

ECOKNIGHT™

FLOOR STANDING GAS FIRED CONDENSING
CIRCULATING TYPE WATER HEATER

Installation, Commissioning, Maintenance
and User instructions

Models

EKW46CE

EKW61CE

EKW86CE



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| Article | Language | Version |
|------------------------------------|----------|--------------|
| EKW water heaters models 46-86 ICM | English | October 2022 |

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1.0 INTRODUCTION

- The Lochinvar EcoKnight™ range is a floor standing direct gas fired circulating type condensing water heater. The equipment comprises of stainless steel radial burner assembly and heat exchanger that permits fully condensing operation. EcoKnight™ water heaters must be used in conjunction with an appropriately sized LST direct storage vessel (available from Lochinvar Limited as an ancillary option)
- The burner is initiated by a full electronic ignition sequence control that incorporates a spark ignition and a flame rectification device for supervision of the flame.
- The output from the water heater is regulated by a variable speed combustion fan and gas/air ratio controls to maintain the correct combustion at all levels of modulation. This configuration allows modulation down to 20% of the rated output.
- For the correct operation of the water heater, it is essential that a suitably sized pump is utilised to maintain a constant water flow rate through the heat exchanger. A suitable shunt pump is supplied as an ancillary with the water heater.
- This equipment is intended for use on Group H Natural Gas (2nd Family) and LPG propane (3rd Family). The information relating to propane firing is to be found in **Section 18.0 LPG FUEL**.



This equipment MUST NOT use gas other than that for which it has been designed and adjusted.

- This equipment must be installed by a competent person, registered with a H.S.E. approved body. All installations must conform to the relevant Gas Safety and Building Regulations. Health & Safety requirements must also be taken into account when installing any equipment. Failure to comply with the above may lead to prosecution.
- If the equipment is to be connected to an unvented (pressurised) system, care must be taken to ensure all extra safety requirements are satisfied should a high or low-pressure condition occur in the system.
- The equipment is designed for direct connection to a flue system.
- **Ancillary Options:**
 - Primary Circulating Pump (EKW46CE & EKW61CE) LM900151A
 - Primary Circulating Pump (EKW86CE) LM900141A
 - LST Direct Storage Vessel (From 297 litre to 2820 litre) See www.lochinvar.ltd.uk
 - Unvented/Boosted Water System Kits See www.lochinvar.ltd.uk
 - De-stratification Pump Kit WH9
 - Condensate Neutralisation Kit KIT2000
 - Flue System Components See Section 10.0

2.0 SAFETY GUIDELINES



READ AND UNDERSTAND THE INSTRUCTIONS

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

Keep these instructions near the water heater for quick reference.

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

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

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

2.1 GENERAL DESCRIPTION OF SAFETY SYMBOLS USED



BANNED

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



WARNING

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



ACTION REQUIRED

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



ELECTRICAL HAZARD

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



HOT SURFACES

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



This symbol shows essential information which is not safety related



Recover or recycle material

2.2 WHAT TO DO IF YOU SMELL GAS



Warning if you smell gas

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



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



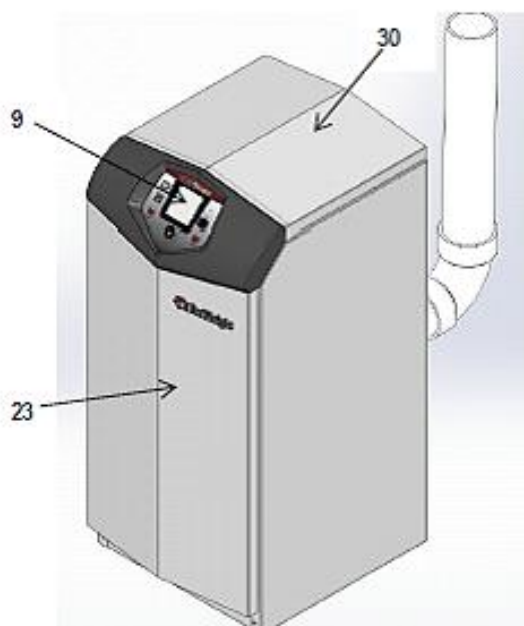
This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children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

3.0 PRINCIPAL PARTS

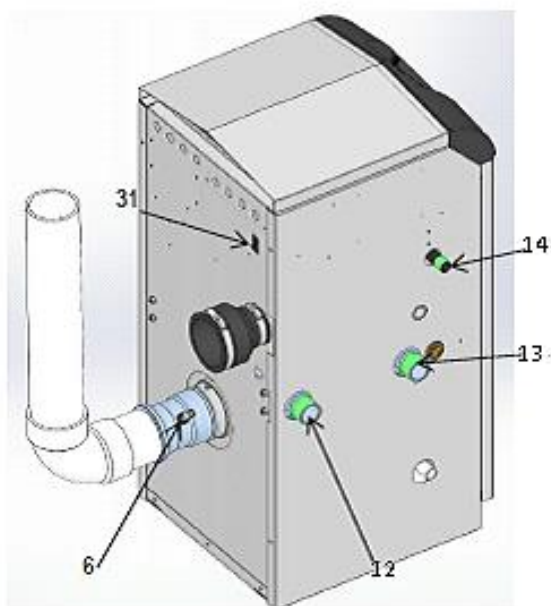
| ITEM | DESCRIPTION | FUNCTION | NOTE |
|------|--|---|--------------------|
| | Stainless steel heat exchanger | Allows water to flow through specially designed coils for maximum heat transfer, while providing protection against flue gas corrosion. The coils are encased in a jacket that contains the combustion process. | Not Shown in 3.1.2 |
| 2 | Heat exchanger access cover | Allows access to the combustion side of the heat exchanger coils. | Not Shown in 3.1.2 |
| 3 | Fan | The fan pulls in air and gas through the venturi (item 5). Air and gas mix inside the fan and are pushed into the burner, where they burn inside the combustion chamber. | Not Shown in 3.1.2 |
| 4 | Gas valve | The gas valve senses the negative pressure created by the fan, allowing gas to flow only if the gas valve is powered and combustion air is flowing. | Not Shown in 3.1.2 |
| 5 | Venturi | The venturi controls air and gas flow into the burner. | Not Shown in 3.1.2 |
| 6 | Flue gas sensor | This sensor monitors the flue gas exit temperature. The control module will modulate and shut down the boiler if the flue gas temperature gets too hot. This protects the flue pipe from overheating. | |
| 7 | Boiler outlet temperature sensor | This sensor monitors boiler outlet water temperature. | Not Shown in 3.1.2 |
| 8 | Boiler inlet temperature sensor | This sensor monitors return water temperature. | Not Shown in 3.1.2 |
| 9 | Electronic display | The electronic display consists of 7 buttons and a dual line 32-character liquid crystal display. | |
| 10 | Flue pipe adapter | Allows for the connection of the flue system to the boiler. | Not Shown in 3.1.2 |
| 11 | Burner | Made with metal fibre and stainless steel construction, the burner uses pre-mixed air and gas and provides a wide range of firing rates. | |
| 12 | Water Inlet | BSP water connection that returns hot water from the system, either 1-1/4" or 2", depending on the model. | |
| 13 | Water Outlet | BSP water connection that supplies water to the system to the heat exchanger, either 1-1/4" or 2", depending on the model. | |
| 14 | Gas connection pipe | Threaded pipe connection, 1/2", 3/4", or 1", depending on the model. This pipe should be connected to the incoming gas supply for the purpose of delivering gas to the boiler. | |
| 15 | SMART Control Module | The SMART Control responds to internal and external signals and controls the fan, gas valve, and pumps to meet the demand. | Not Shown in 3.1.2 |
| 16 | Manual air vent | Designed to remove trapped air from the heat exchanger coils. | Not Shown in 3.1.2 |
| 17 | Air intake adapter | Allows for the connection of the air intake pipe to the boiler. | Not Shown in 3.1.2 |
| 18 | Mains voltage junction box | The junction box contains the connection points for the mains voltage power and all pumps. | |
| 19 | Boiler drain port | Location from which the heat exchanger can be drained. | |
| 20 | Low voltage connection board | The connection board is used to connect external low voltage devices. | |
| 21 | Low voltage wiring connections (knockouts) | Conduit connection points for the low voltage connection board. | Not Shown in 3.1.2 |
| 22 | Condensate drain connection | Connects the condensate drain line to a 1/2" PVC union. | |
| 23 | Access cover - front | Provides access to the gas train and the heat exchanger. | |
| 24 | Ignition electrode | Provides direct spark for igniting the burner. | Not Shown in 3.1.2 |
| 25 | Flame inspection window | The quartz glass window provides a view of the burner surface and flame. | Not Shown in 3.1.2 |
| 26 | Gas shutoff valve | Manual valve used to isolate the gas valve from the gas supply. | Not Shown in 3.1.2 |
| 27 | High limit sensor | Device that monitors the outlet water temperature. If the temperature exceeds its setting, it will break the control circuit, shutting the boiler down. | Not Shown in 3.1.2 |
| 28 | Flame sense electrode | Used by the control module to detect the presence of burner flame. | |
| 29 | Mains voltage wiring connections (knockouts) | Conduit connection points for the mains voltage junction box | Not Shown in 3.1.2 |
| 30 | Top panel | Removable panel to gain access to the internal components. | |
| 31 | Power switch | Turns 230 VAC ON/OFF to the boiler. | |
| 32 | Levelling legs | Used to allow the heat exchanger to be levelled. This is needed for the proper draining of the condensate from the combustion chamber | Not Shown in 3.1.2 |

3.1.1 PRINCIPLE PARTS LIST TO BE USED IN CONJUNCTION WITH 3.1.2

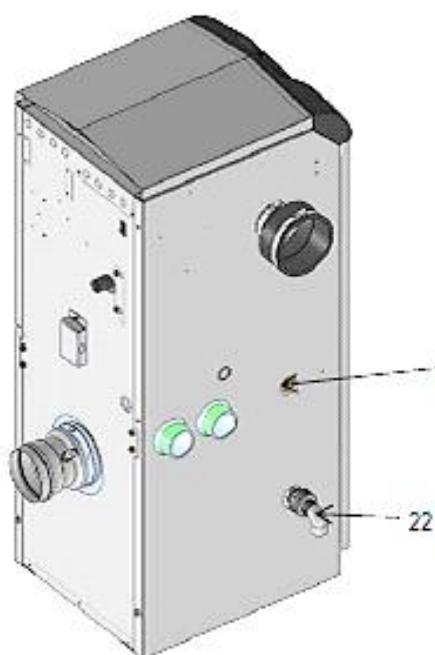
3.1.2 PRINCIPLE PARTS SHOWN, TO BE USED WITH 3.1.1



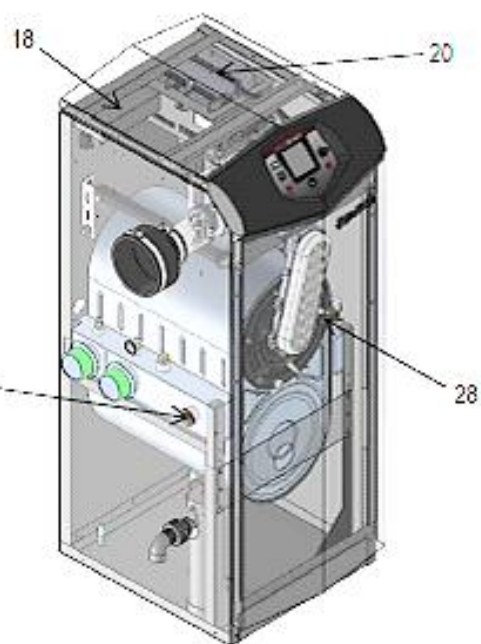
FRONT VIEW ALL MODELS



REAR VIEW MODELS EKW46CE-EKW61CE



REAR VIEW MODELS EKW86CE



LEFT SIDE VIEW MODELS EKW86CE

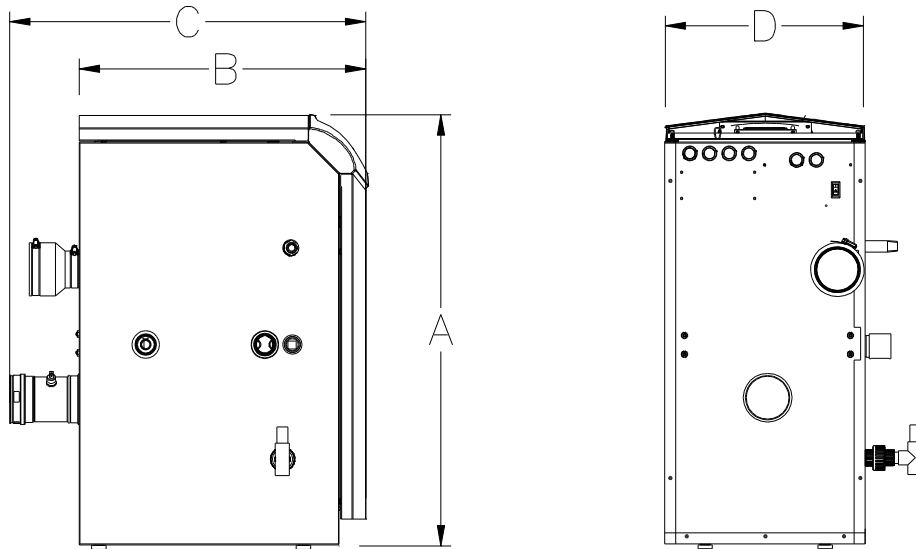
4.0 TECHNICAL DATA

| | | | | |
|---|--------|------------------------|-----------|---------|
| Model Number | | EKW46CE | EKW61CE | EKW86CE |
| GENERAL DATA | | | | |
| Product I.D. Number | | CE 0063CQ3351 | | |
| Classification | | II2H3B/P | | |
| Input (gross) | kW | 44 | 61.5 | 83.5 |
| Input (net) | kW | 39.6 | 55.4 | 75.2 |
| Output (P _m Min-P _n Max) | kW | 8.5-41.2 | 11.8-58.7 | 16-79.7 |
| Recovery Rate (44° ΔT) | l/hr | 806 | 1153 | 1567 |
| Recovery Rate (50° ΔT) | l/hr | 709 | 1014 | 1379 |
| Heat generator seasonal efficiency | % | 93.6 | 95.4 | 95.4 |
| Shipping Weight | kg | 75 | 79 | 102 |
| NOX @ 0% o2 According to EU regulation 812/2013 | mg/kw | 33 | 27.3 | 33.1 |
| NOX Class According to EU regulation EN15502 | | 6 | | |
| Maximum allowable temperature of the combustion air | °C | 40 | | |
| 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 | m3/hr | 4.2 | 5.9 | 8 |
| Flue gas mass rate (@9.0% CO2) | g/sec | 16 | 22.3 | 30.4 |
| Gas inlet connection size | "BSP | ½ | ½ | ¾ |
| GAS DATA - G31 | | | | |
| Nominal gas inlet pressure | mbar | 37 | | |
| Maximum gas inlet pressure | mbar | 45 | | |
| Minimum gas inlet pressure | mbar | 27 | | |
| Gas flow rate | m3/hr | 1.7 | 2.3 | 3.1 |
| Flue gas mass rate (@10.5% CO2) | g/sec | 16.7 | 23.2 | 31.6 |
| Gas inlet connection size | "BSP | ½ | ½ | ¾ |
| ELECTRICAL DATA | | | | |
| Power consumption | W | 120 | 144 | 180 |
| Power supply | | Single phase 230v/50Hz | | |
| Protection class | | IP00 | | |
| WATER DATA | | | | |
| Water content | litres | 4.9 | 6.4 | 9.1 |
| Water connections (F & R) | "BSP | 1 ¼ | | 2 |
| Max. water pressure (PMS) | bar | 11 | | |
| Min. water pressure | bar | 0.5 | | |
| Maximum water temperature | °C | 88 | | |
| EcoKnight water heater product data table August 2019 | | | | |

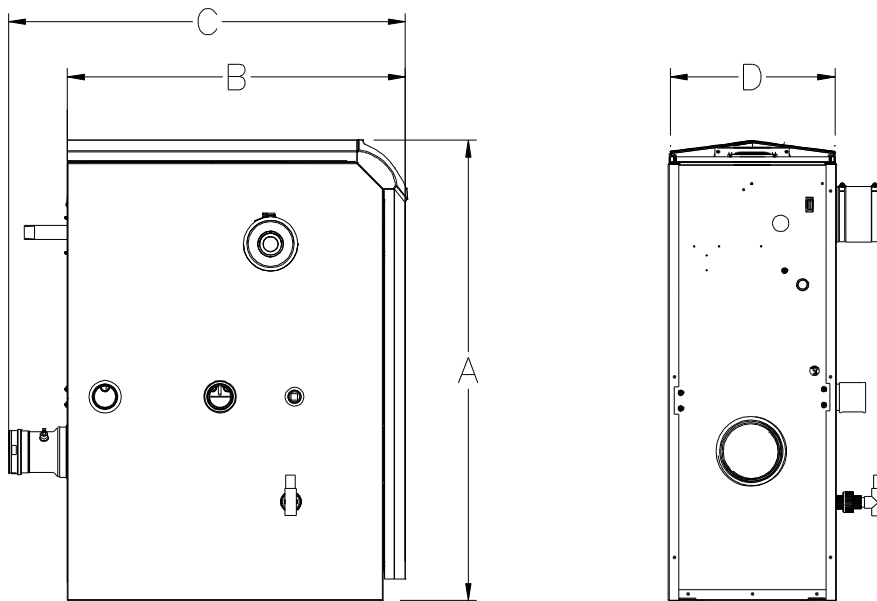
5.0 DIMENSIONS AND CLEARANCE

5.1 DIMENSIONAL DRAWINGS

Note full dimensional drawings showing connection sizes and positions are available from Lochinvar Technical Support



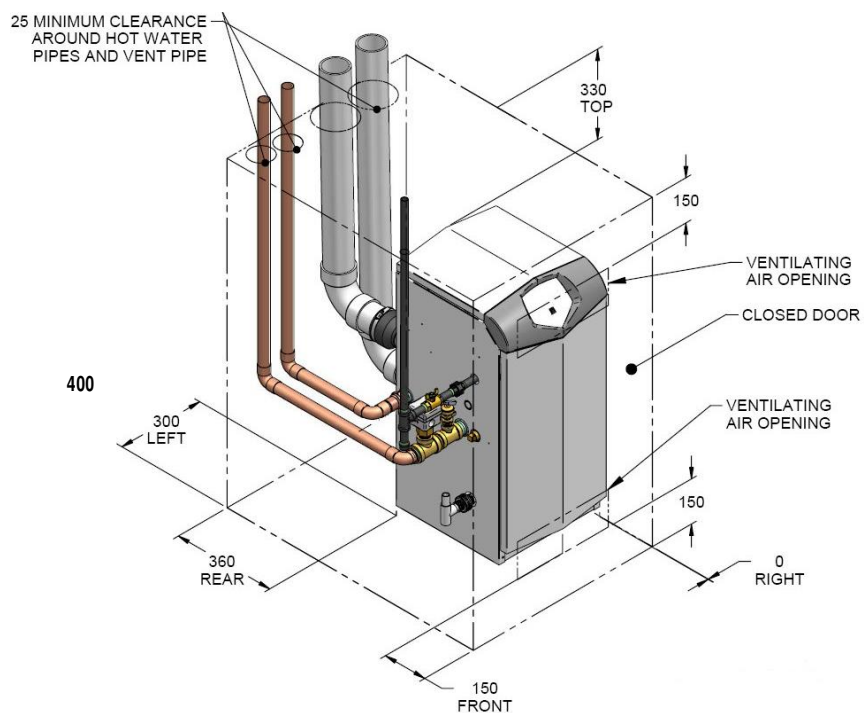
5.1.1 DIMENSIONAL DRAWING EKW46CE-EKW61CE



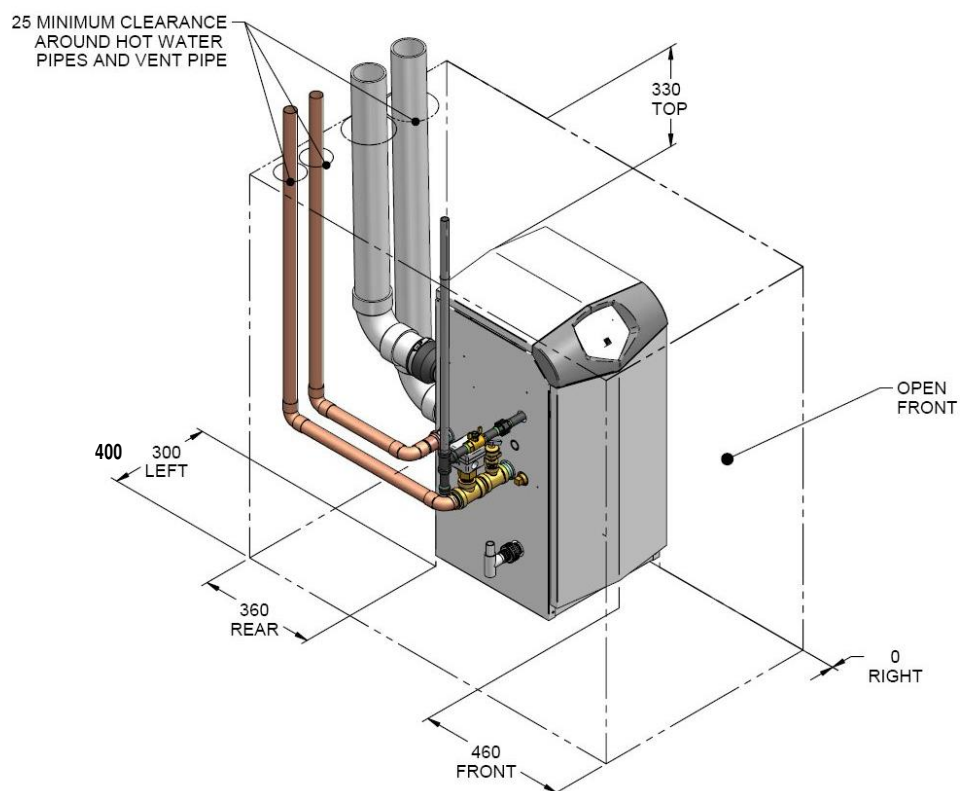
5.1.2 DIMENSIONAL DRAWING EKW86CE,

| Dimension | Unit | Model | | |
|-----------|------|---------|---------|---------|
| | | EKW46CE | EKW61CE | EKW86CE |
| A | mm | 845 | 845 | 1080 |
| B | mm | 457 | 565 | 502 |
| C | mm | 701 | 701 | 641 |
| D | mm | 394 | 394 | 394 |

5.2 CLEARANCES



5.2.1 ENCLOSURE INSTALLATION CLEARANCES (MM)



5.2.2 PLANT-ROOM INSTALLATION CLEARANCES (MM)

6.0 GENERAL REQUIREMENTS

The Lochinvar EcoKnight™ condensing water heater has been designed to operate trouble free for many years. These instructions should be followed closely to obtain the maximum usage and efficiency of the equipment.



READ AND UNDERSTAND THE INSTRUCTIONS



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

6.1 RELATED DOCUMENTS

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

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

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

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

Gas Safety (Installation and Use) Regulations 1998

CIBSE: Guides

Part A Environmental Design

Part G Public health engineering

H.S.E. guidance

INDG 436 Safe management of industrial steam & hot water Heaters

SAFED BG01 Guidance on safe operation of Water Heaters

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

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

7.0 WATER QUALITY

7.1 WATER QUALITY /HARD WATER

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

- Water Hardness – should not exceed 205ppm CaCO₃ and Total Dissolved Solids (TDS) of untreated water should not exceed 350ppm.
If these values are exceeded a water treatment specialist should be consulted. Water Softeners and Water Conditioners may be considered, but whichever method is selected, it should be suitable for installation with Direct Gas-fired Water Heaters. A maintenance regime will also be required for such systems
- High hot water temperature and high demand for hot water is likely to cause quicker limescale formation



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

Additional note: -

See also **section 12.0** in this Instruction manual, for additional guidance on Primary Circulating Pumps, Flow Rates and Pipework headers

8.0 LOCATION

8.1 PLANT ROOM REQUIREMENTS

The Lochinvar EcoKnight™ can only be installed in a room that complies with the appropriate ventilation requirements.

The Lochinvar EcoKnight™ can be used as a type C₁₃, C₃₃, C₄₃ or C₅₃ (room sealed) appliance. Due to its room-sealed design, ventilation allowances for combustion air are not necessary, provided the minimum clearances and service clearances as detailed in 5.2.2 are observed. If the appliance is to be installed in a compartment or a hot environment, the minimum clearances detailed in 5.2.1 should be observed. In addition to this, ventilation for cooling purposes must be fitted. For further guidance, please refer to **Section 11.0** or to **BS5440-2** or **BS6644** as appropriate.

The Lochinvar EcoKnight™ can also be used as a type B₂₃ (open flue) appliance. If such a configuration is to be used, then appropriate ventilation for cooling and combustion must be provided. For further details, please refer to **Section 11.0** or to **BS5440-2** or **BS6644** as appropriate.

8.2 GENERAL REQUIREMENTS

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

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



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

8.3 CLEARANCES

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

See **Section 5.2.1 DIMENSIONS/CLEARANCES**. Further details regarding locations are given in **BS5440** or **BS6644** as appropriate.

8.4 CONDENSATE DRAIN

The condensate drain is located on the left hand side of the water heater. It is fitted with a ½" PVC tee and union, this should be connected to an appropriate condensate drain, sloping continuously away from the water heater at an angle of at least 3° (50mm per metre).

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

9.0 GAS SUPPLY

The Lochinvar EcoKnight™ range is suitable for use on second and third family gasses 2H - G20 - 20mbar and 3P - G31 - 37mbar. Details relating to Natural Gas (2H) appear below; **for details relating to Propane (3P) please refer to Section 18.0: LPG FUEL.**

9.1 SERVICE PIPES

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

9.2 METERS

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

9.3 GAS SUPPLY PIPES

Supply pipes must be fitted in accordance with **IGE/UP/2**. Pipework from the meter to the equipment must be of adequate size. The complete installation must be purged and tested as described in **IGE/UP/1**. Refer to **Section 18.0.LPG FUEL** for information on LPG pipework installation guidance.

9.4 BOOSTED SUPPLIES

Where it is necessary to employ a gas pressure booster, the controls must include a low-pressure cut-off switch at the booster inlet. The local gas distributor must be consulted before a gas pressure booster is fitted. For details of how to connect a low-pressure cut-off switch, please refer to **Section 15.5.2**

9.5 PLANT-ROOM CONTROL VALVE

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

9.6 EQUIPMENT GAS SYSTEM LEAK CHECK

An approved gas-inlet appliance isolating valve and union should be installed for each unit in a convenient and safe position and be clearly marked. Ensure that the gas-inlet appliance isolating valve is in the OFF position. Although the equipment receives a gas leak check and gas train component integrity check prior to leaving the factory, transit and installation may cause disturbance to unions, fittings and components. During commissioning a further test for tightness should be carried out on the equipment gas pipework and components.



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

10.0 FLUE SYSTEM

All versions of the EcoKnight™ Condensing water heater can be installed as either type B23 (fan assisted open flue) or C13, C33, C53 (room sealed) appliances. Only C13, C33, C53 Flue systems are covered in any detail within this document, further information can be found in the EcoKnight Flue assemblies and ancillaries guide available at www.lochinvar.ltd.uk See the relevant section for details of each flue type and requirements.

10.1 FLUE SYSTEM GENERAL REQUIREMENTS



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



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



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



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



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

10.2 FLUE SYSTEM TECHNICAL DETAILS AND MAXIMUM FLUE LENGTH

| Model Number | | EKW46CE | EKW61CE | EKW86CE |
|---|-------|---------------|---------|---------|
| FLUE DATA TYPE B₂₃ | | | | |
| Nominal flue diameter | mm | 80 | | 100 |
| Maximum flue gas temp | °C | 120 | | |
| Maximum equivalent length | m | 60 | | |
| Equivalent length 90° bend | mm | 1000 | | |
| Equivalent length 45° bend | mm | 500 | | |
| Flue gas temperature | °C | 70 | | |
| Flue draught requirements | mbar | -0.03 to -0.1 | | |
| FLUE DATA TYPE C₁₃ & C₃₃ | | | | |
| Nominal flue diameter | mm | 80/125 | | 100/150 |
| Minimum flue gas temp | °C | 35 | | |
| Average flue gas temp (80/60 Flow/Return) | °C | 70 | | |
| Maximum flue gas temp | °C | 120 | | |
| Maximum equivalent length | m | 30 | | |
| Equivalent length 90° bend | mm | 1000 | | |
| Equivalent length 45° bend | mm | 500 | | |
| FLUE DATA TYPE C₄₃ & C₅₃ | | | | |
| Nominal flue diameter | mm | 80 | | 100 |
| Minimum flue gas temp | °C | 35 | | |
| Average flue gas temp (80/60 Flow/Return) | °C | 70 | | |
| Maximum flue gas temp | °C | 120 | | |
| Nominal Flue gas mass rate (@ 9.0% CO ₂) | g/sec | 16 | 22.3 | 30.4 |
| Minimum Flue gas mass rate (@ 9.0% CO ₂) | g/sec | 3.2 | 4.46 | 6.08 |
| Maximum equivalent length | m | 60* | | |
| Equivalent length 90° bend | mm | 1000 | | |
| Equivalent length 45° bend | mm | 500 | | |

10.2.1 FLUE SYSTEM TECHNICAL DATA TABLE

- * On twin pipe systems, the maximum equivalent length is the sum of the air inlet components and the exhaust components.

10.3 FLUE DISCHARGE

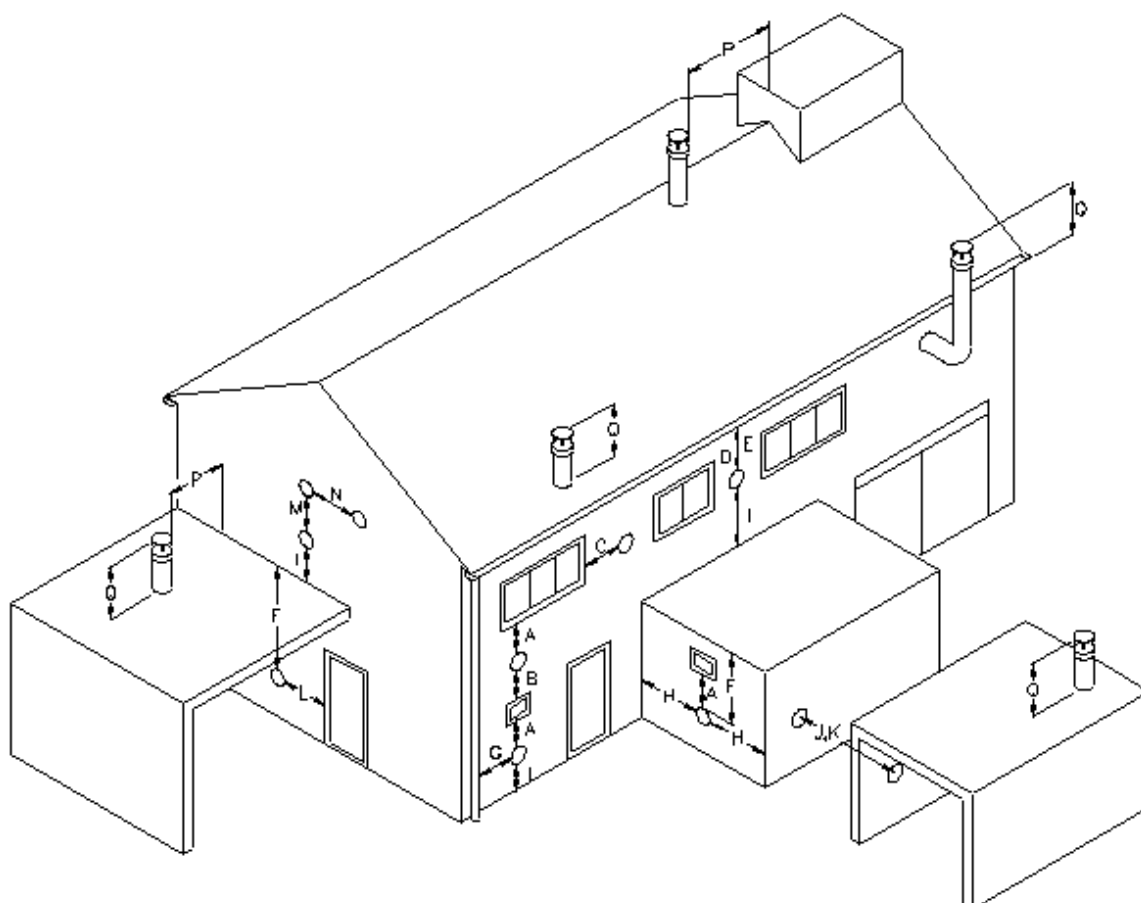
The flue system must ensure safe and efficient operation of the equipment to which it is attached, protect the combustion process from wind effects and disperse the products of combustion to open external air.

The flue must terminate in a freely exposed position and be so situated as to prevent the products of combustion entering any opening in a building. For installations with a total output above 200kW, the clean air act should be consulted and complied with. Under certain operating and weather conditions, the EcoKnight™ water heater may generate a plume at the terminal. Consideration should be given to the nuisance this may cause and the terminal should be sited accordingly.

For further information on terminal locations, please refer to **Section 10.4.1 FLUE TERMINAL POSITIONS**.

10.4 CONDENSATE DRAIN

If the flue system rises at an angle of at least 3° (50mm per metre), no additional condensate drain will be required. Failure to provide an adequate rise in the flue system may lead to pooling of condensate which may lead to premature failure of the flue system.



10.4.1 FLUE TERMINAL POSITIONS

| Location | Description | EKW46CE – EKW61CE | EKW86CE |
|----------|---|-------------------|---------|
| A | Directly below an opening, air brick, opening windows etc. | 300 | 2000 |
| B | Above an opening, air brick, opening windows etc. | 300 | 1000 |
| C | Horizontally to an opening, air brick, opening windows etc. | 300 | 1000 |
| D | Below a gutter or sanitary pipework | 75 | 75 |
| E | Below the eaves | 200 | 200 |
| F | Below a balcony or car port roof | 200 | 200 |
| G | From a vertical drain or soil pipe | 150 | 150 |
| H | From an internal or external corner | 300 | 300 |
| I | Above ground, roof or balcony level | 300 | 300 |
| J | From a surface facing the terminal | 600 | 1000 |
| K | From a terminal facing the terminal | 1200 | 2000 |
| L | From an opening in the car port (e.g. door, window) into the dwelling | 1200 | 1200 |
| M | Vertically from a terminal on the same wall | 1500 | 1500 |
| N | Horizontally from a terminal on the same wall | 300 | 600 |
| P | From a vertical structure on the roof | 300 | 300 |
| Q | Above intersection with the roof | 300 | 300 |

10.4.2 FLUE TERMINAL MINIMUM DISTANCES

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.

10.5 APPROVED FLUE SYSTEM



For Concentric and Twin pipe flue systems only the Lochinvar supplied M&G flue system must be used



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

10.6 INSTALLATION PRECAUTIONS

- The approved flue system is rated to 120°C max. To prevent the exhaust temperature exceeding this, the appliance is supplied with a flue gas temperature sensor.



This must be fitted during the installation of the flue system. Failure to do so may lead to severe personal injury, death or substantial property damage.

- The water heater must not be operated unless the complete flue system is installed. This includes the water heater connections, concentric adaptor (if required) flue pipes, air ducts (if required) and terminals. If discharging at low level, a suitable flue guard must be installed.
- During assembly precaution should be taken to ensure that the internal sealing ring is seated correctly.
- Due to the close tolerances in the flue system, it may be necessary to use a twisting action to fit the joints together. No lubrication other than water should be used.

10.7 ROOM SEALED (TYPE C) FLUE ASSEMBLY

In order to install the EcoKnight™ water heater with a type C (room sealed) flue system a flue transition kit must first be installed, this kit is used for both C₁₃ (horizontal) and C₃₃ (vertical) flue systems. The information in this paragraph describes these flue transition kits and their installation

10.8 INSTALLATION OF FLUE TRANSITION KIT TO EKW46CE – EKW61CE WATER HEATERS



10.8.1 FIGURE 9.2 FLUE TRANSITION PARTS EKW46CE – EKW61CE



Depending upon the flue kit chosen either a vertical or horizontal concentric terminal will be included in the packaging with the transition kit, additional elbows, flue lengths etc. Are available as ancillary items. Additional wall brackets may be required to ensure the flue system is stable.

For a full list of flue components supplied and optional parts to complete the system see the EcoKnight™ flue guide available at www.Lochinvar.ltd.uk

| ITEM NUMBER | DESCRIPTION | EKW 46CE | EKW 61CE |
|-------------|-----------------------|--------------|--------------|
| 1 | 90° ELBOW | 3 REQUIRED | 3 REQUIRED |
| 2 | SAMPLING POINT | 1 REQUIRED | 1 REQUIRED |
| 3 | CONCENTRIC ADAPTOR | 1 REQUIRED | 1 REQUIRED |
| 4 | AIR INTAKE TRANSITION | 1 REQUIRED | 1 REQUIRED |
| 5 | 80mm X 500mm LENGTH | CUT TO 270mm | CUT TO 270mm |

1.1.1 FLUE TRANSITION PARTS EKW46CE – EKW61CE

To install the flue connection to the EKW46CE – EKW61CE Water Heaters the following procedure should be followed:

1. Check you have all items shown in **Section 10.8.1**
2. Check the flue temperature sensor (supplied with the Water Heater) is securely located into the hole on the exhaust transition.



If the flue temperature sensor is not fitted, the flue gas may exceed the maximum temperature rating of the flue and can lead to severe personal injury, death or substantial property damage.

3. Insert the air intake transition (Item 4) into the intake connection reducer (shown below) and tighten the worm drive clip.
4. To the bottom (exhaust) connection of the concentric adaptor fit one of the 80mm 90° elbows, and then fit the 80mm x500mm flue pipe cut to length as in **Section 1.1.1** To the side (intake) connection of the concentric adaptor, fit the remaining 90° elbows.
5. Fit the Concentric adapter (item 3) to the exhaust flue pipe and air inlet elbows
6. Fit the flue gas test point (Item 2) and clamp using its locking band.

The completed transition kit should look like the photos shown below.



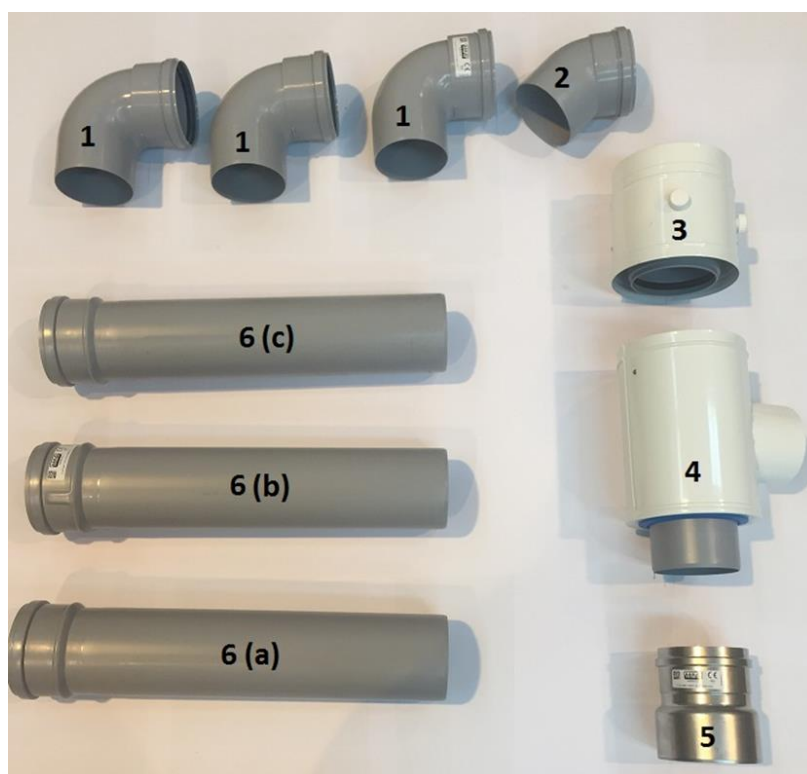
REAR VIEW TRANSITION KIT EKW46CE-EKW61CE



SIDE VIEW TRANSITION KIT EKW46CE-EKW61CE

10.8.2 TRANSITION KIT FITTED TO APPLIANCE

10.9 INSTALLATION OF TRANSITION KIT TO EKW86CE WATER HEATERS



10.9.1 FLUE TRANSITION PARTS EKW86CE



Depending upon the flue kit chosen either a vertical or horizontal concentric terminal will be included in the packaging with the transition kit, additional elbows, flue lengths etc. Are available as ancillary items. Additional wall brackets may be required to ensure the flue system is stable. For a full list of flue components supplied and optional parts to complete the system see the EcoKnight™ flue guide available at www.lochinvar.ltd.uk

| ITEM NUMBER | DESCRIPTION | EKW 86 |
|-------------|-----------------------|--------------|
| 1 | 90° ELBOW | 3 REQUIRED |
| 2 | 45° ELBOW | 1 REQUIRED |
| 3 | SAMPLING POINT | 1 REQUIRED |
| 4 | CONCENTRIC ADAPTOR | 1 REQUIRED |
| 5 | AIR INTAKE TRANSITION | 1 REQUIRED |
| 6 (a) | 100mm X 500mm LENGTH | KEEP 500mm |
| 6 (b) | 100mm X 500mm LENGTH | CUT TO 330mm |
| 6 (c) | 100mm X 500mm LENGTH | CUT TO 330mm |

10.9.2 FLUE TRANSITION PARTS EKW86CE

To install the flue connection to the EKW86CE Water Heaters the following procedure should be followed:

1. Check you have all items shown in Section **10.9.2**.
2. Check the flue temperature sensor (supplied with the Water Heater) is securely located into the hole on the exhaust transition.



If the flue temperature sensor is not fitted, the flue gas may exceed the maximum temperature rating of the flue and can lead to severe personal injury, death or substantial property damage.

3. Insert the air intake transition (Item 5) into the intake connection reducer and tighten the worm drive clip.
4. To the bottom (exhaust) connection of the concentric adaptor fit one of the 80mm 90° elbows, and then fit the 80mm x500mm flue pipe cut to length as in Section **10.9.2**.
5. To the side (intake) connection of the concentric adaptor, fit the remaining 90° elbows.
6. Fit the Concentric adaptor (item 3) to the exhaust flue pipe and air inlet elbows
7. Fit the flue gas test point (Item 2) and clamp using its locking band.

The completed transition kit should look like the photos shown below.



REAR VIEW TRANSITION KIT EKW86CE



SIDE VIEW TRANSITION KIT EKW86CE

10.9.3 TRANSITION KIT FITTED TO APPLIANCE

10.10 C13 CONCENTRIC HORIZONTAL FLUE SYSTEMS

Flue system specifications

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

Each concentric horizontal flue kit includes the items shown in the tables below

| Item No EKWHF001 | | | |
|-------------------------------------|--|--------|----------|
| CONCENTRIC HORIZONTAL FLUE ASSEMBLY | | | |
| MODELS EKW46CE,EKW61CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M85291 | BEND 90° 80mm PP | 1 | 3 |
| M84471 | SAMPLING POINT Ø80/125mm PP | 2 | 1 |
| M75258 | CONCENTRIC ADAPTER TEE Ø80/80mm - Ø80/125mm PP | 3 | 1 |
| M75256 | AIR INLET TRANSITION Ø80mm ALU | 4 | 1 |
| M85271 | EXTENSION Ø80mm (500mm) PP CUT TO LENGTH | 5 | 1 |
| M84460 | CONCENTRIC BEND 90° Ø80/125mm PP | 6 | 1 |
| M86934 | CONCENTRIC HORIZONTAL TERMINAL Ø80/125mm PP (NO WALL PLATES) | 7 | 1 |
| M28925 | TERMINAL WALL PLATES (PAIR) | 8 | 1 |

| Item No EKWHF002 | | | |
|-------------------------------------|---|--------|----------|
| CONCENTRIC HORIZONTAL FLUE ASSEMBLY | | | |
| MODELS EKW86CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M85181 | BEND 90° 100mm PP | 1 | 3 |
| M85182 | BEND 45° 100mm PP | 2 | 1 |
| M84421 | SAMPLING POINT Ø100/150mm PP | 3 | 1 |
| M75259 | CONCENTRIC ADAPTER TEE Ø100/100mm Ø100/150mm PP | 4 | 1 |
| M75257 | AIR INLET TRANSITION Ø100mm ALU | 5 | 1 |
| M85176 | EXTENSION Ø100mm (500mm) PP CUT TO LENGTH | 6 | 3 |
| M84412 | CONCENTRIC BEND 90° Ø100/150mm PP | 7 | 1 |
| LV310758 | CONCENTRIC HORIZONTAL TERMINAL Ø100/150mm PP | 8 | 1 |

10.11 HORIZONTAL FLUE TERMINAL INSTALLATION



If using a C13 flue system with separate Horizontal air inlet and Horizontal combustion outlet the air inlet and combustion outlet must fit inside a square of 500mm for the EKW46 and EKW61 and must fit inside a square of 1000mm for the EKW86

When the Water Heater is installed as a Type C₁₃ (Horizontal concentric) appliance, the flue system should be installed as follows:

1. Determine the location of the flue terminal, taking into account minimum distances as detailed in **Section 10.4.1** And the relevant British Standards.
2. Taking care to protect the appliance from debris and dust, drill a hole in the desired location. The diameter of the hole should be no more than 10mm greater than the diameter of the air supply pipe of the terminal.
3. Determine the required length of the terminal and cut as necessary.



When determining the required length for the flue terminal, the outer wall plate or rosette should be flush to the wall. (see 10.11.1)



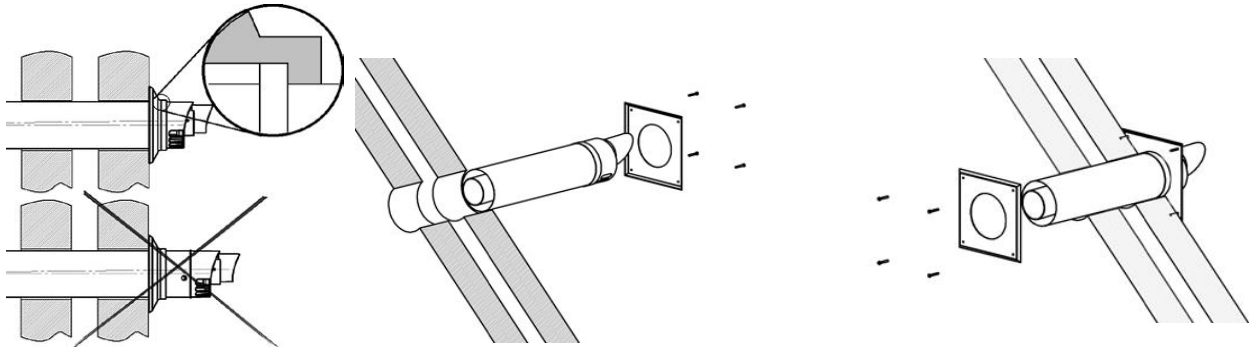
Once cut; remove all burrs and sharp edges

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



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

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



10.11.1 HORIZONTAL TERMINAL INSTALLATION

10.12 FLUE TERMINAL GUARDING

If a horizontal flue terminal is to be fitted less than 2 metres from ground level or in a location where it can be touched from a window, door or balcony, a terminal guard must be fitted.

10.13 C33 CONCENTRIC VERTICAL FLUE SYSTEMS

Flue system specifications

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

Each concentric horizontal flue kit includes the items shown in the tables below

| Item No EKWVF001 | | | |
|-----------------------------------|---|--------|----------|
| CONCENTRIC VERTICAL FLUE ASSEMBLY | | | |
| MODELS EKW46CE,EKW61CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M85291 | BEND 90° 80mm PP | 1 | 3 |
| M84471 | SAMPLING POINT Ø80/125mm PP | 2 | 1 |
| M75258 | CONCENTRIC ADAPTER TEE Ø80/80mm - Ø80/125mm PP | 3 | 1 |
| M75256 | AIR INLET TRANSITION Ø80mm ALU | 4 | 1 |
| M85271 | EXTENSION Ø80mm (500mm) PP CUT TO LENGTH | 5 | 1 |
| LV310744 | CONCENTRIC EXTENSION Ø80/125mm(280-395mm) PP TELESCOPIC | 6 | 1 |
| M86864 | CONCENTRIC VERTICAL TERMINAL Ø80/125mm PP | 7 | 1 |

| Item No EKWVF002 | | | |
|-----------------------------------|--|--------|----------|
| CONCENTRIC VERTICAL FLUE ASSEMBLY | | | |
| MODELS EKW86CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M85181 | BEND 90° 100mm PP | 1 | 3 |
| M85182 | BEND 45° 100mm PP | 2 | 1 |
| M84421 | SAMPLING POINT Ø100/150mm PP | 3 | 1 |
| M75259 | CONCENTRIC ADAPTER TEE Ø100/100mm Ø100/150mm PP | 4 | 1 |
| M75257 | AIR INLET TRANSITION Ø100mm ALU | 5 | 1 |
| M85176 | EXTENSION Ø100mm (500mm) PP CUT TO LENGTH | 6 | 3 |
| M84405 | CONCENTRIC EXTENSION Ø100/150 (500mm) PP CUT TO LENGTH | 7 | 1 |
| LV310754 | CONCENTRIC VERTICAL TERMINAL Ø100/150mm PP | 8 | 1 |

10.14 VERTICAL FLUE TERMINAL INSTALLATION



If using a C33 flue system with separate Vertical air inlet and Vertical combustion outlet the air inlet and combustion outlet must fit inside a square of 500mm for the EKW46 and EKW61 and must have a maximum distance of 500mm between the two orifices. For the EKW86 they must fit inside a square of 1000mm and have a maximum distance between the two orifices of 1000mm

When the water heater is installed as a Type C₃₃ appliance, the flue system should be installed as follows:

1. Confirm that the roof flashing is correct for the type of roof through which the terminal is to be installed. **Section 10.14.1**
2. Determine the desired location for the flue terminal, taking into account minimum distances as detailed in **Section 10.4.1 FLUE TERMINAL POSITIONS** and the relevant British Standards.
3. Taking care to protect the appliance from debris and dust, drill a hole in the desired location. The diameter of the hole should be no more than 10mm greater than the diameter of the air supply pipe of the terminal.



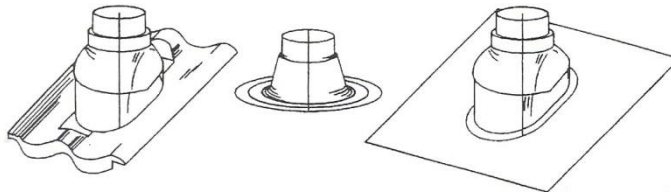
The hole should be drilled from the outside to ensure that no damage is done to the roofing material. Extra care should be taken to ensure that the hole is drilled vertically.

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

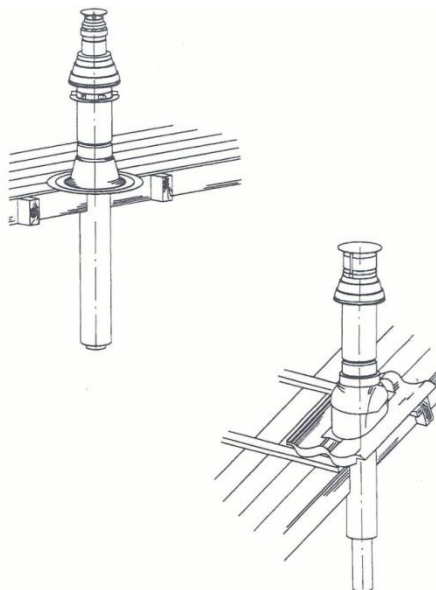


When inserting the roof terminal do not support or turn the terminal using the cap.

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



10.14.1 VERTICAL TERMINAL ROOF FLASHINGS FOR SYNTHETIC, FLAT AND TILED ROOFS

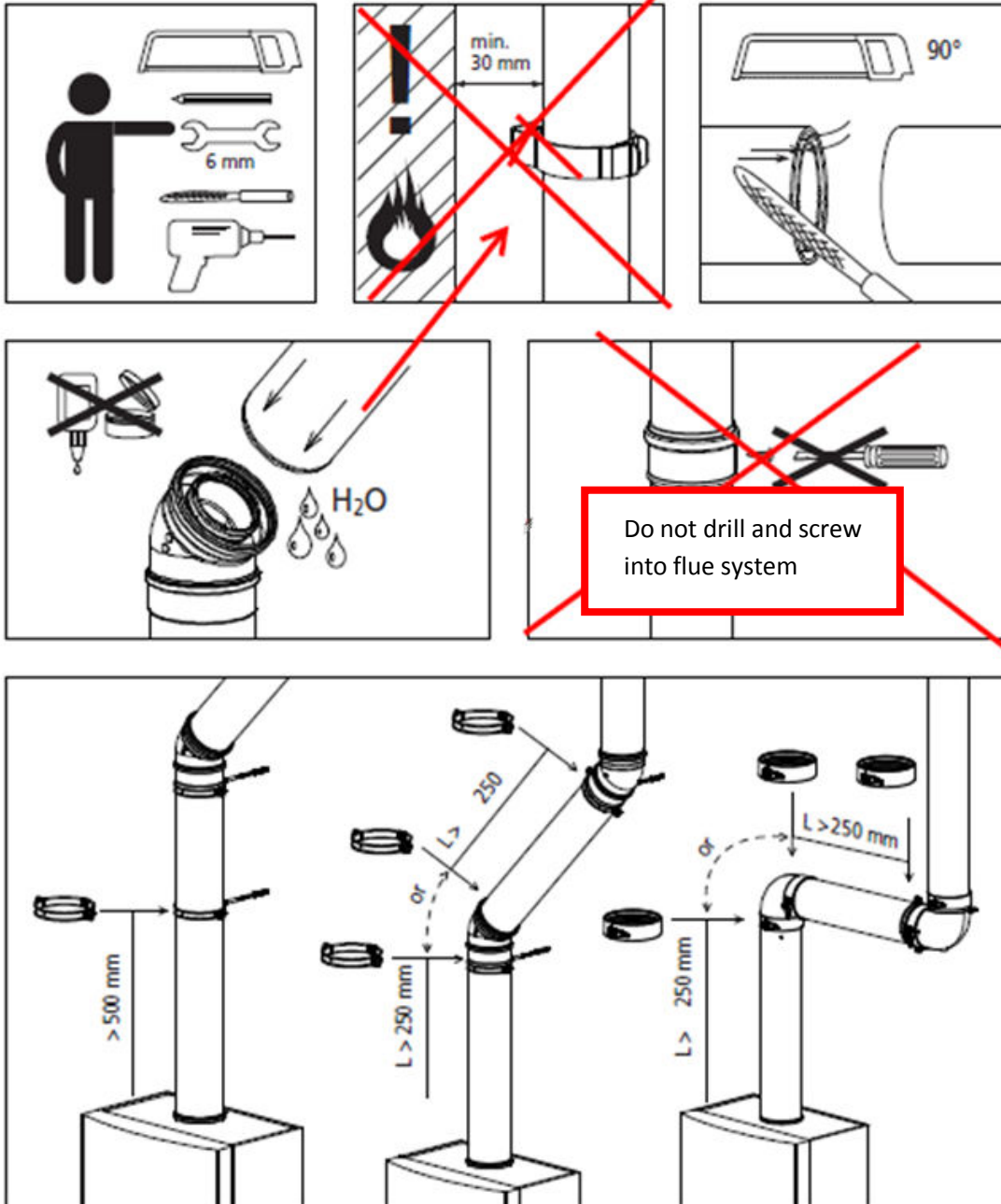


10.14.2 INSTALLING TERMINAL THROUGH ROOF FLASHING

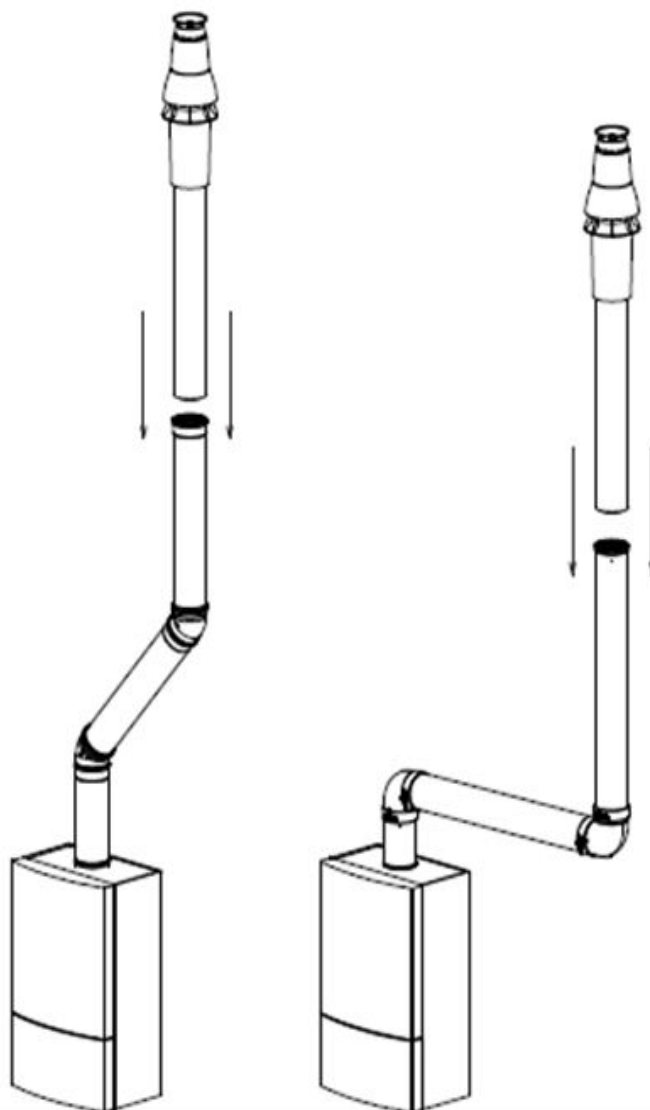
10.14.3 GENERAL CONCENTRIC FLUE SYSTEM INSTALLATION GUIDELINES



The information in this section is for General guidance only and may not fully represent the installation on site

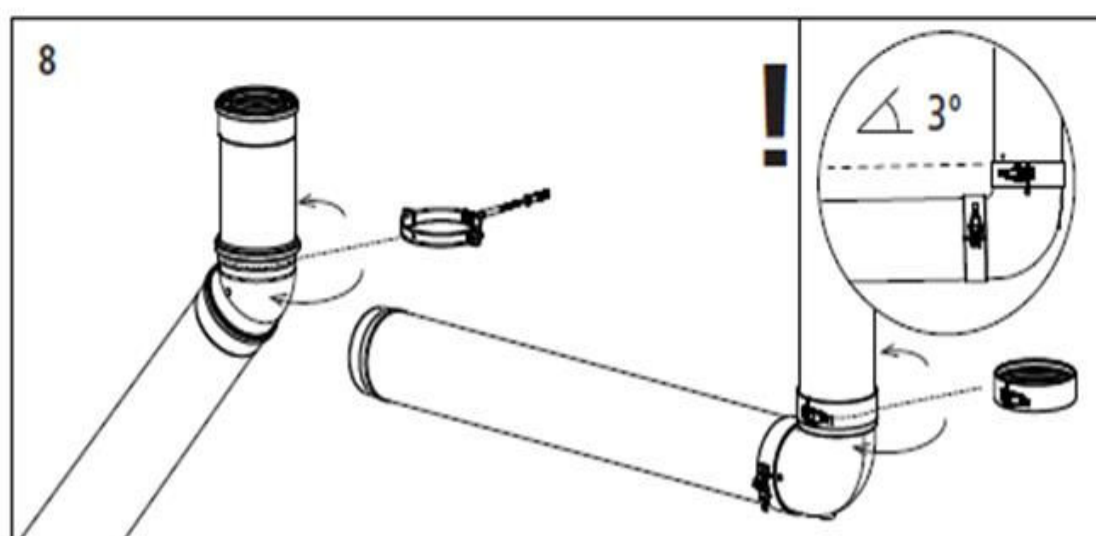
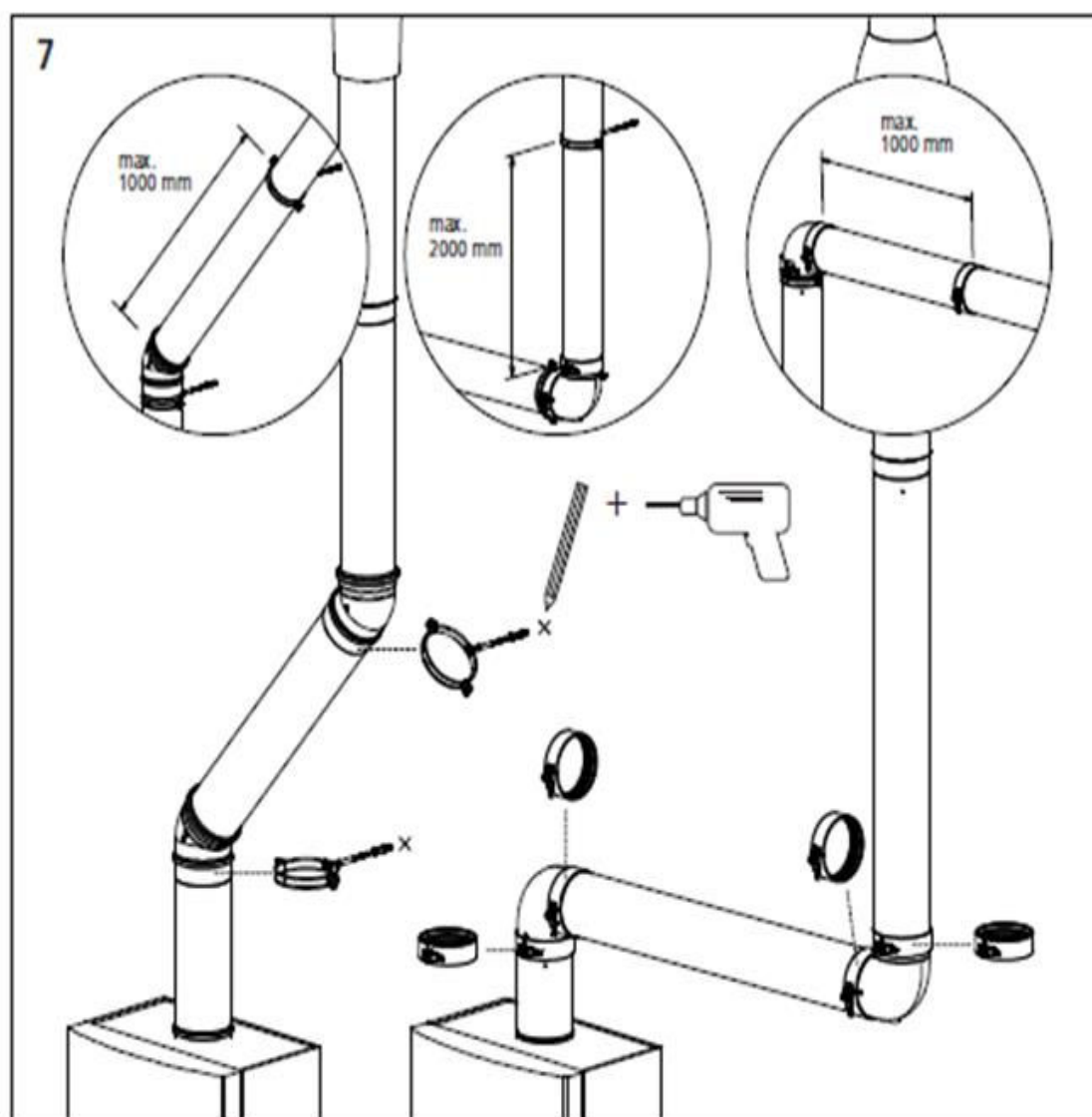


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10.15 TYPE C₄₃ COMMON VENTED FLUE SYSTEMS IN MULTI FLOOR BUILDINGS

This appliance can operate on a U-Duct common flue system. The maximum lengths for the interconnecting flue can be found in **Section 10.2**.



Only use a C₄₃ venting system when the common duct is a natural draught chimney. The common duct is part of the building, not a part of the system.

Concrete components of the U-Duct must meet the requirements of **BS EN 1858**.

10.15.1 CONDENSATE DRAIN

Condensate can flow back to the appliance, this will travel through the heat exchanger into the condensate drain via the trap. If the flue system rises at an angle of at least 3° (50mm per metre), no additional condensate drain will be required. Failure to provide an adequate rise in the flue system may lead to pooling of condensate which may lead to premature failure of the flue system.

| Model No. | Nominal Flue Diameter | Mass Rate @ 100% (@ 9% CO ₂) (G20) | Mass Rate @ 23% (@ 9% CO ₂) (G20) | Mass Rate @ 100% (@ 10.5% CO ₂) (G31) | Mass Rate @ 23% (@ 10.5% CO ₂) (G31) |
|-----------|-----------------------|---|--|--|---|
| EKW46CE | 80+/-0.6 | 16.0g/s | 3.7g/s | 16.7g/s | 3.8g/s |
| EKW61CE | 80+/-0.6 | 22.3g/s | 5.1g/s | 23.2g/s | 5.3g/s |
| EKW86CE | 100+/-0.6 | 30.4g/s | 7.0g/s | 31.6g/s | 7.3g/s |

10.15.2 FLUE GAS MASS RATES

10.16 C₅₃ (TWIN PIPE) FLUE SYSTEMS

Flue system specifications

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

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

| Item No EKWTF001 | | | |
|---|--------------------------------|--------|----------|
| TWIN-PIPE FLUE STARTER ASSEMBLY | | | |
| Kit contains components to start the connection to the appliance only | | | |
| MODELS EKW46CE,EKW61CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M75256 | AIR INLET TRANSITION Ø80mm ALU | 1 | 1 |
| M85279 | SAMPLING POINT Ø80mm PP | 2 | 1 |

| Item No EKWTF002 | | | |
|---|---------------------------------|--------|----------|
| TWIN-PIPE FLUE STARTER ASSEMBLY | | | |
| Kit contains components to start the connection to the appliance only | | | |
| MODELS EKW86CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M75257 | AIR INLET TRANSITION Ø100mm ALU | 1 | 1 |
| M85189 | SAMPLING POINT Ø100mm PP | 2 | 1 |

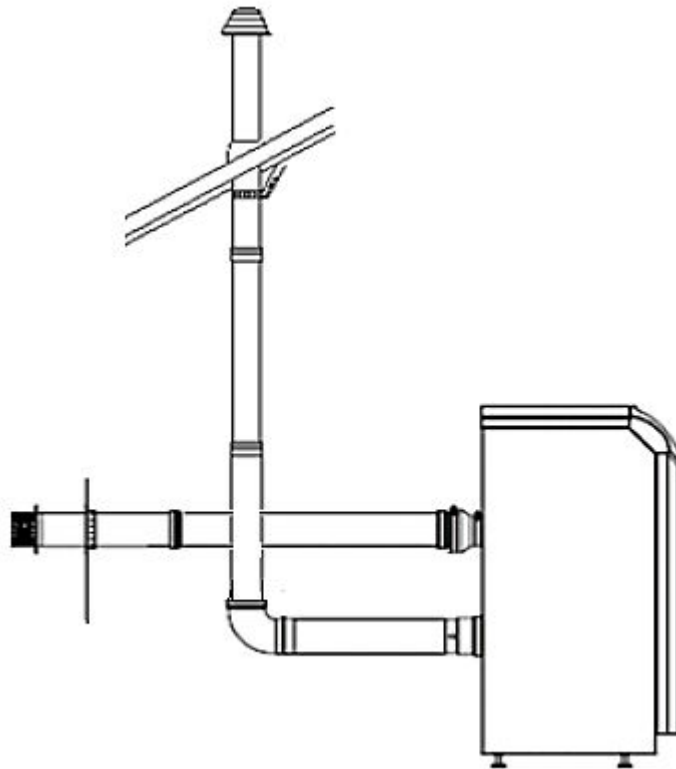
When installing the EcoKnight™ on a C₅₃ twin pipe flue system, the Lochinvar Twin pipe flue starter assembly must be fitted first including the flue temperature sensor.



When installing the water heater as a Type C₅₃ appliance, it should be noted that the terminals must not be installed on opposite sides of the building.



If the flue temperature sensor is not fitted, the flue gas temperature may exceed the maximum temperature rating of the flue and can lead to severe personal injury, death or substantial property damage.



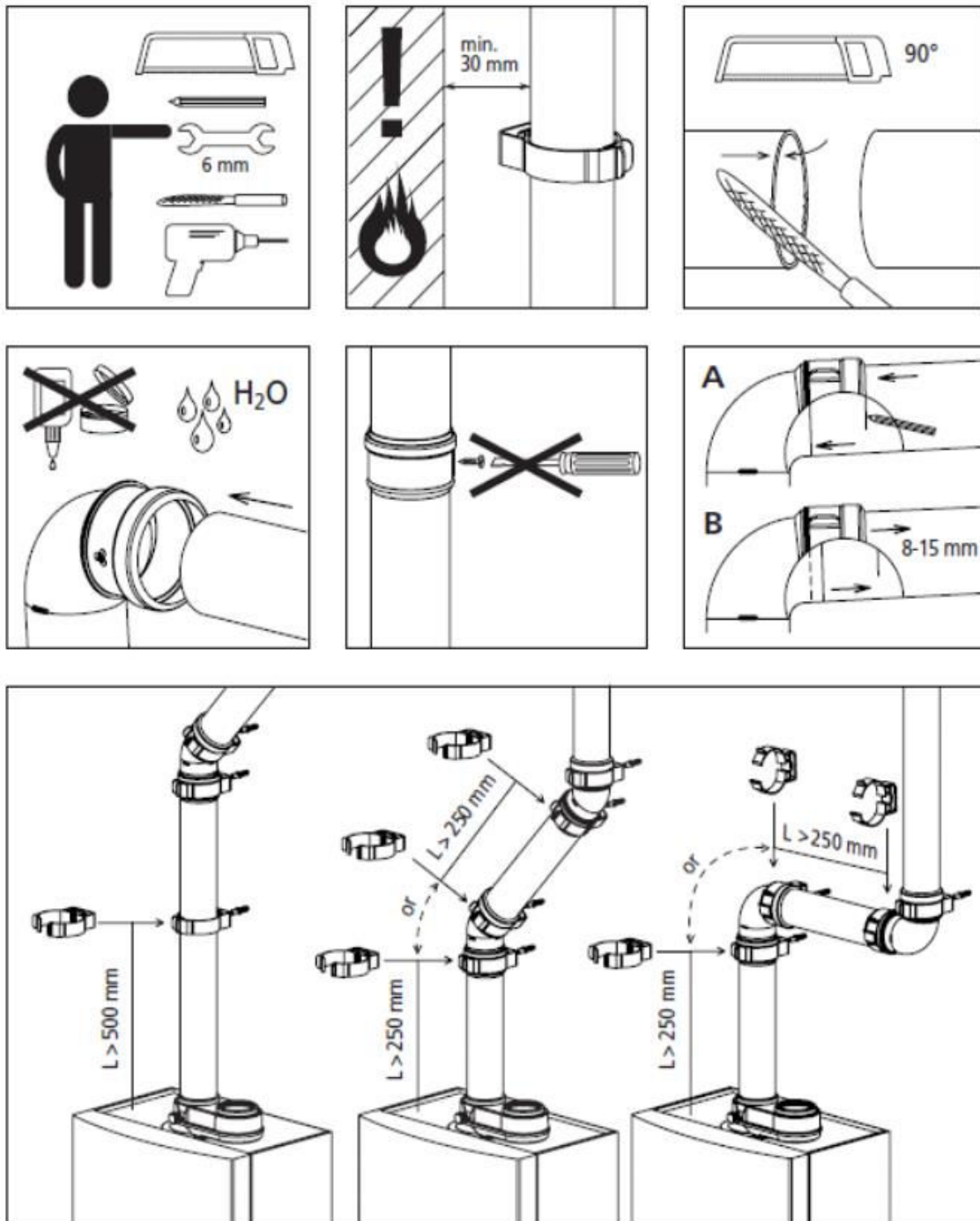
Typical C₅₃ Twin-Pipe flue arrangement

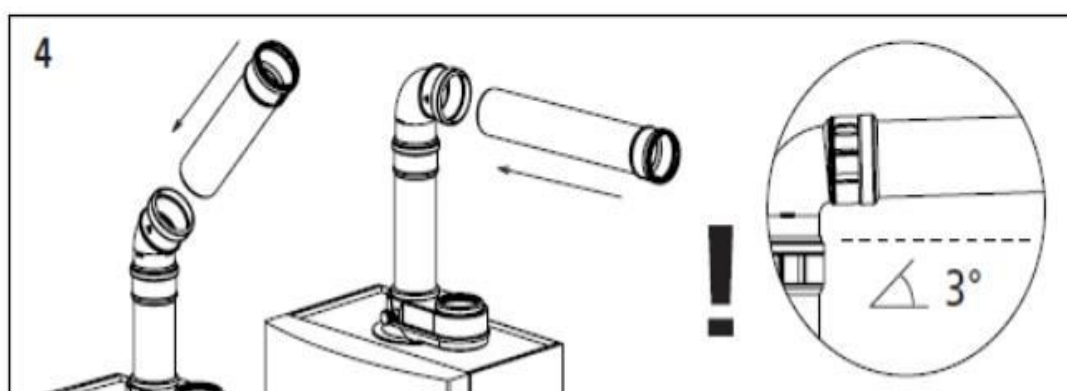
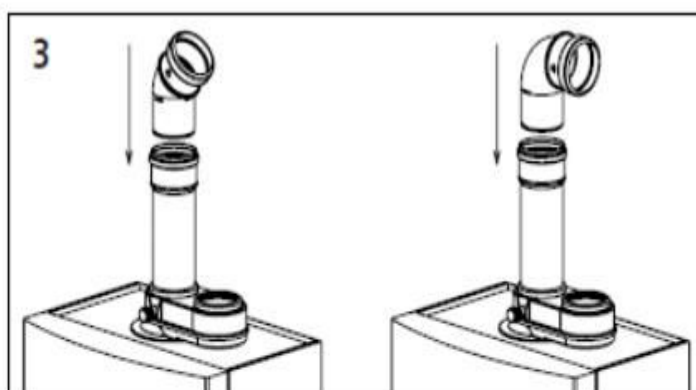
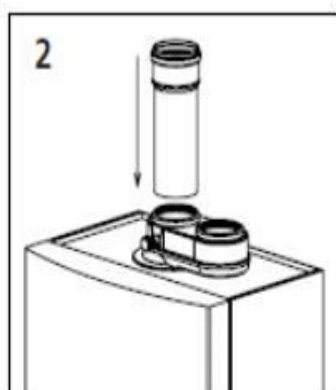
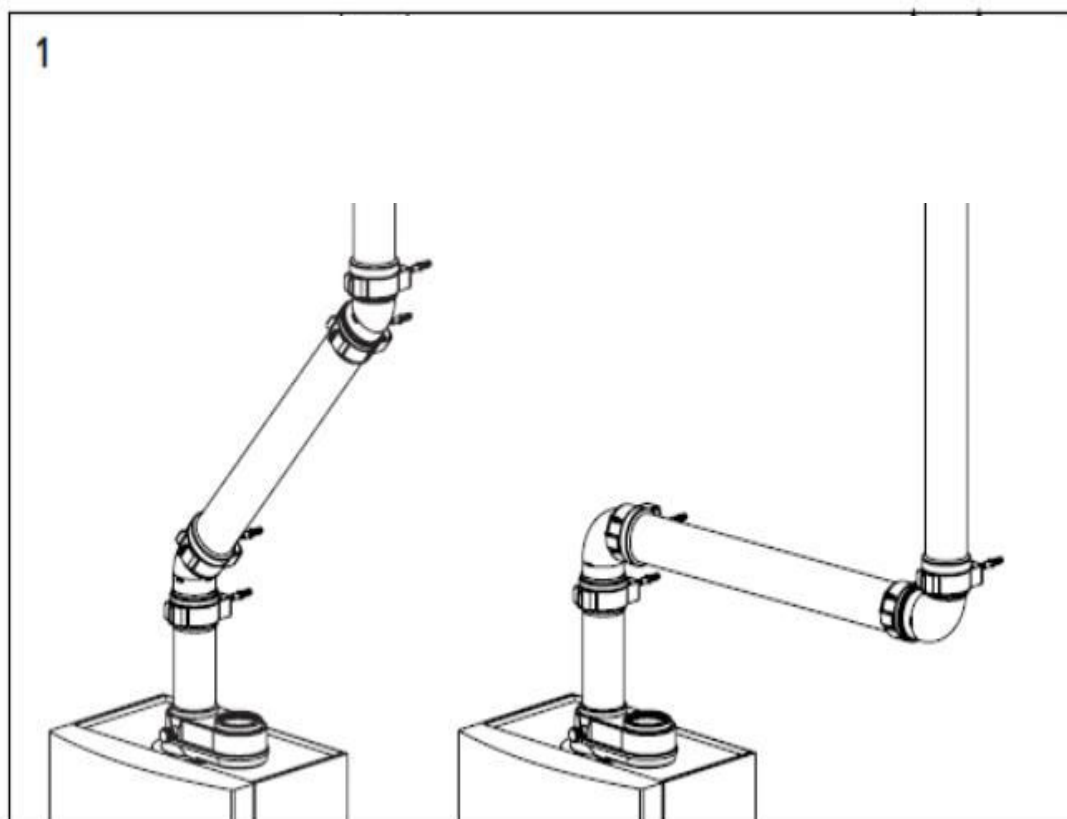
To install a Type C₅₃ terminal or air inlet, the procedure for either a Type C₁₃ (horizontal) or a Type C₃₃ (vertical) terminal should be followed noting that the annular space of the terminal should be sealed off.

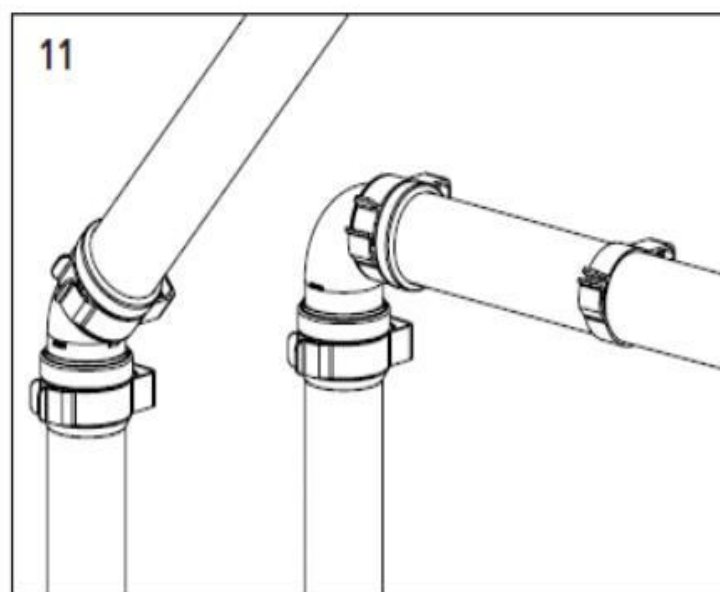
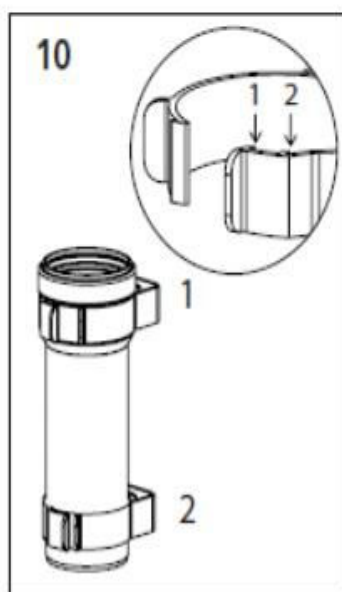
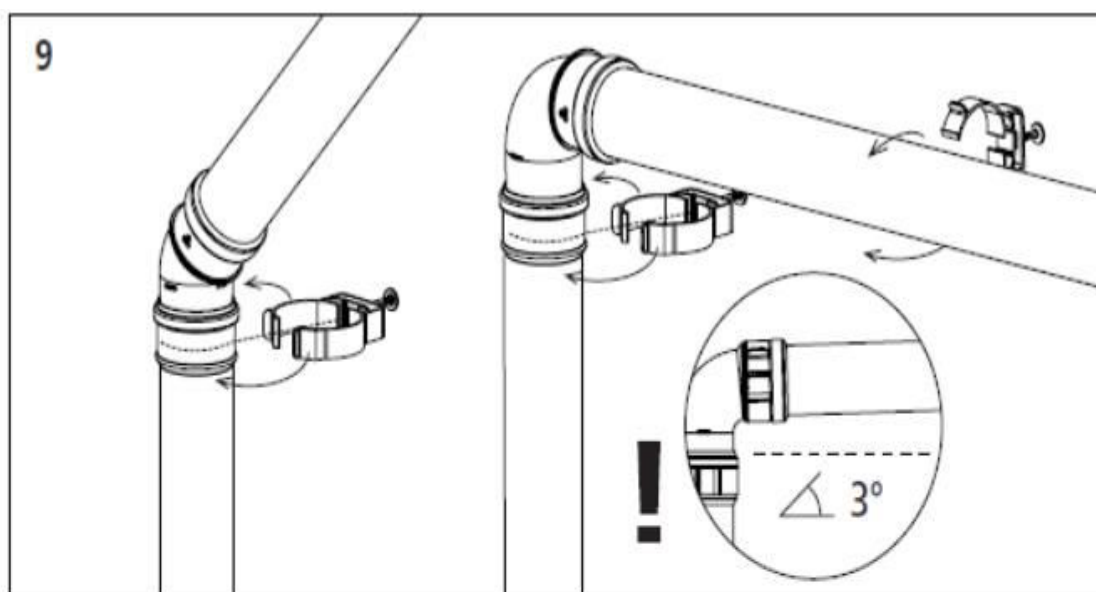
10.16.1 GENERAL TWIN-PIPE INSTALLATION GUIDELINES



The information in this section is for General guidance only and may not fully represent the installation on site







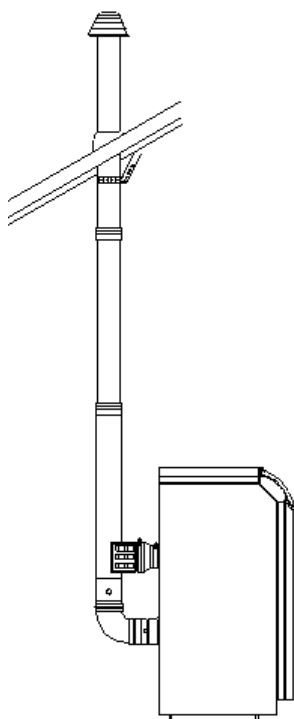
10.17 TYPE B₂₃ (CONVENTIONAL FLUE WITH FAN ASSISTANCE)

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

| Item No EKWCF001 | | | |
|---|--------------------------------|--------|----------|
| FAN ASSISTED OPEN FLUE STARTER ASSEMBLY | | | |
| Kit contains components to start the connection to the appliance only | | | |
| MODELS EKW46CE,EKW61CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M75256 | AIR INLET TRANSITION Ø80mm ALU | 1 | 1 |
| M73039 | AIR INLET GRILLE Ø80mm ALU | 2 | 1 |
| M85279 | SAMPLING POINT Ø80mm PP | 3 | 1 |

| Item No EKWCF002 | | | |
|---|----------------------------------|--------|----------|
| FAN ASSISTED OPEN FLUE STARTER ASSEMBLY | | | |
| Kit contains components to start the connection to the appliance only | | | |
| MODELS EKW86CE | | | |
| COMPONENTS INCLUDED | | | |
| Item No. | Description | Number | Quantity |
| M75257 | AIR INLET TRANSITION Ø100mm ALU | 1 | 1 |
| M86787 | APPLIANCE AIR INLET GUARD Ø100mm | 2 | 1 |
| M85189 | SAMPLING POINT Ø100mm PP | 3 | 1 |

The above is a kit of components to facilitate conventional flueing of the appliance and must be fitted prior to fitting any other flue components.



10.17.1 TYPICAL CONVENTIONAL FLUE ARRANGEMENT

- 1.Insert the exhaust transition into the exhaust port of the water heater.
- 2..Insert the flue temperature sensor into the location hole on the exhaust transition.



If the flue temperature sensor is not fitted, the flue gas may exceed the maximum temperature rating of the flue and can lead to severe personal injury, death or substantial property damage.

- 3.Insert the air intake into the intake connection and tighten the worm drive clip.
- 4.Insert the air inlet grill into the air inlet transition. For safety reasons this must be fitted prior to operating the appliance.

10.18 C₆₃ CERTIFIED FLUE SYSTEMS

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

| 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 required PP | EN 14471 | T120 | P1 | W | 1 | | O | 30 | I of E | C/E | L |
| Min required Inox | EN 1856-1 | T120 | P1 | W | 1 | L20040 | O | 40 | | | |

10.18.1 C₆₃ FLUE SYSTEM SPECIFICATION

| Twin-pipe Flue Systems | | | | | |
|-------------------------|----------------|------------------|----------------------------|-------------------------|------------|
| Material | Water heater | d _{nom} | D _{outside} | d _{inside} | Insert |
| PP | EKW46-EKW61 CE | 80 | 80 +/-0.3 | 81 +/-0.6 | 50 +20/ -2 |
| PP | EKW86 CE | 100 | 100 +/-0.3 | 101 +/-0.6 | 50 +20/ -2 |
| Concentric Flue Systems | | | | | |
| Material | Water heater | d _{nom} | D _{outside} | d _{inside} | Insert |
| PP | EKW46-EKW61 CE | 80/100 | 80 +/-0.3-124 +0.5/-1 | 81 +/-0.6-125.5 +/-0.5 | 56 +/-3 |
| PP | EKW86 CE | 100/150 | 100 +/-0.3 - 148.5 +0.5/-1 | 101 +/-0.5 - 150 +/-0.5 | 50 +20/ -2 |



When installing the water heater as a Type C₆₃ appliance, it should be noted that the terminals must not be installed on opposite sides of the building.



The maximum allowable recirculation rate is 10% under wind conditions



Aluminum 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.

10.18.2 CONDENSATE DRAIN

Condensate can flow back to the appliance; this will travel through the heat exchanger into the condensate drain via the trap. If the flue system rises at an angle of at least 3° (50mm per metre), no additional condensate drain will be required. Failure to provide an adequate rise in the flue system may lead to pooling of condensate that may lead to premature failure of the flue system.

| Model Number | | EKW46CE | EKW61CE | EKW86CE |
|---|----|---------|---------|---------|
| FLUE DATA TYPE C ₆₃ WITH TWIN-PIPE FLUE | | | | |
| Minimum flue gas temp | °C | 35 | | |
| Average flue gas temp | °C | 70 | | |
| Maximum flue gas temp | °C | 120 | | |
| Maximum equivalent length | m | 48 | | |
| Model Number | | EKW46CE | EKW61CE | EKW86CE |
| FLUE DATA TYPE C ₆₃ WITH CONCENTRIC FLUE | | | | |
| Minimum flue gas temp | °C | 35 | | |
| Average flue gas temp | °C | 70 | | |
| Maximum flue gas temp | °C | 120 | | |
| Maximum equivalent length | m | 24 | | |

11.0 AIR SUPPLY

The following information is based on single water heater installations only. If more than one water heater is being used, **BS5440-2** or **BS6644** (as appropriate) should be consulted to calculate the necessary requirements.

11.1 COMBUSTION VENTILATION

When used as a Type C (room sealed) appliance, provided sufficient clearance is provided, ventilation for combustion is not necessary as the combustion air is ducted directly from outside.

When used as a Type B (open flue) appliance, the combustion air requirements are as follows:

| Model | Gross Input (kW) | Net Input (kW) | Ventilation (Room) (cm ²) | Compartment | | Compartment | |
|---------|------------------|----------------|---------------------------------------|-------------------------|------------------------|-------------------------|------------------------|
| | | | | (Direct to Outside) | | (To Internal Space) | |
| | | | | High (cm ²) | Low (cm ²) | High (cm ²) | Low (cm ²) |
| EKW46CE | 43.9 | 39.6 | 165 | 200 | 400 | 400 | 800 |
| EKW61CE | 58.6 | 52.8 | 230 | 265 | 530 | 530 | 1060 |

11.1.1 COMBUSTION VENTILATION REQUIREMENTS EKW46CE – EKW61CE

| Model | Input (Gross) kW | Input (Net) 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) |
| EKW86CE | 83.5 | 75.3 | 152 | 304 | 228 | 380 | 304 | 456 | 380 | 760 | 456 | 836 | 532 | 912 |

11.1.2 COMBUSTION VENTILATION REQUIREMENTS EKW86CE

11.2 COOLING VENTILATION

When used as a type C (room sealed) appliance, installed in a compartment or an enclosure, as shown in **Figure 5.2.1**, cooling ventilation should be provided as follows:

| Model | Input (Gross) kW | Input (Net) kW | Enclosure/Compartment | | Enclosure/Compartment | | Water heater Room | |
|---------|------------------|----------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|
| | | | (Direct to Outside) | | (To Internal Space) | | | |
| | | | High (cm ²) | Low (cm ²) | High (cm ²) | Low (cm ²) | High (cm ²) | Low (cm ²) |
| EKW46CE | 43.9 | 39.6 | 200 | 200 | 400 | 400 | N/A | N/A |
| EKW61CE | 58.6 | 52.8 | 265 | 265 | 530 | 530 | N/A | N/A |
| EKW86CE | 83.5 | 75.3 | 380 | 380 | 760 | 760 | 152 | 152 |

11.2.1 COOLING VENTILATION REQUIREMENTS

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

12.0 WATER CONNECTIONS

12.1 GENERAL



Adaptors are required to convert the NPT (male) thread on the heat exchanger to BSP (female). These adaptors can be found in the packing carton. The BSP section of the adaptor is indicated with blue paint.



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



Lochinvar limited insists on the use of glanded pumps and a suitably sized pump will always be quoted alongside the water heater. Failure of the heat exchanger or other components due to insufficient flow will not be covered under the warranty.

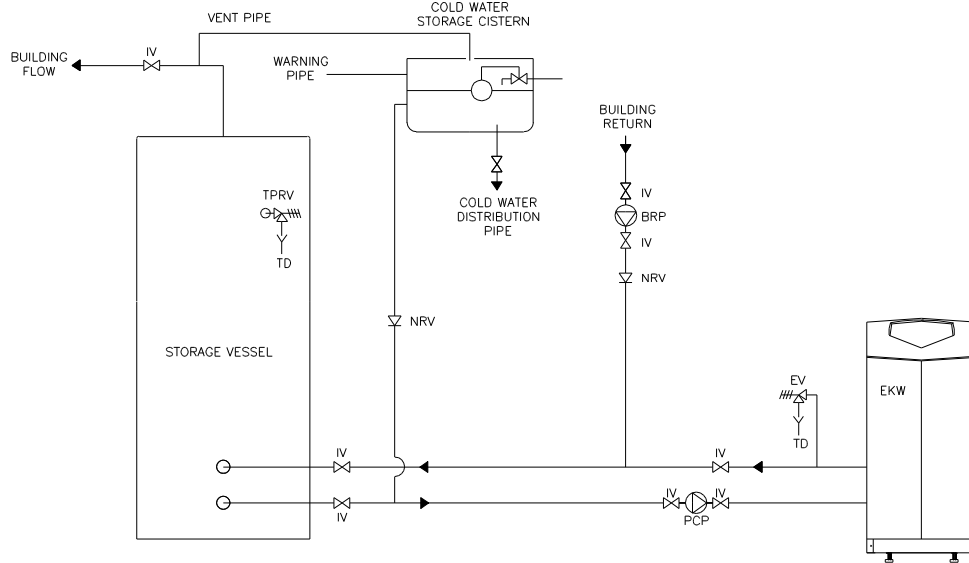
Recommended pipework layouts are available for different water heater and storage vessel combinations. Please contact Lochinvar Technical Support for details.

The requirements of minimum water flow are given in **Table 12.4.1**. Recommendations for the water circulation system are given in **BS6644** and **CP 342**. The following notes are of particular importance.

1. EcoKnight™ must be used with a direct type storage vessel (LST). Contact Lochinvar Limited for help in sizing the storage vessel.
2. Circulating pipework not forming part of the useful heating surface should be insulated. Cisterns, expansion vessels and pipework situated in areas exposed to freezing conditions should also be insulated.
3. Drain valves must be located in accessible positions that will permit draining of the entire system including the unit and the storage vessel.
4. Tapping sizes for connection to the water system are detailed in **Section 4.0**.
5. Ideally, individual valves should be fitted to each unit to enable isolation from the system. The arrangement must comply with the requirements of **BS6644**.
6. The flow and return circulating pipework must be correctly sized to ensure the water heaters can supply sufficient hot water, general guidance is provided in **Section 0** If your installation is outside this guidance please contact Lochinvar Technical Support for assistance with pipework sizing.

12.2 OPEN VENTED SYSTEM ARRANGEMENT

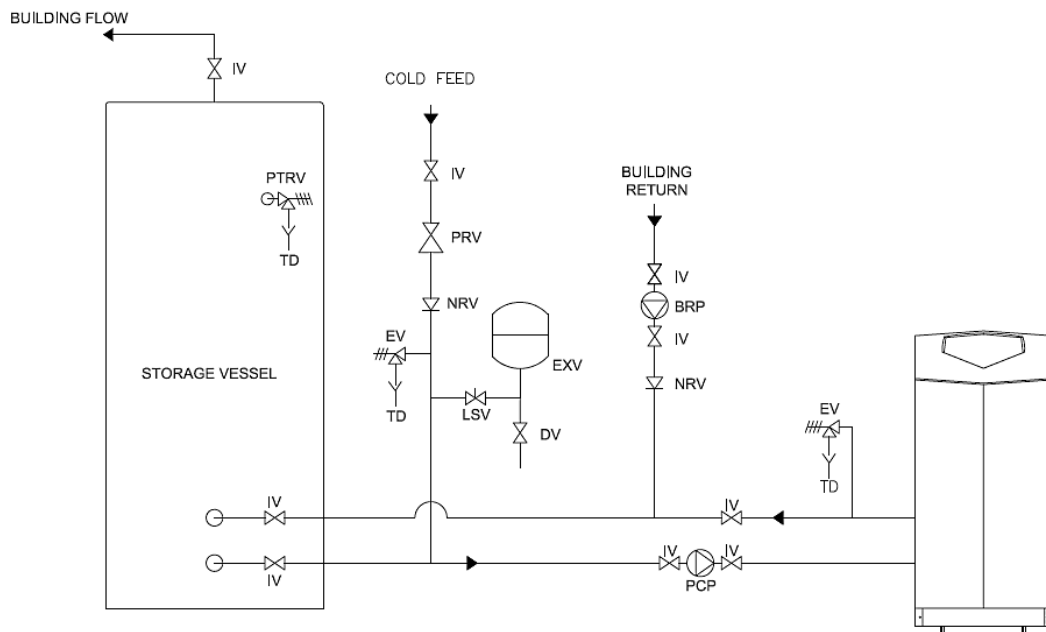
The Lochinvar EcoKnight™ can be used in an open vented arrangement provided that a vent pipe in accordance with CP342, BS6644 or BS6700 as appropriate is fitted. The minimum static head requirement for an open vented system is 0.5 bar.



12.2.1 TYPICAL SCHEMATIC, ECKNIGHT™ WATER HEATERS ON AN OPEN VENTED SYSTEM

12.3 UN-VENTED SYSTEM ARRANGEMENT

If the Lochinvar EcoKnight™ is to be used in an unvented arrangement, the system should follow the guidance given in **BS6700** and must comply with **The Building Regulations: Part G3 in England and Wales, P5 in Northern Ireland and P3 in Scotland**. A kit of components that have been suitably sized for the unvented or boosted operation of the appliance is available from Lochinvar Limited. For further information, contact Lochinvar Limited.



12.3.1 TYPICAL SCHEMATIC, ECKNIGHT™ WATER HEATER ON AN UN-VENTED SYSTEM

12.3.2 EXPANSION VESSEL SIZING

The following information is based on an inlet pressure of 3.5 bar and an expansion vessel efficiency of 0.45 using a standard 6 bar unvented kit. If the system will have different parameters a more detailed calculation will need to be made.

$$V V = \frac{S V * e}{0.45}$$

Where:

V V = Vessel Volume
S V = System Volume
e = Coefficient of Expansion

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

12.3.3 COEFFICIENT OF EXPANSION OF WATER AT 3.8 BAR COLD FILL PRESSURE

12.4 CIRCULATING PUMPS

In order to ensure the correct flow rates through the water heater, the unit requires a bronze glanded pump sized to overcome the resistance of the heat exchanger and a primary pipework loop. Lochinvar will supply a suitable bronze glanded shunt pump with each water heater as shown in **Section 12.4.1**. The primary loop should be no longer than 14 metres plus the following fittings:

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



For longer distances or a greater number of fittings, the pump may have to be resized.

The specification of this type of pump ensures that the bronze body and associated parts in contact with water are suitable for potable use. A "glanded" construction is required to ensure that any scale in the system does not build up within the pump and cause a resistance that can lead to a loss of water flow. Glandless (canned rotor) pumps are not recommended due to the fact that in hard water areas, scale can build up within the rotor and failure can occur, not only of the pump but also the heater itself. The warranty will be void if a failure of the heat exchanger occurs due to a "glandless" pump being used.

| Model | Differential (K) | FLOW (Litre/sec) | Total System Pressure Loss (Meter- H ₂ O) | Shunt Pump supplied |
|---------|------------------|---------------------|---|---------------------|
| EKW46CE | 10.0 | 0.98 | 7.32 | LM900151A |
| EKW61CE | 10.0 | 1.17 | 6.71 | LM900151A |
| EKW86CE | 10.0 | 1.80 | 6.07 | LM900141A |

12.4.1 FLOW RATES AND SHUNT PUMP SIZES

Lochinvar will supply a suitably sized pump with all EcoKnight™ water heaters based on the parameters shown above, for projects outside these parameters the pump will have to be re-sized.

12.5 PRIMARY PIPEWORK HEADER SIZING



The pipework header between the EcoKnight™ water heater(s) and LST(s) buffer vessels must be sized as per the guidance given in this section. Failure to use the correct size of pipe header will cause operational problems and potential early failure of the water heater; this will not be covered under the water heater warranty.

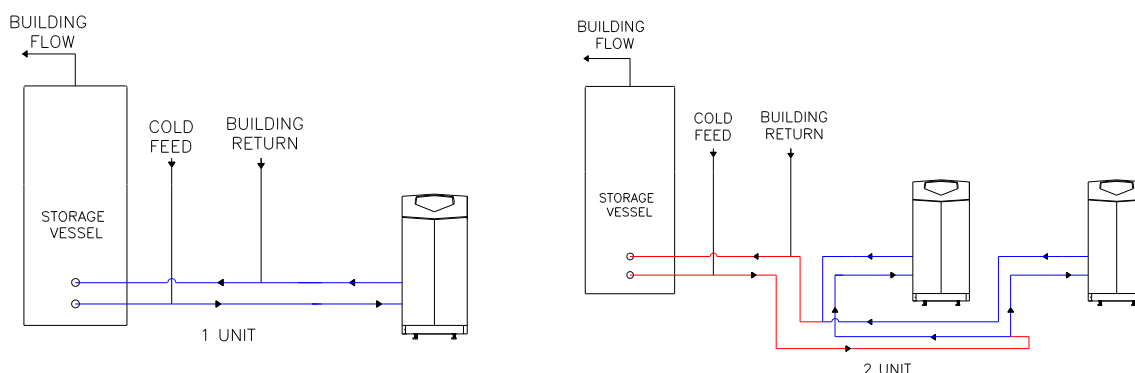
If your installation is outside the scope of this guidance, please contact Lochinvar Technical support before proceeding with the installation.

The tables below show the pipework header sizing required in order to ensure the correct flow rate is maintained between the EcoKnight™ water heater and the LST direct storage vessel. Using the simple schematics shown in **section 12.5.2** size the pipework header A shown in blue and pipework header B shown in red.

Using the example schematics shown and assuming the EcoKnight™ is an EKW46CE in both cases the header would be sized as:
Single unit = as there is only a single heater there is no common header so all the pipework should be 35mm.
2 units = the common header shown in red should be sized according to the table at 42mm with the pipework between the header and each individual units shown in blue at 35mm.

| MODEL | PIPEWORK A BLUE SIZE (mm) | PIPEWORK B RED SIZE (mm) | | | |
|---------|---------------------------|--------------------------|----|----|--|
| | | NUMBER OF ECKNIGHT™ | | | |
| | 1 | 2 | 3 | 4 | |
| EKW46CE | 35 | 42 | 54 | 67 | |
| EKW61CE | 35 | 42 | 54 | 67 | |
| EKW86CE | 54 | 54 | 67 | 76 | |

12.5.1 PIPEWORK HEADER SIZES



12.5.2 PIPEWORK SCHEMATIC SHOWING PIPEWORK A AND PIPEWORK B

13.0 CONTROL OPTIONS/INSTALLATION

The EcoKnight™ water heater has various control options available, depending upon the installation and if there is a BMS available. The relevant wiring diagram should be consulted along with information shown in **Section 15.0**



Lochinvar Ltd reserves the right to change specifications without prior notice. All necessary additional valves and fittings to be determined by those other than Lochinvar Ltd. Lochinvar Ltd may provide technical advice and guidance to assist with best practice, optimisation and installation of Lochinvar products; however, we will not be liable for any duties as Designers under Construction (Design and Management Regulations 2015). In all cases where information is provided, the customer must assess and manage risks associated with the technical information and advice provided.



Lochinvar have developed the EcoKnight water heater to operate at its most efficient when using the internal sensors and cascade control, if it is the intention to use a BMS to control the EcoKnight water heater then Lochinvar must approve the general scheme of control prior to installation. Failure to control the EcoKnight and associated pumps correctly could lead to a non-warranted early failure.

13.1 VESSEL TEMPERATURE SENSOR SINGLE WATER HEATER INSTALLATION

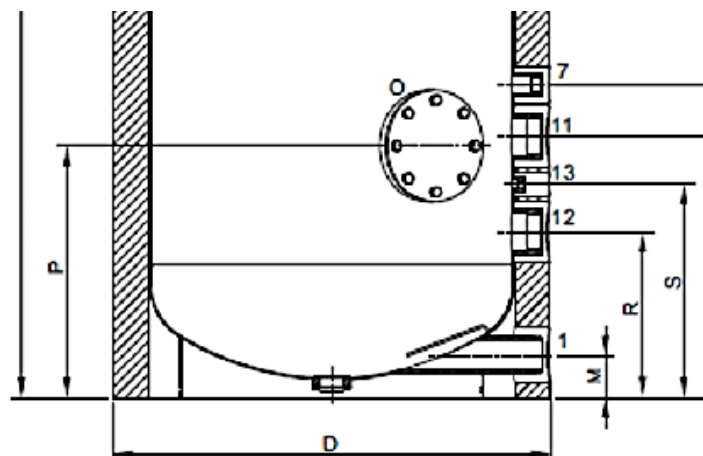
Each EcoKnight™ is supplied with a vessel temperature sensor and sensor pocket. This must be fitted to the LST direct storage vessel supplied with the EcoKnight™ water heater.



This is installed within the vessel as close to the flow and return connections as possible depending upon vessel chosen **see diagram 13.1.1. Point 7**



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



13.1.1 TYPICAL LST CONNECTION POINTS

13.2 VESSEL TEMPERATURE SENSOR MULTIPLE WATER HEATER INSTALLATION

When installing multiple water heaters it is recommended that the water heaters are installed using the cascade management system, see **section 21.6**. When in cascade only the lead water heater and alternate lead have tank sensors fitted **see 1.1.1**. The lead water heater will monitor the tank temperature and control the water heaters within the cascade, in the event of a failure of the lead water heater then the alternate leader will take over control of the system, hence it is also required to have a tank sensor fitted.



It may not be possible to fit two sensors into a single tank when using a cascade system with lead/alternate lead. If there are two tanks then the alternate lead can have its sensor placed in the second tank see 14.6.1, due to the fact the vessels should be balanced then the temperature will be the same in both tanks. If the system only has a single tank then the alternate lead will need to use a strap on sensor located onto the pipework near to the tank see 14.4.1 – this is less accurate but will allow the system to continue operating whilst the lead water heater is repaired.

13.3 SENSOR WIRING

For guidance on installing the wiring for the temperature sensor, please refer to **Section: 15.5.1**

14.0 SCHEMATICS

14.1 KEY FOR SCHEMATICS

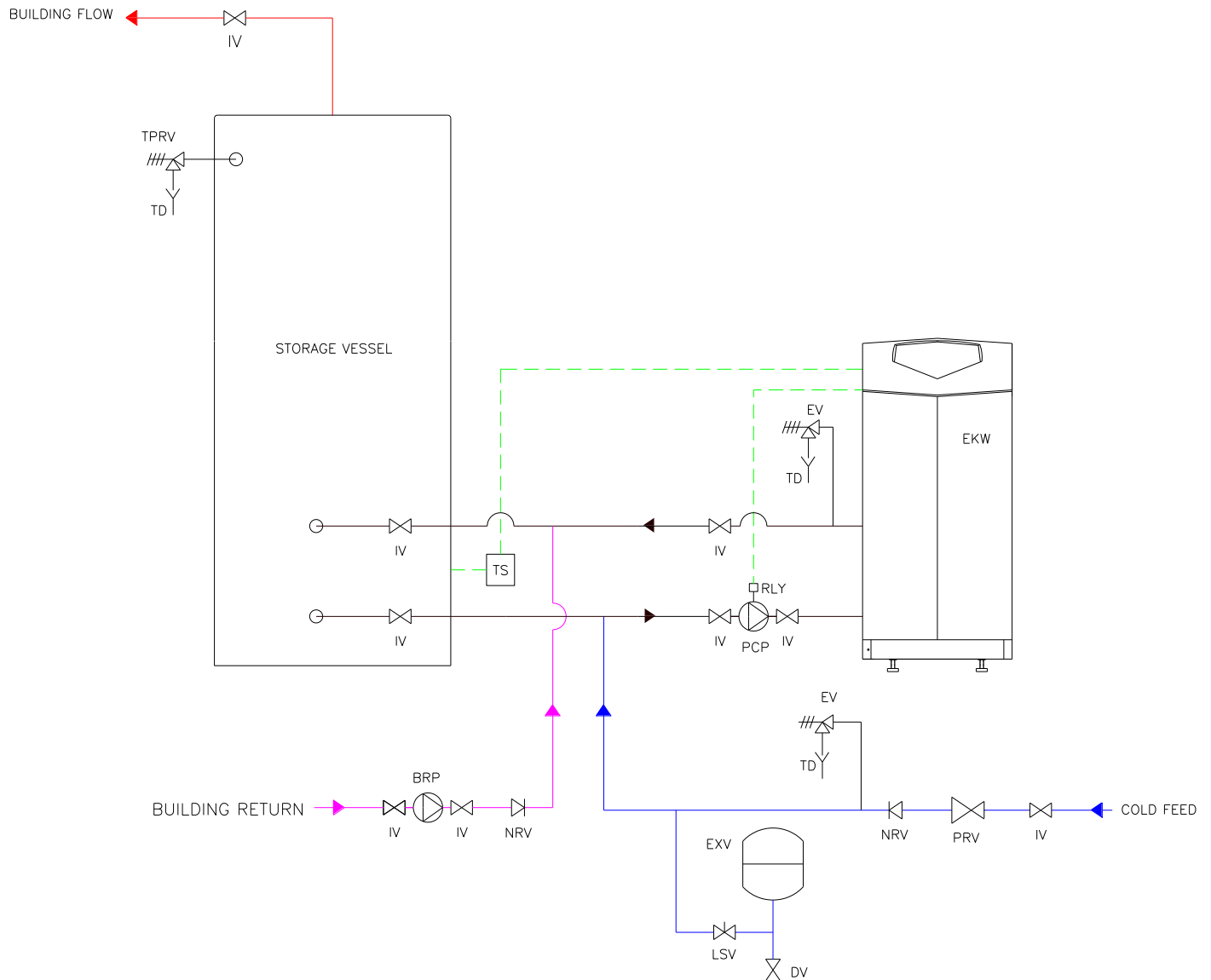


Lochinvar limited may provide technical advice and guidance to assist with best practice, optimisation and installation of Lochinvar products; however, we will not be liable for any duties as designers under construction (design and management regulations 2015). In all cases where information is provided,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

| SYMBOL | DESCRIPTION |
|--------|---------------------------------------|
| IV | ISOLATION VALVE |
| LSV | LOCKSHIELD VALVE |
| TPRV | TEMPERATURE AND PRESSURE RELEIF VALVE |
| TD | TUNDISH |
| EXV | EXPANSION VESSELQ |
| EV | EXPANSION VALVE |
| PRV | PRESSURE REDUCING VALVE |
| NRV | NON RETURN VALVE |
| PCP | PRIMARY CIRCULATING PUMP |
| TS | TEMPERATURE SENSOR (VESSEL SENSOR) |
| JB | JUNCTION BOX |
| BRP | BUILDING RETURN PUMP |
| PCP | PRIMARY CIRCULATING PUMP |
| RLY | RELAY |
| SS | STRAP ON PIPE SENSOR |

14.2 STANDALONE INSTALLATION, SINGLE WATER HEATER

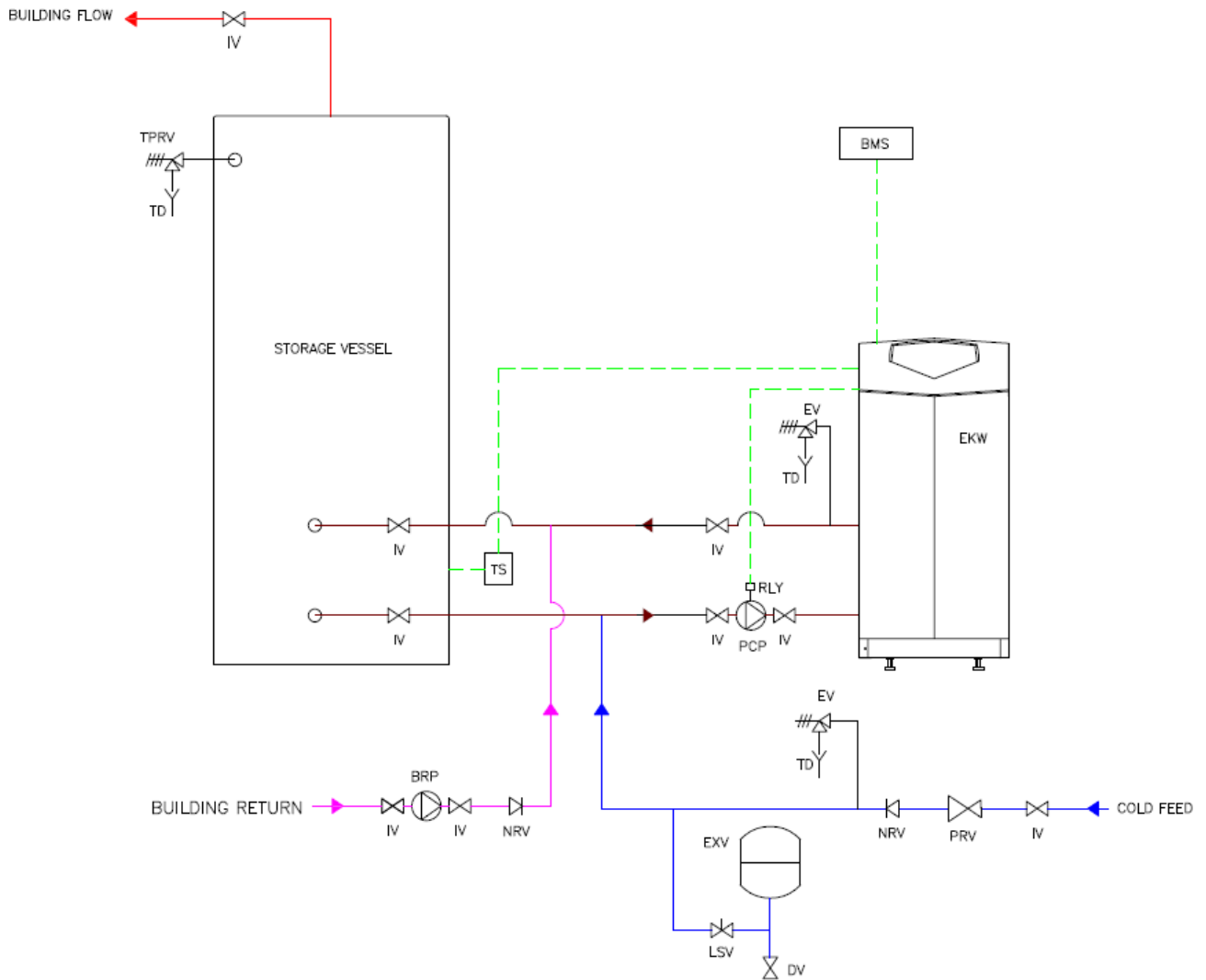
The installation shown below features an EcoKnight™ water heater working on its own sensors only, the supplied tank sensor is installed within the sensor point on the LST direct storage vessel. This arrangement gives close temperature control and is particularly suitable for installations with a constant low level demand such as leisure centres. The EcoKnight™ water heater shunt pump will continue to run for a short period after the burner has stopped firing to clear any residual heat from the heat exchanger. **See 21.8.1.**



14.2.1 STANDALONE INSTALLATION

14.3 BMS INSTALLATION, SINGLE WATER HEATER

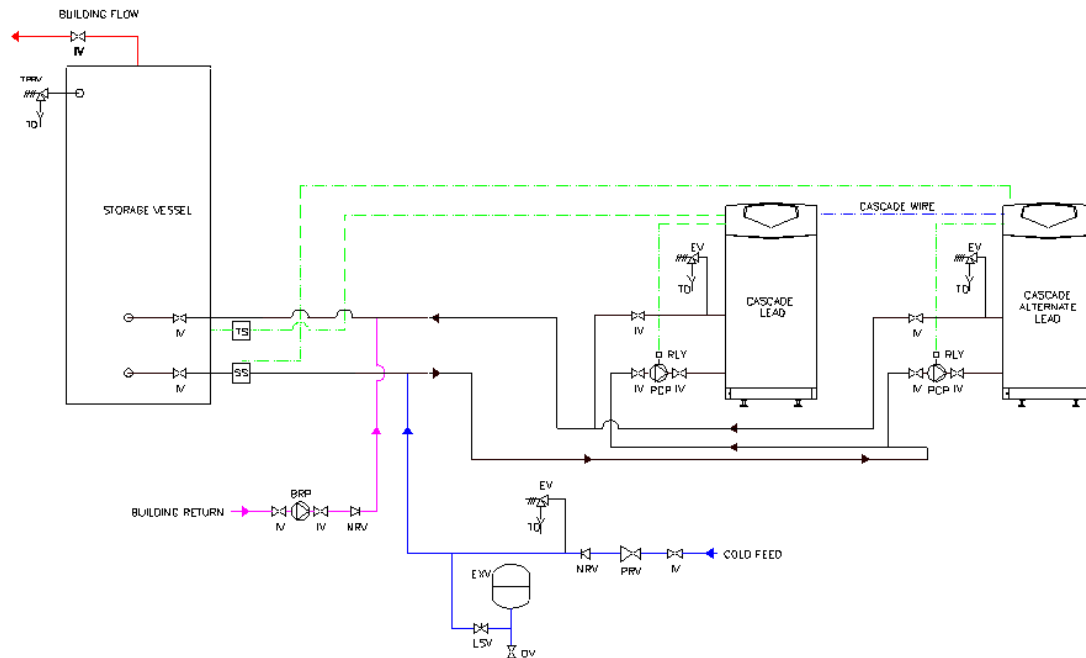
The installation shown below features an EcoKnight™ water heater with BMS control, the BMS can send an on/off signal as required depending upon the temperature within the storage vessel. This will be monitored by a BMS sensor shutting the EcoKnight™ water heater down when the vessel is at set point. This application gives greater control and is suitable for installations when the DHW demand is intermittent such as hotels. The EcoKnight™ water heater shunt pump will continue to run for a short period after the burner has stopped firing to clear any residual heat from the heat exchanger. **See 21.8.1.**



14.3.1 SINGLE WATER HEATER WITH BMS CONTROL

14.4 INSTALLATION, TWO WATER HEATERS WITH SINGLE VESSEL – ALTERNATE LEAD WITH STRAP-ON SENSOR

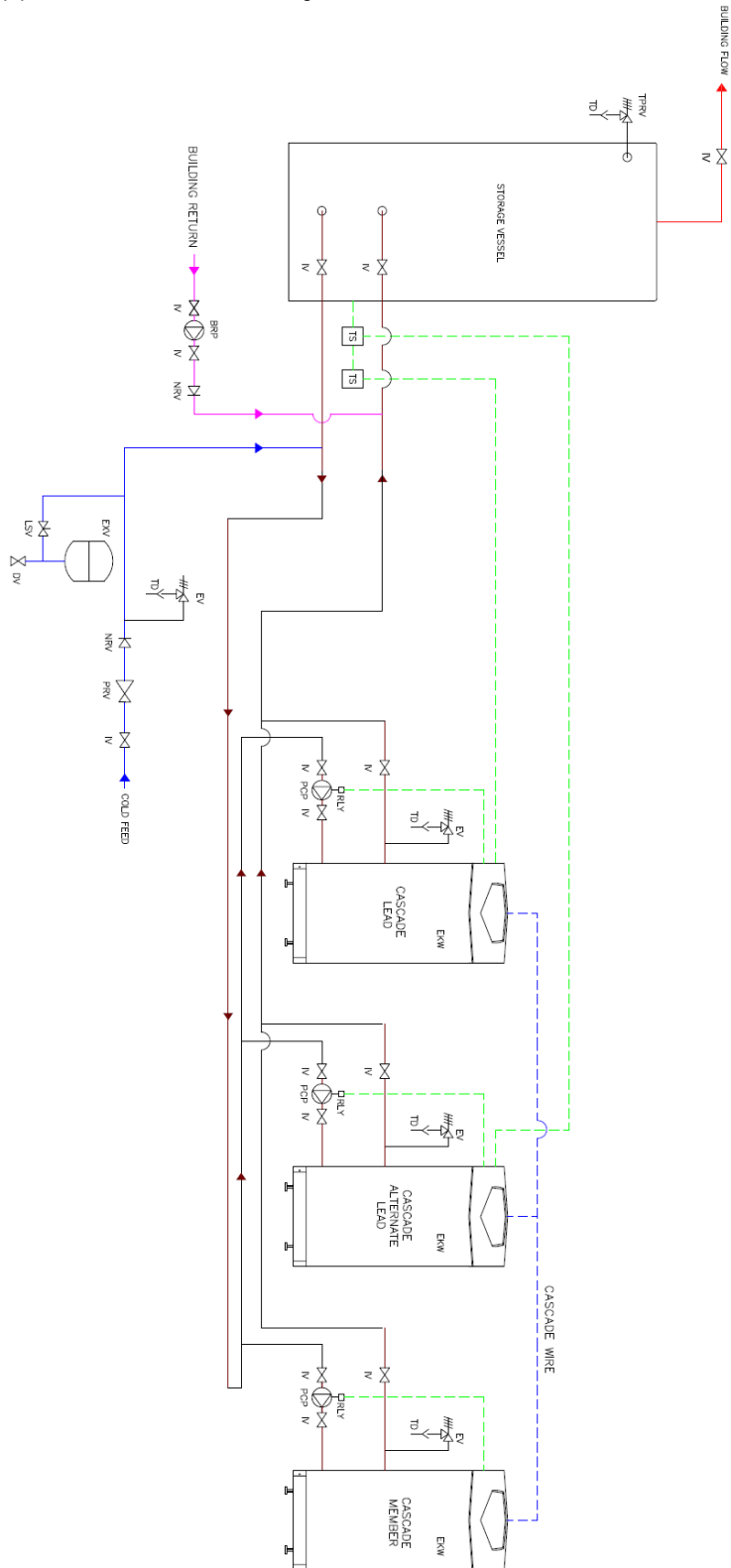
The installation shown below features two EcoKnight™ water heaters working with a single tank sensor. The water heaters would be put into cascade - the supplied tank sensor is installed within the sensor point on the LST direct storage vessel and connected back to the lead water heater. The alternate leader has a strap-on sensor fitted to the pipework.



14.4.1 MULTIPLE WATER HEATERS SINGLE VESSEL ALTERNATE WITH STRAP-ON SENSOR

14.5 MULTIPLE WATER HEATERS WITH SINGLE VESSEL

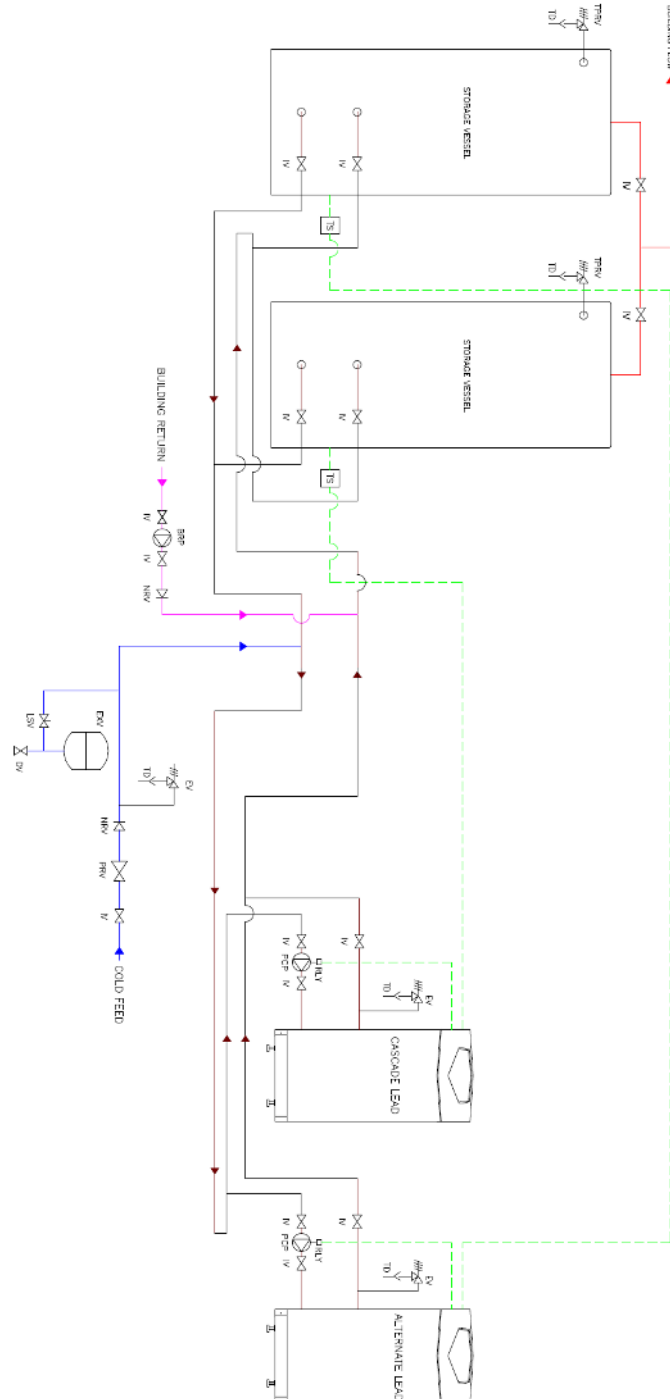
When multiple EcoKnight™ water heaters are installed as shown below one water heater is designated as the leader water heater. The leader will decide how many member water heaters to activate and at what firing rate depending upon information received from the tank sensor. This will increase the system efficiency as this closer control prevents the water heaters cycling at low demand. The water heaters should be piped on a reverse return arrangement.



1.1.1 MULTIPLE WATER HEATERS WITH CASCADE CONTROL ALTERNATE WITH ADDITIONAL TANK SENSOR FITTED

14.6 MULTIPLE WATER HEATERS WITH MULTIPLE LST DIRECT STORAGE VESSELS

Sometimes it may be necessary to install multiple LST direct storage vessels, for example to reduce the kW required meeting the demand or if a single larger vessel will not fit within the plant room. The vessels should be installed as shown below utilising a reverse return pipework arrangement to ensure an even temperature distribution between the vessels. The water heaters should be put into cascade with the lead water heater monitoring the tank temperature. Due to the fact there is more than one vessel; the alternate lead can have a sensor in one of the additional tanks.



14.6.1 MULTIPLE WATER HEATERS WITH MULTIPLE LST DIRECT STORAGE VESSELS – ALTERNATE LEAD USING TANK SENSOR IN ADDITIONAL VESSEL.

15.0 ELECTRICAL SUPPLY

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

| Model | Normal Supply Voltage | External Fuse Rating | Power Consumption |
|---------|--------------------------|----------------------|-------------------|
| EKW46CE | 230V AC 50 Hz 1 PH | 6.0 A | 120 W |
| EKW61CE | | | 144 W |
| EKW86CE | | | 180 W |

15.1.1 ELECTRICAL SUPPLY REQUIREMENTS



Warning: this appliance must be earthed



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

15.2 EXTERNAL CONTROLS

The EcoKnight™ Water Heater **utilises the same control board as that used in the Herald boiler, as such some of the features shown will not work.** EcoKnight can be controlled via a BMS system utilising a simple on/off arrangement, The Water Heater has the following inputs/outputs:

- Building Management System (BMS) 0-10VDC analogue input
- Volt-free "burner on" (runtime) signal
- Volt-free "lock-out" (alarm) signal
- 0-10V "burner firing rate"
- 0-10V "Water Heater pump speed"
- 24VAC auxiliary device enable signal (e.g. to start fan dilution system)

The EcoKnight™ Water Heater is also compatible with the following control and safety systems allowing the Water Heater to operate as a complete standalone system. See the relevant sections within **Section 21.0** for details of programming the various functions required for a standalone system.

- Storage vessel sensor (modulating type)
- Internal Cascade control
- Gas pressure switch (e.g. gas booster under pressure/over pressure safety switch)
- Water flow proving device (e.g. differential pressure switch or flow switch)
- Auxiliary safety system proving switch (e.g. fan dilution system proving switch)



Lochinvar have developed the EcoKnight water heater to operate at its most efficient when using the internal sensors and cascade control, if it is the intention to use a BMS to control the EcoKnight water heater then Lochinvar must approve the general scheme of control prior to installation.

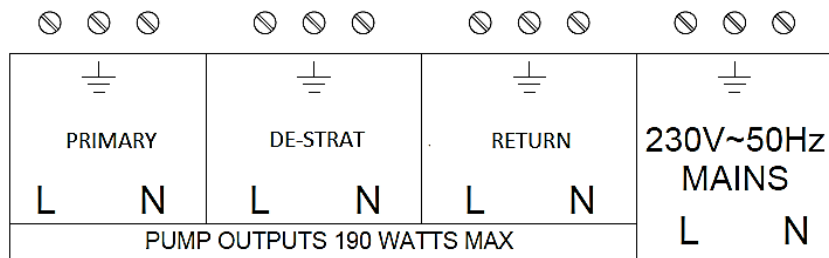
15.3 REMOTE CONTROL VIA A BUILDING MANAGEMENT SYSTEM (BMS)

15.3.1 GENERAL SCHEME OF CONTROL

The EcoKnight water heater has various control options when connected to a BMS, many of these options are available as the control is also used by a Boiler version and are unsuitable for use with the EcoKnight water heater. Lochinvar recommend leaving the water heater to operate based on the temperature within the storage vessel monitored from its own sensor (included with each water heater). This will activate the water heater and shunt pump on demand (utilising the built in Cascade control if there is more than one water heater), when demand is satisfied the water heater will activate the pump overrun to clear any excess heat from the heat exchanger prior to shutting down the unit. When operating this way the BMS can still pick-up a fault or run signal. See drawing [here](#).

If there is a requirement to turn the water heater On/off via a BMS then this scheme must be approved by Lochinvar prior to installation. The BMS can turn the water heater on/off but must not be used to activate the associated shunt pump that must be controlled by the water heater to allow a suitable pump overrun. See drawing [here](#) for a typical scheme. If there are multiple water heaters installed the BMS should only turn on the lead appliance which will decide on the number and modulation of burners to fire depending upon demand. In all cases the EcoKnight water heater must have the supplied temperature sensor fitted within the storage vessel.

15.4 HIGH VOLTAGE CONNECTOR STRIP



15.4.1 HIGH VOLTAGE CONNECTION STRIP



The output across the 3 terminals should not exceed 190W per terminal. It is highly recommended these switched outputs are only used to switch suitable starter/overload relays on the pumps.

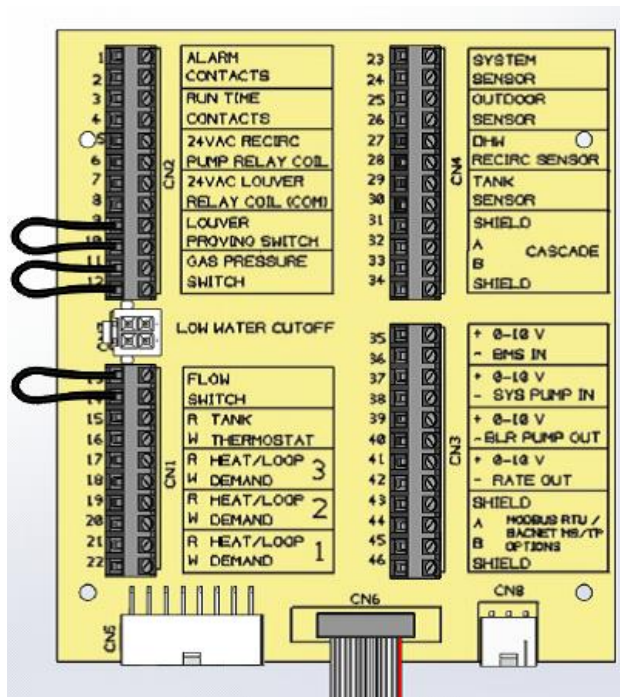
| CONNECTION | OUTPUT | NOTES |
|------------|---|--|
| PRIMARY | 230VAC – Output is when there is a call for DHW MAX 190 WATTS | 230 VAC Live, Neutral and Earth connections for a primary circulation pump starter. NOTE: On all EcoKnight™ water heaters, the primary pump exceeds the maximum power output and therefore a suitable starter/overload relay will be required. |
| DE-STRAT | NO OUTPUT | CONNECTION NOT USED |
| RETURN | 230VAC – Constant output when unit powered MAX 190 WATTS | 230 VAC Live, Neutral and Earth connections for a secondary circulation pump. If the pump rating exceeds the maximum 190 watts available over the three terminals, the Live and Neutral connections should then be used to switch a suitable starter/overload relay. |
| MAINS | | Connections for a 230V ~ 1 ph 50Hz power supply. NOTE: The power supply cable should be secured using the anchor supplied. |

15.4.2 HIGH VOLTAGE CONNECTION TERMINAL DETAILS

15.5 LOW VOLTAGE CONNECTOR STRIP



The low voltage connector strip is used on both EcoKnight water heaters and Herald boilers; as such, some connections will not be applicable to your installation.



15.5.1 LOW VOLTAGE CONNECTION STRIP

| PIN | CONNECTION | OUTPUT / INPUT | NOTES |
|-------|-------------------------------|---|--|
| 1-2 | ALARM CONTACTS | Volt free – Close on alarm | An internal volt free contact across pins 1 and 2 will close in the event of the heater locking out. This connection can be used by a BMS to monitor the operation of the heater. |
| 3-4 | RUNTIME CONTACTS | Volt free – Close when unit running | An internal volt free contact across pins 3 and 4 will close in the event of the burner operating. This connection can be used by a BMS to monitor the operation of the heater |
| 5-6 | 24VAC RECIRC PUMP RELAY COIL | 24VAC Output – when recirc sensor calls – switches on Neutral | When the heater gets a call for heat from the DHW RECIRC SENSOR a 24VAC supply will be sent to a DHW recirculation pump relay (field supplied) |
| 7-8 | 24VAC LOUVER RELAY COIL (COM) | 24VAC Output – When unit calls for heat. | When the heater gets a call for heat, a 24VAC supply becomes present on pin 7. Used in conjunction with the ground pin (pin 8), these terminals can be used to send a signal to energise an auxiliary device such as a fan dilution system or mechanical ventilation system. |
| 9-10 | LOUVER PROVING SWITCH | 24VAC Output – When unit calls for heat. | If an auxiliary device such as a fan dilution system or mechanical ventilation system is to be used, the link should be taken out of pins 9 and 10 and the auxiliary device safety circuit wiring installed. If there is no continuity across the terminals the heater will not fire. |
| 11-12 | GAS PRESSURE SWITCH | 24VAC Output – constant when unit is powered | If a gas pressure switch is to be used to ensure the incoming gas pressure is correct, the link should be taken out of pins 11 and 12 and the gas pressure switch wiring installed. If there is no continuity across the terminals the heater will not fire. |
| 13-14 | FLOW SWITCH | 24VAC Output – constant when unit is powered | If a flow switch is to be used to ensure the primary pump is operating, the link should be taken out of pins 13 and 14 and the flow switch wiring installed. If there is no continuity across the terminals the heater will not fire. |
| 15-16 | TANK THERMOSTAT | 24VAC Output – constant when unit is powered | This connection should not be used for controlling DHW temperature. The supplied temperature sensor should be connected to pins 29 & 30. For further information, please refer to Section 13.0: The Tank thermostat can be used as an enable – when a tank sensor is fitted and the BMS Thermostat is enabled see section Error! Reference source not found. The tank sensor (terminals 29 & 30) is still used for temperature control, the thermostat connection just used to enable. |
| 17-18 | HEAT/LOOP DEMAND 3 | 24VAC Output – constant when unit is powered | This connection should not be used with a water heater. |
| 19-20 | HEAT/LOOP DEMAND 2 | 24VAC Output – constant when unit is powered | This connection should not be used with a water heater. |
| 21-22 | HEAT/LOOP DEMAND 1 | 24VAC Output – constant when unit is powered | This connection should not be used with a water heater. |
| 23-24 | SYSTEM SENSOR | Contacts read a resistance | This connection should not be used with a water heater. |
| 25-26 | OUTDOOR SENSOR | Contacts read a resistance | This connection should not be used with a water heater. |
| 27-28 | DHW RECIRC SENSOR | Contacts read a resistance | The heater can control a DHW recirculation pump. A sensor must be installed in the circulation loop return and connected to terminals 27 and 28. |
| 29-30 | TANK SENSOR | 24VAC Output – When unit calls for heat. | A sensor located in the direct vessel must be connected to terminals 29 and 30 to control the output from the heater. This connection is not polarity sensitive. This sensor is included with the EcoKnight™ water heater. |
| 31-34 | CASCADE | Communication | If the heaters are to be operated in a cascade, shielded 2-wire twisted pair communication cable should be used. The shielding should be connected to pin 31 or 34 and then all "A" terminals (pin 32) should be linked together and all "B" terminals (pin 33) should be linked together. |
| 35-36 | BMS IN | 0 – 10 V DC input | When the heater is to be controlled by a 0-10V DC analogue output from a Building Management System (BMS), the 0-10V line should be connected to pin 35 and the 0V line should be connected to pin 36. See section 21.7 |
| 37-38 | SYS PUMP IN | 0 – 10 V DC input | This connection should not be used with a water heater. |
| 39-40 | BLR PUMP OUT | 0 – 10 V DC output | This connection should not be used with a water heater. |
| 41-42 | RATE OUT | 0 – 10 V DC output | Provides a 0-10V signal that is proportional to the firing rate of the heater. This may be used by a BMS system to monitor the actual rate of the heater. |
| 43-46 | MODBUS/BACNET OPTION | Communication | When an optional ModBus or BACnet interface module is installed the RS-485 cable is connected to these terminals |

15.5.2 LOW VOLTAGE CONNECTION TERMINAL DETAILS

15.6 ELECTRICAL CONNECTIONS

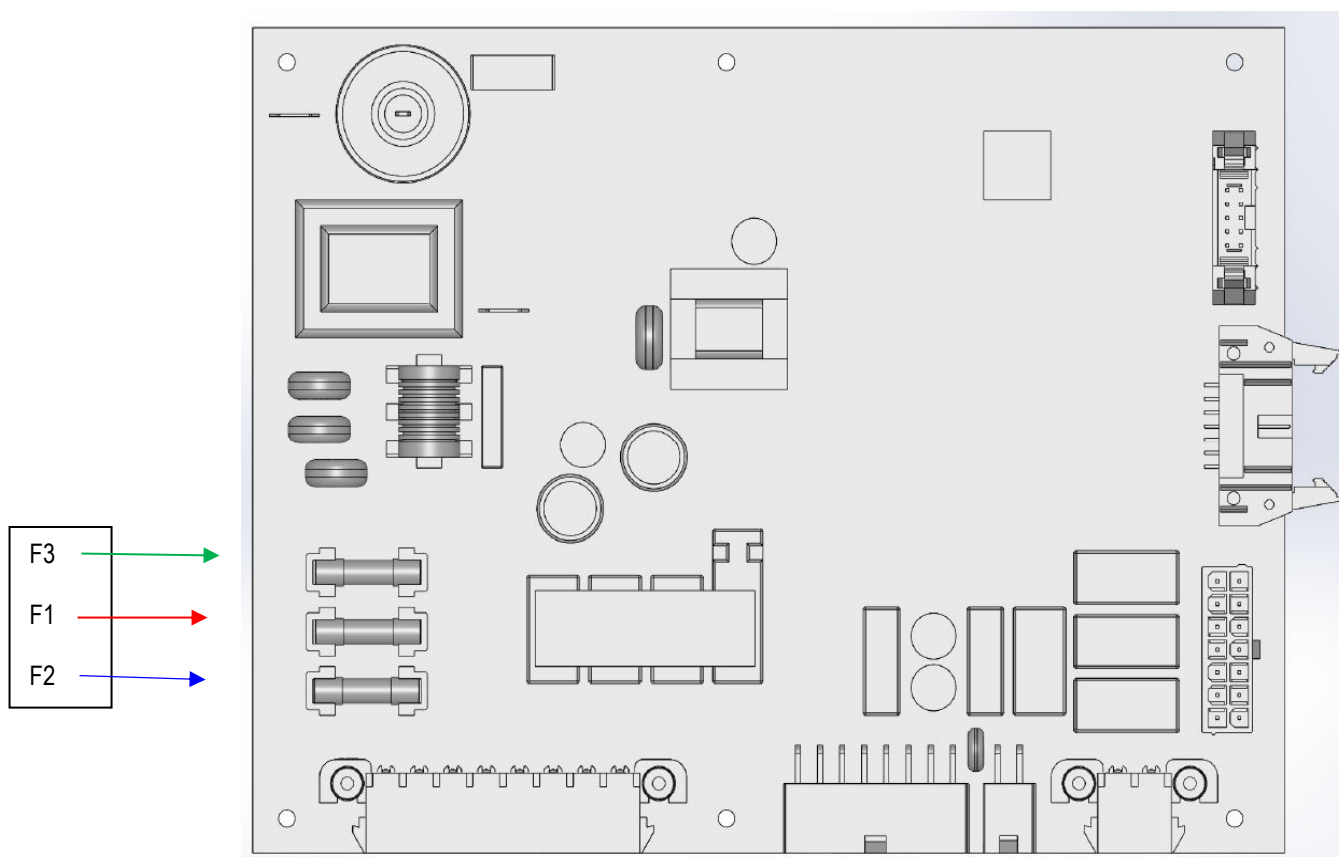
Access to the High Voltage and Low Voltage Connection Strips can be made by removing the appropriate knockouts on the back panel of the water heater. All connections should be secured using an appropriate cord anchorage. One cord anchor is supplied with the water heater for securing the mains supply to the unit. If additional controls and ancillaries are to be used, the appropriate knockout should be removed and an anchor such as RS Components part number 607-897 plus locking nut 444-3085 should be fitted.



If a knockout is removed by mistake, the resulting hole must be blocked with an appropriate anchor, plug or grommet to prevent accidental access to the live parts within the water heater.

15.7 FUSES

The EcoKnight™ has three internal fuses. All are slow blow fuses, located and rated as follows:



15.7.1 FUSE RATINGS AND LOCATIONS

The EcoKnight™ has three internal fuses. All are slow blow fuses, located and rated as follows:

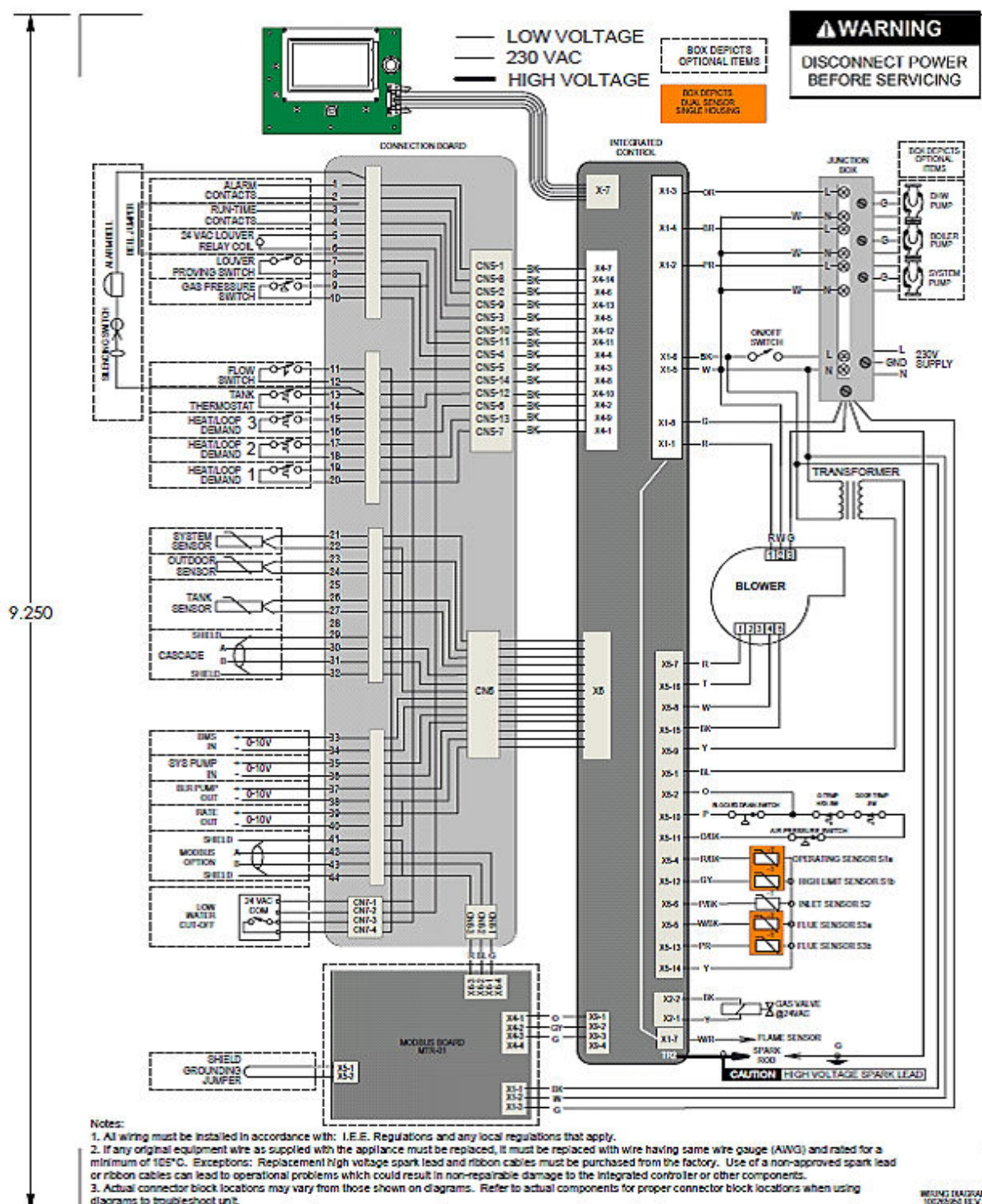
| | |
|----|-------|
| F1 | 5 A |
| F2 | 3.15A |
| F3 | 80A |

The water heater has three spare fuses in a plastic bag attached to the control module cover. Only replace with an equivalent rated fuse. Use of non-equivalent fuses or link wires will invalidate the warranty.

15.8 ARC WELDING PRECAUTIONS

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

15.9 WIRING DIAGRAM



15.9.1 WIRING DIAGRAM

15.10.1 LADDER DIAGRAM



NOTES:

1. Where possible, switches are shown without utilities (gas, water or electricity) connected to the unit. As such, actual switch states may vary from those shown on diagrams depending upon whether utilities are connected or a fault condition is present.
2. See wiring diagram for additional notes.

⚠ WARNING
DISCONNECT POWER
BEFORE SERVICING

**BOX CONTENTS
OPTIONAL ITEMS**

LOW VOLTAGE

220 VAC

HIGH VOLTAGE

LADDER DIAGRAM
100155-45 REV

16.0 SMART SYSTEM CONTROL

16.1 GENERAL

The Lochinvar EcoKnight™ uses the SMART SYSTEM control interface. The control panel display give information on set-up, system status and diagnostic data in words rather than codes.

16.2 SMART SYSTEM CONTROL PANEL



The information on the bottom of the display shows the functions of the two SELECT keys on both corner, and the NAVIGATION dial in the centre.

| | |
|-----------|-------------------------------|
| MENU | Left SELECT key |
| SETPOINTS | NAVIGATION dial-pressing down |
| SHDN | Right SELECT key |

The smart system control face instantly informs the user of the status of the Water Heater by changing colour according to the status of the Water Heater as below.



Normal operation



Service required



Water heater Locked out

16.3 ACCESS MODES

16.3.1 USER

The user can adjust tank target temperatures by pressing the NAVIGATION dial when “↓SETPOINTS” is flashing at the bottom of the display. The date, time and the temperature units can also be changed.

16.3.2 INSTALLER

Most parameters are available only for the installer, accessible by entering the installer password.

16.4 SAVING PARAMETERS



Please note that the brackets ([]) denote screen status.


































16.4.1 TO SAVE PARAMETERS AND EXIT PROGRAMMING

Press the RIGHT SELECT (SAVE) key and then press the RIGHT SELECT (HOME) KEY.

16.4.2 TO ENTER A PARAMETER AND CONTINUE PROGRAMMING





Press the RIGHT SELECT (SAVE) key 1 time to return to the parameter listings, press again to return to the menu listings. Remember to press the RIGHT SELECT key when programming is completed in order to save the changes made.

| Operation | Display |
|---|--|
| 1 Upon a call for heat , the gas pressure switch(s) must be closed | STANDBY SYSTEM DHW TANK BOILER DHW CIRC SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN |
| 2 Once the gas pressure switch(s) are closed the control turns on the appropriate pumps. The flow switch and or LWCO must close | STANDBY SYSTEM DHW TANK BOILER DHW CIRC SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN |
| 3 The control turns on power to the louvre relay, the louvre proving switch and blocked drain switch must close | START SYSTEM DHW TANK BOILER DHW CIRC SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN |
| 4 The control starts the pre-purge cycle by initiating the fan | PRE-PURGE SYSTEM DHW TANK BOILER DHW CIRC SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN |
| 5 The control starts the trial for ignition by firing the spark electrode and opening the gas valve | IGNITION SYSTEM DHW TANK BOILER DHW CIRC SYSTEM: 117°F(118) TANK: 124°F(130) OUTDOOR: 56°F INLET: 109°F OUTLET: 124°F DHW RECIRC: 115°F MENU SCREEN SHDN |

| | |
|--|--|
| <p>6 If flame is not detected after spark ends the control will perform a post-purge, then start another pre-purge cycle and try to light the water heater again. On the 145 model up the control will lock out after this second attempt on the 115 down a further four attempts will be made before the unit goes to lock-out.</p> | <p>POST-PURGE </p> <p>SYSTEM  DHW TANK  BOILER  DHW CIRC  SYSTEM: 117°F (118) TANK: 124°F (130) OUTDOOR: 56°F INLET: 103°F OUTLET: 124°F DHW RECIRC: 115°F</p> <hr/> <p>MENU   SCREEN SHDN</p> |
| <p>7 If the flame is detected it holds the firing rate steady for a few seconds then begins to modulate the firing rate based on a set point or some other command (such as the 0-10v signal)</p> | <p>41%  </p> <p>SYSTEM  DHW TANK  BOILER  DHW CIRC  SYSTEM: 117°F (118) TANK: 124°F (130) OUTDOOR: 56°F INLET: 103°F OUTLET: 124°F DHW RECIRC: 115°F</p> <hr/> <p>MENU   SCREEN SHDN</p> |
| <p>8 Once the call for heat is satisfied the control will turn off the burner. The fan will continue to run during the post-purge period.</p> | <p>POST-PURGE ANTI-CYCLING</p> <p>SYSTEM  DHW TANK  BOILER  DHW CIRC  SYSTEM: 117°F (118) TANK: 124°F (130) OUTDOOR: 56°F INLET: 103°F OUTLET: 124°F DHW RECIRC: 115°F</p> <hr/> <p>MENU   SCREEN SHDN</p> |
| <p>9 Any pumps that are running will continue for their respective pump overrun time period before switching off. A 60 second anti-cycle period will start which will delay any call for heat.</p> | <p>BLOCKED ANTI-CYCLING</p> <p>SYSTEM  DHW TANK  BOILER  DHW CIRC  SYSTEM: 117°F (118) TANK: 124°F (130) OUTDOOR: 56°F INLET: 103°F OUTLET: 124°F DHW RECIRC: 115°F</p> <hr/> <p>MENU   SCREEN SHDN</p> |
| <p>10 In standby ready to start a new cycle.</p> | <p>STANDBY</p> <p>SYSTEM  DHW TANK  BOILER  DHW CIRC  SYSTEM: 117°F (118) TANK: 124°F (130) OUTDOOR: 56°F INLET: 103°F OUTLET: 124°F DHW RECIRC: 115°F</p> <hr/> <p>MENU   SCREEN SHDN</p> |

1.1.1 SEQUENCE OF OPERATION

16.5 STATUS DISPLAY SCREENS

| Section | Display | Description |
|------------------------------|---|---|
| A (Water heater status bar) | STANDBY | The unit has not received a call for heat |
| | START | The unit has received a call for heat and is checking all safety circuits |
| | PREPURGE | The unit has received a call for heat and has initiated a pre-purge period |
| | IGNITION | The unit has initiated the spark ignition to the main burner |
| | %  | The unit has fired and is running at the displayed firing rate |
| | POSTPURGE | The call for heat has ended, the unit runs the fan for a set period to purge the combustion chamber and vent the system of additional flue products |
| | SHUTDOWN | The unit is in the OFF position |
| | SETPOINT MET | The control temperature has exceeded the set point and offset |
| | BLOCKED | The unit has detected a condition that has temporarily interrupted the call for heat |
| B (Call for heat indicators) |  | DHW tank sensor has called for heat |
| |  | The unit is being controlled by a 0-10V BMS signal |
| |  | The member unit is supplying heat whilst in Cascade mode |

| Section | Display | Description |
|-----------------------------|------------------|--|
| C (Operational information) | DETAILS SCREEN 1 | b. TANK TEMP |
| | | d. INLET TEMP |
| | | f. DHW RECIRC TEMP temperature of DHW recirc sensor if fitted |
| | DETAILS SCREEN 2 | a. DELTA T |
| | | b. FLUE TEMP |
| | | c. FLAME CURRENT |
| | | d. FAN SPEED |
| | I/O SCREEN | a. GAS PRESSURE SW |
| | | b. FLOW SW |
| | | c. LOUVRE RELAY |
| | | d. LOUVRE SW |
| | | e. BLOCKED DRAIN |
| | | f. GAS VALVE |
| | | g. APS state of the air pressure switch |

16.5.1 SMART SYSTEM CONTROL PARAMETERS

| Section | Display | Description |
|-----------------------------|----------------|--|
| C (Operational information) | BMS SCREEN | a. 0-10V BMS IN |
| | | b. 0-10V BMS OUT |
| | | c. BMS ADDRESS |
| | | d. BMS CONTROL? |
| | | e. SYS PUMP SPEED |
| | | f. BLR PUMP OUT |
| | | c. DHW RUN TIME total DHW running time |
| | | d. DHW CYCLES total DHW demand cycles |
| | | e. POWER HOURS total time powered on |
| | | f. IGNITIONS total number of successful ignition attempts |
| | | g. IGN ATTEMPTS total number of ignition attempts |
| | LAST 10 FAULTS | a. FAULT NO |
| | | b. FAULT NO |
| | | c. DATE |
| | | d. TIME |
| | CASCADE STATUS | a. CASCADE STATUS |
| | | b. CASCADE POWER |
| | | c. PRESENT |
| | NIGHT SETBACK | b. TRIGGER 2 next DHW night setback trigger |

| Section | Display | Description |
|-------------------------------|---------|--|
| D (LEFT SELECT key function) | USB | Press the LEFT SELECT key to access the USB and installer menu |
| E (NAVIGATION dial function) | MODIFY | Pressing the NAVIGATION dial will allow the installer to change the text |
| F (RIGHT SELECT key function) | SHDN | Press the RIGHT SELECT key to turn the water heater off |
| | ON | Press the RIGHT SELECT key to turn the water heater on |
| | NO | Press the RIGHT SELECT key to cancel the shutdown operation |
| | SAVE | Press the RIGHT SELECT key to save the current change |
| | HOME | Press the RIGHT SELECT key to return to the Status Screen and upload parameter changes |

16.5.2 SMART SYSTEM CONTROL PARAMETERS CONTINUED

17.0 COMMISSIONING AND TESTING

17.1 ELECTRICAL INSTALLATION

Notes on the requirements for electrical installation are provided in **Section 15.0: ELECTRICAL SUPPLY**. A schematic drawing of the control circuit is shown in **Figure 15.9**.

17.2 GAS INSTALLATION

For design see **Section 9.0: GAS SUPPLY**. See **Section 3.0: PRINCIPAL PARTS** for details on the position of the gas connection.

17.3 WATER CONNECTIONS

For design see **Section 12.0: WATER CONNECTIONS**



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

Check the system for leaks and repair as necessary. If the system is configured in a sealed arrangement, check the expansion vessel cushion pressure and pressurisation unit settings.

17.4 COMMISSIONING THE EQUIPMENT

17.4.1 GENERAL CHECKS PRIOR TO LIGHTING



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

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



If the condensate trap is not filled before use, products of combustion may escape and can lead to severe personal injury or death

17.4.2 EQUIPMENT CHECKS PRIOR TO LIGHTING

This unit has been designed for a nominal gas inlet pressure of 20.0 mbar when used on natural gas. Information relating to propane firing can be found in Section 18.0: LPG FUEL

1. Gas supply is connected but turned to the “off” position. Any unions or fittings are correctly tightened, test points are closed and the flame sense electrode lead is connected correctly. Ensure the ceramic sheath around the flame sense electrode is not cracked or broken.
2. Ensure electricity supply is connected.

17.4.3 PROCEDURE FOR INITIAL LIGHTING

IF THE UNIT IS TO OPERATE ON LPG REFER TO SECTION 18.0 BEFORE PROCEEDING

1. Ensure that the external gas-inlet appliance isolating valve, provided by the installer, is in the "off" position.
2. Press the power rocker switch, positioned on the back of the appliance to bring the equipment on.
3. The combustion fan should ramp up to full speed to purge the combustion chamber and then drop back to half rate in order to light. The spark generator should create a spark, visible through the burner sight glass. As the gas-inlet appliance isolating valve is closed, the controls should go to a flame failure condition after four ignition attempts (EKW46CE – EKW116CE) or two ignition attempts (EKW146CE – EKW236CE). If the above occurs correctly, open the gas-inlet appliance isolating valve and reset the unit by depressing the Enter/Reset button on the control panel.
4. The combustion fan will repeat the pre-purge procedure and attempt to light. Once a flame is established, the LCD display will change to display the rate at which it is firing.
5. Allow the system to reach temperature to check operation of the control sensors.
6. Once the appliance has reached temperature and shut down, check that the flame has extinguished.

17.4.4 GAS PRESSURE ADJUSTMENT AND COMBUSTION CHECKS



The Lochinvar EcoKnight™ series are supplied with a pre-set gas/air ratio inlet assembly. This must not be tampered with. Any attempt to adjust the gas valve or venturi will invalidate the warranty.

Combustion figures should be as follows:

| Model No. | CO ₂ | CO |
|-----------|-----------------|----------|
| EKW46CE | 9.0% ±0.5% | <100 ppm |
| EKW61CE | 9.0% ±0.5% | <100 ppm |
| EKW86CE | 8.8% ±0.5% | <100 ppm |

17.4.5 NATURAL GAS COMBUSTION FIGURES

If the combustion figures are not within the range specified, contact Lochinvar Technical Support for further guidance.

Combustion figures for Propane firing can be found in **Section 18.0: LPG FUEL**.

17.5 TEMPERATURE ADJUSTMENT PROCEDURE

17.5.1 DHW SETPOINT

The set point should be adjusted to ensure that the water is stored above 60°C and distributed at 50°C within 1 (one) minute at all outlets. Care is needed to avoid much higher temperatures because of the risk of scalding. At 50°C the risk of scalding is small for most people, but the risk increases rapidly with higher temperatures and for longer exposure times. The risk to young children and to those with a sensory or mobility loss will be greater. Where a significant scalding risk has been identified, the use of thermostatic mixing valves on baths and showers should be considered to reduce temperature, this need to be placed as close to the point of use as possible.

17.6 LEGIONELLA PREVENTION

During normal use the EcoKnight™ water heater and direct storage vessel should not pose a Legionella risk providing the vessel temperature setting is at 60°C or above. See **Section 21.4.1**. The cold feed is fed into the flow and return pipework between the EcoKnight™ water heater and direct storage vessel to prevent cold spots on the base of the direct storage vessel. Also the large high flow shunt pump supplied with each EcoKnight™ water heater prevents temperature stratification within the direct storage vessel.

17.7 PASTEURISATION

If a pasteurisation cycle is to be used at a temperature raised above the standard set-point this can be achieved in one of three ways, the method chosen will depend on the frequency and monitoring required. Contact Lochinvar Technical Support for further guidance.

- 1 Use the BMS 0-10v output to raise the temperature, for example 8v could be set at 60°C while 10v will set the water heater temperature to 70°C.
- 2 Manually raise the temperature via the SMART SYSTEM CONTROL see **Section 17.5.1** Use the DHW Night set back facility to automatically raise the temperature either daily or weekly.

17.8 PASTEURISATION USING THE NIGHT SET BACK FACILITY

The procedure below assumes a DHW set point of 60°C is required with a pasteurisation temperature of 70°C required.

- 1 Set the DHW tank setpoint to 70°C see **Section 21.4.1**
- 2 Set the Night set back offset to 10°C see **Section 21.1.5**
- 3 Set the Night set back times for each day to start at 01.00AM and end at 11.55PM see **Section 21.1.6**

This will set the water heater to operate each day between 1AM and 11.55 PM at 60°C and then the temperature will raise to 70°C between 12AM and 1AM.



Using this function the EcoKnight™ SMART DISPLAY will show the heater is in Night set back mode during normal working hours.

17.9 INSTALLATION NOISE

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

18.0 LPG FUEL



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

18.1 RELATED DOCUMENTS

In addition to those documents listed in **Section 6.1: RELATED DOCUMENTS** within the main body of the installer's guide the gas installation should also comply with the guidance offered in the following documents.

BS 5482-1: 2005

Code of practice for domestic butane and propane gas burning installations.

Part 1: Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding dn25 for steel and dn28 for corrugated stainless steel or copper.

The operation of the EcoKnight™ range on LPG-Propane (3rd Family) 3P is similar to that on Natural Gas (2nd Family) 2H and the design and installation details described in the main body of the installer's guide should be followed.

18.2 CONVERSION TO LPG



This process must be carried out in the order stated before the water heater is switched on. Failure to follow the following procedure may lead to non-warrantable damage to the water heater. The conversion **MUST** be carried out by a competent person certified for work on LPG fuel.



In the event of any seal or gasket being broken it is essential that the seal or gasket be replaced. Contact Lochinvar limited for replacement seals and gaskets.

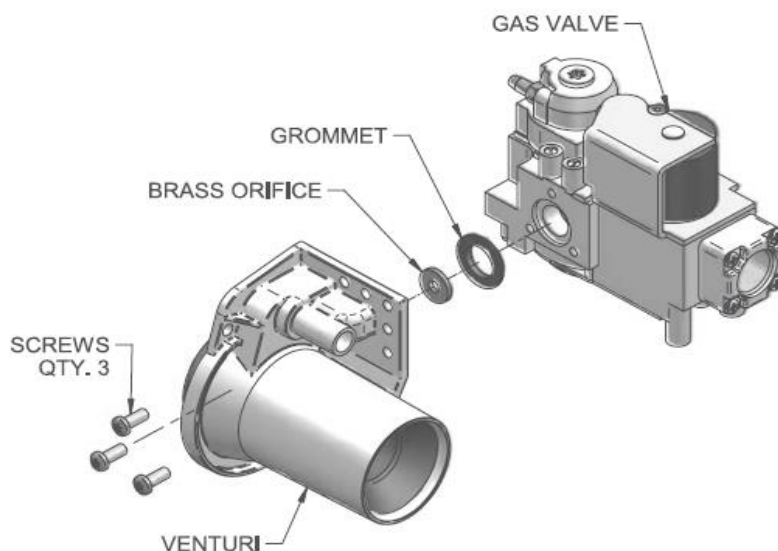
| Model | Part No. | Stamp | Size |
|---------|----------|-------|------------------|
| EKW46CE | ORF2022 | 150 | 4.98 ± 0.025 |
| EKW61CE | ORF2023 | 210 | 5.56 ± 0.025 |
| EKW86CE | ORF2024 | 285 | 6.76 ± 0.025 |

18.2.1 LPG ORIFICE MARKINGS

If the water heater is already installed and operational, you must turn off the gas supply, turn off the power supply and allow the water heater to cool before proceeding. The conversion procedure is as follows:

18.2.2 EKW46CE – EKW86CE

1. Remove the top and front access covers from the unit (no tools required for removal).
2. Remove the impulse tube and wiring plug from the gas valve.
3. Remove the three cap-head screws securing the gas valve to the venturi.
4. Locate the propane orifice disk from the conversion kit bag. Verify that the stamping on the orifice disk is correct for the water heater see **18.2.1**. Place the orifice into the black rubber grommet in the side of the gas valve ensuring the orifice and grommet are seated correctly.
5. Reposition the gas valve against the venturi and replace the cap-head screws securing the valve to the venturi.
6. Refit the impulse tube and wiring plug to the gas valve.
7. After installation is complete, attach the propane conversion label (in the conversion kit bag) next to the water heater rating plate. Attach the LPG caution label (in the conversion kit bag) to the left side of the unit in the lower left corner.
8. Replace the top and front access covers.



18.2.3 CONVERSION PROCEDURE EKW46CE – EKW86CE

18.3 LPG COMMISSIONING AND TESTING

The commissioning procedure on LPG is similar to that when the water heater is firing on Natural Gas. As such, the same procedure should be followed taking in to account the following information:

18.3.1 LPG PRESSURE ADJUSTMENT AND COMBUSTION CHECKS



The Lochinvar EcoKnight™ series are supplied with a pre-set gas/air ratio inlet assembly. This must not be tampered with. Any attempt to adjust the gas valve or venturi will invalidate the warranty.

Combustion figures should be as follows:

| Model No. | CO ₂ | CO |
|-----------|-----------------|----------|
| EKW46CE | 10.5% ±0.5% | <100 ppm |
| EKW61CE | 10.5% ±0.5% | <100 ppm |
| EKW86CE | 10.5% ±0.5% | <100 ppm |

18.3.2 LPG COMBUSTION FIGURES

If the combustion figures are not within the range specified, contact Lochinvar Technical Support for further guidance.

19.0 MAINTENANCE

19.1 GENERAL



Keep appliance area clear and free from combustible materials and flammable vapours and liquids.

A competent person should check and ensure that the flue, its support and terminal, the ventilation to the Boiler house, safety valve, drain, pressure gauge etc. are in a serviceable and working condition and still comply with the relevant standards and codes of practice, as detailed in **Section 6.0: GENERAL REQUIREMENTS**.

Servicing is recommended at intervals no greater than 12 months to aid trouble free operation. Even if a maintenance schedule is determined to be less than annually, it is important that all controls and safety features are checked for correct operation on an annual basis.

Measuring flue gas CO₂ and flue gas temperatures will give an indication of the state of the flue and burner. Results of the flue gas analysis should be compared with previously measured values to identify any changes in operational characteristics.

19.2 MAINTENANCE SCHEDULE

The water heater has a built in function that reminds the user that routine maintenance is due. As a default, this is set to 12 months 10,000 operational hours or 10,000 ignition cycles. Lochinvar recommends that this be the maximum service interval.

19.3 BURNER INSPECTION

The heat exchanger has a sight glass for inspection of the flame picture.



NOTE: If the appliance has been in recent operation, this area may be hot. Appropriate precautions should be taken to prevent personal injury.

To check the flame picture at high and low fire, the following procedure should be followed:

1. Place the water heater into service mode. This is done by depressing the small button below the Enter/Reset button for 5 seconds.
2. The water heater should shut down and relight.
3. Depress the service button momentarily, this should ramp the water heater up to full rate.
4. Check the flame condition.
5. Depress the service button momentarily, this should ramp the water heater down to low rate.
6. Check the flame condition.
7. Press and hold the service button for 5 seconds to take the unit out of service mode.

19.4 BURNER REMOVAL

If it has been determined that the flame picture is unacceptable, the burner can be removed and cleaned using the following procedure:

1. Isolate the electrical and gas supplies to the heater.
2. Allow the water heater to cool down.
3. Disconnect the wiring connections to the ignition electrode.
4. Disconnect the power and control connection leads and earthing wire from the combustion fan.
5. Apply suitable release oil to the 6 studs around the edge of burner door.
6. Remove the 6 retaining nuts around the edge of the burner door.



NOTE: Once loosened, the nuts should be removed by hand. If any of the nuts seize, the nut should gently be re-tightened and additional release oil used.

7. Withdraw the heat exchanger front plate and burner assembly from the heat exchanger complete with the combustion fan.
8. With the burner assembly away from the water heater, the burner can be gently cleaned with the brush attachment of a vacuum cleaner.

The reassembly procedure is the reverse of the above taking care to ensure that the for the heat exchanger front plate sealing gasket, the combustion fan connection gasket, the burner door insulation and the combustion chamber rear wall insulation are in good condition or are replaced as necessary.



Note: particular attention should be paid to the combustion chamber rear wall insulation. If any deterioration in the insulating material is noted, the insulation panel must be replaced.

19.5 CLEANING THE HEAT EXCHANGER

To clean the heat exchanger, the following procedure should be carried out:

1. Remove the burner as above.
2. Use a vacuum cleaner to remove any accumulation on the heating surfaces. Do not use any solvent.
3. Finish cleaning using a clean cloth dampened with warm water.
4. Reinstall the burner.
5. Close isolation valves on piping to isolate the appliance from the system. Attach a hose to the appliance drain valve and flush the heat exchanger thoroughly with clean water by using purging valves to allow water to flow through the water make-up line to the appliance.
6. Once the heat exchanger has been flushed, close the drain valve and open the isolation valves.
7. Restart the water heater as detailed in **Section 17.4.3: PROCEDURE FOR INITIAL LIGHTING**.

19.6 DRAINING WATER HEATER SYSTEM

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

1. Turn off the water heater electrical disconnect switch.
2. Connect a hose to the system drain valve.
3. Locate hose's discharge in an area where hot water will not cause any damage or injury.
4. Close the cold-water inlet valve from the header tank or pressurisation unit to water heater system.
5. Open the drain valve.
6. Working systematically from the highest point in the heating system, open bleed valves to allow the system to drain.
7. Close all bleed valves
8. If the water heater is being drained for an extended shutdown, it is suggested the drain valve be left open during this period.



Note: The heat exchanger cannot be completely drained of water without purging with compressed air at a pressure of 1 bar.

19.7 REFILLING THE SYSTEM

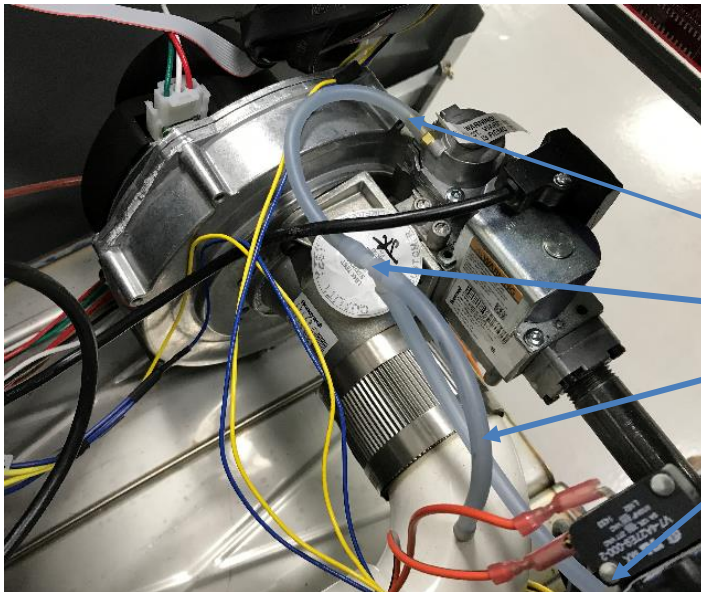
1. Close the drain valve.
2. Open the cold-water inlet valve from the header tank or pressurisation unit to water heater system.
3. Working systematically towards the highest point in the system, open all bleed valves and allow any trapped air to escape.
4. Follow the lighting instructions as detailed in **Section 17.4.3: PROCEDURE FOR INITIAL LIGHTING**.
5. Check for water leakage and airlocks, remedy as necessary.

19.8 OTHER CHECKS

19.8.1 AIR PRESSURE SWITCH LINES

During the annual service, check the lines to/from the air pressure switch to ensure:

1. They are correctly fitted
2. There is no damage



Check all connections

19.8.2 RELIEF VALVE

At least once a year, the pressure relief valve should be checked to ensure correct operation. To check the valve, the manual override lever should be operated several times. The valve should seat properly and operate freely.

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

19.8.3 FLUE SYSTEM

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

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

19.8.4 CONDENSATE NEUTRALISATION KIT

If fitted the condensate neutralisation kit will require replacing after 12 months of operation. Please refer to the item specific instructions for further details.






20.0 SMART SYSTEM CONTROL SETTINGS

20.1 DISPLAY PANEL ACCESS MENU

To access menus from the display panel, use the procedure shown below:



Only suitably qualified engineers should alter the settings and parameters within the EcoKnight™ water heater. Incorrect settings could lead to operational problems within the water heater. These problems would not be covered under the EcoKnight™ water heater warranty

| Button | Screen Status | Operation | Display |
|---|---------------|--|---|
|  | MENU | Press and hold the LEFT SELECT soft key menu for 5 seconds | STANDBY SYSTEM <input type="radio"/> DHW TANK <input type="radio"/> BOILER <input type="radio"/> DHW CIRC <input type="radio"/> SYSTEM: 117°F (118) TANK: 124°F (138) OUTDOOR: 86°F INLET: 189°F OUTLET: 124°F DHW RECIRC: 115°F MENU <input type="radio"/> SCREEN <input type="radio"/> SHDN <input type="radio"/> |
|  | | Rotate the NAVIGATION dial clockwise until 5 is displayed (first digit on the left) | STANDBY SYSTEM <input type="radio"/> DHW TANK <input type="radio"/> BOILER <input type="radio"/> DHW CIRC <input type="radio"/> PASSWORD 0000 EXIT <input type="radio"/> NEXT <input type="radio"/> SAVE <input type="radio"/> |
|  | | Press the NAVIGATION dial to select the next digit. Rotate the NAVIGATION dial clockwise until 3 is displayed | STANDBY SYSTEM <input type="radio"/> DHW TANK <input type="radio"/> BOILER <input type="radio"/> DHW CIRC <input type="radio"/> PASSWORD 5000 EXIT <input type="radio"/> NEXT <input type="radio"/> SAVE <input type="radio"/> |
|  | | Press the NAVIGATION dial 2 times to move to the last digit. Rotate the NAVIGATION dial counter clockwise until 9 is displayed | STANDBY SYSTEM <input type="radio"/> DHW TANK <input type="radio"/> BOILER <input type="radio"/> DHW CIRC <input type="radio"/> PASSWORD 5300 EXIT <input type="radio"/> NEXT <input type="radio"/> SAVE <input type="radio"/> |
|  | SAVE | Press the RIGHT SELECT soft key (SAVE) | STANDBY SYSTEM <input type="radio"/> DHW TANK <input type="radio"/> BOILER <input type="radio"/> DHW CIRC <input type="radio"/> PASSWORD 5309 EXIT <input type="radio"/> NEXT <input type="radio"/> SAVE <input type="radio"/> |

20.1.1 DISPLAY PANEL ACCESS MENU

20.2 PARAMETER SETTING

| Menu | Description | See Section | User Access | Installer Access |
|--------------|---|----------------------|-------------|------------------|
| GENERAL | Vacation Mode (On/Off) | 21.1 | Yes | Yes |
| | Time and Date | 21.1 | Yes | Yes |
| | Software Version (read only) | 21.1 | No | Yes |
| | Temperature Units (°C/°F) | 21.1 | Yes | Yes |
| | DHW Night Setback Offset IF DHW NSB > 0: i. DHW Night Setback On Times ii. DHW Night Setback Off Times | 21.1 21.1 21.1 | No | Yes |
| | Display Timeout | 21.1 | No | Yes |
| | Display Contrast | 21.1 | Yes | Yes |
| DATA LOGGING | Reset Last 10 Errors | 21.2 | No | Yes |
| FUNCTIONS | Service Mode Delay | 21.3 | No | Yes |
| | Freeze Protection Pump On | 21.3 | No | Yes |
| | Freeze Protection Burner On | 21.3 | No | Yes |
| | Freeze Protection Burner Differential | 21.3 | No | Yes |
| DHW SETTINGS | Tank Set Point | 21.4 | Yes | Yes |
| | Tank Set Point Differential | 21.4 | No | Yes |
| | DHW Recirc Pump Offset | 21.4 | No | Yes |
| | DHW Recirc Pump Differential | 21.4 | No | Yes |
| | Tank Minimum Set Point | 21.4 | No | Yes |
| | Tank Maximum Set Point | 21.4 | No | Yes |
| ANTI-CYCLING | Anti-cycling Time | 21.5 | No | Yes |
| | Anti-cycling Override Differential | 21.5 | No | Yes |
| | Ramp Delay (Enable/Disable) | | No | Yes |
| | Modulation Factor | | No | Yes |

| Menu | Description | See Section | User Access | Installer Access |
|---------------|--|-------------|-------------|------------------|
| CONTROL MODES | Controlling Sensor(Outlet/System Supply/Inlet) | 21.6 | No | Yes |
| | Cascade Address IF Address = 0: Maximum Cascade Outlet Set Point Cascade Offset Cascade Differential Cascade Type (L/L, EFF) Minimum On/Off Time Minimum Next On Time Minimum Pumps On ELSE IF Address = 1: Alternate Leader? (Y/N) IF Yes: Maximum Cascade Outlet Set Point Cascade Offset Cascade Differential Cascade Type (L/L, Eff) Minimum On/Off Time Minimum Next On Time Minimum Pumps On | 21.6 | No | Yes |
| | Water heater Size i. Cascade Address ii. Type ii. Type iii. Input | 21.6 | No | Yes |
| BMS | BMS (Active, Inactive) IF Active: i. BMS Type (Power, Set Point) IF Power: 1. Power at Minimum Volts 2. Power at Maximum Volts ELSE: 1. Set Point at Minimum Volts 2. Set Point at Maximum Volts ii. Minimum Volts iii. Maximum Volts iv. TStat Input (Active, Inactive) IF Inactive: 1. On Volts 2. Off Differential Volts | 21.7 | No | Yes |
| | ModBus/BACNet (Active, Inactive) IF Active: i. BAS Timeout | 21.7 | No | Yes |

| Menu | Description | See Section | User Access | Installer Access |
|----------------------|---|-------------|-------------|------------------|
| CIRCULATING PUMPS | DHW Pump Delay | 21.8 | No | Yes |
| | DHW Pump Anti-Seize Delay | 21.8 | No | Yes |
| SERVICE NOTIFICATION | Service Notification Months | 21.9 | No | Yes |
| | Service Notification Running Time | 21.9 | No | Yes |
| | Service Notification Cycles | 21.9 | No | Yes |
| | Reset Service Reminder | 21.9 | No | Yes |
| | Installer Name | 21.9 | No | Yes |
| | Installer Phone Number | 21.9 | No | Yes |
| BASIC SETUP | Time & Date | 21.10 | No | Yes |
| | Cascade Address IF Address = 0: i. Maximum Cascade Set Point ii. Cascade Offset iii. Cascade Differential iv. Cascade Type (L/L, EFF) | 21.10 | No | Yes |
| | BMS (Active, Inactive) IF Active: i. BMS Type (Power, Set Point) IF Power: 1. Power at Minimum Volts 2. Power at Maximum Volts ELSE: 1. Set Point at Minimum Volts 2. Set Point at Maximum Volts ii. Minimum Volts iii. Maximum Volts iv. TStat Input (Active, Inactive) IF Inactive: 1. On Volts 2. Off Differential Volts | 21.10 | No | Yes |
| | | | | |
| USB | | 21.10 | No | Yes |

20.2.1 SMART SYSTEM CONTROL PARAMETERS

21.0 VIEWABLE AND CHANGEABLE CONTROL PARAMETERS



Before changing parameters, note the settings so that the unit can be returned to its original operating parameters. These can be uploaded to a USB for later use see 21.10.1.

21.1 GENERAL

21.1.1 VACATION MODE

This parameter forces the DHW set points to decrease by the amounts programmed in the Night Setback Offset parameters. This is used to save energy, such as when the building is unoccupied for an extended period of time. For this function to work, the DHW Night Setback Offset parameters must be set to a value higher than 0°. The default value of this parameter is OFF.

21.1.2 TIME AND DATE

The control uses an internal clock for the night setback feature and for logging of events. For these features to work correctly, the clock must be set when the water heater is first installed or anytime the water heater has been powered off for more than four (4) hours. This parameter must be accessed to set the clock.



The internal clock does not adjust for British summer time and therefore, will require a manual adjustment. The clock is automatically updated whenever a pc is connected and the Win_Pro-installer program is started.

21.1.3 SOFTWARE VERSION

The software version allows the user to view the software version in use by the control. This software controls the operation of the water heater. When a new software version becomes available, the existing control can be replaced with a new control to update the software.

Software version is read only.

21.1.4 TEMPERATURE UNITS (°C / °F)

The control can be configured to display temperature in either °C or °F. This parameter can be changed by the user or the installer by accessing the Temperature Units parameter. The default is °F.

21.1.5 DOMESTIC HOT WATER (DHW) NIGHT SETBACK OFFSET

Once the unit's internal clock has been set correctly, the Night Setback feature can be used to program a lower set point during unoccupied times. When in night setback, the control reduces the set point by a fixed amount. For DHW, it subtracts the DHW night setback offset from the tank set point (Tank Set point parameter).



The DHW night setback will not work without a tank sensor installed.

21.1.6 DOMESTIC HOT WATER (DHW) NIGHT SETBACK ON AND OFF TIMES

These are the times at which the DHW Night Setback Offsets become active and inactive. There are seven (7) stop times and seven (7) start times each for the DHW night setback functions. Any start or stop time may be set to any time during the week. When a start time and a stop time are programmed for the same day and time, the stop time has priority (this is how a start time can be disabled). The installer can access the DHW Night Setback start and stop times by accessing the DHW NSB On/Off Times parameter. These settings can be adjusted as follows:

1. When the screen is first accessed, start and stop triggers 1 are displayed. If a different trigger number is desired, rotate the NAVIGATION dial until the desired trigger number appears. Once it is found, press the NAVIGATION dial to adjust the start and stop times. The day of the week for the start time will flash.
2. Rotate the NAVIGATION dial to adjust the day of the week of the start trigger. Once it is set to the desired day of the week, press the NAVIGATION dial again. The start time hour will flash.
3. Rotate the NAVIGATION dial to adjust the start time hour to the desired time. Press the NAVIGATION dial again. The start time minutes will flash.
4. This process may be continued until the start and stop days and times are adjusted as desired. When finished with this set of triggers, press the [SAVE] key.
5. Rotate the NAVIGATION dial to select another set of start and stop triggers, or press the [EXIT] key to return to the previous menu.

21.1.7 NIGHT SETBACK OVERRIDE

Any Night Setback On trigger currently active or scheduled within the next seven (7) days can be skipped. To skip a trigger, go to the Night Setback Status Screen and press the SKIP button. Rotate the NAVIGATION dial until the arrow (>) is next to the trigger you wish to skip. Press the NAVIGATION dial once. "SK" will appear next to that trigger to indicate that it will be skipped. You can restore an upcoming trigger by selecting that trigger, and pressing the NAVIGATION dial again. The "SK" next to that trigger will disappear.

To save any changes and return to the Home Screen, press the RIGHT SELECT [HOME] key. To return to the Status Screen without saving the changes, press the LEFT SELECT [EXIT] key.

21.1.8 DISPLAY TIMEOUT

This is the time in which the display remains illuminated. The range is 10 seconds to 10 minutes. The default is 10 minutes.

21.1.9 DISPLAY CONTRAST

The contrast of the LCD display can be adjusted to improve readability. The contrast is adjusted automatically when the display board is tested at the factory, but different ambient conditions may warrant changing the setting. This parameter can be changed by accessing the Display Contrast setting. The range of this parameter is -10 to +10. The default setting is 0.

21.2 DATA LOGGING

21.2.1 RESET LOG ERRORS

The reset log errors function clears the last 10 errors log.

21.3 FUNCTIONS

21.3.1 SERVICE MODE DELAY

By pressing the pin button on the front of the display for five (5) seconds, the control will be placed in Service Mode. This will override all other heat demands. The Service Mode allows the installer to set the unit to any firing rate for the purpose of combustion analysis. The delay sets the length of time the water heater will stay in the Service Mode if no keys have been pressed before going back to its original state. This parameter can only be changed by the installer by accessing the Service Mode Delay parameter. The time range of this parameter is 1 to 10 minutes. The default value is 10 minutes.

21.3.2 FREEZE PROTECTION PUMP ON

The SMART SYSTEM control will turn on the water heater and system pump outputs whenever the inlet temperature drops below this setting. This is done to prevent the water in the heat exchanger from freezing. Certain low temperature applications (such as snow melt) can operate at temperatures around freezing, so this setting needs to be lowered in these cases. The installer can adjust the temperature at which the pump outputs are turned on by accessing the Freeze Protection Pump On parameter. The minimum setting is -19°C, and the maximum setting is 7.2°C. The default setting is 7.2°C.

21.3.3 FREEZE PROTECTION BURNER ON

If running the pumps does not prevent the inlet temperature from falling closer to freezing, the SMART SYSTEM control will fire the burner at low fire. The installer can adjust the temperature at which the burner fires by adjusting the Freeze Protection Burner On parameter. The minimum setting is -19°C, and the maximum setting is the Freeze Protection Pump On parameter. The default setting is 2.8°C.

21.3.4 FREEZE PROTECTION BURNER DIFFERENTIAL

Once the burner has started firing due to a low inlet temperature, the inlet temperature must increase by this amount before the burner turns back off. The installer can adjust this differential by accessing the Freeze Protection Burner Differential parameter. The minimum setting is 0°, and the maximum is 11°C. The default setting is 2.8°C.

21.4 DHW SETTINGS

21.4.1 DHW TANK SET POINT

By installing a tank sensor, the SMART SYSTEM control can perform the tank thermostat function. The SMART SYSTEM control automatically detects the presence of this sensor, and generates a DHW call for heat when the tank temperature drops below the tank set point differential (Tank Set point Differential parameter), and finishes the call for heat when the tank temperature reaches tank set point. This parameter can be changed by the installer by accessing the DHW Tank Set point parameter. The temperature range of this parameter is from the tank minimum set point to the tank maximum set point. The default value is 49°C. This should be set at 60°C.



The SMART SYSTEM control will only operate with the tank sensor fitted.

21.4.2 TANK SET POINT DIFFERENTIAL

When a tank sensor is installed, the tank temperature must drop this amount below the tank set point (DHW Tank Set point parameter) before the water heater turns back on. The installer can adjust this setting by accessing the Tank Set point Differential parameter. The minimum setting is 0°C, and the maximum is 22°C. The default setting is 3°C.

21.4.3 DHW RECIRCULATION PUMP OFFSET (RECIRCULATION PUMP)

The SMART SYSTEM control will turn the DHW recirculation pump on when the DHW return water temperature drops below the DHW Tank Set Point minus the DHW Recirculation Pump Offset. The range for this parameter is 0° to 30°C. The default value is 5°C.

21.4.4 DHW RECIRCULATION PUMP DIFFERENTIAL

Once the SMART SYSTEM control turns the DHW recirculation pump on, the DHW return water temperature must increase by the DHW Recirculation Pump Differential before the control turns the DHW recirculation pump back off. The range of this parameter is 0° to 50°C. The default value is 2°C.

21.4.5 TANK MINIMUM SET POINT

This setting controls the minimum tank set point for the tank temperature. The installer can adjust this by accessing the Tank Minimum Set point parameter. The minimum setting is 16°C and the maximum setting is the maximum tank set point (Tank Maximum Set point parameter). The default value is 16°C.

21.4.6 TANK MAXIMUM SET POINT

This setting controls the maximum tank set point for the tank temperature. The installer can adjust this by accessing the Tank Maximum Set point parameter. The minimum setting is the minimum tank set point (Tank Minimum Set point parameter) and the maximum setting is 88°C. The default value is 88°C.

21.5 ANTI-CYCLING

21.5.1 ANTI-CYCLING TIME

Once the burner turns off, a set amount of time must elapse before the control will respond to a new demand. The control will block the new heat demand and anti-cycling will be shown in the display until the time has elapsed or the water temperature drops below the Anti-Cycling Override Differential parameter. This parameter can be changed by the installer by accessing the Anti-Cycling Time parameter. The time range for this parameter is 1 minute to 10 minutes. The default value is 1 minute.

21.5.2 ANTI-CYCLING OVERRIDE DIFFERENTIAL

The control will bypass the anti-cycling time if the inlet water temperature drops too much. The control will use the inlet water temperature present at the water heater when it shuts off as the starting point. If the inlet temperature drops below the temperature parameter, the control will abort anti-cycling and allow the water heater to fire. This parameter can be changed by the installer by accessing the Anti-Cycling Override Differential parameter. The temperature range of this parameter is 0°C to 30°C. The default value is 6°C.

21.6 CONTROL MODES

21.6.1 CONTROLLING SENSOR

The controlling sensor parameter selects the sensor the control will use to regulate the water heater firing rate. This parameter is adjustable by the installer by accessing the Controlling Sensor parameter. The sensor selections are as follows: The outlet sensor regulates the firing rate based on the outlet water temperature of the water heater and the inlet sensor regulates the firing rate based on the inlet water temperature of the water heater. If the outlet sensor is selected, and the optional system supply sensor is connected, the control will regulate the firing rate based on the system supply sensor temperature. The default sensor is the Outlet Sensor.

21.6.2 CASCADE ADDRESS

The water heater designated as the Leader needs to be programmed with address 0. All the Member water heaters require addresses from 1 to 7, and the addresses must be different for each Member. The addresses can be in any order, regardless of the order in which the units are wired together. This parameter is adjustable by the installer by accessing the Cascade Address Parameter. The default address is 1.

21.6.3 MAXIMUM CASCADE SET POINT

This parameter determines the set point used by the individual water heaters in a Cascade when a system sensor is connected to the Leader water heater. When a water heater is commanded to fire by the Leader water heater, it will attempt to achieve this temperature at its outlet. The Leader water heater will limit the modulation of the water heater(s) in order to hold the temperature at the system supply sensor to the user set point. If any of the water heater outlet temperatures reach the maximum cascade set point, that water heater will then modulate down on its own in order to keep its outlet temperature within the maximum cascade set point. Therefore, this parameter can be used to limit the outlet temperatures of all the water heaters in a Cascade this parameter is adjustable by the installer by accessing the Maximum Cascade Set Point parameter. The temperature range of this parameter is 0°C to 88°C. The default maximum cascade set point is 85°C.

21.6.4 CASCADE OFFSET

This parameter determines how much the temperature must go above set point before the lead water heater will turn off. This parameter can be adjusted by the installer by accessing the Cascade Offset parameter. The temperature range of this parameter is 0° to 11°C the default value is 6°C.

21.6.5 CASCADE DIFFERENTIAL

This parameter determines how much the temperature must go below the turn off temperature (Set point + Offset) before the lead water heater turns on. This parameter can be adjusted by the installer by accessing the Cascade Differential parameter. The temperature range of this parameter is 0°C to 33°C the default value is 11°C.

21.6.6 CASCADE TYPE (L/L / EFF)

There are two (2) options for the way a Cascade divides the load between its heaters. The first is Lead/Lag, designated as L/L in the menu. This method is used when it is desired to have the least amount of total flow through the water heaters. This method will modulate the last two (2) water heaters that are firing. This provides for smooth transitions when a water heater turns on or off. When the last water heater reaches 100% and the calculated load is still increasing, it will start the next water heater at 20% and reduce the previous water heater to 80%, thus eliminating the sudden jump in total output of the Cascade. When the calculated load is decreasing and the last water heater gets down to 20% fire, it will hold it there and start lowering the firing rate on the next-to-last water heater. When the next-to-last water heater reaches 20%, it will turn the last water heater off and raise the rate of the next-to-last water heater to 40%, thus eliminating the sudden drop in total output of the Cascade.

The other Cascade divider method is Efficiency Optimization, designated as EFF in the menu. This method is used, as the name implies, when it is desired to have the most efficient system. When the first water heater reaches 100% rate, it lowers its rate to 50% and turns on the next water heater at 50%. The two (2) water heaters then modulate at the same rate. As the calculated load increases further and both water heaters ramp up to 100%, it lowers the rate of the first two (2) water heaters to 67% and brings the next water heater on at 67%. The three (3) water heaters then modulate together. As the calculated load decreases, the water heaters will reach 20%, at which time the last water heater (the third in our example) will turn off and the Cascade will increase the rates of the remaining water heaters to provide the equivalent total output as before $((3 \times 20\%) / 2 = 30\%$ in our example). Efficiency optimization is automatically selected when water heaters of different sizes are programmed into the Leader control (see 21.6.11).

21.6.7 MINIMUM ON/OFF TIME

In order to prevent units in a Cascade from short cycling, this parameter defines the minimum ON and OFF time for each unit. The installer can adjust this time by accessing the Minimum On/Off Time parameter. The minimum setting is 0 seconds and the maximum setting is 10 minutes. The default is 30 seconds.

21.6.8 MINIMUM NEXT ON TIME

In order to reduce the risk of temperature overshoot with a Cascade, this parameter defines the minimum time delay from starting one unit until the next unit may be started. The installer can adjust this time delay by accessing the Minimum Next on Time parameter. The minimum setting is 0 minutes and the maximum setting is 10 minutes. The default is 60 seconds.

21.6.9 MINIMUM NUMBER OF PUMPS ON

When the water heater is a Cascade Leader, it can force a minimum number of water heater pump outputs to be on continuously, regardless of how many water heaters are firing. This is normally used when the water heaters are piped in a full-flow configuration, and the water heater pump outputs are controlling isolation valves. The Leader will force the water heater pump output on the highest priority water heater to turn on first, then the water heater pump output on the second highest priority water heater, and so forth, until the minimum number of pump outputs are turned on. The range of this parameter is 0 to 8. The default value is 0.

21.6.10 ALTERNATE LEADER

This parameter allows the Member 1 water heater to automatically assume control of the Cascade should it lose communication with the Leader water heater. When programmed to YES, it is recommended that the Member 1 water heater have its own set of external sensors installed (such as the Vessel sensor), to maintain the same level of temperature control as with the Leader water heater. Voltage signals (such as the 0 - 10V system pump speed input) can be connected to both water heaters.



Do not connect the sensors connected to the leader water heater to the member 1 water heater. The actual water temperatures will be higher than expected, which could lead to property damage or personal injury.

When communication is re-established with the Leader water heater, Member 1 will automatically relinquish control of the Cascade to the Leader water heater.

The default value of this parameter is NO.

21.6.11 WATER HEATER SIZE

When water heaters of different sizes are connected together in a Cascade, the Leader water heater has to know the size of each water heater in that Cascade. The Water Heater Size parameters allow the installer to program the size based on the Cascade address. This screen shows the Cascade address and the size of the water heater with that address (in kBtu/hr):

1. When the water heater size screen is first accessed, Cascade Address (SELF) is shown.
2. Press the NAVIGATION dial twice to access the Input setting. Rotate the NAVIGATION dial to increase the boiler input. Input settings 0 - 400 Btu/hr can be adjusted in increments of 5 (5000 Btu/hr). When the closest approximate boiler size is shown, press the RIGHT SELECT [SAVE] key.
3. Rotate the NAVIGATION dial to select the address of the next water heater in the Cascade. Repeat Step two above.
4. Once the size of the last water heater in the Cascade has been entered and saved, press the LEFT SELECT [EXIT] key to return to the Control Modes menu.
5. If no other parameters are to be adjusted, press the RIGHT SELECT [HOME] key to save the new settings and return to the Status screens.

The SMART SYSTEM control automatically uses the Efficiency Optimisation Cascade type when controlling water heaters of different sizes.

21.7 BUILDING MANAGEMENT SYSTEM (BMS)



Lochinvar have developed the EcoKnight water heater to operate at its most efficient when using the internal sensors and cascade control, if it is the intention to use a BMS to control the EcoKnight water heater then Lochinvar must approve the general scheme of control prior to installation.

21.7.1 GENERAL SCHEME OF CONTROL

The EcoKnight water heater has various control options when connected to a BMS, many of these options are available as the control is also used by a Boiler version and are unsuitable for use with the EcoKnight water heater. Lochinvar recommend leaving the water heater to operate based on the temperature within the storage vessel monitored from its own sensor (included with each water heater). This will activate the water heater and shunt pump on demand (utilising the built in Cascade control if there is more than one water heater), when demand is satisfied the water heater will activate the pump overrun to clear any excess heat from the heat exchanger prior to shutting down the unit. When operating this way the BMS can still pick-up a fault or run signal. See [drawing here](#).

If there is a requirement to turn the water heater On/off via a BMS then this scheme must be approved by Lochinvar prior to installation. The BMS can turn the water heater on/off but must not be used to activate the associated shunt pump that must be controlled by the water heater to allow a suitable pump overrun. See [drawing here](#) for a typical scheme. If there are multiple water heaters installed the BMS should only turn on the lead appliance which will decide on the number and modulation of burner to fire depending upon demand. In all cases the EcoKnight water heater must have the supplied temperature sensor fitted within the storage vessel.

21.7.2 BMS

The set point or modulation of the water heater may be controlled through the 0 - 10V BMS input, BACnet, or ModBus. When the BMS parameter is set to INACTIVE, the 0 - 10V input will be ignored. When set to ACTIVE, the set point or modulation will be controlled by the voltage on the 0 - 10V input (in the case of 0 - 10V BMS control), or the 0 - 10V input value received through ModBus or BACnet. The default value is INACTIVE.

21.7.3 BMS TYPE

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet, the 0 - 10V signal can be interpreted as either a modulation command or a set point. When the BMS Type parameter is set to POWER, the 0 - 10V signal

will control the modulation. When set to SETPOINT, the 0 - 10V signal will control the SH set point. The default setting is SETPOINT.

21.7.4 RATE AT MINIMUM VOLTS

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as POWER, the modulation percentage represented by the Volts at Minimum parameter is set by the Rate at Minimum Volts parameter. The minimum value is 0% and the maximum is the Rate at Maximum Volts setting. The default value is model dependant.

21.7.5 RATE AT MAXIMUM VOLTS

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as POWER, the modulation percentage represented by the Volts at Maximum parameter is set by the Rate at Maximum Volts parameter. The minimum value is the Rate at Minimum Volts setting and the maximum is 100%. The default value is 100%.

21.7.6 SET POINT AT MINIMUM VOLTS

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as SETPOINT, the set point represented by the Volts at Minimum parameter is set by the Set Point at Minimum Volts parameter. The minimum value is 32°F (0°C) and the maximum is the Set Point at Maximum Volts setting. The default value is 70°F (21°C).

21.7.7 SET POINT AT MAXIMUM VOLTS

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Type is programmed as SETPOINT, the set point represented by the Volts at Maximum parameter is set by the Set Point at Maximum Volts parameter. The minimum value is the Set Point at Minimum Volts setting and the maximum is 88°C. The default value is 82°C.

21.7.8 VOLTS AT MINIMUM

When programmed for BMS control through the 0 -10V BMS input or through ModBus/BACnet, the Volts at Minimum parameter should be set to the minimum voltage signal sent to the SMART SYSTEM control. The range of this parameter is 0.0V to the Volts at Maximum value. The default setting is 2.0V.

21.7.9 VOLTS AT MAXIMUM

When programmed for BMS control through the 0 -10V BMS input or through ModBus/BACnet, the Volts at Maximum parameter should be set to the maximum voltage signal sent to the SMART SYSTEM control. The range of this parameter is the Volts at Minimum value to 10.0V. The default value is 10.0V.

21.7.10 BMS THERMOSTAT INPUT

With the BMS Thermostat Input parameter set to ACTIVE, the water heater will be enabled by closing the thermostat connection across terminals 15-16 see **Error! Reference source not found.** section 3 for further details. When set to INACTIVE, the water heater will be enabled by the voltage level on the 0 - 10V input (in the case of 0 - 10V BMS control), or the 0 - 10V input value received through BACnet or ModBus. The default value is INACTIVE.

21.7.11 ON VOLTS

When programmed for BMS control through the 0 -10V BMS input or through ModBus/BACnet and the BMS Thermostat Input is set to INACTIVE, the On Volts parameter determines the 0 - 10V BMS input voltage at which the water heater is enabled. The minimum value is 0.5V and the maximum is 10.0V. The default value is 2.0V.

21.7.12 OFF DIFFERENTIAL VOLTS

When programmed for BMS control through the 0 - 10V BMS input or through ModBus/BACnet and the BMS Thermostat Input is set to INACTIVE, the Off Differential Volts parameter determines how far below the On Volts setting the 0 - 10V BMS input voltage must be in order to disable the water heater. The minimum value is 0.2V and the maximum is the On Volts setting. The default value is 1.0V.

21.7.13 MODBUS/BACNET

When BMS is set to ACTIVE (see BMS Active / Inactive) and the water heater is being controlled through BACnet or ModBus, set ModBus/BACnet parameter to ACTIVE. Otherwise, set the ModBus/BACnet parameter to INACTIVE. Note that the water heater can still be monitored by ModBus or BACnet with this parameter set to INACTIVE. The default value is INACTIVE

21.7.14 BAS T/O

This is the amount of time the unit controls will wait to receive a communication string from the BMS controller before reverting back to its own internal parameters. This parameter is adjustable by the installer by accessing the BAS T/O parameter. The adjustment range of this parameter is 5 seconds to 2 minutes. The default value is 10 seconds.

21.8 CIRCULATION PUMPS

21.8.1 DHW PUMP DELAY

The DHW pump delay parameter sets the length of time the DHW pump will run after a DHW demand has been satisfied. This parameter is adjustable by the installer by accessing the DHW Pump Delay parameter. The time range for this parameter is 10 seconds to 40 minutes. The default time is 1 minute.

21.8.2 DHW PUMP ANTI-SEIZE DELAY

If the water heater pump does not run for 24 hours, it will be turned on briefly to prevent it from seizing. The length of time it runs is determined by the DHW Pump Anti-Seize Delay parameter. The range of this setting is 0 seconds to 40 minutes. The default setting is 20 seconds.

21.9 SERVICE NOTIFICATION

21.9.1 SERVICE NOTIFICATION IN MONTHS

When the water heater control determines that a scheduled service is due based on days of installation, the water heater display will turn yellow and a new status screen will appear informing the user that maintenance is required. This parameter is adjustable by the installer by accessing the Service Notification in Months parameter. The time range for this parameter is 0 months to 100 months. The default time is 12 months.

21.9.2 SERVICE NOTIFICATION RUNNING TIME

When the water heater control determines that a scheduled service is due based on the hours of actual operation, the water heater display will turn yellow and a new status screen will appear informing the user that maintenance is required. This parameter is adjustable by the installer by accessing the Service Notification Running Time parameter. The time range for this parameter is 0 hours to 17,500 hours. The default time is 8,760 hours.

21.9.3 SERVICE NOTIFICATION CYCLES

When the water heater control determines that a scheduled service is due based on the number of water heater cycles, the water heater display will turn yellow and a new status screen will appear informing the user that maintenance is required. This parameter is adjustable by the installer by accessing the Service Notification Cycles parameter. The range for this parameter is 0 cycles to 100,000 cycles.

The default is 50,000 cycles

21.9.4 RESET MAINTENANCE REMINDER



- 1 USB Drive
- 2 PC Connection
- 3 Left select key
- 4 Navigation dial
- 5 Reset switch
- 6 Right select key

Once servicing has been completed, the service notification counter should be reset. This parameter can be reset by the installer by accessing the Reset Maintenance Reminder parameter as shown below.

- Press and hold the **L/H SELECT button (3)**
- Enter the code **5309** using the **DIAL (4)** scan through the numbers and pushing the dial to accept correct number
- Press **SELECT (6)**
- "installer Code" should be displayed
- Scroll through the sub menus using the **DIAL (4)** until you find **Service notification**
- Press **SELECT (6)**
- Scroll using the **DIAL (4)** to **Reset service reminder**
- Press **SELECT (3)**
- It will ask you to **confirm**
- Press **SELECT (3)**
- You should see the word "engaged" briefly displayed.
- Press the **R/H SELECT (6)** button **three times** to return to the front display screen

The service notification is now reset.

21.9.5

SERVICE NAME AND PHONE NUMBER



Please note that the brackets ([]) denote screen status.

When a Maintenance Reminder timer or counter has expired, a Maintenance Reminder screen will appear on the display. By programming the installer's name and phone number, this information will appear on the Maintenance Reminder Screen at that time. This can be programmed by accessing the Service Name and Phone Number parameter. When selected, another menu will appear with PHONE and NAME.

1. Rotate the NAVIGATION dial to point to the name/phone number to program and press the NAVIGATION dial. The screen will now display the selected item (either PHONE or NAME).
2. Press the NAVIGATION dial again. A cursor will appear at the bottom of the screen. By rotating the NAVIGATION dial, various numbers and characters will appear. When the desired number/character is found, press the NAVIGATION dial. The cursor will move to the next position.
3. Repeat this procedure until the entire message is entered. If you make a mistake and wish to back up one character, rotate the NAVIGATION dial until the back arrow (m) character is displayed and press the NAVIGATION dial.
4. When finished, press the RIGHT SELECT [SAVE] key to return to the previous menu.

21.10 BASIC SETUP

The Basic Setup Menu contains the most frequently used parameters from the list above. See the descriptions above to set these parameters.

21.10.1 USB

Parameter files can be copied directly to and from a USB flash drive. When USB is selected from the Main Menu, the display will ask you to insert a flash drive into the USB-A (rectangular) port next to the display. Once a drive is inserted, the display will search the root directory of this drive for a folder named "Lochinvar". If it does not find it, the display will ask if you want it to create this folder. Press either the [YES] or [NO] key. If you press [NO], no further operations are allowed, so you must remove the flash drive. If you press [YES], it will create the folder in the flash drive. If the flash drive contains a folder named Lochinvar, the display will show all of the parameter files stored in that folder.

If you wish to copy the parameters from the Smart System control into the flash drive, press the [SAVE] key. The display will create a file name based on the current date and time (year-month-date-hours-minutes). If you wish to cancel this operation, press the [NO] key. If you wish to change the filename, press the NAVIGATION dial. The first character of the filename will flash. Rotate the NAVIGATION dial to change this character. Once it is correct, press the NAVIGATION dial again, and edit the next character as before. When the new filename is ready, press the [SAVE] key. The control will save the parameters to the flash drive, and the new file will appear in the list of parameter files. Press the [EXIT] key to return to the Main Menu.

If you wish to copy a parameter file from the flash drive into the Smart System control, rotate the NAVIGATION dial until the file you wish to copy is selected. Press the NAVIGATION dial once. The display will ask you if you want to load the parameters from the file you selected. You can press [NO] to cancel the operation, or press [YES] to continue with writing the parameters into the control. Once the loading process is complete, the display will return to the Main Status Screen

22.0 ERP DATA TABLE

| Type Circulating water heater: | | EKW46CE | EKW61CE | EKW86CE |
|--|--------|-------------|-----------|-----------|
| Condensing boiler: | | Yes | Yes | Yes |
| low temperature boiler: | | Yes | Yes | Yes |
| B11 boiler: | | No | No | No |
| Cogeneration space heater: | | No | No | No |
| Combination heater: | | No | No | No |
| | Unit: | Value | Value | Value |
| Rated heat output | | 38.5 | 52 | 74 |
| P-rated (P4) at 60-80C | kW | 38.1 | 51.1 | 73.1 |
| Heat output (p1) 30% at 30-37C | kW | 13 | 17.1 | 25.4 |
| Seasonal space heating energy efficiency (η_s). | | 95 | 94 | 94 |
| Energy efficiency (η_4) at 58-77C | % | 88 | 88.3 | 88.7 |
| Energy efficiency (η_1) at 30-37C | % | 101.1 | 99.8 | 99.5 |
| Auxiliary electricity consumption | | | | |
| At full load (elmax). | kW | 0.096 | 0.122 | 0.144 |
| At part load (elmin) | kW | 0.028 | 0.034 | 0.043 |
| In standby mode (Psb) | kW | 0.003 | 0.004 | 0.006 |
| Other | | | | |
| Standby heat loss (Pstby) | kW | 0.13 | 0.172 | 0.241 |
| Ignition burner power consumption | kW | nil | nil | nil |
| Emissions (NOx) of nitrogen oxides (EN15502) | mg/kWh | 33 | 27.3 | 33.1 |
| Sound power level, indoors (EN 14436-1:2006) | dB | 58 | 60 | 62 |

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

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

23.0 USER INSTRUCTIONS



Following installation of the water heater, the installer shall instruct the user in the operation of the water heater and the safety devices and shall leave a copy of these instructions with the user.

23.1 GENERAL REQUIREMENTS



This equipment must be installed by a competent person, registered with an 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.



A competent person must also undertake any alterations that require the gas train or flue system to be broken.



Any interference with a sealed component is forbidden.



Failure to comply with the above may lead to prosecution.



Incorrect use may result in injury and will also invalidate the warranty

23.2 PROCEDURE FOR LIGHTING

7. Ensure that the gas inlet appliance isolating valve, provided by the installer, is in the "off" position.
8. Press the power rocker switch, positioned on the back of the appliance to bring the equipment on.
9. The combustion fan should ramp up to full speed to purge the combustion chamber and then drop back to half rate in order to light. As the gas inlet appliance isolating valve is closed, the controls should go to a flame failure condition after four ignition attempts. If the above occurs correctly, open the gas inlet appliance isolating valve and reset the unit by depressing the Enter/Reset button on the control panel.
10. The combustion fan will repeat the pre-purge procedure and attempt to light. Once a flame is established, the LCD display will change to display the rate at which it is firing.

23.3 PROCEDURE FOR SHUTTING DOWN

To take the appliance out of service, hold down the RIGHT SELECT key (SHDN) in the main menu and choose yes. If the appliance is to be shut down for a long period of time, the power supply should be isolated using the rocker switch on the back and the gas supply should be isolated at the manual isolation valve.

23.4 SMART SYSTEM CONTROL



- 1 USB Drive
- 2 PC Connection
- 3 Left select key
- 4 Navigation dial
- 5 Reset switch
- 6 Right select key

The information on the bottom of the display shows the functions of the two SELECT keys on both corner, and the NAVIGATION dial in the centre.

| | |
|-----------|-------------------------------|
| MENU | Left SELECT key |
| SETPOINTS | NAVIGATION dial-pressing down |
| SHDN | Right SELECT key |

The smart system control face instantly informs the user of the status of the Water Heater by changing colour according to the status of the Water Heater as below.



Normal operation



Service required



Water Heater is not working

23.5 TEMPERATURE ADJUSTMENT PROCEDURE

23.5.1 DHW SETPOINT

The stored water temperature is controlled by a tank sensor supplied with the water heater, the default setpoint is 52°C. The setpoint should be adjusted to ensure that the water is stored at 60°C and distributed at 50°C within 1 (one) minute at all outlets. Care is needed to avoid much higher temperatures because of the risk of scalding. At 50°C the risk of scalding is small for most people, but the risk increases rapidly with higher temperatures and for longer exposure times. The risk to young children and to those with a sensory or mobility loss will be greater. Where a significant scalding risk has been identified, the use of thermostatic mixing valves on baths and showers should be considered to reduce temperature, this need to be placed as close to the point of use as possible.

Should the default value need adjusting, please refer to **Section 17.5 Temperature adjustment**

23.6 MAINTENANCE

See section 19.0 Maintenance

23.7 AIR SUPPLY

- When installed as a conventionally flued appliance, the room in which the appliance is installed must be ventilated.



Blocking these vents may lead to severe injury, serious property damage or death.

- The area in which the appliance is installed should not be used to store any other materials

23.8 SMART SYSTEM CONTROL

See Section 16.0 Smart system control

23.9 PARAMETER SETTINGS



The tables below show the parameters that can be changed by the user, these are highlighted in green. All other parameters should only be changed by a competent engineer.

| Menu | Description | See Section | User Access | Installer Access |
|----------------------|---------------------------------------|-------------|-------------|------------------|
| GENERAL | Vacation Mode (On/Off) | 21.1.1 | Yes | Yes |
| | Time and Date | 21.1.2 | Yes | Yes |
| | Software Version (read only) | | No | Yes |
| | Temperature Units (°C/°F) | 21.1.4 | Yes | Yes |
| | DHW Night Setback Offset | | No | Yes |
| | Display Timeout | | No | Yes |
| | Display Contrast | 21.1.9 | Yes | Yes |
| TEMPERATURE SETTINGS | 3-Way Valve Time | | No | Yes |
| DATA LOGGING | Reset Last 10 Errors | | No | Yes |
| FUNCTIONS | Service Mode Delay | | No | Yes |
| | Freeze Protection Pump On | | No | Yes |
| | Freeze Protection Burner On | | No | Yes |
| | Freeze Protection Burner Differential | | No | Yes |
| DHW SETTINGS | Tank Set Point | 17.5.1 | Yes | Yes |
| | Tank Set Point Differential | | No | Yes |
| | DHW Recirc Pump Offset | | No | Yes |
| | DHW Recirc Pump Differential | | No | Yes |
| | Tank Minimum Set Point | | No | Yes |
| | Tank Maximum Set Point | | No | Yes |

23.9.1 SMART SYSTEM CONTROL PARAMETERS WITH USER ACCESS

[illegible]

This image shows a full page of blank handwriting practice paper. It features approximately 28 evenly spaced horizontal green lines across the entire page, providing a guide for letter height and placement. The background is plain white, and there are no margins, text, or other markings present.



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