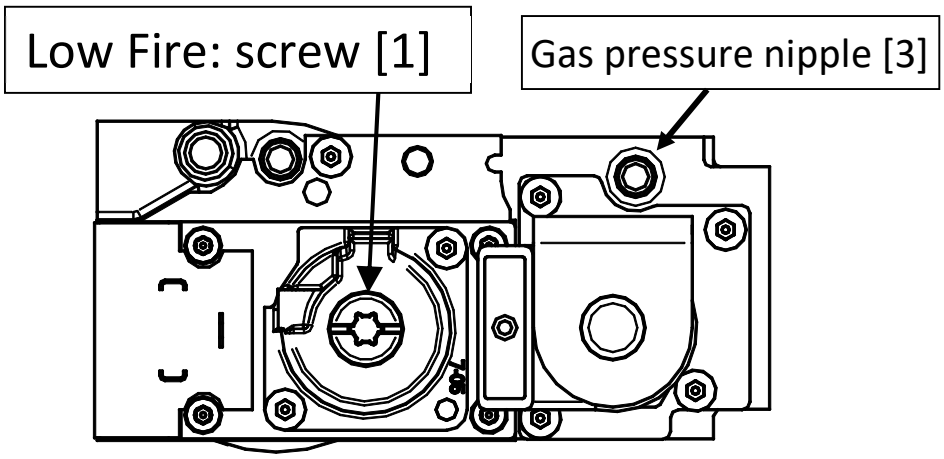
Location of the setting screws:



High Fire: venturi adjustment screw: use hex key 4 mm (5/32 Allen wrench)



Low Fire: gas valve adjustment screw: Torx T40.



18.2 ADJUSTMENT PROCEDURES

Procedure 1: adjust at High Fire

Carry out the next steps:

1. From status screen, press MENU ☰.→ "Central Heating/ Information/ Settings/ System Test"
2. Press UP/DOWN ↑↓ to select "System Test"Press CONFIRM ↵
3. Password needed to continue
4. Press CONFIRM ↵ to activate the test state. → "Test State: **Off**"
5. Press UP/DOWN ↑↓ multiple times to select "High Power" → "Test State: **High Power**".
   The boiler becomes active, after about 10 seconds, the boiler burns at high fire.
   If the boiler doesn't start, open screw [2] two turns extra - clockwise
   Note: once the test state is active, it is not necessary to press a button, selecting the desired power is sufficient.
   Wait a minimum of 10 seconds for the boiler to stabilize before taking combustion readings between changes and adjustments to the combustion.
   For your information, "Fan speed" and "Ionization" are displayed.
6. Measure the O_2 percentage at the flue gas test port on the vent connection.
7. By setting screw [2], adjust the gas valve to obtain the O_2 value of table 18.1.
8. To return to the status screen, and stop the boiler, press ESCAPE ⎋ or MENU ☰ 3 times, or RESET ↺ once.

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

The system test automatically stops after 10 minutes, after this the system continues with normal demand handling. When the system test mode is changed during an active system test, the 10-minute timer is restarted.

Procedure 2: adjust at Low Fire

Carry out the next steps:

1. Press UP/DOWN ↑↓ multiple times to select "Low Power" → "Test State: **Low Power**".
   After about 10 seconds, the boiler burns at low fire.
2. Measure the O_2 percentage at the flue gas test port on the vent connection.
3. By setting screw [1], adjust the gas valve to obtain the O_2 value of table 18.1.

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

4. To return to the status screen, and stop the boiler, press ESCAPE ⎋ or MENU ☰ 3 times, or RESET ↺ once.

The system test automatically stops after 10 minutes, after this the system continues with normal demand handling. When the system test mode is changed during an active system test, the 10-minute timer is reloaded.

Repeat procedures 1 and 2 until measured values match table values best

18.3 VENTURI REPLACEMENT ADJUSTMENT

A new venturi is shipped with an unknown setting. It must be adjusted before it can be used in the boiler.

- First, turn setting screw [2] on the venturi clockwise until you feel resistance. This means that the valve is open, *do not try to tighten the screw any further*.
- Now turn screw [2] counter clockwise 38 turns.

After this, perform adjustments according to 18.2

18.4 CONVERSION FROM NATURAL GAS TO PROPANE

Adjustment of the boiler to a different gas type must be performed by a fully trained competent Engineer
Parameter 92 and 93 must be set correctly
Incorrect settings can lead to damage to the appliance or shorten the lifespan of the appliance
The boiler warranty will be void if this conversion is not correctly carried out

Use only parts/conversion kits obtained from Lochinvar and intended to be used with this particular boiler.
Every conversion kit is provided with instructions on how to assemble the kit to the boiler.

Converting the boiler to propane requires the following:

1. Check boiler model
2. Install the orifice
3. Set parameter 92 and 93 (fan speed)
4. Adjust O_2 / CO_2 percentage
5. Check the gas pressure
6. Confirm and apply the Propane sticker and mark the boxes

18.4.1 CHECK BOILER MODEL

Check which boiler model you are working on, the data plate is located on the inside of the casing at the top.

18.4.2 INSTALL THE ORIFICE

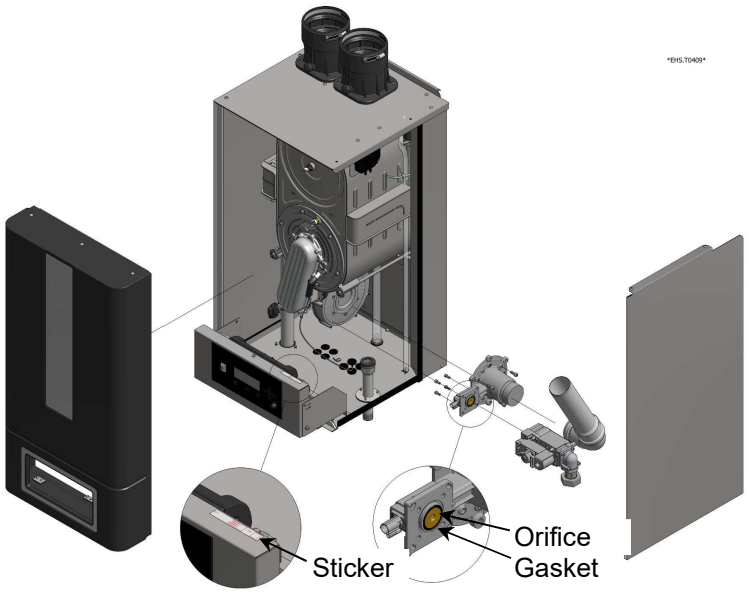
Model	Orifice Inner Diameter
EFB 85	6.2
EFB 105	6.2
EFB 125	7.2
EFB 155	7.5

Converting the boiler to propane is done by placing a propane orifice between gas valve and venturi. By using the correct orifice size (see table below), the measured O_2 (CO_2) percentage in the flue gas will already be close to the desired value.

18.4.3 INSTALLING THE ORIFICE (SEE ALSO PICTURE BELOW):

Tools required: wrench 55, Hex key 5 mm and Hex key 4 mm

1. Close the external gas shutoff valve and disconnect the electrical power before opening the boiler.
2. Use a wrench to open the coupling in the gas line in the boiler. The three screws, with which the venturi is mounted onto the fan, can now be removed.
3. Venturi and gas combination valve can now be separated. The orifice is to be placed between venturi and gas combination valve. The rounded side of the orifice must be on the side of the gas combination valve.
   The orifice must be mounted into the gas entry of the venturi and secured with the rubber gasket.
4. Venturi and gas combination valve now can be reconnected.
5. Remount the gas combination valve and the venturi onto the fan. Close the coupling in the internal gas line.
6. The external gas valve shutoff can now be opened.
7. Check for gas leaks.
8. Reconnect the electrical power.
9. If in operation, check again for gas leaks



18.4.4 SET PARAMETER 92 AND 93

The fan speed has to be changed in the software of the boiler according to the tables below:.

	Boiler type	fan speed high fire parameter 92		Fan speed low fire parameter 93	
		Propane G31	Nat. gas	Propane G31	Nat. gas
Internal igniter	EFB 85	6500	7400	1850	1800
	EFB 105	7300	7900	2000	1900
	EFB 125	7200	7950	1950	2000
	EFB 155	5750	6450	2000	1800

1. From the status screen, press MENU button once.
2. Press UP/DOWN ↑ ↓ to select "Settings" and press ENTER ↵
3. Press UP/DOWN ↑ ↓ to select "Boiler Settings" and press ENTER ↵
4. Enter the installer password by pressing UP/DOWN ↑ ↓ and LEFT ← / RIGHT →.
5. Press UP/DOWN ↑ ↓ to select "Boiler parameters" and press ENTER ↵
6. Press UP/DOWN ↑ ↓ to select parameter "(92) Fan Speed Maximum" and press ENTER ↵
7. Press UP/DOWN ↑ ↓ to adapt the fan speed according to the table and press ENTER ↵
8. Press UP/DOWN ↑ ↓ to select parameter "(93) Fan Speed Minimum" and press ENTER ↵
9. Press UP/DOWN ↑ ↓ to adapt the fan speed according to the table and press ENTER ↵

To return to the status screen, press ESCAPE ⎋ or MENU ☰ 4 times, or RESET ↺ once.

⚠ **WARNING!**	Check during start-up of the boiler no gas mixture is leaking on all parts that have been apart!

18.4.5 ADJUST THE O_2 / CO_2 PERCENTAGE

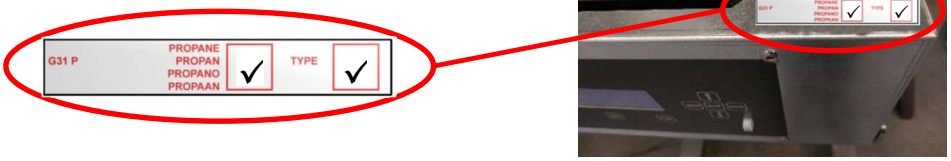
Perform O_2 adjustments according to the procedures in 18.2, using the values in table 18.1.1.

18.4.6 CHECK THE GAS PRESSURE

Measure the gas pressure at high fire. The dynamic pressure should be at least 25 mbar. If there are more boilers in the boiler room the gas pressure should be checked on the boiler at the end of the gas line, with all boilers burning at high fire. If the gas pressure is too low, check gas lines, reducers and propane tank.

18.4.7 CONFIRMATION

When finished, apply the corresponding sticker at the appropriate position in the boiler and mark the box for the used gas type. Also mark the box "Type", indicating that the correct parameter values have been set for this boiler.



Please ensure the boiler is clearly labelled if operating on propane supply!

It is possible to improve the ignition spark by using an external ignition transformer. Available on request, see the accessories list.

18.5 START UP CHECKLIST

Installation/start-up checklist

Installer information	
Company	
Engineer name	
Address	
Postal code	
City	
County	
Telephone number	

Site information	
Site name	
Site contact (owner/end user)	
Address	
Postal code	
City	
County	
Telephone number	

Boiler information	
Model	
Serial number	
Installation date	
New boiler or replacement	New / Replacement
Cascade installation (Y/N)	(YES / NO)
Number of boilers	
Type of boilers in cascade	

Lochinvar
HIGH EFFICIENCY BOILERS & WATER HEATERS

After filling in form please send a copy by e-mail to: info@lochinvar.ltd.uk or send a copy to address:

Lochinvar Limited.
7 Lombard way, the MXL Centre, Banbury OX164TJ

Flue information		
Direct vent or using combustion air from indoor?	indoor / outdoor	
	Air inlet	**Flue outlet**
Diameter		
Total length		
Length horizontal		
Length vertical		
Length sloped at …..°		
Number elbows 90°		
Number elbows 60°		
Number elbows 45°		
Number elbows 30°		
Air intake location (e.g. roof/wall)		
Distance vertical from roof		
Distance from (closest) wall		
Common air intake system	(YES / NO)*	
If YES => how many Air intakes are joined?		
Air intake (under)pressure (on top of boiler)		
Possibility of dust/chemicals drawn in to air intake?	(YES / NO)*	
If YES => of which kind?		
Distance from Flue outlet (top of chimney) vertical		
Distance from Flue outlet (top of chimney) horizontal		
Is there a condensate drain installed to common flue system?		
Flue outlet pressure (on top of boiler)		

Condensate Drain	
Check the level of the heat exchanger; It must have a slight angle from the rear to ensure that the condensate drains from the heat exchanger.	(YES / NO)
Condensate trap (from package) installed according installation manual?	(YES / NO)
Inside diameter of drain piping	mm/inch
Is there a definite air gap between the condensate trap and the connection to drain pipe?	(YES / NO)
Total drop in height from boiler to drain piping exit point	
Any additional trap points?	(YES / NO)
Perform PH test and register PH value	
Condensate neutralizer installed	(YES / NO)

Water circulation & temperature regulation (for DHW)	
Piping diameter	
Total length of straight pipe between boiler & tank	
Number of elbows	
Number of tees	
Temperature rise between inlet and outlet after 5 min. cold-start operating max. power	°C / °F
Water temperature setpoint	
Test of Water Flow Switch (DHW)?	(YES / NO)

**Gas valve
Pressure Nipple

Gas supply	
Type of Gas from installation	
Is gas isolation valve installed under boiler according to installation manual?	(YES / NO)
Which diameter gas isolation valve is installed?	
Gas piping (inside) diameter	
Gas piping material (if possible specify mark/type)	
Gas piping flexible	(YES / NO)
Gas piping inside structure (e.g. smooth/corrugated)	
Measured Gas pressure @Gas valve (Static) **	
Measured Gas pressure @Gas valve (dynamic - all gas appliances in the building must be turned on and running at full load)	
Is there a secondary gas pressure regulator before the boiler?	(YES / NO)
If YES what is the length of the Gas piping in between?	
If YES what is the Brand & Model?	

Combustion settings		unit:
Set for NG (Natural Gas) or LP (Liquid Propane)?	NG or LP?	
If LP is the right gas orifice mounted?	(YES / NO)	
Diameter gas orifice for LP?		mm
O_2 / CO_2 level at high fire …%		%
O_2 / CO_2 level on low fire …%		%
Flue pressure @ O_2 / CO_2 measuring point at high fire		Pa
Flue pressure @ O_2 / CO_2 measuring point at low fire		Pa
If cascaded with common flue system run all appliances at high fire and measure Flue pressure		Pa
If cascaded with a common flue system; run all appliances at low fire and measure the flue pressure		Pa

Electronics & Power supply		unit:
Version Burner Controller Hardware (see 3.2 in Manual for location)		
Version Burner Controller Firmware (see 3.2 in Manual for location)		
is ground connected to building grounding system	(YES / NO)	
Voltage incoming (Hot to Neutral)		V
Voltage incoming (Hot to Ground)		V
Voltage measured between Ground and Neutral		V
Total of amperage switched by the Boiler Controller is below 3.5 A or 800 W		A

Additives	
Used chemical additions	
Mixing Ratio	

19 INSPECTION, MAINTENANCE AND SERVICE.

19.1 GENERAL

For a good, safe and long-time operation of the boiler and to maintain warranty it is mandatory to carry out inspection, maintenance and service on the boiler at least once a year, and/or after 2000 burning hours maximum, whichever comes first.

Inspection, maintenance and service of the boiler must also be carried out on the following occasions:
- **When a number of similar error codes and/or lock-outs appear.**
- **At least every twelve months and/or after 2000 burning hours maximum, whichever comes first, maintenance must be done to ensure safe and efficient operation.**

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

Service intervals
The normal service frequency for the boiler is once a year and/or after 2000 burning hours maximum, whichever comes first. Every service interval the boiler must be cleaned and checked, according to the maintenance procedures. If there is doubt whether the boiler is operating with the correct water and/or combustion air quality, it is advised that a first check is already executed after six months. This check serves to determine the frequency of the future services. The maximum interval between two services is one year and/or after 2000 burning hours maximum, whichever comes first.

Inspection, maintenance and service must be executed for safe and efficient operation of the boiler.

Caution: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.
"Verify correct operation after servicing."

19.2 INSPECTION, MAINTENANCE AND SERVICE.

Inspection, maintenance and service including the replacement of boiler parts must only be carried out by a licensed professional, service agency or the gas supplier. Apart from the maintenance proceedings it is required to maintain a service log for each boiler that includes all of the following information:

- 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.
- Static Gas Pressure.
- O_2 / CO_2 % at high and low fire.
- Gas Pressure at high fire.
- Gas Pressure at low fire.
- pH of the water or water/glycol in the system
- name of service company
- date of service

During maintenance, the following items in bold listed below of the boiler must be checked and inspected.

Before starting to work on the boiler:
- **Switch off the electrical power to the boiler (service switch and/or unplug boiler)**
- **Close the gas valve to block gas supply to the boiler**

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

Service history
The operational and fault history (total amount and since the last service) can be viewed in the boiler controller
This information can be used to specify the maintenance and service proceedings in relation to the boiler (parts).

Boiler History	
Successful Ignitions	32
Failed Ignitions	10
Flame Failures	0
Operation Days	0 days ▼

Water leakage
The water pressure of the heating installation must be more than 1.0 bar (21 psi) and at a maximum of 4.0 bar (87 psi) in normal operation. When the water pressure drops below the minimum occasionally, there might be a water leak. Check the boiler and the complete heating installation for any water leakages and have these repaired.
Higher water pressures are allowed with the use of a different relief valve and a pressure switch kit

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 top side of the boiler 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.
Check to ensure the flow there are no obstructions for the exhaust venting or the intake combustion air venting.
Check that all intake and exhaust venting has been properly reassembled and sealed before leaving the job site

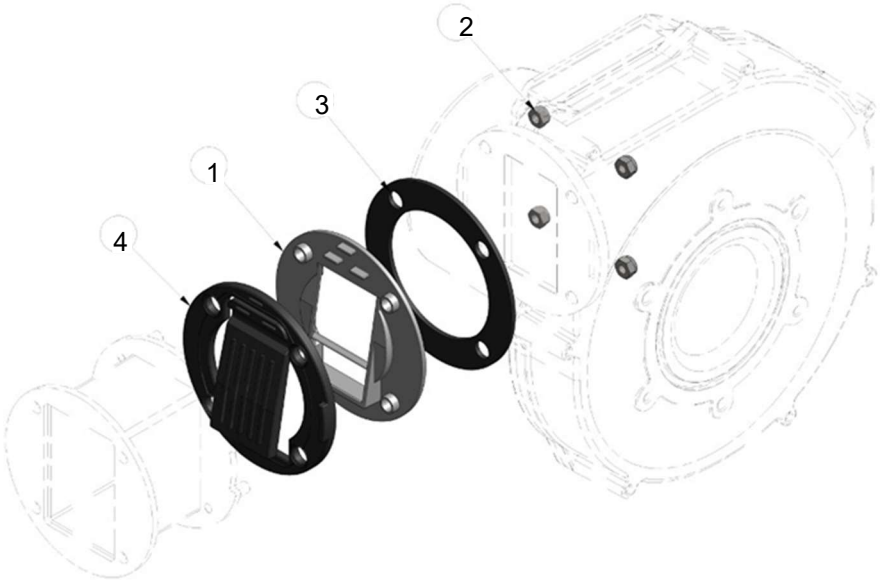
Gas supply & safeties
The gas pipes must be checked for gas tightness. Also check if the mounting of these pipes is correct, safe and not damaged. Any built-in safeties must be checked for a correct functioning. Any gas pipe or fitting that have been opened or adjusted must be checked for leaks.

Remove complete burner unit
The complete boiler unit consists of the fan, venturi, gas valve, the burner plate and the internal burner. To make more space to dismantle the complete burner unit pull down the burner control unit.
To remove this part for an internal heat exchanger check: remove the six M6 nuts, the ignition cable and the thermal fuse cables. Close the gas tap under the boiler and loosen the gas coupling by untighten the swivel joint under the gas valve. Remove the air intake pipe from the venturi.
After this, take out the complete burner unit by moving it forward out of the boiler housing.

NOTICE: During removal of the burner take care not to damage the burner plate insulation during this operation.

While removing the complete burner unplug both of the electrical and controlling cables of the fan. After all this dismantle the venturi on the suction side of the fan and check the blade wheel of the fan.

Checking the Non-return Valve (NRV)
The NRV is placed directly after the fan and has to be replaced once every five years during maintenance.
For the EFB 85, 105 and 125: Replace the NRV by removing the 4 nuts that are holding the fan. All the parts included in the NRV maintenance kit must be replaced the gaskets, NRV seat, lock nuts, and NRV. Do not reuse any of the old parts.
Reassemble the NRV to the burner unit be sure that the nuts are tightened again so no air/gas mixture is leaking into the cabinet. Check during start-up of the boiler to ensure no gas mixture is leaking on these gaskets near the NRV.
For the EFB 155: A separate instruction is provided with the service set.



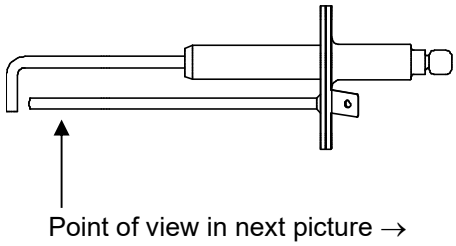
1 = Seat check valve small
2 = Lock nut M5 DIN985
3 = Gasket gas air mixing
4 = check valve small

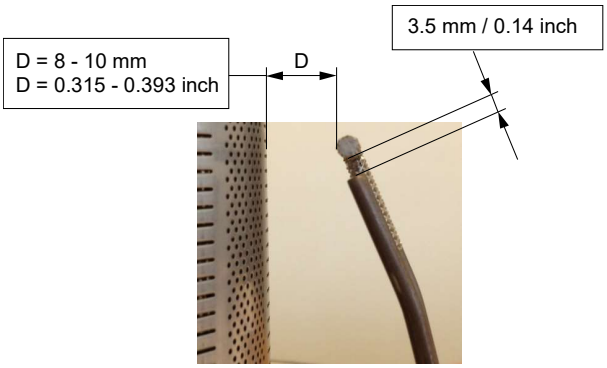
Always check gaskets on NRV for air/gas leakage

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

Ignition / ionization electrode
When the complete burner is removed, it is 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 figure below. When these are not correct, try to bend the electrodes into the right position. Notice: The electrodes undergo high temperatures, therefore the electrodes become hard and are difficult to bend. While bending used electrodes they might break or burst. Check the electrode, after bending, for any tear/crack and signs of rust. When they are damaged in any manner 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 replaced, also the gasket must be replaced. The electrode must be replaced annually. Emory cloth, sandpaper, and any other abrasive material may never be used to clean the electrode.

Tools Required: Phillips #2 screwdriver.





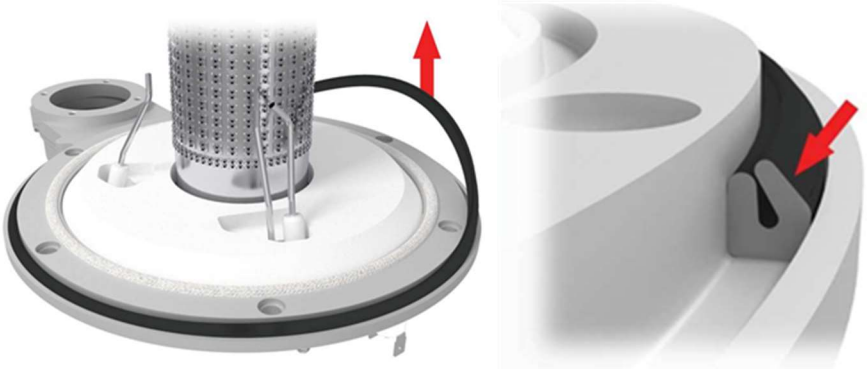
Burner door thermostat
Tool required: Wrench 16 mm.
This thermostat is activated if the temperature of the burner door has been too high, most likely because of defective insulation, gasket or fibre braid.
The thermostat has to be replaced (spare part).

Replacement:
- Disconnect the wiring and remove the thermostat.
- Tighten the new burner door's thermostat with a torque of 2 Nm.
- Reconnect the wiring.

Burner door gasket
If any part of the gasket has discoloured, changed texture, or hardened, the rubber has cured and/or has damages, this gasket must be replaced. Notice: only use gaskets that are supplied by the boiler manufacturer.

Burner door gasket replacement:

- Remove the old gasket
- Place a new gasket in its groove.
- Respect the mounting direction.



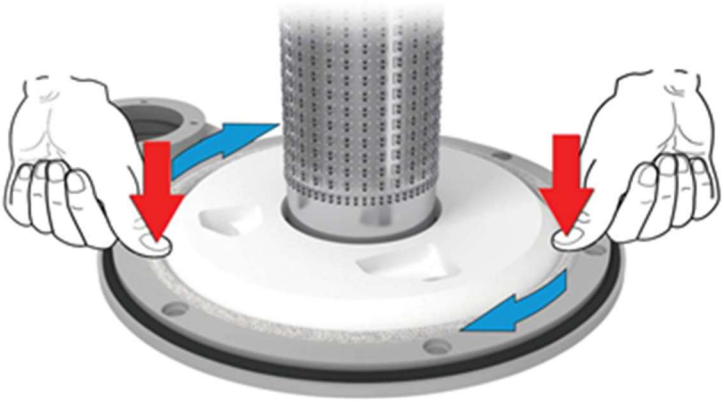
Fibre braid replacement
If the high temp braided rope is damaged and needs to be changed, it has to be replaced by new braids using the method described below.

The high temp braided rope is maintained by silicone glue.

- Remove electrodes.

- Remove the braids by sliding under the periphery a thin tool to loosen the braids and remove it.
- Remove and clean the residues of the braids and silicone glue.

- Put a thin string of temperature-resistant silicone glue in the seal housing. (Loctite 5366 or Ottoseal S17)



- Engage the high temp braided rope and place it in contact of the glue and press the braids.

- Reinstall electrodes

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 disc shows any signs of (water) damage or degradation it must be exchanged. Also check if there are any indications in the burner room of a high condensate level (caused by a blocked condensate trap) that might have wetted the rear wall insulation. When this has happened the rear wall insulation must also be replaced.
Only use the insulation disc that is supplied by the boiler manufacturer.
The same procedure must be applied on the insulation and gaskets fitted on the burner door.

Rear wall insulation disc; changing procedure:

If the insulation disc has degraded or is damaged, it has to be replaced.
- Wait until the heat exchanger has cooled down.
- To prevent debris from falling in between the coils, place a sheet (e.g. paper) on the bottom, beneath the disc.
- Make the insulation wet, by spraying water over it. This will keep airborne dust to a minimum.

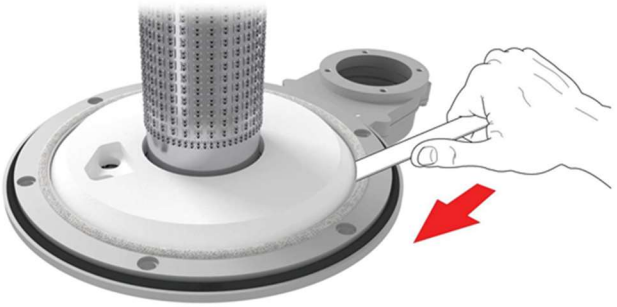
- With a knife, cut a cross in the insulation disc, avoiding the central insert (on the back, not visible)

- Make a square cut around the central insert
- Remove the segments
- Remove the central insert

The new disc has the clip on the back.
- Do **NOT** remove the protective film on the new disc
- With the central insert on the back, place the new insulation disc by pushing it to the rear of the wall. A "click" means the fitting is ok.

Replacement of burner door insulation.

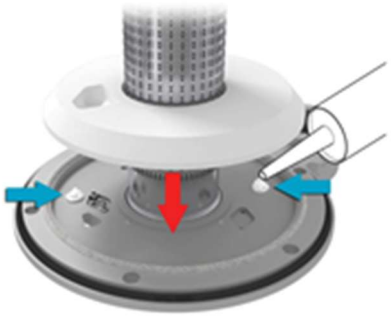
Removal of the insulation:
- remove electrode
- remove the defective insulation by sliding a thin tool under the periphery of the insulation to loosen the insulation and remove it.



- remove and clean the residues of the insulation and silicone glue

Install the new insulation:

- Put two dots of temperature-resistant silicone glue, (Loctite 5366 or Ottoseal S17), according to the locations indicated.
- Make sure that the burner is in proper condition, remove any possible insulation residues on the burner
- Engage the insulation carefully and place it in contact with the two dots of silicone glue
- Check the condition of the electrode, if necessary replace it
- Reinstall electrodes
- Mount the burner door correctly back onto the heat exchanger, taking in account the correct torque values, see 19.2.1"Mounting the burner door"



Fan

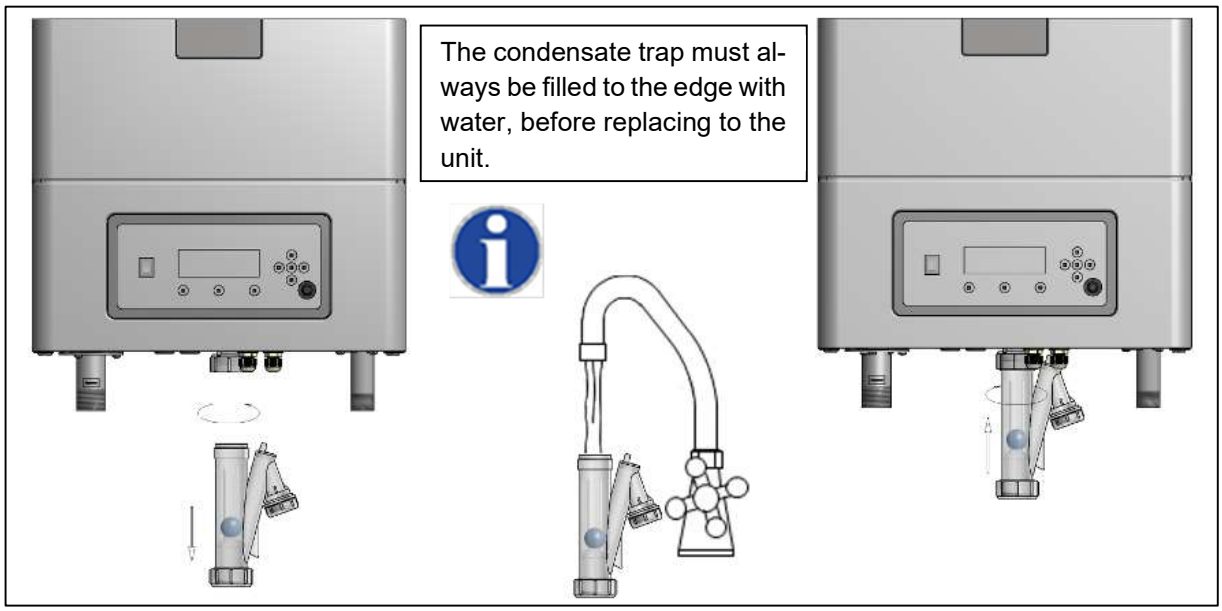
When the fan blades are polluted and dirty, carefully clean the blades with a soft brush. Notice: do not use too much force on the blades or else the fan might be out of balance and run irregularly, causing noises and fan failures. Check the fan also for any water damages. In doubt always replace the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

Condensate trap

Disassemble the condensate trap and clean every part of it. Check the condensate trap connection of the heat exchanger for any blocking or pollution and clean it (if necessary). Check the functioning of the condensate trap by pouring clean tap water in the boiler combustion chamber (when burner door is removed). This water will exit the heat exchanger by the condensate trap. Notice: do not wet the rear wall insulation.

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

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



Heat exchanger and boiler 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 boiler combustion chamber with water. Never expose the refractory insulation in the back of the combustion chamber to water or get it wet. Do not forget afterwards to clean the condensate trap once again.

Do not use acid or alkali products for cleaning, except for white vinegar with maximum 7% acetic acid. This must be thoroughly rinsed away afterwards ensuring the insulation remains dry.

Gas/air ratio
With every service check and/or maintenance of the boiler always check the gas/air ratio by measuring the O_2 / CO_2 percentage (flue gas) at the maximum and minimum load of the boiler. If necessary, adjust these values. See for information chapter “Adjusting and setting the boiler” chapter 18.

Pump (supplied separated from the boiler)
Check the electrical parts and the motor of the pump for a correct functioning. The pump must generate a sufficient water flow over the (heat exchanger of) the boiler. 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 faults and abnormalities are found by the service technician during service and maintenance and these are not repairable, this information must be reported to the owner/end-user of the installation. Also the owner/end-user must be advised how to fix these faults and these faults must 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.

Do not use acid or alkali products for cleaning, except for white vinegar with maximum 7% acetic acid. This must be thoroughly rinsed away afterwards ensuring the insulation remains dry.

19.2.1 MOUNTING THE BURNER DOOR

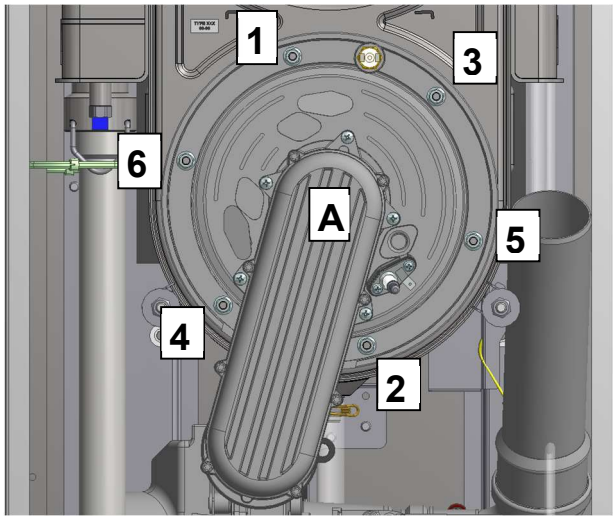
IMPORTANT:
Before mounting the burner door, make sure that its gaskets and insulation are in excellent shape.
If any signs of damage or ageing are present, these parts must be replaced.

The burner door must be mounted back on the heat exchanger as follows:
- 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.
- Ensure that the door is well positioned with respect to the threaded studs, before pushing it onto the exchanger.
- Keep the burner door firmly in place by pushing the gas/air premix manifold with one hand at the middle at point A.
- Hand 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 wrench.
- Tighten the nuts in the order given in the picture
- The specified torque value for tightening the burner door flange nuts is **8 Nm (70.8 inch lbs)**

Tighten in given order.

Torque value = 8 Nm



19.3 MAINTENANCE CHECKLIST

Allowing the boiler to operate with a dirty combustion chamber will damage operation. Failure to clean the heat exchanger as required by the manual and dictated by the operating location could result in boiler failure, property damage, personal injury, or death.
Such product failures ARE NOT covered under warranty.

Periodic maintenance must be performed once a year and/or after 2000 burning hours maximum, whichever comes first, by a qualified service technician to assure that all the equipment is operating safely and efficiently. The owner must make necessary arrangements with a qualified heating contractor for periodic maintenance of the heater. The technician must also inform the owner that the lack of proper care and maintenance of the boiler may result in a hazardous condition.

Maintenance Table

Inspection Activities		Date Last Completed			
		1st Year	2nd Year	3rd Year	4th Year
Near boiler piping	Check system and boiler piping for any sign of leakage. Take off boiler cover and inspect connections in boiler for any leaks or corrosion				
Flue	Check condition of all vent pipe and joints				
	Check to ensure vent termination not blocked or obstructed				
Gas	Check gas piping, test for leaks and signs of aging. Record gas pressure and note pressure drop upon start-up. Record O_2 at high and low fire				
Visual and Temperature	Visual inspection of all system components and verify programmed temperature settings				
Connections	Check wire connections and make sure they are tight				
Combustion chamber	Check burner tube and combustion chamber coils. Clean with nylon brush and vacuum. Avoid touching white ceramic fibre. Also see maintenance section of manual				
Spark igniter	Ensure spacing of igniter prongs are aligned properly.				
Replace NRV	Replace NRV once every five years. Be sure it is not leaking gas after reassembling.				
Condensate trap	Disconnect condensate hose and trap. Ensure no blockage, rinse and clean out. Fill completely again with fresh water and re-install				
Relief Valve	Check to make sure it is not weeping				
Pump and Fan	Listen to sound of the pump and fan. If either makes noise during operation, it is recommended to replace the part.				
Low water cut-off	Check the LWC is not leaking and check for right pressure value by draining the water from the boiler and comparing the value with calibrated meter equipment				
Building User	Question building user before maintenance if they have any issues and after completion, confirm activities performed during maintenance visit.				
Chemical additions	Check the chemical additives and add or renew if the mixing ratio is out of spec.				
Mixing Ratio					

20 END USER

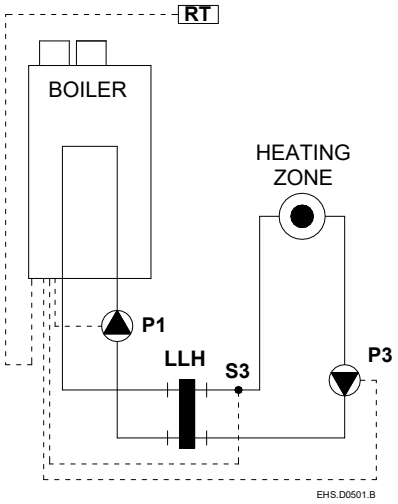
After installing and commissioning of the boiler, demonstrate the operation of the entire central heating system to the end-user. The user must be made familiar with all safety precautions of the boiler and the installation. The user must be instructed that service and maintenance of the boiler is required every twelve months. Regular service and maintenance is essential for a safe and proper operation of the boiler. Hand over the documents supplied with the boiler.

21 INSTALLATION EXAMPLES

The following schematics present several examples of heating installations:

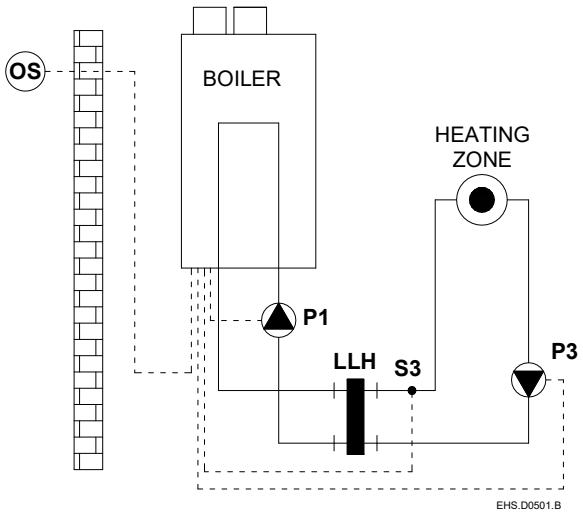
All schematics are purely functional.
Safety components, bypass, control devices and so on must be added to conform to all applicable standards and regulations.

21.1 SYSTEM EXAMPLE 1



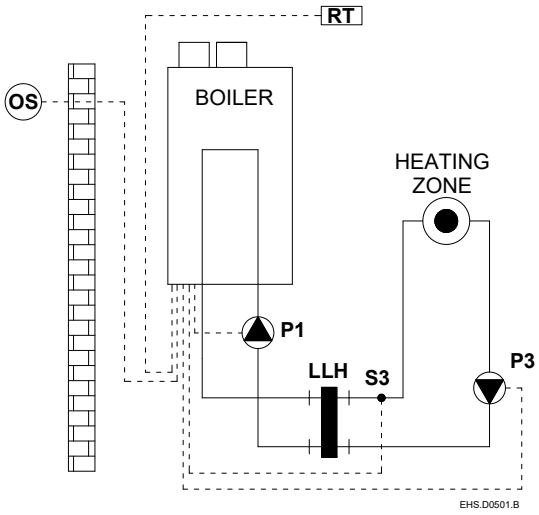
Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
S3	System temperature sensor	3-4
LLH	Low loss header	
Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P3	System heating circulator	4-PE-5

21.2 SYSTEM EXAMPLE 2



Low Voltage Connections		
	Name	**Wire terminal**
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
LLH	Low loss header	
Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P3	System heating circulator	4-PE-5

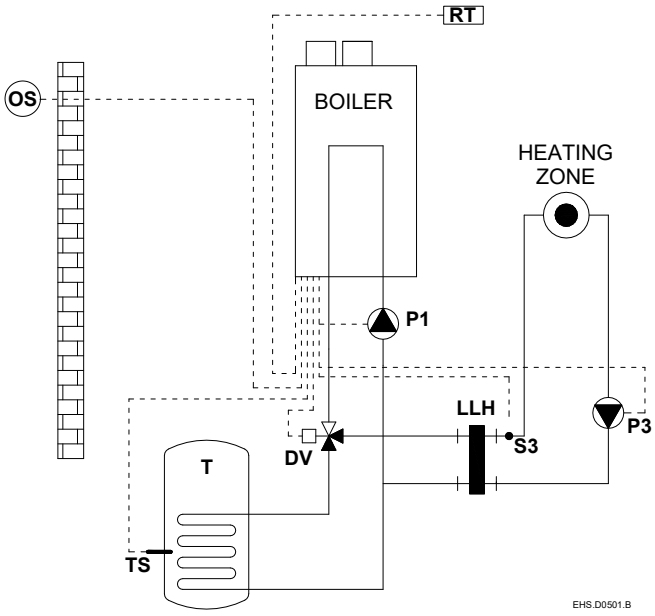
21.3 SYSTEM EXAMPLE 3



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
LLH	Low loss header	

Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P3	System heating circulator	4-PE-5

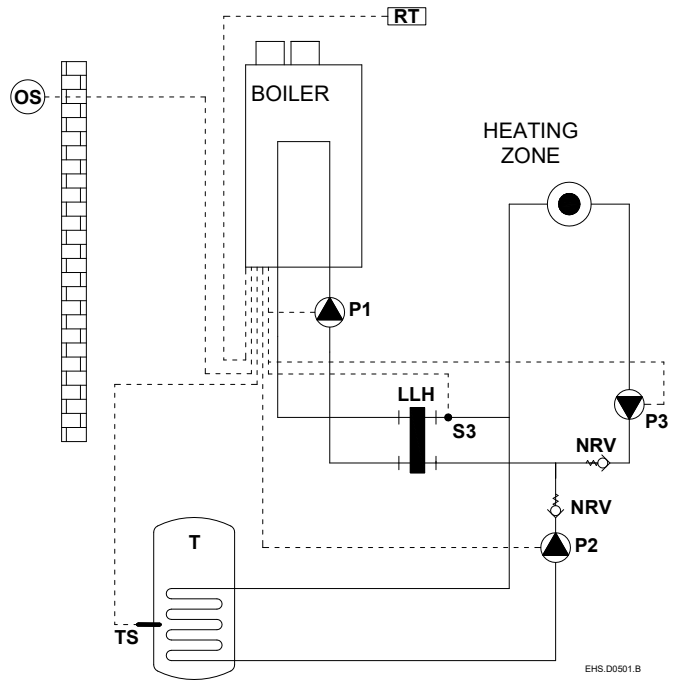
21.4 SYSTEM EXAMPLE 4



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
S3	System temperature sensor	3-4
OS	Outdoor temperature sensor	1-2
TS	DHW Tank thermostat or sensor	5-6
LLH	Low loss header	
T	DHW indirect Tank	

Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P3	System heating circulator	4-PE-5
DV	Diverter valve (3-way-valve)	1-2-3-PE

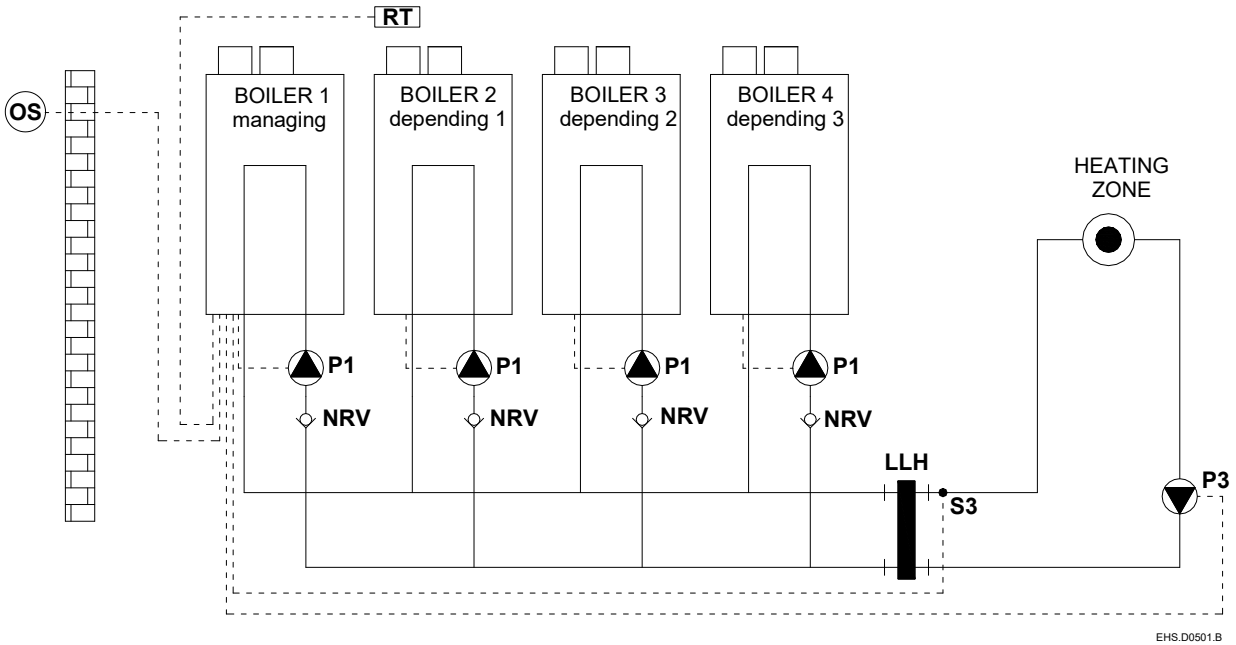
21.5 SYSTEM EXAMPLE 5



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
S3	System temperature sensor	3-4
OS	Outdoor temperature sensor	1-2
TS	DHW Tank thermostat or sensor	5-6
LLH	Low loss header	
T	DHW indirect Tank	
NRV	Non-return valve (low resistance type)	

Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P2	DHW primary circulator	2-3-PE
P3	System heating circulator	4-PE-5

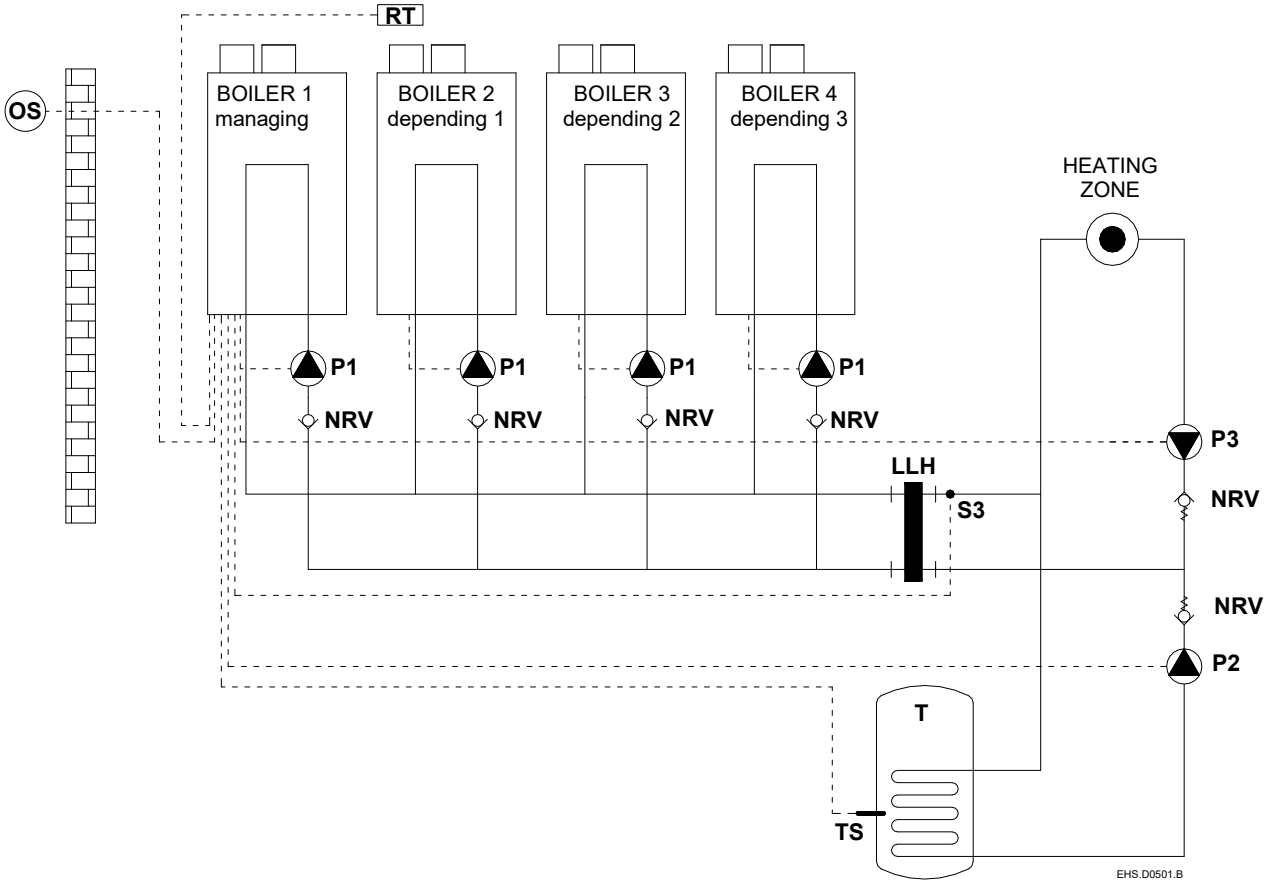
21.6 SYSTEM EXAMPLE 6



Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
NRV	Non-return valve (low resistance type)	
LLH	Low loss header	

Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P3	System heating circulator	4-PE-5

21.7 SYSTEM EXAMPLE 7

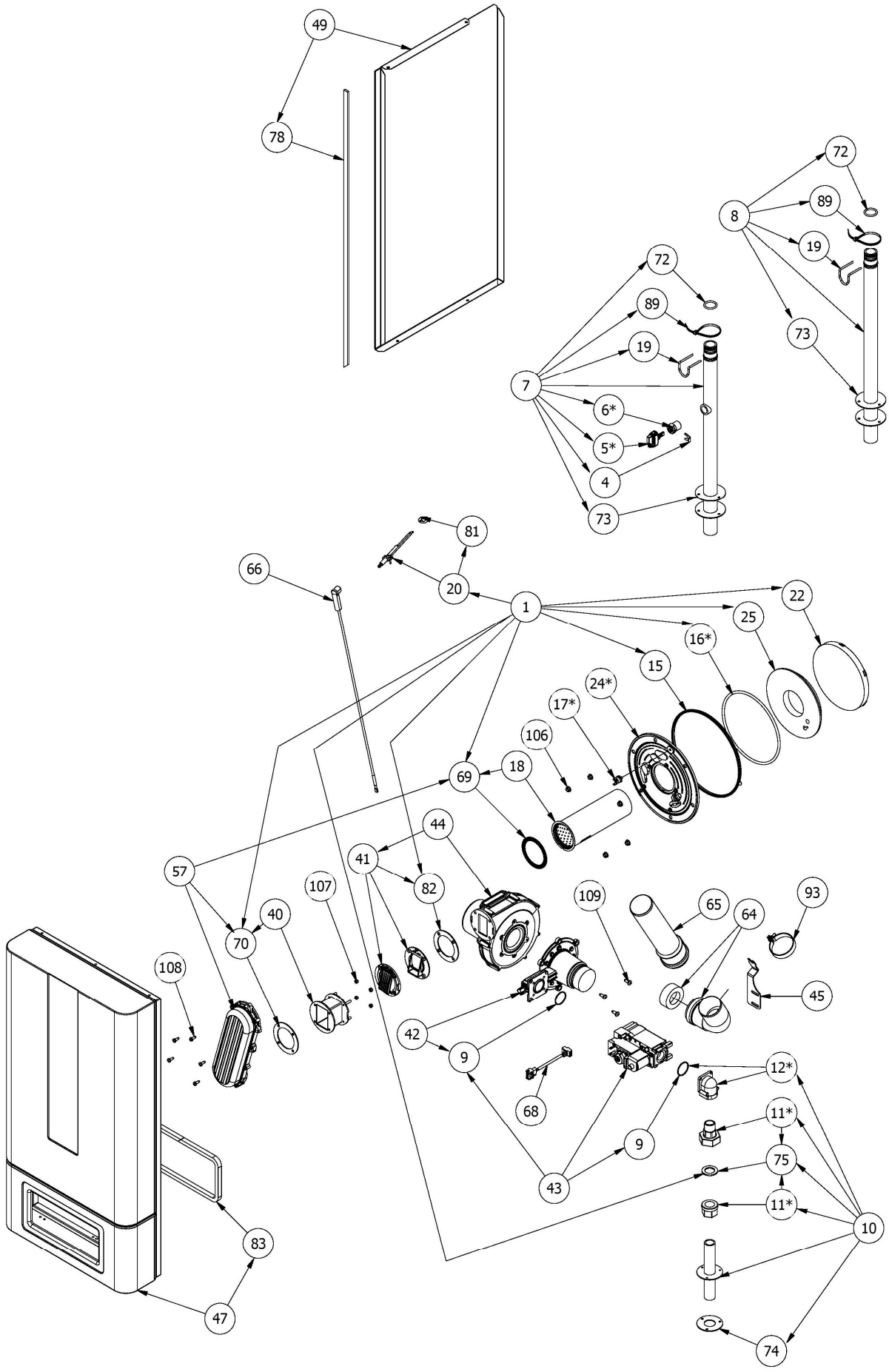


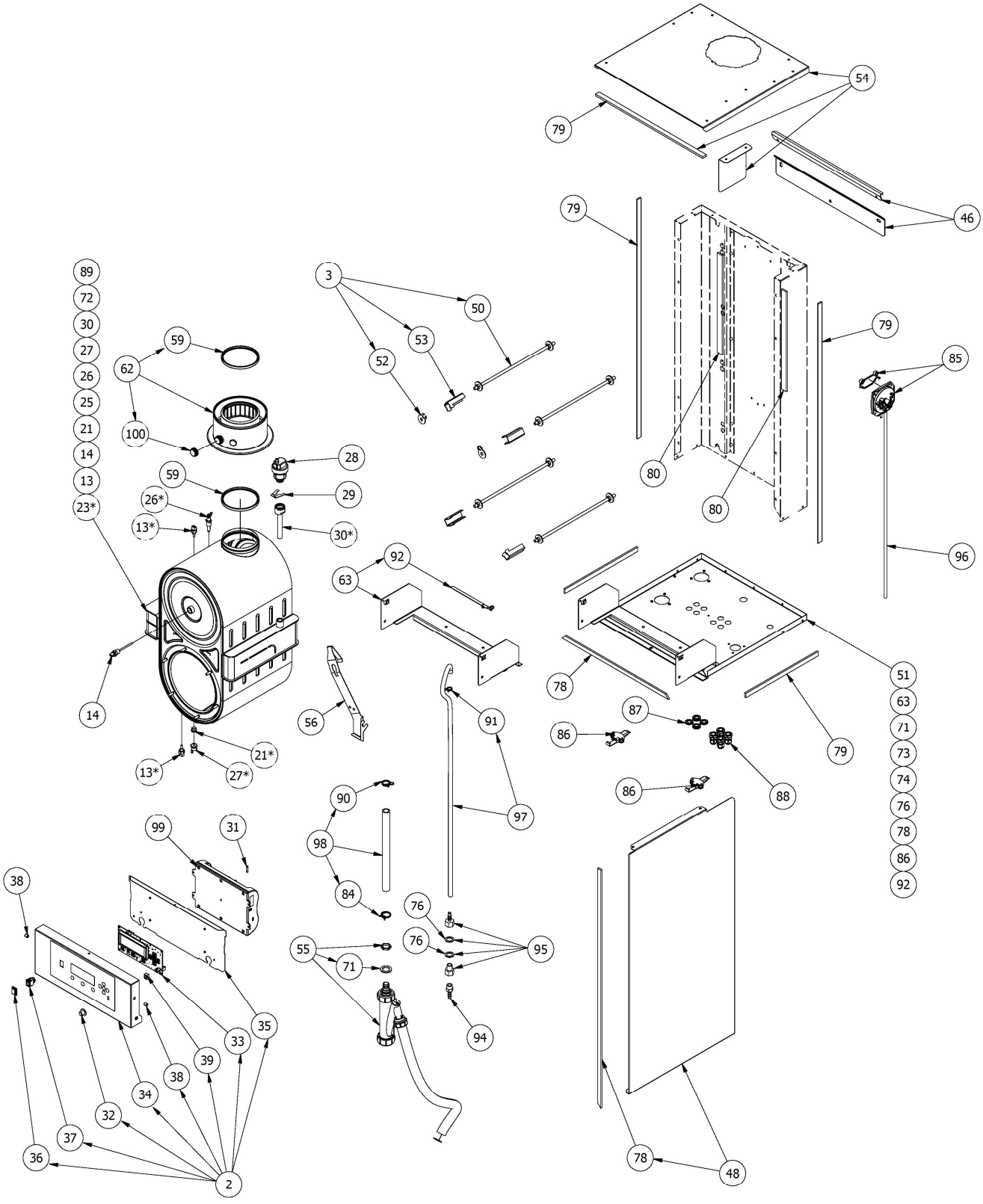
Low Voltage Connections		
	Name	**Wire terminal**
RT	Room thermostat	12-13
OS	Outdoor temperature sensor	1-2
S3	System temperature sensor	3-4
TS	DHW Tank thermostat or sensor	5-6
T	DHW indirect Tank	
NRV	Non-return valve (low resistance type)	
LLH	Low loss header	

Mains voltage Connections		
P1	Boiler circulator	6-PE-7
P2	DHW primary circulator	2-3-PE
P3	System heating circulator	4-PE-5

22 SPARE PARTS

22.1 EFB85, EFB105 AND EFB125 EXPLODED VIEW





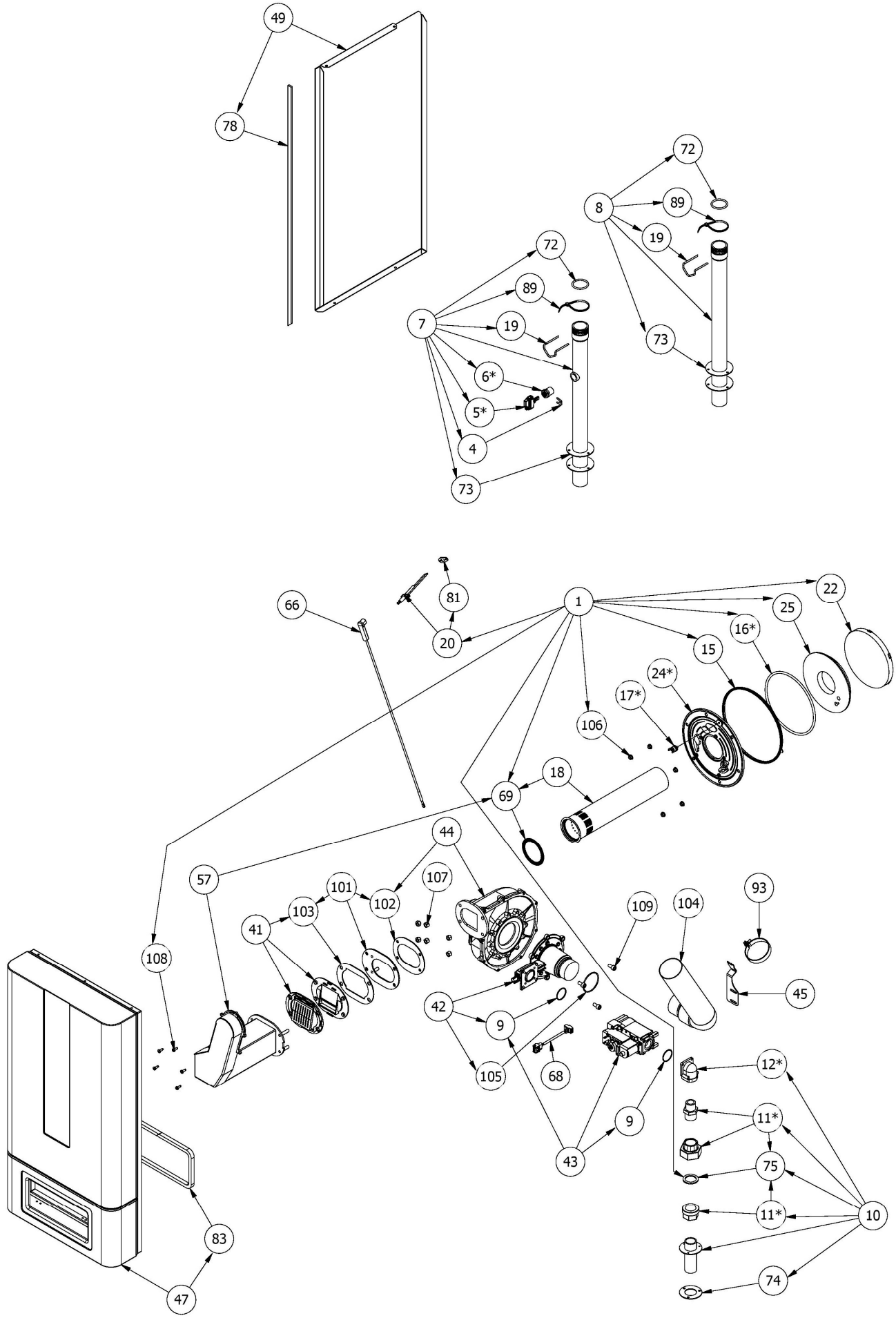
67 → Wiring harness

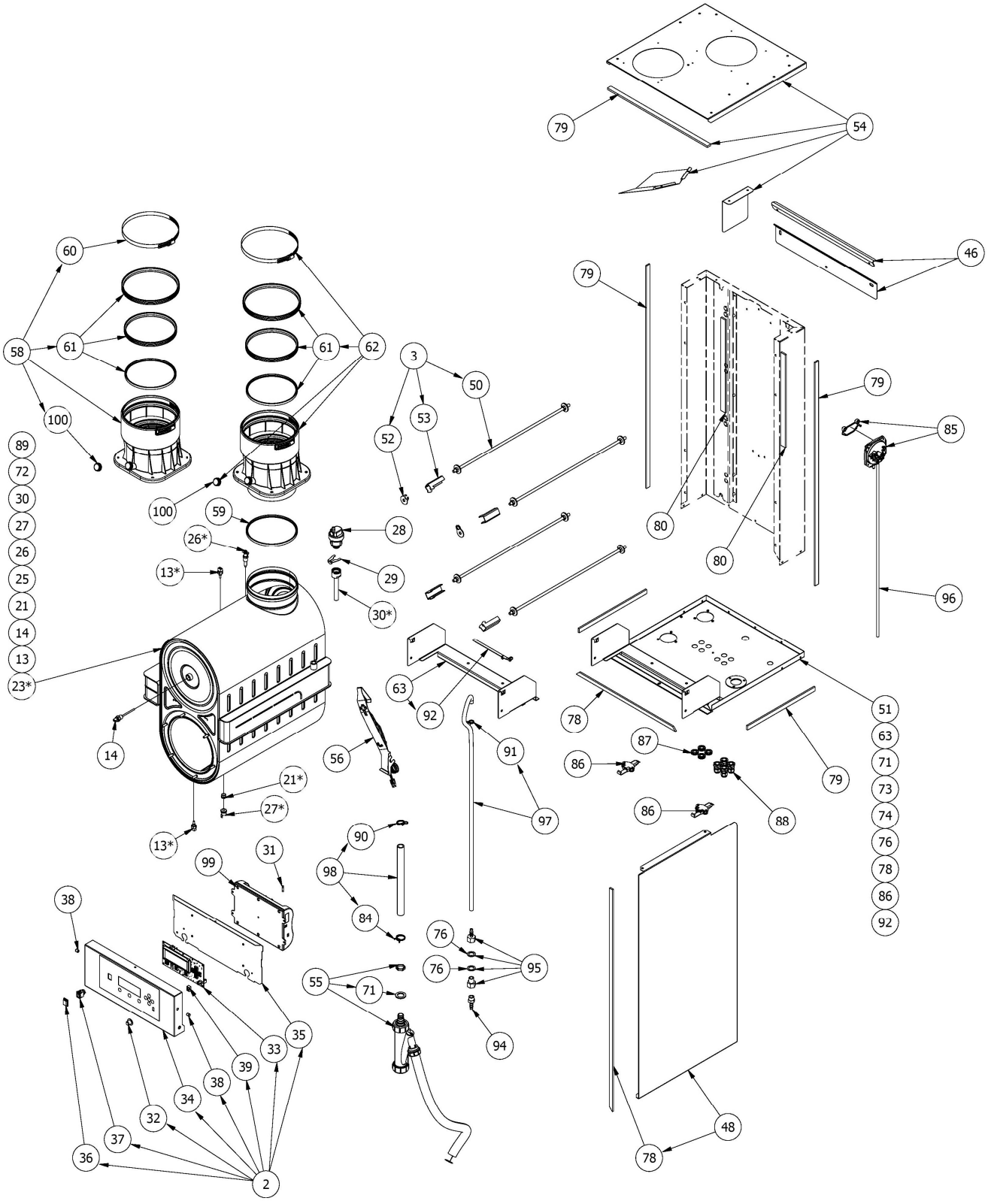
Remarks:

All parts are supplied with glued/bonded parts, such as grounding lips, strips, isolation, stickers. Also bolts and nuts are supplied if necessary.

*= installation additions (see sparepart list)

22.2 EFB155 EXPLODED VIEW





67 → Wiring harness

Remarks:

All parts are supplied with glued/bonded parts, such as grounding lips, strips, isolation, stickers. Also bolts and nuts are supplied if necessary.

*= installation additions (see sparepart list)

22.3 PART NUMBERS EFB85 - 155

Nr.	Description	*	Part number:	EFB 85	EFB 105	EFB 125	EFB 155
1	Set. Universal maintenance kit EFB 85, 105, 125, 155	2	LE000500001	x	x	x	NA
2	Set. Electronics holder		LE000500002	x	x	x	x
3	Set. Anchoring bar EFB 85		LE000500007	x	NA	NA	NA
3	Set. Anchoring bar EFB 105		LE000500008	NA	x	NA	NA
3	Set. Anchoring bar EFB 125		LE000500009	NA	NA	x	NA
3	Set. Anchoring bar EFB 155		LE000500010	NA	NA	NA	x
4	Clip for WPS 10bar		LE001500003	x	x	x	x
5	Water pressure sensor 10bar		LE001500004	x	x	x	x
6	Nipple for RPS D15	1	LE001500005	x	x	x	x
7	Flow pipe EFB 85		LE001500006	x	NA	NA	NA
7	Flow pipe EFB 105, 125		LE001500007	NA	x	x	NA
7	Flow pipe EFB 155		LE001500008	NA	NA	NA	x
8	Return pipe EFB 85		LE002500003	x	NA	NA	NA
8	Return pipe EFB 105, 125		LE002500004	NA	x	x	NA
8	Return pipe EFB 155		LE002500005	NA	NA	NA	x
9	O-ring gas valve connection		LE003100007	x	x	x	x
10	Gas pipe EFB 85, 105, 125		LE003500003	x	x	x	NA
10	Gas pipe EFB 155		LE003500004	NA	NA	NA	x
11	Malleable coupling, flat sealing surfaces, GF331, ¾"	1	LE003500005	x	x	x	NA
11	Malleable coupling, flat sealing surfaces, GF330, 1"	1	LE003500007	NA	NA	NA	x
12	Hooked gas valve VR4615 connection	1	LE003500006	x	x	x	x
13	NTC sensor 1/8" SS	1	LE004100018	x	x	x	x
14	NTC Flue gas sensor 10 KOHM = R25 B=3977K t2		LE004100019	x	x	x	x
15	Seal Burner door	2	LE004200004	x	x	x	x
16	Insulation fibre braid burner door	1	LE004200008	x	x	x	x
17	Burner door thermostat 260° C (M5)		LE004200009	x	x	x	x
18	Burner EFB 85, 105		LE004200010	x	x	NA	NA
18	Burner EFB 125		LE004200011	NA	NA	x	NA
18	Burner EFB 155		LE004500020	NA	NA	NA	x
19	Spring fast connection EFB 85		LE004200014	x	NA	NA	NA
19	Spring fast connection EFB 105, 125		LE004200012	NA	x	x	NA
19	Spring fast connection EFB 155		LE004200013	NA	NA	NA	x
20	Electrode		LE004500002	x	x	x	x
21	Reducing coupling G¼ x M5	1	LE004500003	x	x	x	x
22	Backwall isolation 16mm		LE004500004	x	x	x	x
23	Heat exchanger EFB 85	2	LE004500008	x	NA	NA	NA
23	Heat exchanger EFB 105	2	LE004500019	NA	x	NA	NA
23	Heat exchanger EFB 125	2	LE004500009	NA	NA	x	NA
23	Heat exchanger EFB 155	2	LE004500018	NA	NA	NA	x
24	Burner door right sided ignition (metal sheet burner)	2	LE004500013	x	x	x	x
25	Burner door isolation right sided ignition hole Ø70,5		LE004500014	x	x	x	x
26	Sensor LWCO	1	LE004500015	x	x	x	x
27	Clixon 100° C	1	LE004500022	x	x	x	x
28	Automatic air vent with clip connection		LE005500002	x	x	x	x
29	Locking clip air vent		LE005500003	x	x	x	x
30	Extension pipe air vent	1	LE005500004	x	x	x	x
31	Box 10pcs Fuse 5 AT		LE006200001	x	x	x	x
32	Rubber plug Ø13		LE006200004	x	x	x	x
33	Pixel Button Display		LE006500001	x	x	x	x
34	Display front panel		LE006500002	x	x	x	x
35	Mounting plate burner control		LE006500003	x	x	x	x
36	Dustcover ON/OFF switch		LE006500004	x	x	x	x
37	Main switch		LE006500005	x	x	x	x

*1) Install with LE022000001 (see accessoires)
*2) Install with LE022000002 (see accessoires)

Nr.	**Description**	Part number:	EFB 85	EFB 105	EFB 125	EFB1 155
38	Spring plunger 8mm	LE006500006	x	x	x	x
39	EPDM sealing for EBM 957	LE006500007	x	x	x	x
40	Offset piece EFB 85	LE008500001	x	NA	NA	NA
40	Offset piece EFB 105	LE008500010	NA	x	NA	NA
40	Offset piece EFB 125	LE008500006	NA	NA	x	NA
41	Seat check valve EFB 85, 105, 125	LE008500002	x	x	x	NA
41	Seat check valve EFB 155	LE008500013	NA	NA	NA	x
42	Venturi VMS L	LE008500004	x	NA	NA	NA
42	Venturi VMS N	LE008500008	NA	x	NA	NA
42	Venturi VMS P	LE008500009	NA	NA	x	x
43	Modulating gas valve VR4615 (230VAC)	LE008500012	x	x	x	x
44	Radial Blower EFB 85	LE008500014	x	NA	NA	NA
44	Radial Blower EFB 105	LE008500015	NA	x	NA	NA
44	Radial Blower EFB 125	LE008500016	NA	NA	x	NA
44	Radial Blower EFB 155	LE008500017	NA	NA	NA	x
45	Mounting plate silencer	LE008500019	x	x	x	x
46	Wall mounting plate	LE009100001	x	x	x	x
47	Front panel	LE010500001	x	x	x	x
48	Side panel right	LE011500001	x	x	x	x
49	Side panel left	LE011500002	x	x	x	x
50	Anchoring bar EFB 85	LE011500006	x	NA	NA	NA
50	Anchoring bar EFB 105	LE011500004	NA	x	NA	NA
50	Anchoring bar EFB 125	LE011500003	NA	NA	x	NA
50	Anchoring bar EFB 155	LE011500005	NA	NA	NA	x
51	Bottom panel EFB 85, 105	LE011500010	x	x	NA	NA
51	Bottom panel EFB 125	LE011500011	NA	NA	x	NA
51	Bottom panel EFB 155	LE011500012	NA	NA	NA	x
52	Special washer heat exchanger	LE011500013	x	x	x	x
53	Clamping bracket heat exchanger	LE011500014	x	x	x	x
54	Top panel EFB 85, 105, 125	LE011500017	x	x	x	NA
54	Top panel EFB 155	LE011500016	NA	NA	NA	x
55	Condensate drain assembly l=800	LE012200002	x	x	x	x
56	Backwall clixon	LE013100002	x	x	x	x
57	Gas-air mixing pipe EFB 85, 105, 125	LE014500001	x	x	x	NA
57	Gas-air mixing pipe EFB 155	LE014500002	NA	NA	NA	x
58	Boiler air connector EFB 155	LE015500002	NA	NA	NA	x
59	Seal EPDM EFB 85, 105, 125	LE016100011	x	x	x	NA
59	Seal EPDM EFB 155	LE016500003	NA	NA	NA	x
60	Clamp galvanised EFB 155	LE016500009	NA	NA	NA	x
61	Set. Seal EPDM Adapter EFB 155	LE016500011	NA	NA	NA	x
62	Boiler flue gas connector EFB 155	LE016500014	NA	NA	NA	x
62	Boiler flue gas connector EFB 85, 105, 125	LE017500001	x	x	x	NA
63	Connection bar display holder	LE021500001	x	x	x	x
64	Elbow silencer EFB 85, 105	LE024500002	x	x	NA	NA
64	Elbow silencer EFB 125	LE024500003	NA	NA	x	NA
65	Extension pipe silencer EFB 85, 105, 125	LE024500004	x	x	x	NA
66	Ignition cable	LE031200001	x	x	x	x
67	Wiring Harness HV/LV	LE031500001	x	x	x	x
68	Adapter cable fan	LE031500002	x	x	x	x
69	Gasket Burner & gas/air inlet pipe	LE032200001	x	x	x	x
70	Gasket gas/air inlet pipe & fan EFB 85, 105, 125	LE032200002	x	x	x	NA
71	Gasket siphon/bottom plate	LE032200003	x	x	x	x
72	O-ring flow/return pipe EFB 85	LE032200006	x	NA	NA	NA
72	O-ring flow/return pipe EFB 105, 125	LE032200007	NA	x	x	NA
72	O-ring flow/return pipe EFB 155	LE032200005	NA	NA	NA	x

Nr.	**Description**	Part number:	EFB 85	EFB 105	EFB 125	EFB 155
73	Gasket flow/return pipe EFB 85, 105 125	LE032500003	x	x	x	NA
73	Gasket flow/return pipe EFB 155	LE032500014	NA	NA	NA	x
74	Gasket gas pipe EFB 85, 105, 125	LE032500004	x	x	x	NA
74	Gasket gas pipe EFB 155	LE032500002	NA	NA	NA	x
75	Gasket malleable coupling EFB 85, 105, 125	LE032500005	x	x	x	NA
75	Gasket malleable coupling EFB 155	LE032500018	NA	NA	NA	x
76	Gasket Condensate drain/bottom plate	LE032500006	x	x	x	x
78	Silicone seal 13x5 self adhesive L=10m	LE032500008	x	x	x	x
79	EPDM seal 15x6 self adhesive L=5m	LE032500009	x	x	x	x
80	EPDM seal 20x5 self adhesive L=5m	LE032500010	x	x	x	x
81	Gasket electrode	LE032500011	x	x	x	x
82	Gasket gas/air mixing EFB 85, 105, 125	LE032500012	x	x	x	NA
83	EPDM seal 10x12 self adhesive L=5m	LE032500013	x	x	x	x
84	Hose clamp Ø23,83 (DW15)	LE033500001	x	x	x	x
85	Air press. switch DL 2 E with S-clip 140/160 Pa	LE033500014	x	x	x	x
86	Quick-action clamp	LE033500003	x	x	x	x
87	Blind grommet Ø18,5mm	LE033500004	x	x	x	x
88	Cable Gland M16x1,5 Black	LE033500005	x	x	x	x
89	Ty-Rap Heat resistant 3,5x200 mm	LE033500006	x	x	x	x
90	Hose clamp Ø20,62 (DW13)	LE033500007	x	x	x	x
91	Hose clamp Ø12,7 (DW8)	LE033500015	x	x	x	x
92	Cable tie with rivet	LE033500009	x	x	x	x
93	PVC bracket EFB 85, 105, 125	LE033500010	x	x	x	NA
93	PVC bracket EFB 155	LE033500011	NA	NA	NA	x
94	NPT Male Connector 3/8	LE033500012	x	x	x	x
95	NPT Female Connector 3/8	LE033500013	x	x	x	x
96	Hose pressure switch	LE034500001	x	x	x	x
97	Hose air vent	LE034500002	x	x	x	x
98	Hose condensate trap EFB 85, 105, 125	LE034500003	x	x	x	NA
98	Hose condensate trap EFB 155	LE034500004	NA	NA	NA	x
99	Burner Control EFB 85, 105, 125, 155	LE160010	x	x	x	x
100	Measuring Cap M20x2 Ral-9016	LE016500001	x	x	x	NA
100	Measuring Cap M20x2 Ral-9011	LE016500002	NA	NA	NA	x
101	Adapter check valve EFB 155	LE008500018	NA	NA	NA	x
102	Gasket v1 gas-air mixing EFB 155	LE032500015	NA	NA	NA	x
103	Gasket v2 gas-air mixing EFB 155	LE032500016	NA	NA	NA	x
104	Silencer EFB 155	LE024500005	NA	NA	NA	x
105	O-ring venturi/silencer EFB 155	LE032500017	NA	NA	NA	x
106	10x Flanging head nut M6	LE004200005	x	x	x	x
107	4x Nut M5 DIN985	LE008500003	x	x	x	NA
107	6x Nut M8 DIN982	LE008500023	NA	NA	NA	x
108	5x Screw M5x14 DIN7500C	LE014500003	x	x	x	NA
109	3x Screw M6x16 DIN7500C (venturi EFB 85, 105)	LE008500020	x	x	NA	NA
109	3x Screw M6x16 DIN912 (venturi EFB 125)	LE008500021	NA	NA	x	NA
109	3x Screw M8x16 DIN912 (venturi EFB 155)	LE008500022	NA	NA	NA	x

23 USER INSTRUCTIONS

This section is written for the user
Lochinvar is not accountable for any damage caused by incorrectly following these instructions. For service and repair purposes use only original Lochinvar spare parts.
All documentation produced by the manufacturer is subject to copyright law.

23.1 ABBREVIATIONS.

EFB = Condensing Boiler
DHW = For Direct Hot Water (drinking water) usage only.
CH = Central Heating (for central heating purposes and/or indirect hot water)

23.2 SAFETY GUIDELINES.

"FOR YOUR SAFETY READ BEFORE OPERATING"

"WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand."

BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor."

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 must be supervised to ensure that they do not play with the appliance.

Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water."

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury (exposure to hazardous materials)* or loss of life. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

23.3 TO TURN OFF GAS TO THE APPLIANCE

1. Set the thermostat to lowest setting.
2. Turn off all electric power to the appliance if service is to be performed.
3. The main gas switch is situated underneath the boiler in the gas supply line.
4. Turn the valve clockwise  to OFF." to close the gas supply. **Do not use excessive force.**

"Must overheating occur or the gas supply fail to shut off, do not turn off or disconnect the electrical supply to the pump. Instead, shut off the gas supply at a location external to the appliance."

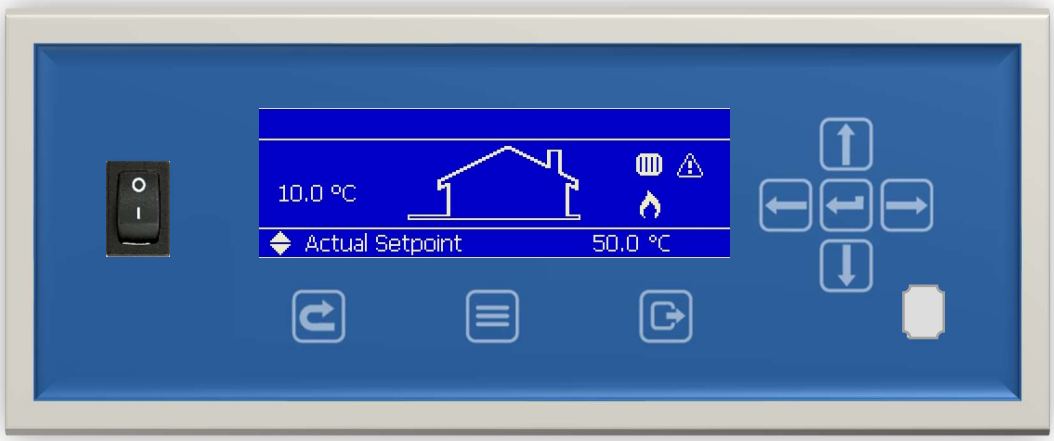
23.4 MAINTENANCE AND INSPECTION

Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.

Maintenance and inspection of the boiler must be carried out at the following occasions:
- **When a number of similar error codes and/or lock-outs appear.**
- **At least every 12 months** and/or after **2000 burning hours maximum, whichever comes first, maintenance must be done to ensure safe and efficient operation.**

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

23.5 DISPLAY AND BUTTONS

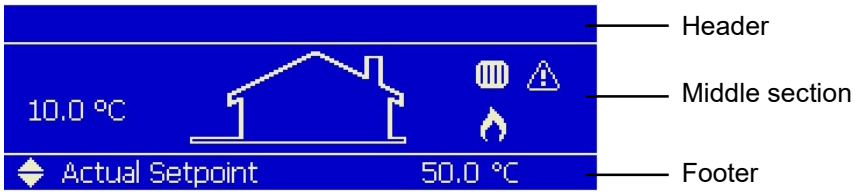


23.5.1 EXPLANATION OF THE BUTTONS

	On / off switch. Switches electrical power to the boiler
	Connector for computer cable
	Reset lockout error
	Main Menu
	Escape / Return to the status overview
	**Right** Enter a menu item or confirm selection in Status overview (when directly setting Actual setpoint or DHW setpoint)
	**Left** Return to previous menu item or Status overview
	**Up** Directly select Actual setpoint of DHW setpoint in the Status overview, push RIGHT to confirm and use UP or DOWN to adjust value.
	**Down** Directly select Actual setpoint of DHW setpoint in the Status overview, push RIGHT to confirm and use UP or DOWN to adjust value.
	**Enter** Confirm a setting or enter a menu item

23.6 DISPLAY CONFIGURATION

The Status overview has the three different sections that show specific information:



Header

- Left: For cascade systems the cascade icon is shown, with the cascade manager indication (M) or the dependent number.
- Centre: Shows the CH and/or DHW disabled icons when CH and/or DHW is disabled
- Right: Shows the time (only if the real-time clock is available).

Icon	Description
	Cascade icon
	CH Disabled
	DHW Disabled

Middle section

- Left: Shows user-configured information (by default only the outside temperature):

Line	Info
Top	Burner state (when enabled)
Middle	Configured/selected temperature (one of the following): ▪ Outside temperature ▪ Demand based (Flow or DHW temperature based on active demand) ▪ Flow temperature ▪ DHW temperature ▪ System temperature (module cascade flow/supply temperature) ▪ Cascade temperature (boiler cascade flow/supply temperature)
Bottom	CH water pressure (when enabled)

- Centre: The house icon is always displayed.
- Right side: Shows several status icons:

Icon	Description
	CH demand
	DHW demand
	Emergency mode is active (for cascade systems only)
	Burner is on (and flame is detected)
	Frost protection is active
	Anti-legionella program is active.
	Error is set in the Main Control (see footer for error description)

Footer

Shows Error/Warning messages when an Error or Warning is set in the Main Control, otherwise a quick menu is displayed where the user can quickly edit setpoints and enable/disable CH or DHW.

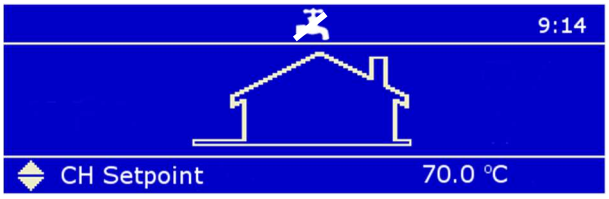
23.7 STARTING THE BOILER.

If the boiler is not on make sure the gas switch beneath the boiler is open and the power cord is connected to the mains, use the on/off button to switch the boiler on. The following screen will occur:

This screen is active during power up until communication with the main Controller has been established.
After communication has been established the DAir mode is running and the following screen appears:

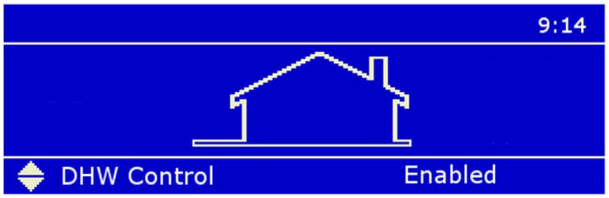
The “De-Air” sequence is a safety function that starts at every power-up and is used to remove the air from the heat exchanger.
The De-Air sequence takes around 14 minutes to complete. It can be cancelled by pressing the Enter button for over 5 seconds.

After completion or manual ending the “De-Air” sequence one of the following Status overview screens appears:



Central Heating only

OR



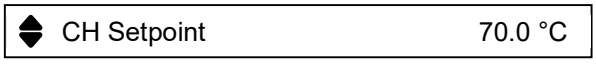
Central Heating
AND
Domestic Hot Water

23.8 CHANGING THE SETPOINT AND/OR ENABLING CH/DHW.

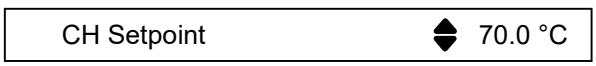
This can be done directly via the Status overview (as shown above) or via the MENU.
When CH is active, you can adjust the Actual setpoint directly on the bottom of the Status overview. When DHW is active, you can adjust the DHW setpoint directly on the bottom of the Status overview.
This means that when CH is active, you cannot set the DHW setpoint directly via the Status overview. When DHW is active, you also cannot set the Actual setpoint (CH setpoint) directly via the Status overview.

23.8.1 CHANGING THE CENTRAL HEATING SETPOINT DIRECTLY.

Press the UP or DOWN button to select the mode:



70.0 °C is just an example of a possible temperature value.
Use the left/right buttons to move the ⬍ sign to the front of the temperature digits.



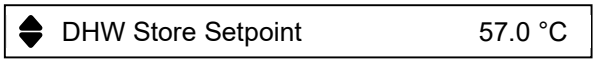
Use UP/DOWN buttons to increase/decrease the setpoint.
Press the ENTER or RIGHT button to confirm your alteration or press the BACK or LEFT button to cancel

A setpoint is only visible on the main screen when no error or alert is active. In case of an active error or alert, the bottom right part of the PB (display board) screen is used to display the error or alert

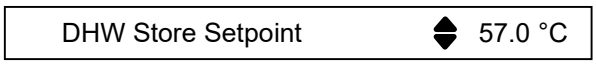
23.8.2 CHANGING THE DHW SETPOINT DIRECTLY.

Only applicable if this function is available.

Press the UP or DOWN button to select the mode:



57.0 °C is just an example of a possible temperature value.
Use the left/right buttons to move the ⬍ sign to the front of the temperature digits.

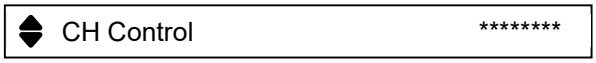


Use UP/DOWN buttons to increase/decrease the setpoint.
Press the ENTER or RIGHT button to confirm your alteration or press the BACK or LEFT button to cancel.

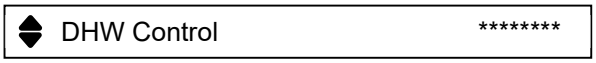
A setpoint is only visible on the main screen when no error or alert is active. In case of an active error or alert, the bottom right part of the PB (display board) screen is used to display the error or alert

23.8.3 ENABLE / DISABLE CH OR DHW CONTROL.

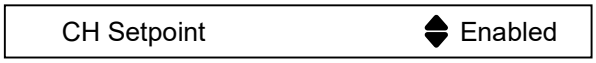
The CH or DHW Enable/Disable option is available when its set-up in the software (by the installer) only.
Press the UP or DOWN button to select the mode:



OR



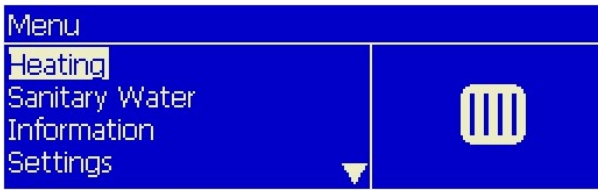
Use the left/right buttons to move the ⬍ sign to the front of Enable/Disable text.



Use UP/DOWN buttons to change from Enabled to Disabled or vice versa
Press the ENTER or RIGHT button to confirm your alteration or press the BACK or LEFT button to cancel

23.9 THE MENU (BUTTON).

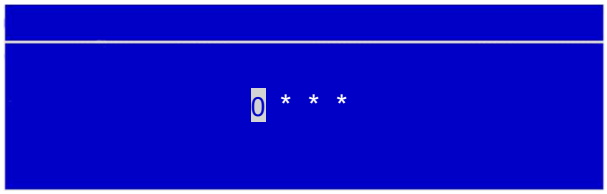
Enter the menu by pressing the MENU button once. The header in the screen shows you are inside the main menu. Whilst scrolling through the menu you will see that the selected menu item is shown in a white rectangle.
At the right, there will be an icon shown, depending on the selected item.
The number of items depends on the selected/programmed options by the installer.



Enter a menu item by pressing ENTER or RIGHT.
The header shows your location inside the menu, as seen in the following image on the next screen:

If you are inside the menu (or a menu item) and want to return directly to the Status overview press MENU/ESC. If you want to go back one step in the menu press BACK/LEFT. Going to the Start-up screen directly is achieved by pressing the Menu button once.
It's also possible to set the setpoint at this stage by performing the same steps as described above at § 23.8.1 "Changing the Central Heating setpoint directly" and § 0 "Changing the DHW setpoint directly".

23.10 PASSWORD



Menus protected by a password are only accessible by the installer.
Passwords are always customer specific and (for safety reasons) will be provided to the installer only
The following menu items require a password:

Menu item	Location inside menu
Start-up Settings	Settings/General Settings/Other Settings/Start-up Settings
Boiler Parameters	Settings/Boiler Settings/Boiler Parameters
Module Cascade Settings	Settings/Boiler Settings/Module Cascade Settings
Boiler Cascade Settings	Settings/Boiler Settings/Boiler Cascade Settings

23.11 AVAILABLE MENU ITEMS

Depending on the installed/programmed options by the installer following menu items could be visible.

Menu / Parameter	Description	Value / Unit
Central Heating (CH)	Enter the Central Heating (CH) menu	
Domestic Hot Water (DHW)	Enter the Domestic Hot Water (DHW) menu	
Information	Enter the Information menu	
Settings	Enter the Settings menu	
System Test	Enter the System Test menu	

23.11.1 CENTRAL HEATING (CH)

Menu / Parameter	Description	Value / Unit
CH Setpoint	Set the CH setpoint	°C/°F
Outdoor reset	Enter the Outdoor Reset menu	

23.11.2 DOMESTIC HOT WATER (DHW)

Menu / Parameter	Description	Value / Unit
DHW Setpoint	Set the DHW setpoint	°C/°F
DHW Store Setpoint	Set the DHW store setpoint for DHW mode 1 and 2	°C/°F

23.11.3 INFORMATION

Menu / Parameter	Description	Value / Unit
Software versions	Enter the Software Versions menu	
Boiler Status	Enter the Boiler Status menu	
Boiler History	Enter the Boiler History menu	
Error Log	Enter the Error Log menu	
Service	Enter the Service menu	

23.11.4 SOFTWARE VERSIONS

Menu / Parameter	Description	Value / Unit
Display	Display the software checksum	[xxxx xxxx]
Boiler	Display the boiler software checksum	[xxxx xxxx]
Device Group	Display the boiler group ID	xxxMN

23.11.5 BOILER STATUS

Menu / Parameter	Description	Value / Unit
Flow Temperature	Actual supply flow temperature	°C/°F
Flow 2 Temperature	Actual supply 2 flow temperature	°C/°F
Return Temperature	Actual return temperature	°C/°F
DHW Temperature	Actual DHW temperature	°C/°F
DCW Temperature	Actual DCW temperature	°C/°F
Outside Temperature	Actual outside temperature	°C/°F
Flue Temp	Actual flue gas temperature	°C/°F
Flue 2 Temp	Actual flue gas 2 temperature	°C/°F
System Temperature	Actual system temperature	°C/°F
0-10 V Input	Actual 0-10 V input value	V
Flowrate	Actual DHW flowrate	l/min
RT Input	Actual RT input status	open/closed
Water Pressure	Actual CH water pressure	bar/psi
Fan Speed	Actual fan speed	RPM
Ionization	Actual ionization current	uA
State	Actual burner state	
Error	Actual internal error code	#
Calculated Setpoint	Actual CH setpoint	°C/°F

23.11.6 BOILER HISTORY

Menu / Parameter	Description	Value / Unit
Successful Ignitions	Display the number of successful ignitions	#
Failed Ignitions	Display the number of failed ignitions	#
Flame Failures	Display the number of flame losses	#
Operation Days	Display the total time in operation	days
CH Burner Hours	Display the amount of burn hours for CH	hrs.
DHW Burner Hours	Display the amount of burn hours for DHW	hrs.

23.11.7 ERROR LOG

Menu / Parameter	Description	Value / Unit
Error Log	Display the complete error log	
Filter Error Type	Set the error log filter	
Clear Error Log	Clear the complete error log	

23.11.8 SERVICE

Menu / Parameter	Description	Value / Unit
Service history	Display the service history	
Burn hours since last service	Display the burn hours since last service	hrs.
Burn hours till service	Display the hours remaining until next service	hrs.
Reset Service Reminder	Reset the service reminder	

23.11.9 SETTINGS

Menu / Parameter	Description	Value / Unit
General Settings	Enter the General Settings menu	
Boiler Settings	Enter the Boiler Settings menu	

23.11.10 GENERAL SETTINGS

Menu / Parameter	Description	Value / Unit
Language	Enter the Language menu	
Unit Type	Enter the Unit Type menu	
Date & Time	Enter the Date & Time menu	
Cascade mode	Enter the Cascade Mode menu	
Other Settings	Enter the Other Settings menu	

23.11.11 LANGUAGE

Menu / Parameter	Description	Value / Unit
English	Select the English language	English
Français	Select the French language	Français
中文	Select the Chinese language	中文
Italiano	Select the Italian language	Italiano

23.11.12 UNIT TYPE

Menu / Parameter	Description	Value / Unit
Metric (˚C, bar)	Select Metric units	˚C, bar
Imperial (˚F, psi)	Select Imperial units	˚F, psi

23.11.13 DATE & TIME

Menu / Parameter	Description	Value / Unit
Date	Set the current date	dd-mm-yyyy
Time	Set the current time	hh:mm
Time Zone Settings	Enter the time zone settings menu	
Display Settings	Enter the display settings menu	

23.11.14 TIME ZONE SETTINGS

Menu / Parameter	Description	Value / Unit
Time Zone Correction	Set the time zone correction	
Daylight Savings Time	Select the daylight savings time mode	

23.11.15 DISPLAY SETTINGS

Menu / Parameter	Description	Value / Unit
Time Notation	Select 24h or 12h time notation	24h/12h
Date Order	Select the date-format	
Day of Month	Select how the day of month is displayed	1 or 2 digits
Month	Select how the month is displayed	
Year	Select how the year is displayed	2 or 4 digits
Date Separation Character	Select the date separation character	
Day of Week	Select how the day of week is displayed	
Seconds	Select if seconds are displayed	yes/no

23.11.16 CASCADE MODE

Menu / Parameter	Description	Value / Unit
Full	Select full cascade mode	
Basic	Select basic cascade mode	

Note: for proper functioning of the cascade system, some settings have to be changed, see § 15.4.2 "Emergency mode"

23.11.17 OTHER SETTINGS

Menu / Parameter	Description	Value / Unit
Modbus Address	Select the Modbus communication address	0…255
Modbus Stopbits	Select the number of Modbus communication stopbits	1 – 2
Startup Settings	Select the start-up logo (if enabled)	

23.11.18 BOILER SETTINGS

Menu / Parameter	Description	Value / Unit
Boiler Parameters	Enter the Boiler Parameters menu	
Module Cascade Settings	Enter the Module Cascade Settings menu	
Boiler Cascade Settings	Enter the Boiler Cascade Settings menu	
Service	Enter the Service menu	

23.12 BOILER HISTORY

The boiler history (found in the information menu) displays several history counters that keep track of the boiler usage. The following boiler history data is available:

(Sub) Menu item	Description
Successful Ignitions	Number of successful ignitions.
Failed Ignitions	Number of failed ignitions.
Flame Failures	Number of flame failures (loss of flame).
Operation Days	Number of days that the appliance is operational (powered ON).
CH Burner Hours	Number of hours that the appliance has burned for Central Heating.
DHW Burner Hours	Number of hours that the appliance has burned for Domestic Hot Water.

23.13 ERROR LOGGING

Errors will be logged for a stand-alone system or for a complete cascade system (based on the cascade settings). The display will monitor the error number(s) it receives from the boiler(s): new errors will be stored in the error log.
An error will be logged with a (Real Time Clock) time stamp (date and time) when the error was detected and a boiler ID of the boiler on which the error was detected.

Note: the error log is a completely different error logging mechanism than the one used by the burner controller itself. Therefore, the error log is different from the (internal) error history of the burner controller.

The error log can be seen from the error log menu, which is located in the Information menu. In the Error log menu the following options can be selected:

(Sub) Menu item	Description
Error Log	Show the error log (based on the selected filter options)
Filter Error Type	Filter errors based on the Error type (lockout/blocking)
Filter Boiler ID (Cascade System only)	Filter errors based on Boiler ID (Managing, Dep 1, Dep2, etc.)
Clear Error Log	Clear the error log (protected by password)

When no filtering option is selected (disabled) the error log will show all errors for that category. So, if both filters are disabled, the error log will show all the errors in the log.

The following table describes what is displayed inside the Error log:

Error Log content	Description
First line	- Boiler ID (for which boiler the error was detected – cascade system only) - Error code (internal) - Error number - Error type (lockout/blocking)
Second line	- Error description
Bottom line	- Time Stamp (date and time) when the error was detected (in the format configured in the Date & Time settings menu) - The selected error index from the total numbers of errors in the (filtered) error log

23.14 SERVICE REMINDER

If set, the Service reminder will remind the owner/user of the appliance to service the appliance at a specified Service Interval (Factory setting). When service is not done within the specified time, a Service reminder will be shown on the screen "Service is required!" alternating with the normal status display.

NOTE: with the message "Service is required" the boiler keeps running, but maintenance must be done before resetting this message.

When the Service reminder has become active, the time it takes before service is actually done is being logged (in hours). This time is called the Service Overdue Time.
The Service reminder can be reset by the installer who services the appliance.

Service status information can be viewed: Menu / Information / Service:

(Sub) Menu item	Description
Service history	View the Service history (log). For each service moment the Service overdue counter is stored. When the overdue counter is 0 hrs, it means service was done before the Service reminder was active. The log is ordered so the most recent service moment is shown first (on top of the list).
Hours since last service / Burn hours since last service	Shows the number of hours (or burn hours) since the last service moment. Depends on the *Service_Hour_Counter* setting (burn or normal hours).
Hours till service / Burn hours till service	Shows the number of hours (or burn hours) until service is required. Depends on the *Service_Hour_Counter* setting (burn or normal hours).
Reset service reminder	Reset the Service reminder (and store Service overdue counter in the service history). The installer must enter the installer password first before it can be reset.

23.15 RECYCLING

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

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.

HIGH EFFICIENCY BOILERS & WATER HEATERS

7 Lombard Way, The MXL Centre, Banbury, Oxon, OX16 4TJ
Tel: +44(0) 1295 269 981, Fax:+44(0) 1295 271 640, Email: info@lochinvar.ltd.uk
www.lochinvar.ltd.uk