



Plant Room Heat Pump

Installation and Commissioning Manual



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1. Introduction—a message from the Managing Director



Kensa Engineering has been manufacturing ground source heat pumps since 1999. In the early days, it was difficult to find contractors willing to consider the technology. As a consequence, Kensa made considerable efforts to simplify the installation process to allow any competent contractor to perform the work. The company is now reaping its rewards as heat pumps become mainstream heating appliances.

The purpose of this manual is to guide you through the installation process. It is expected that all the required information has been provided to allow you to connect the heat pump. Critical instructions, aimed at ensuring you do not experience any difficulties, are highlighted on the 'Golden Rules' in the installation section.

Please note you will need to speak to the Technical Support Team on 01872 862140 to receive the 'online commissioning' service, offered free-of-charge. Opening hours are 8.00am to 5.00pm .

Finally, please feel free to contact Kensa should you have any questions, wish to consider ground source heat pumps for any future projects or even just to share your experiences of using a ground source heat pump with us.

Simon Lomax
Managing director
Kensa Engineering Ltd



For further information on ground source heat pumps and their application, please refer to www.kensaengineering.com

2. Safety information



Safe operation of this unit can only be guaranteed if it is properly installed and commissioned in compliance with the manufacturer's requirements. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.

Manufacturer:-
Kensa Engineering
Mount Wellington
Chacewater
Truro
Cornwall
TR4 8RJ
Tel 01872 862140
www.kensaengineering.com

The product is designed and constructed to withstand the forces encountered during normal use. Use of the product for any other purpose, or failure to install the product in accordance with these Installation and Commissioning Instructions, could damage the product, will invalidate the warranty, and may cause injury or fatality to personnel.

2.1 Access

Ensure safe access before attempting to work on the product. Arrange suitable lifting gear if required.

2.2 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

2.3 Tools and consumables

Before starting work ensure that you have suitable tools and / or consumables available.

2.4 Handling

Manual handling of large and /or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

2.5 Residual hazards

Many products are not self-draining. Take due care when dismantling or removing the product from an installation.

2.6 Freezing

Provision must be made to protect products which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

2.7 Disposal/Decommissioning

Kensa offer a life time decommissioning service for this product. This is available on a return to base basis (carriage at users' cost).

Disposal of any antifreeze water mix should follow the disposal instructions as laid out on the COSH Safety Data Sheet on page 34.

3. General Product Information

This manual explains how to install and commission a Kensa ground source plant room heat pump.

The Kensa Plant Room Heat Pump is designed to provide a low cost renewable heat source for a buildings heating system. Heat pumps can provide lower running costs and will generate significantly lower carbon emissions compared with traditional fossil fuels.

The Kensa Plant Room Heat Pump is designed for straightforward installation and intergration into a buildings heating system. The installation must conform to all relevant construction and electrical codes.

3.1 Equipment delivery and handling.

Factory shipment

Prior to shipment, the Kensa Compact Single Compressor Heat Pump is tested, calibrated and inspected to ensure proper operation.

Receipt of shipment

Each pallet should be inspected at the time of delivery for possible external damage. Any visible damage should be recorded immediately on the carrier's copy of the delivery slip.

Each pallet should be unpacked carefully and its contents checked for damage.

If it is found that some items have been damaged or are missing, notify Kensa immediately and provide full details. In addition, damage must be reported to the carrier with a request for their on-site inspection of the damaged item and its shipping pallet.

Storage

If a Kensa Heat Pump is to be stored prior to installation, the environmental storage conditions should be at a temperature between 0°C and 50°C (32°F and 122°F), and between 10% and 80% relative humidity (non-condensing).



Fig 1. The internals of a heat pump

3.2 Kensa Plant Room Technical Details—Single Compressor—3 Phase 400 Volts Only

| Thermal Output | Ground Design Flow Rate | Output Design Flow Rate | Ground Design Flow Rate | Output Design Flow Rate | Ground Design Flow Rate | Output Design Flow Rate |
|----------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| kW | l/s | l/s | l/m | l/m | m ³ /h | m ³ /h |
| 20 | 1.00 | 0.67 | 60.00 | 40.00 | 3.60 | 2.40 |
| 25 | 1.25 | 0.83 | 75.00 | 50.00 | 4.50 | 3.00 |
| 30 | 1.50 | 1.00 | 90.00 | 60.00 | 5.40 | 3.60 |
| 40 | 2.00 | 1.33 | 120.00 | 80.00 | 7.20 | 4.80 |
| 50 | 2.50 | 1.67 | 150.00 | 100.00 | 9.00 | 6.00 |
| 60 | 3.00 | 2.00 | 180.00 | 120.00 | 10.80 | 7.20 |
| 75 | 3.75 | 2.50 | 225.00 | 150.00 | 13.50 | 9.00 |



| Thermal Output | Model Reference | Power supply rating | Max running Current | Typical running current | Typical starting current | Power supply cable size | Power input | Nominal dry weight | Dimensions | Connection size |
|----------------|-----------------|---------------------|---------------------|-------------------------|--------------------------|-------------------------|-------------|--------------------|--------------|-----------------|
| kW | No. | Amps | Amps | Amps | Amps | mm | kW | Kg | HxWxD | mm OD |
| 20 | 70700701 | 30 | 20 | 11 | 123 | 4 | 5.00 | 180 | 1600x750x750 | DN40 PN10/16 |
| 25 | 70700702 | 30 | 22 | 13 | 127 | 4 | 6.25 | 200 | 1600x750x750 | DN40 PN10/16 |
| 30 | 70700703 | 30 | 27 | 14 | 167 | 4 | 7.50 | 250 | 1600x750x750 | DN40 PN10/16 |
| 40 | 70700704 | 40 | 32 | 17 | 198 | 6 | 10.00 | 280 | 1600x750x750 | DN40 PN10/16 |
| 50 | 70700705 | 50 | 41 | 22 | 225 | 10 | 12.50 | 300 | 1750x800x800 | DN40 PN10/16 |
| 60 | 70700706 | 60 | 52 | 28 | 272 | 10 | 15.00 | 330 | 1750x800x800 | DN40 PN10/16 |
| 75 | 70700707 | 70 | 63 | 32 | 310 | 16 | 18.75 | 380 | 1750x800x900 | DN40 PN10/16 |

The figures above are based on a rating to BS EN14511, 0 deg C from the ground, 35 deg C flow to underfloor.

For clarification of starting currents and details on how these figures are calculated please contact Kensa.

4. Installation

Note: Before actioning any installation observe the 'Safety information' in Section 1.

It is essential that the following installation guidelines are followed carefully.

Any electrical work required to install or maintain this appliance should be carried out by a suitably qualified electrician in accordance with current IEE regulations.

Any plumbing work should be carried out to local water authority and WRC regulations.

Kensa plant room heat pumps do not come with any water circulating pumps for either the load or ground side. These should be specified by the M and E consultant and will depend on site conditions.

Important

The following section includes typical schematics of how a heat pump can be connected. It is important to note that the schematics are only general arrangements and hence do not illustrate all required valves or fittings. System designs are also very site specific and should be provided by the M and E consultant. The following is a guide only.

4.1 The golden rules of installing a plant room heat pump

1. A 'D' Type MCB should be used for the heat pumps power supply.
2. All pipe connections to the heat pump must be vibration isolated using bellows or equivalent..
3. Use the Kensa recommended purge pump for purging the ground arrays and heat pump.
4. Pipe lengths to the ground arrays should be kept equal to maintain equal flow and connected reverse return.
5. Read this manual fully before commencing installation

4.2 Plantroom heating schematics

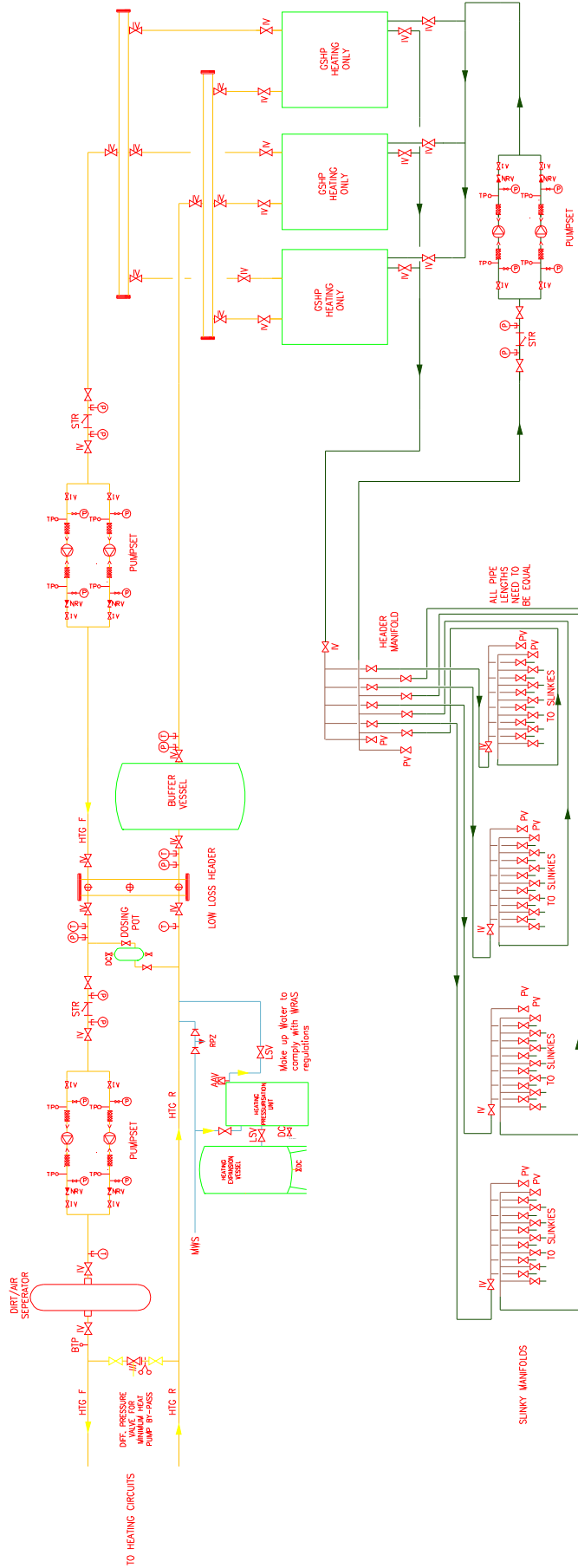
The key to obtaining low CO2 emissions and running costs for any heat pump is to maintain the flow output at as low a temperature as possible. Any increase in outlet temperature will result in a drop in efficiency and systems should be designed to reflect this.

The following schematic details how a heating system for a commercial property can be designed.

The modular design of Kensa plant room heat pumps enables the system to closely match the required heating load. Each unit should be configured via the BMS to operate sequentially to allow part operation to match the heat demand of the building. The multiple unit approach also offers a degree of redundancy in the unlikely event of a problem with one of the units.

Depending on the system design it might be necessary to incorporate a buffer vessel to avoid short cycling problems and it is recommended, to improve overall efficiency of the system, that this is a twin connection buffer vessel. The vessel should be sized for 10 litres per kW of the smallest heat pump module. For example for a 60kW heating load using 3 x 20kW heat pumps the buffer vessel should be approx 20 x 10 = 200 litres. (If low loss headers are used which provide sufficient volume then an additional buffer vessel might not be required).

Kensa heat pumps can work equally as well with horizontal, vertical or lake arrays as the energy source. Although Slinky ground arrays are shown on the drawing, in large commercial projects it can be more usual to use a borehole field design due to space considerations. Kensa can offer a thermal response test on a trail borehole to provide data to enable an accurate borefield design to be produced. For any loads above 100kW this is highly recommended. Please contact Kensa for further details.



Abbreviations

- 2PCV - 2 port control valve
- AAV - Automatic air vent
- HTG F - Heating flow
- TP - Temperature/ pressure sensor

- HTG R - Heating return
- IV - Isolation valve
- NRV - Non return valve

- GSHP - Ground source heat pump
- LTHW - Low temperature hot water
- P - Pressure gauge
- RPZ - Reduced Pressure zone valve

- PV - Purge valve
- STR - Strainer
- T - Temperature gauge

Fig 3 Typical commercial plant room heating only schematic

4.3 Plantroom heating and cooling schematics

In many modern commercial buildings, with the improvement in energy saving measures such as insulation, the requirement for cooling is now almost as great (if not greater) than the requirement for heating. This cooling requirement is generally being driven by the use of heat emitting devices such as computers and printers and even the staff themselves.

Kensa's commercial ground source heat pump range can be designed as reverse cycle modules which can provide heating or cooling. This option needs to be specified at time of order as it cannot be field fitted.

The modular design of Kensa plant rooms enables the system to closely match the required loads. Each unit should be configured via the BMS to operate sequentially to allow part operation to match the heat/cooling demand of the building. With multiple units it is possible to provide heating and cooling to different parts of the building simultaneously. The multiple unit approach also offers a degree of redundancy in the unlikely event of a problem with one of the units.

Depending on the system design it might be necessary to incorporate a buffer vessel to avoid short cycling problems and it is recommended, to improve overall efficiency of the system, that this is a twin connection buffer vessel. The vessel should be sized for 10 litres per kW of the smallest heat pump module. For example for a 60kW heating load using 3 x 20kW heat pumps the buffer vessel should be approx 20 x 10 = 200 litres. (If low loss headers are used which provide sufficient volume then an additional buffer vessel might not be required).

Kensa heat pumps can work equally as well with horizontal, vertical or lake arrays as the energy source. Although Slinky ground arrays are shown on the drawing, in large commercial projects it can be more usual to use a borehole field design due to space considerations. Kensa can offer a thermal response test on a trail borehole to provide data to enable an accurate borefield design to be produced. For any loads above 100kW this is highly recommended. Please contact Kensa for further details.

The following schematic details how a heating and cooling system can be designed, however each heating and cooling system should be designed for each application.

Principle of operation

In the following example two of the ground source heat pumps are designed as reverse cycle units and one as heating only. If there is a demand for cooling the heat pump modules can be switched by the Building Management System (BMS) to cooling mode by the use of a simple volt free relay. At the same time the BMS system will divert the flow from the heating circuit to the cooling circuit by means of a three port diverting valve (3PDV) in the flow line. The return flow to the heat pump is also diverted from the heating circuit to the cooling circuit and the heating pumps turned off and the cooling pumps started.

It is important that a sufficient quantity of glycol antifreeze is added to the cooling and heating circuit fluid to avoid freezing of the fluid in cooling mode.

Abbreviations

| | |
|--------------------------------|-----------------------------------|
| 2PCV - 2 port control valve | IV - Isolation valve |
| 3PDV - 3 port diverting valve | LTHW - Low temperature hot water |
| AAV - Automatic air vent | NRV - Non return valve |
| CHW F- Chilled water flow | P - Pressure gauge |
| CHW R- Chilled water return | PV - Purge valve |
| HTG F- Heating flow | STR - Strainer |
| HTG R- Heating return | T - Temperature gauge |
| GSHP - Ground source heat pump | TP - Temperature/ pressure sensor |

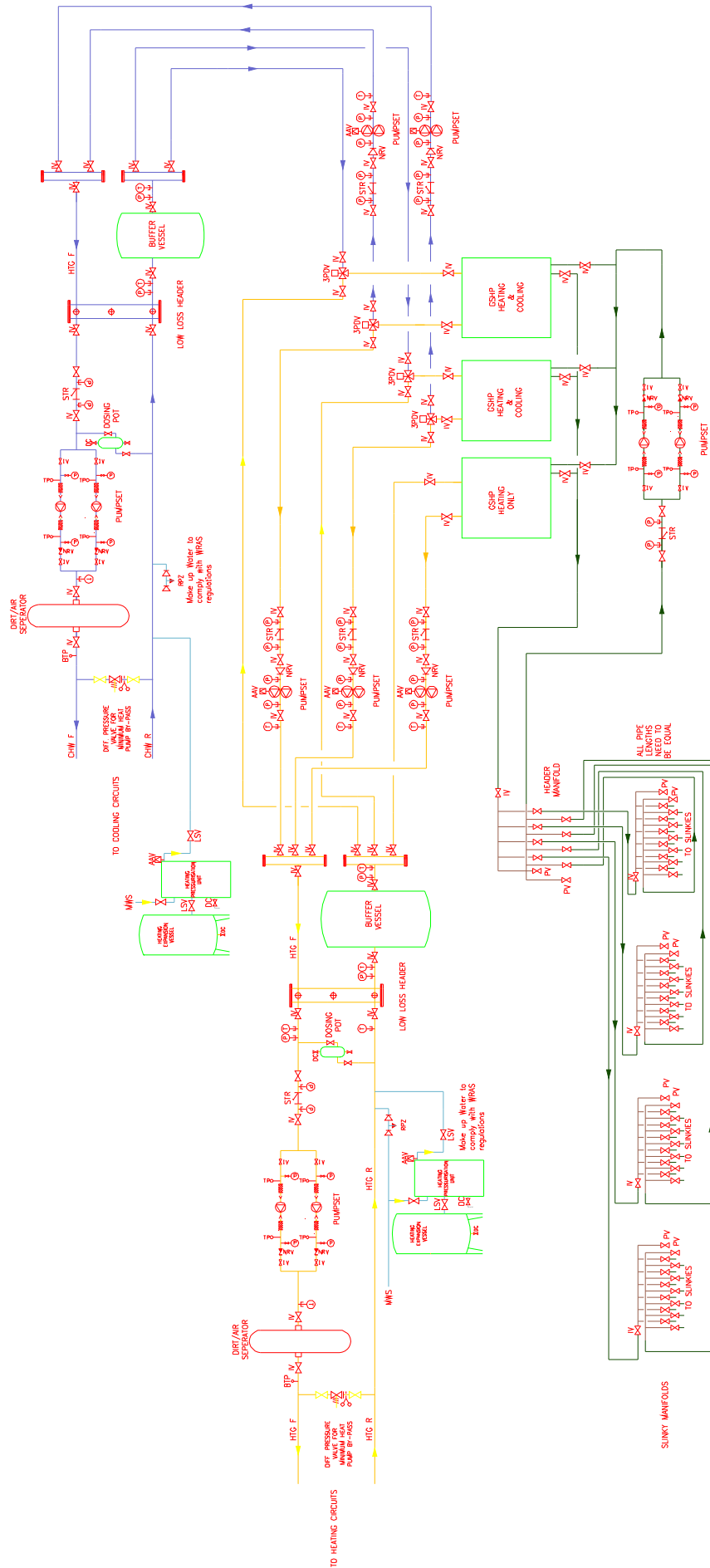


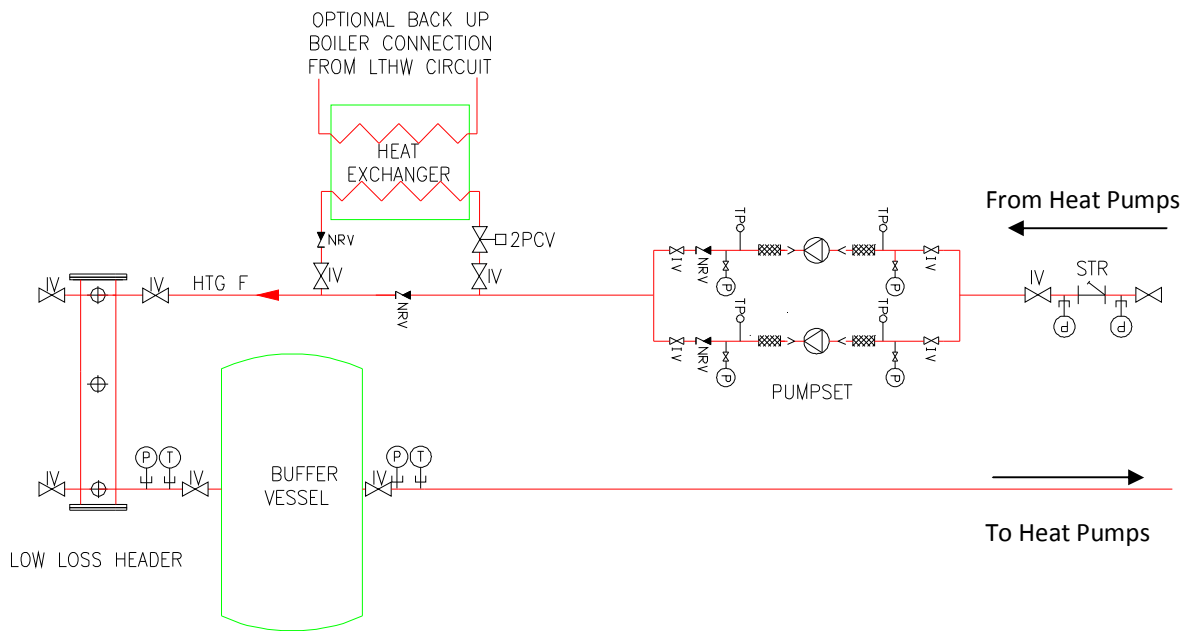
Fig 3 Typical commercial heating and cooling schematic

4.4 Secondary boiler back up systems (either/or systems)

For plant where a secondary back up is required this can be achieved by the use of a plate heat exchanger placed within the flow line.

The ideal situation is that either the heat pumps will be providing the full load or the back up boiler i.e. An either or system. This is because if the return temperature from the heating distribution system is higher than the control set point in the heat pump the heat pump will not operate and the back up boiler will take the whole load.

By using a plate heat exchanger the two systems are hydraulically separated.



Abbreviations

- 2PCV - 2 port control valve
- AAV - Automatic air vent
- HTG F - Heating flow
- HTG R - Heating return
- IV - Isolation valve
- LTHW - Low temperature hot water

- NRV - Non return valve
- P - Pressure gauge
- PV - Purge valve
- STR - Strainer
- T - Temperature gauge
- TP - Temperature/ pressure sensor

Fig 4 Secondary boiler back up

4.5 Mechanical Installation

4.5.1 Locating the heat pump

Decide on a suitable location for the Heat Pump. This should be in a plant room which isolates any occupied spaces from the noise and vibration of the heat pumps. It should not be placed near, under, or above, any inhabited space. Take into account the "Recommended Clearances" when finalising the location and future requirements for access and removal.

Check the appliance for transport damage. Under no circumstances should a damaged appliance be operated or installed without prior agreement.

Position the appliance on a firm, level and substantial concrete base that will absorb vibration well away from any occupied rooms

Ensure that the appliance does not stand on the electrical supply cable. If the supply cable is damaged, it must be replaced.

Ensure all pipes and wires are adequately supported where necessary, pipes are properly insulated and concentrations of inhibitor (where added) are correct. The appliance and any metal pipes should be properly earthed.

A water treatment device should be provided in hard water areas.

4.5.2 Recommend clearances

Remember to consider any future maintenance or removal requirements.

Refer to section 3.2 technical details for dimensions of each different unit

If multiple units are used then these should have a clearance of approximately 200mm between them to enable access to the hex screws securing the hood to the frame.

800mm
required
for hood
removal

Approx
1750 mm
high

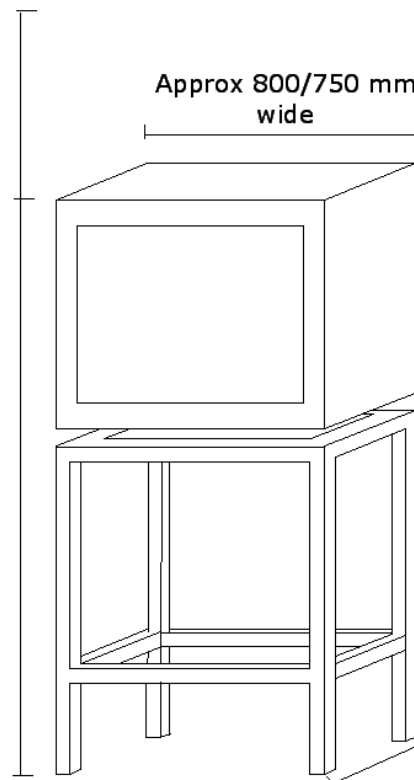


Fig 5 Heat Pump clearances

4.5.3 Installation of the heat pump

Ideally the heat pump should be placed next to an external wall allowing easy access to the externally mounted ground array manifold. Any pipes internal to the building must be insulated with vapour barrier insulation such as Armaflex. It is not recommended that the ground or header array manifold is installed within a building due to condensation and difficulty in lagging the manifold to overcome this.

It is possible to place manifolds in underground chambers, however due to a possible flooding risk and easier access Kensa recommend that the manifold is placed on an external wall.



Fig 6 Plant room heat pumps



Fig 7 Header manifold connections

- i. Remove the door by turning the lock with a screwdriver, opening and lifting off.
 - ii. Remove the hood by unscrewing the 5 mm hex key screws on either side of the base of the hood. Carefully lift the hood off, which will require two people.
 - iii. Place the Heat Pump's base frame into position and level it using the adjustable feet if necessary; please tighten the locking nuts on the feet when level.
 - iv. Using specialist lifting equipment, place the Heat Pump on its base frame, and tighten the fastenings on the anti-vibration mounts.
 - v. Ensure the heating distribution system has been thoroughly purged of any debris.
 - vi. All pipe connections to the heat pump must be vibration isolated using bellows or equivalent. Connect the ground feed & return pipes from the ground array/header manifold (which can be connected either way round), and the feed and return pipes from the heating distribution manifold (which must be connected the correct way round), according to the Illustration overleaf.
- The reason for using flexible connections is that the heat pump is suspended on anti-vibration mounts, so the connections must also be flexible. For multiple plant room modules the flows and returns should be manifolded together ideally in a reverse return arrangement if possible.
- vii. Thread the power supply and timeclock/room thermostat wires from under the Compact into the control box and connect them to the terminals required, (see electrical installation section).
 - viii. If required fit the optional weather compensation sensor to a North facing wall, and connect with two-core minimum 0.5mm sq cable (see Section 4.6.2). The use of weather compensation on heat pumps is unlikely to give any significant cost savings and can actually increase the cost of running a heat pump. For this reason, Kensa Heat Pumps are supplied with this function disabled in the software.
 - ix. Check and rectify any leaks that may be in the plumbing system.
 - x. The appliance should be left for 12 hours after installation before it is turned on, to allow the refrigerant to settle. The area where the heat pump is installed must be dry and rodent free.

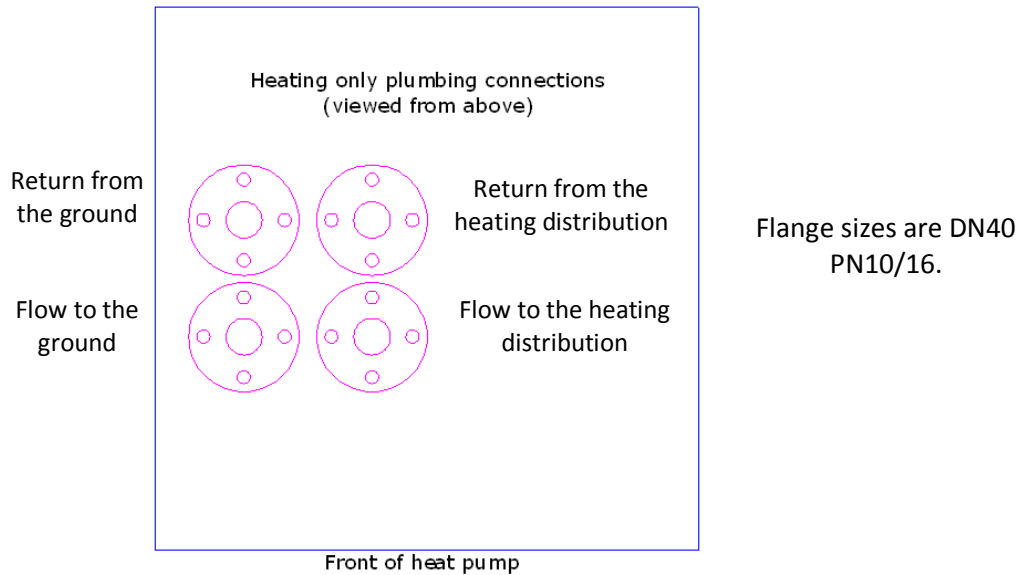


Fig 8 Plant room heat pump connections (from the front of the unit.)

4.6 Electrical installation

The Kensa Plant Room heat pump range is available in three phase power supply versions only (415V 50-60 Hz).

Any electrical work required to install or maintain this appliance should be carried out by a suitably qualified electrician in accordance with current IEE regulations

To access the wiring terminals :-

- i. remove the door by turning the lock with a screwdriver, opening and lifting off.
- ii. remove the electronics cover plate by unscrewing the two 3mm cross head screws on the front



Fig 9 Position of hex screws on the electronics cover plate



Fig 9 Electrics box with the front removed

Controller

Compressor MCBs

Wiring Terminals

Ground pump relay

Controller 4mA MCB

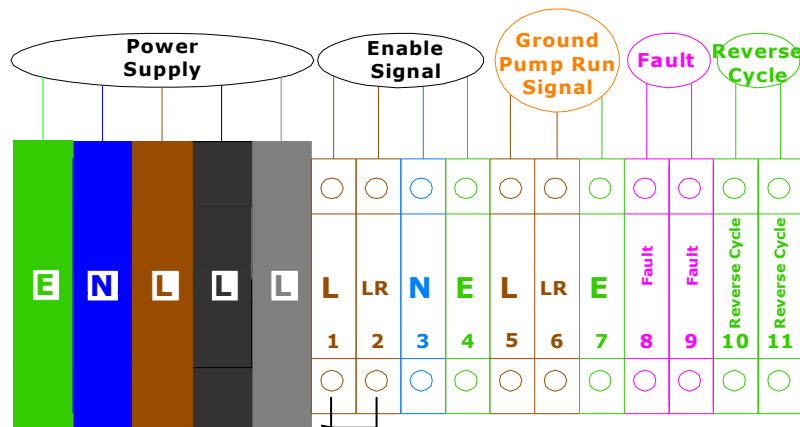
Cables should enter the unit from below using the cable entry ports provided.

The following sections detail the standard wiring connections.

In all wiring diagrams the terminals marked 'Reverse Cycle' change the mode from heating to cooling (If this option is fitted). This requires a volt free relay, open is heating mode, closed cooling.

The terminals marked 'Fault' are to provide remote indication that a fault has occurred within the heat pump. This is a volt free relay and the internal relay will close if a fault occurs.

4.6.1 Three phase power supplies



Enable Signal connection is supplied with a temporary link across it. This should be removed after commissioning and connection to the heating control system. (Terminals 1 and 2)

Fig 10 Heat pump wiring—Three phase power supplies

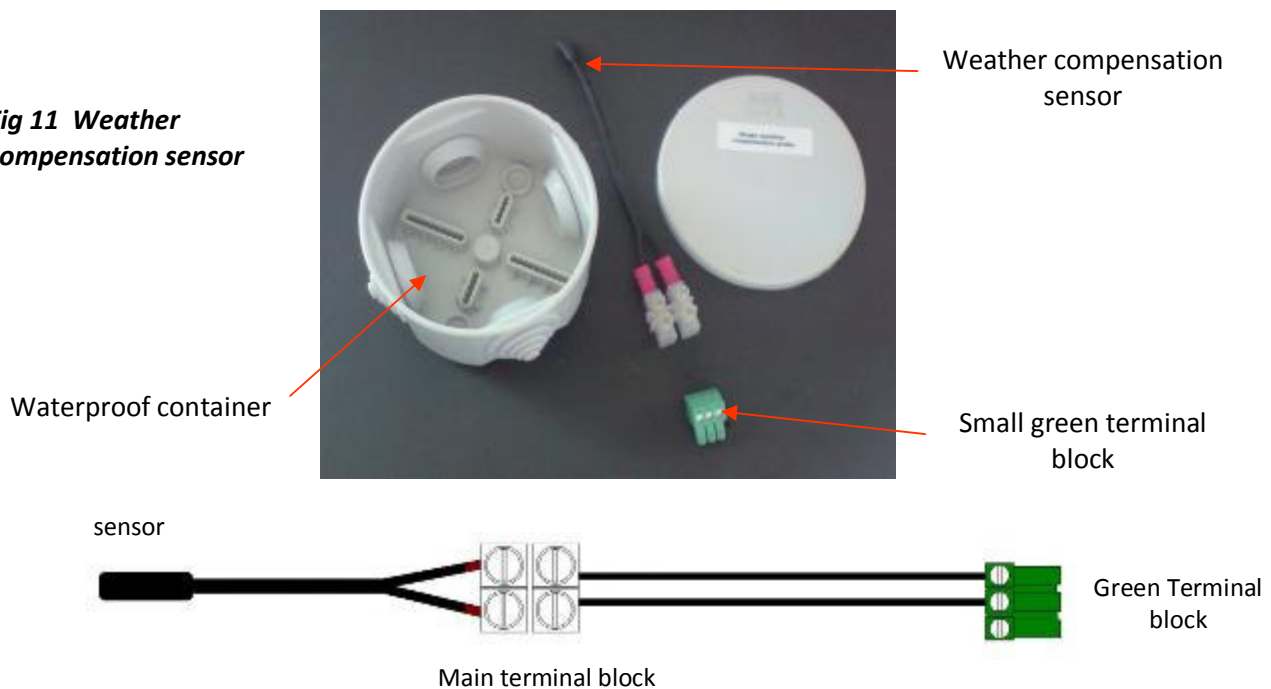
4.6.2 Weather compensation (optional)

All Kensa Heat Pumps are supplied with Weather Compensation as standard. This facility will reduce the return water set-point against a schedule of external ambient temperatures. In more simple terms, the temperature of water flowing into the building's radiators or underfloor heating is reduced in mild weather, which allows the heat pump to run more efficiently. This is particularly important with radiators, as much higher temperatures are required. In cold weather, many people already turn up the temperature of water flowing from their boiler by hand and are therefore weather compensating their heating system manually. Weather compensation can also be provided by the buildings Building Energy Management System (BEMS) by controlling the operation of the heat pumps.

In the UK, the use of banded tariffs such as Economy 7, or more especially Economy 10, makes the use of weather compensation on heat pumps unlikely to give any significant cost savings and can actually increase the cost of running a heat pump. This is because during a banded and cheaper rate of electricity it is desirable to run the heat pump at its maximum heat output so that as much heat is forced into the building as possible, whilst being careful not to overheat it in milder weather.

For this reason, Kensa Heat Pumps are supplied with the required sensors for installation, however the function is disabled in the software and it is **recommended that this function is not enabled**. Tariffs might possibly change in the future and so to enable weather compensation (if required) on your heat pump you can contact our Technical department, who can run through the reprogramming procedure.

Fig 11 Weather compensation sensor



The weather compensation sensor is supplied in a small waterproof enclosure.

This sensor needs to be fixed to a North-facing wall, and connected with 2 core 0.5 mm cable, unshielded, to the heat pump. The cable should be routed inside the heat pump case and left coiled up inside, with the small green terminal block attached. The weather compensation should then be left disabled. If weather compensation is required contact Kensa Technical Department.

Do not disconnect or connect any terminal blocks until Kensa Technical Department has been contacted on 01872 862140.

Kensa's Technical department will guide you through the procedure for enabling the weather compensation.

5. Commissioning

After all mechanical and electrical work has been completed, the following commissioning instructions should be followed.

5.1 Purging the ground array of air.

It is important for correct operation that all the air is removed from the ground arrays. Slinkies consist of a large number of 1 metre diameter loops of 32mm OD pipe and air can collect at the top of these loops. Even vertical (ie. drilled) arrays can have trapped air and should be purged.

To remove the air from ground arrays, a suitable pump will be required. For slinkies, the longest slinky trench is 50 metres, which will contain a total of approx. 300 metres of pipe. To achieve the minimum velocity required to remove the air, a minimum pump power in excess of 1 kW is required. In addition, the pump needs to have a flow of at least 60 litres per minute against a pressure of at least 1 bar. To achieve this, a multi-stage pump is required.

A normal rising cold water main in a building has insufficient flow to force out this air. Mains water is also "aerated", so should not be used.

The recommended purge pump is the Clarke CPE130SS (part no. 051010379). The pump is supplied ready to take a 1" BSP fitting. Two x 1" BSP male to 28 mm compression fittings are required to enable the pump to be connected to the slinky manifold using 28 mm "Speedfit" or similar pipe and elbows. These are readily available from plumbing merchants.

**Fig 12 Clarke
CPE130SS purge
pump**



The Clarke CPE130SS can achieve as much as 5 bar pressure against a closed valve, so ensure the connections to the pump and manifold are robust.

On large commercial projects it is also advisable that automatic air vents are fitted, in the header system, at high points where air could collect.

5.1.1 Purging procedure for multiple slinkies/ground arrays.

- i. Remove the plastic blanking plugs, and connect the purge pump to the fill and purge ports on the ground array manifold, see diagram over leaf. Keep the isolating valve to the heat pump closed. The purge ports can be connected either way round.
- ii. Connect the purge pump to draw from an 80 litre dustbin half filled with clean water. This pump must be capable of circulating 60 litres per minute against a pressure of 1 bar. If the pump's electrical rating is less than 1 kW, then it is unlikely to be suitable. Kensa recommend the use of the Clarke CPE130SS pump as above. The water level in the dustbin will need to be topped up constantly during the following process. The pump may need priming by pouring water into its priming port until it overflows.

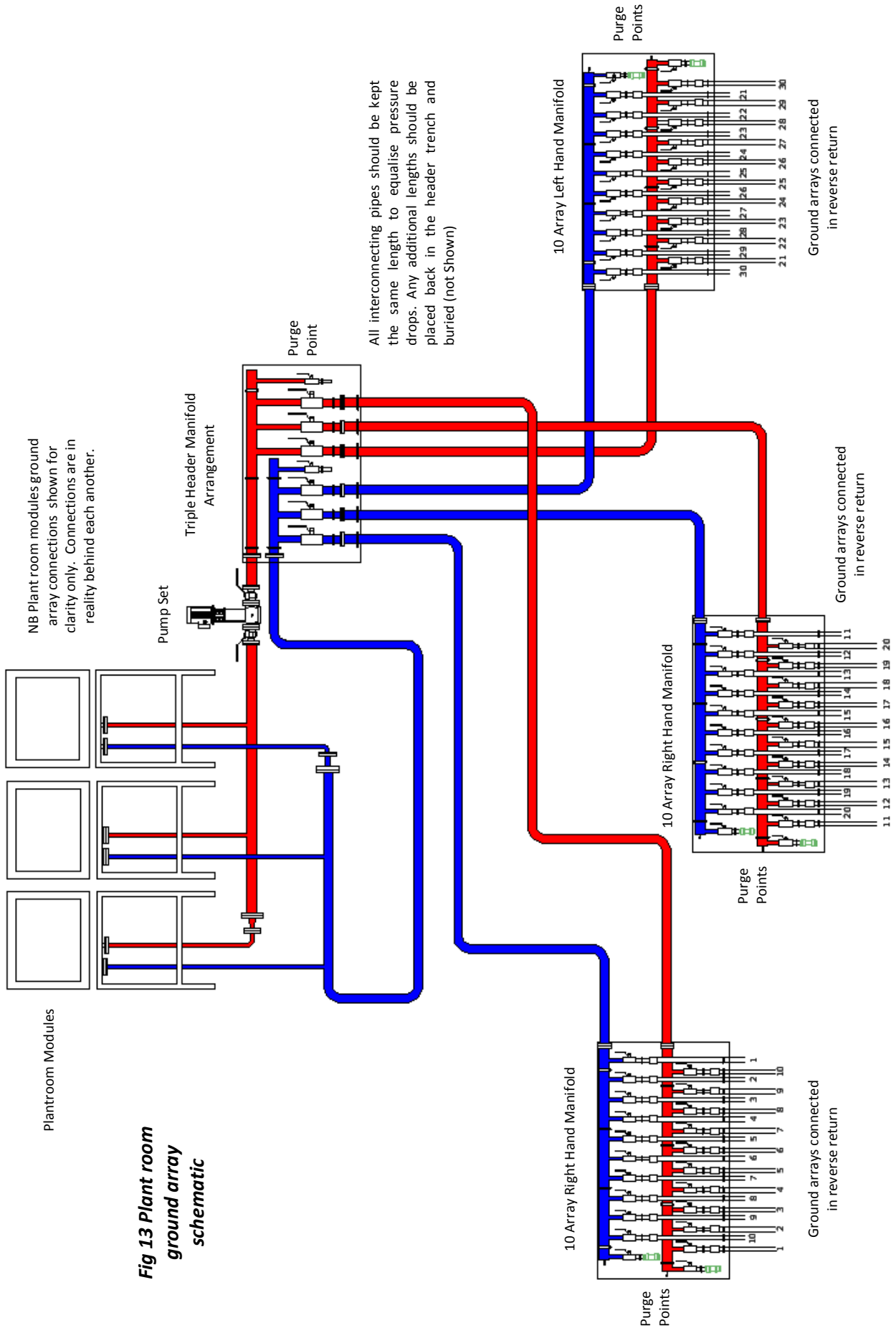


Fig 13 Plant room ground array schematic

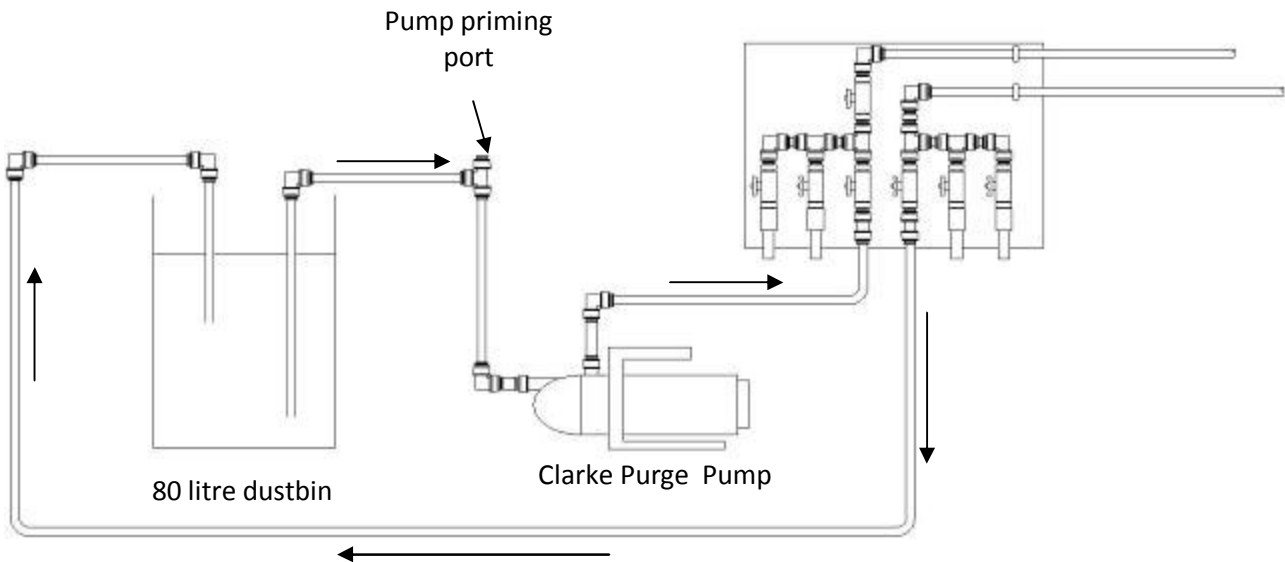


Fig 14 Slinky purging kit connected to a manifold

iii. Place a filter such as a kitchen sieve over the pipe returning water to the dustbin so any debris will be captured. Ensure all valves are closed including the flow valves to the heat pumps. Open the valves on the manifold in the following order (refer to Fig 13) :-

- a. Open 1_{return}
- b. Open 1_{flow}
- c. Open both purge valves

Start the purge pump, being careful that the water pipe returning water to the dustbin is secure.

iv. If the water level in the dustbin does not start to drop, then repeat the pump priming. No water should be flowing through the heat pump or through the other arrays. The flow rate should be in excess of 30 litres per minute. This can be checked simply by holding a 10 litre bucket to collect water returning from the slinky, and ensuring that it fills in less than 20 seconds. If the flow is less than this, sufficient velocity is not being achieved to displace the air from the arrays.

Fig 15 Purging the arrays of air



Fig 16 Arrays purged of air



v. After water has circulated for about ten minutes, and no more debris has collected in the sieve, place the return pipe below the water level in the dustbin to ensure all the air has also been expelled (Fig 16). Stop the purge pump and then the valves on the first slinky can then be closed, again ensure that the return pipe into the dustbin is secure. At this stage, the valve to the heat pump should still be closed.

- c. Close 1_{flow}
- d. Close 1_{return}

Repeat the above procedure (steps iii to v) for the next array (i.e. Number 2 on the diagram).

Once the first ground array has been purged move onto the second array and repeat the process. After all the ground array manifolds have been purged the header manifold and pipe between this and the

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ground array manifold needs to be purged using the same procedure.

- vi. When all the ground and header arrays have been purged, the valve to the heat pump can be opened, which will purge the heat pump of air care should be taken that the hose discharging into the dustbin is secure, as any air in the heat pump will be rapidly expelled.
 - e. Close all valves to the ground arrays.
 - f. Open the valves to the heatpump
- vii. Continue purging the heat pump until all the air has been expelled. (No more bubbles are expelled from the return pipe. Fig 16)

5.1.2 Purging the headers

Once the ground arrays have been purged of air it is important that the header pipe is also purged. This should be done by connecting the purge points together on each array manifold in turn using suitable pipe to create a loop. The purging should then be carried out from the header manifold following the same purging procedure as for the ground arrays. (Section 5.1.1).

To ensure all the air is removed it is advised that when the headers have been purged the ground arrays are purged again and automatic air vents are connected at high points where air can collect.

5.1.3 Adding antifreeze

The antifreeze provides protection to the heat pump by preventing the circulating ground fluid from freezing in the heat exchanger. If not added in sufficient quantities the heat pump can freeze and cease working. All antifreeze provided with the order should be added and it is recommended that the quantity is roughly divided between the number of arrays. This amount of antifreeze is the minimum required for a standard system. If the heat pump and manifold are a distance apart and header manifolds are present this quantity may need to be increased. Please contact Kensa for further details.

It is very important to purge all the air from the system before adding the antifreeze as it is very difficult to remove the air with the antifreeze in the system due to the higher viscosity of the mixture.

Once the purging of all the air within the arrays and heat pump has been completed the antifreeze needs to be added.

- i. Open the flow and return valves to one of the arrays and with the purge pump running, empty some of the water out of the dustbin via the return pipe to the dustbin. This is fresh water and hence can be discharged to drain. The level needs to drop to about 200 to 250mm. Take care that the suction pipe remains covered with water to stop any air being admitted into the system.
- ii. Turn the purge pump off and close both the flow and return valves on the slinky.
- iii. Carefully pour a drum of antifreeze into the dustbin using appropriate handling protection as outlined in the COSH (Section 8). Allow the solution to settle for a few moments to allow any trapped air to escape.
- iv. Open the valve to the heat pump and start the purge pump to circulate the antifreeze around the system. Leave the pump running until antifreeze is seen returning to the dustbin. The amount of time this will take depends upon the length of the header pipe.
- v. Close the valve to the heat pump and turn the purge pump off.
- vi. Open the first array flow and return valve and with the return pipe inside of the dustbin start the purge pump. Once the return discharge runs clear, i.e. It's discharging fresh water, move the return pipe out of the dustbin and discharge this fresh water to drain until the antifreeze level within the dustbin drops to approximately 200-250mm. Take care that the suction pipe remains covered with

water to stop any air being admitted into the system. (Depending on the length of header pipe additional antifreeze might be required to be added at this stage). The discharge pipe can then be placed back into the dustbin and the purge pump should be run for about 5-10mins and then turned off.

- vii. Close the array valves; add the next quantity of antifreeze to the dustbin and repeat the above steps vi and vii for each individual array.

5.1.4 Pressurizing the system.

- i. Open all valves EXCEPT THE DISCHARGE PURGE CONNECTION. Keep a close eye on the level of water in the dustbin and start the purge pump. This should pressurise the whole system. If the level of water drops significantly this indicates the system hasn't been correctly purged of air and needs to be re-purged.
- ii. Close the fill purge valve on the slinky manifold with the pump running, so that the ground array is left under pressure.
- iii. Most purge pumps will attain around 5 bar, and the circuit should be left at this pressure for a minimum of 15 mins, as any leaks will become immediately apparent. The pressure will slowly fall as the pipes in the ground arrays slowly expand in the coming months, and may need topping up using the cold fill system provided.
- iv. Remove the purging equipment. Replace the plastic blanking plugs in the array manifold purge connections.

There should be approximately 200-250mm of water/antifreeze mix within the dustbin which can be poured back into an empty drum and disposed off according to the disposal instructions in section 8 or retained for topping up the system.

To mix the antifreeze around the ground arrays thoroughly, it is advised that the ground array circulation pump is turned on before the compressor is turned on. This ground array circulation pump should be left running for two to three hours to ensure the antifreeze is mixed in all the ground arrays and the heat pump.

5.1.5 Testing of antifreeze concentration

It is important that the concentration of the antifreeze within the ground arrays should be a minimum of 20% or a protection level of -10°C . Concentrations below this could cause an A1 alarm and the heat pump to cease operation during severe prolonged cold weather.

The antifreeze concentration should be tested with a refractometer. If required a sample can be sent to Kensa for testing.

The concentration of antifreeze is required for the commissioning certificate and it is advised that this figure is noted in the settings table. A sample of the fluid can be obtained from the ground side Schrader valve as shown in Fig 17.

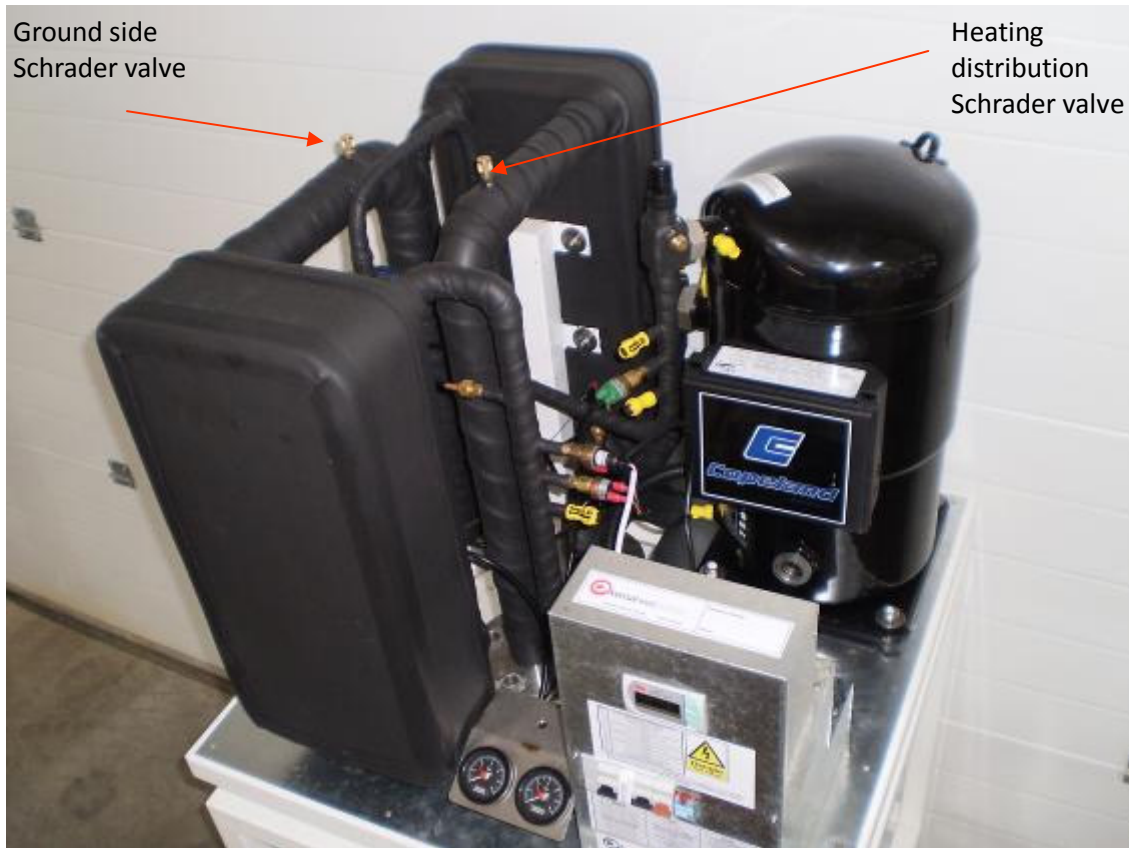


Fig 17 Location of heat pump schrader valves (Bleed Points)

5.1.6 Heating distribution and load side purging

- i. Find the cold fill for the heating system and open the valve on the heating system to allow water into the heating system and the Compact.
- ii. Follow the manufacturer's procedures for purging the heating system.
- iv. Remove the cap from the heating pump bleed port and depress the Schrader valve using a small screw driver, as shown in Fig 17
- v. Alternatively, the Schrader valve core can be unscrewed completely using a car valve core remover and a 10 mm internal diameter plastic pipe placed on the outside of the valve to allow any water or air to be vented into a bucket.
- vi. When a constant stream of water comes from the valve the pump will have been bled. This procedure needs to be repeated at intervals during the commissioning procedure if there is any air in the heating system. Place the cap back on the bleed valve.

We recommend a central heating inhibitor is added to the heating water in the heating distribution circuit

5.1.7 Reassembling the heat pump

- i. Ensure all tools and materials are removed from the inside of the unit.
- ii. Carefully lift the hood back onto the heat pump using the appropriate lifting procedures.
- iii. Using the 5mm hex socket screws on either side of the base of the hood secure the hood in place.
- iv. Replace the door and lock it shut.

5.2 Heat pump operation

Prior to use: -

- i. Turn off the power supply at the local isolator
- ii. Open the front door using a screwdriver or similar implement.
- iii. Check that the ground pressure gauge reads at least 0.3 bar. If the pressure is lower than this, open the mains cold water supply valve (fitted outside the case) fully until the gauge reads at least 1.8 bar, at which point a “click” will be heard. Close the mains cold water supply valve fully.
- iv. Check that the heating distribution system pressure gauge reads at least 0.3 bar. If the pressure is lower than this, find the mains cold water supply valve and pressurize the system until the gauge reads at least 1.8 bar, at which point a “click” will be heard. Close the mains cold water supply valve fully. Reassemble the front panel taking care to ensure that the 4 x hex screws are located correctly. A purge pump can achieve pressures of 5 bar and it is acceptable that the ground arrays are left at this pressure.
- v. Turn on the power supply at the local isolator and program the external BMS/timeclock / thermostat.

5.3 Turning the heat pump on for the first time.

- i. Turn the power on to the heat pump.
- ii. Turn the 4 Amp MCB on to enable the controls to operate. Operating this MCB should result in a sudden sharp change in pressure on the load pressure gauge and indicates that the pump is operational. Shortly after operating this MCB, the compressor contactor should engage. This will result in a sudden sharp change of pressure indicated on the ground array pressure gauge and this indicates that the ground array water pump is operational. **DO NOT operate the compressor MCB until Kensa Engineering has been contacted and flow has been confirmed around the system.** Failure to do this may cause the unit to freeze and will invalidate the warranty.
- iii. The controller display will read the temperature of the water returning from the heating system. If the error Tp is displayed, then the heat pump will not run until both heating distribution and ground circuits are above 1.8 bar pressure.
- iv. The commissioning of the heat pump will be carried out remotely (via phone) by a Kensa commissioning engineer and a heat pump commissioning certificate and checklist issued on completion. Please contact Kensa Engineering to book a commissioning call.

5.4 Altering the flow temperature from the heat pump

Each heat pump has a dedicated control unit which can be interrogated to view various parameters, alter the heat pump outlet flow temperature and indicate faults/alarms.



n.b. the numbers above refer to the points below.

Fig 30 Heat pump display

The display normally reads the temperature of the water returning from the heating distribution system. The controller will turn the heat pump off once a pre-set temperature of water returning from the heating system has been achieved. This setting is normally 30 °C. These are typical return temperatures for an underfloor application.

The Kensa Plantroom Range of heat pumps are delivered with the software pre-configured for a typical underfloor mounted in screed application.

1. The display on the controller indicates the return temperature of the underfloor circuit.
2. The left hand symbols, sun, (top left) and frost, (bottom left) indicate heating & cooling respectively (Heating only heat pumps will only use the sun symbol and cooling heat pumps only the frost symbol. Reverse cycle machines will use both symbols, the one being displayed being dependant on the operating mode selected at the time.)



Sun symbol—heating mode



Frost symbol—cooling mode

3. A number “1” will appear top right of controller, if the number “1” is flashing the internal timer is activated and compressor is waiting to run. When the compressor is running the number “1” and the compressor run symbol will be on.



Compressor running

A flashing error code may appear if there is a fault with the heat pump, the most common will be: -

| Alarm | Description |
|-----------|---|
| TP | Low water pressure (ground or heating distribution) |
| HP | High gas pressure caused by low or no flow on the heating distribution circuit. |
| LP | Low gas pressure fault (can occur temporarily on first start up). Call Kensa Technical Department. |
| A1 | Anti freeze alarm, ground getting to cold / insufficient anti freeze/ unit not commissioned correctly/ low flow around ground arrays. |

(See Fault Finding Section 6 for further details)

5.4.1 To read flow temperatures and refrigerant pressures

Using the display it is possible to interrogate the heat pump to read flow temperatures and refrigerant pressures.

To read flow temperatures and refrigerant pressures, on each controller: -

- 1 Press and hold SEL until -/- is displayed
- 2 Press the UP arrow until -b- is displayed
- 3 Press SEL and b01 is displayed
- 4 Press SEL
- 5 Temperature of water returning from the underfloor is displayed = b01
- 6 Press SEL
- 7 Press the UP arrow once until b02 is displayed
- 8 Press SEL
- 9 Temperature of water returning from ground arrays is displayed = b02
- 10 Press SEL
- 11 Press the UP arrow once until b03 is displayed
- 12 Press SEL
- 13 Temperature of water going out to the ground arrays is displayed = b03
- 14 Press SEL
- 15 Press the UP arrow once until b04 is displayed
- 16 Press SEL
- 17 Refrigerant pressure (in Bar) is displayed = b04
- 18 Press SEL
- 19 Press PRG twice until S-P is displayed
- 20 Press and hold PRG until the display returns to normal

5.4.2 To change the heat pump return flow temperatures.

Heat pumps are generally controlled on the return temperature from the heating distribution system and work on a temperature differential of approximately 5 degrees, i.e. if the return temperature set point is 30°C the actual flow temperature out of the heat pump is approximately 35°C.

The outlet flow temperature of the heat pump determines the efficiency of the heat pump.

For underfloor systems mounted in screed a flow temperature of 35°C is generally suitable, therefore the return temperature should be set at 30°C/31°C. However for joisted systems or systems with insulative floor coverings then a higher flow temperature may be required and hence the return flow temperature set point may need to be increased.

For radiator systems a flow temperature of 50°C is generally required. This means the return temperature set point should be set to approximately 45°C

Warning :- Increasing the outlet flow temperature of the heat pump will result in the unit operating at a lower efficiency with higher fuel bills.

Warning :- for underfloor systems do not increase the outlet flow temperature until the screed that the underfloor is mounted in is fully dry.

Changing the flow temperatures is protected by a passcode to prevent unauthorised changes. This passcode is 22 and not changeable.

- 1 Press and hold SEL until 0 is displayed
- 2 Using the UP arrow increase the displayed number to 22
- 3 Press SEL
- 4 Press and hold SEL until -/- is displayed
- 5 Press SEL
- 6 Press the UP arrow until -r- is displayed
- 7 Press SEL and r01 is displayed
- 8 Press the UP arrow until r03 is displayed
- 9 Press SEL
- 10 The return water temperature setpoint is displayed
- 11 Press the UP or DOWN arrows to change the setpoint
- 12 Press SEL
- 13 Press PRG twice until S-P is displayed
- 14 Press and hold PRG until the display returns to normal

It is advised that any settings that are changed are noted within Section 8 'Heat Pump Settings Sheet' page 32.

6. Fault Finding

Many faults which occur on commissioning are found to be due to incorrect wiring or setting up, therefore it is recommended that a thorough check is carried out should there be a problem.

| Symptom | Possible Cause | Action |
|--|---|--|
| Blank display on software controller | No power supply | Check wall mounted electrical isolator switch or call electrician |
| | Controls MCB tripped | Call electrician to investigate cause |
| | There is no call from the time-clock, BMS or thermostat for heat pump operation | Programme time-clock according to manufacturer's instructions |
| Compressor not running but display reading temperature near setpoint | Heat pump is up to temperature | No fault |
| Display flashes fault code tP | Low water pressure in the ground or heating system side due to pipe relaxation or other pressure loss. | Check the pressure gauges below the two water pumps. The pressures should be between 1 and 2 bar. If below this, the pressure needs to be increased above 1.8 bar To increase the pressure in either circuit, the cold fill valve will need to be opened. The Ground cold fill is provided with every Kensa heat pump, and is found on the right hand side of the heat pump, underneath. The heating distribution system should have it's own fill point. |
| Display flashes fault code HP | Overheat warning. No or low flow around heating distribution circuit because of air in water pump, or stuck water pump impellor, or heating distribution system valves/ actuators closed. | Bleed the heating distribution system pump within the heat pump, using the schrader valve above the pump. (See Fig 28). Check that the water pumps are operational and spin the impellers. (See section 5.3) |
| Display flashes fault code LP | Low gas pressure in machine. Can occur simultaneously with an A1 alarm. | Check that the water pumps are operational and spin the impellers (see section 5.3) If symptom persists outside of the two listed circumstances, contact Kensa Technical department. |
| | Can occur temporarily on first start up when unit is new or after a long period out of use. Insufficient antifreeze added and heat pump frozen. | No action Allow heat pump to defrost and add the correct antifreeze quantity. |
| Display flashes fault code A1 | Freeze protection system activated. Low or no water flow on the ground (cold) side of the machine. Can also occur after many months of running in very cold weather. | Check antifreeze has been added and unit commissioned correctly. Check that the water pumps are operational and spin the impellers (see section 5.3) Ensure no flow restrictions and wait approximately 4 hours (with the machine turned off) for automatic reset. |
| Display flashes fault code E1, E2, E3 or E4 | Loss of contact with probes inside heat pump. E4 could be loss of contact with weather compensation sensor | Refer to Kensa Technical department |

7. RTB and Extended Warranty Statement

All Kensa heat pumps have a two year RTB (Return To Base) warranty as standard. The warranty runs from the date of delivery of the heat pump.

RTB means that if a product is thought to be defective, then it is returned to the manufacturer, with carriage paid by the customer. The manufacturer then examines the product. If no fault is found, then the customer pays the return carriage. The manufacturer may also charge the customer for anytime or materials expended, before returning the product. If a fault is found, then the manufacturer pays for both the parts and labour for the repair, and the return carriage is paid by the manufacturer.

The situation is the same for a suspect component, except that the component is despatched direct to the client, for which payment is made by the client, including the carriage. The client's installer then installs the new component, and sends the old component back to the manufacturer. If the manufacturer confirms the component as faulty, then the cost of the component and the carriage back to the client is paid. Most manufacturers would also meet the costs of an installer, although if the installer had received a discount on supplying the equipment, then this would usually be expected to cover minor labour costs. The above is a description of the "bare minimum" as prescribed by an RTB warranty.

7.1 Extending the RTB warranty

The RTB warranty can be extended. The warranty extension must be requested, and paid for in full prior to delivery.

The warranty can be extended for a maximum of five years from date of delivery.

7.1.1 Parts only

The cost of this is 5% of the original list price of the heat pump for every year that the warranty is extended.

Excluded from the warranty is neglect or misuse of the products, or their components.

7.1.2 Labour & parts

The cost of this is 7.5% of the original list price of the heat pump for every year that the warranty is extended.

Any labour supplied under an extended warranty will be on a "planned" rather than "emergency" call out basis only.

Please note that labour may be provided by a company or person nominated by Kensa Heat Pumps, or by another nominated party by written mutual agreement prior to any work being undertaken.

8. Antifreeze COSH Sheet



CoolFlow

COOLFLOW IG

SAFETY DATA SHEET

1. PRODUCT AND COMPANY IDENTIFICATION

| | |
|-------------------------|--|
| Product Name | CoolFlow IG (aka IG Antifreeze) |
| Manufacturer / Supplier | Hydra Technologies Ltd. (aka Hydratech) |
| Address | Mercantile Buildings P.O. Box 222 Swansea SA5 4YT United Kingdom |
| Telephone No. | 01792 586800 |
| Facsimile No. | 01792 561606 |
| E-Mail | info@hydratech.co.uk |

2. COMPOSITION / INFORMATION ON PRODUCT COMPONENTS

| Hazardous Components for EC | | | | |
|--|----------|---------------|----------|--------------------------|
| COMPONENT NAME | CAS no | CONCENTRATION | R PHASES | CLASSIFICATION |
| I. Mono Ethylene Glycol with corrosion, scale and biological inhibitors. | 107-21-1 | 90 -100% | R22 | Xn -Harmful if swallowed |

3. HAZARD IDENTIFICATION

Main Hazards Harmful if swallowed.

4. FIRST AID MEASURES

| | |
|----------------------------|--|
| Health effects - Eyes | Wash eyes promptly and rinse for 15 minutes. Get medical attention. |
| Health effects - Skin | Remove affected person from source of contamination. Wash skin with soap or mild detergent. |
| Health effects - Ingestion | Following over exposure by ingestion, treatment may be needed for CNS depression and severe acidosis. Early administration of ethanol may counter the effects of monoethylene glycol. Haemodialysis or peritoneal dialysis may be effective. |
| First Aid - Inhalation | Remove person to fresh air at once. Perform artificial respiration if breathing has stopped. Keep the affected person warm and at rest. Get medical attention. |

5. FIRE FIGHTING MEASURES

| | |
|---|---|
| Extinguishing Media | Water, foam. Carbon Dioxide (CO2). Dry chemicals, sand and dolomite etc |
| Protective equipment for fire fighting. | Wear self contained breathing apparatus. |

6. ACCIDENTAL RELEASE MEASURES

| | |
|--------------------------|---|
| Personal precautions | Wear rubber or PVC gloves and goggles. |
| Environmental protection | Inform local authorities. Protect drains by covering. |
| Spill clean up | Stop leak if possible without risk. Inform authorities if large volumes involved. Absorb with inert, damp, non-combustible materials then flush with water. Disposal should be carried out in accordance with any Special Waste Regs. |

7. HANDLING AND STORAGE

| | |
|--------------------|--|
| Handling & Storage | Avoid inhalation of any vapours. Keep away from heat or naked flame. Avoid static build up. Containers should be : kept tightly sealed and dry. |
|--------------------|--|

8. EXPOSURE CONTROL/PERSONAL PROTECTION

| | |
|------------------------------|---|
| See section 7 | LT Exp (8 hrs) : 60mg/m3. ST Exp (15 mins) 125mg/m3 |
| Engineering Control Measures | Engineering methods to prevent or control exposure are preferred. Methods include process or personnel enclosure, mechanical ventilation (dilution and local exhaust), and control of process conditions. |
| Respiratory Protection | Respiratory protection if risk of exposure to high vapour concentrations. |
| Hand Protection | PVC gloves |
| Eye Protection | Chemical goggles or face shield must be worn. |
| Body protection | Wear overall or apron. |

COOLFLOW IG

SAFETY DATA SHEET

9. PHYSICAL AND CHEMICAL PROPERTIES

| | |
|------------------------------|---|
| Physical State | Liquid. Hygroscopic. Viscous. |
| Colour | According to specification. Eg. may be dyed one of several colours. |
| Odour | Almost odourless (slightly sweet) |
| pH at 500g/l, 20°C | Range between 7.5 - 10 pH depending on inhibitors and additives. |
| Density (g/cm ³) | 1.04 to 1.20 depending on inhibitor concentration and dilution. |

10. STABILITY AND REACTIVITY

| | |
|---------------------|-----------------------------------|
| Stability | No particular stability concerns. |
| Conditions to Avoid | Heat, flames sparks. |
| Materials to Avoid | strong oxidising agents. |

11. TOXICOLOGICAL INFORMATION

| | |
|------------------|---|
| Acute Toxicity | LD 50/oral/rat:4700.00 mg/kg, Human poison by ingestion. Lethal dose to humans 100 ml. Gas or vapour is harmful on prolonged exposure or high concentration. Narcotic effect. Nephrotoxin. chronic respiratory failure. Swallowing may cause severe internal injury. Liver and/or kidney damage. |
| Route of entry | Ingestion. Skin and or eye contact. |
| Target organs | Central nervous system. Heart or cardiovascular system. Kidneys, liver respiratory system, lungs, brain. |
| Medical symptoms | Nausea, vomiting. Central nervous system depression. Drowsiness dizziness, disorientation, vertigo. |

12. ECOLOGICAL INFORMATION

| | |
|-------------|--|
| Mobility | The product will dissolve rapidly in water. |
| Ecotoxicity | The product is rated as : goldfish 24 hr LD50 >500mg/l. Guppy 7d LC50 : 49, 300ppm. |

13. DISPOSAL

| | |
|--------------------|---|
| Product Disposal | Incinerate in suitable combustion chamber. Dilute with organic solvent and incinerate using gas effluent cleaner. Collect on absorbent material place in cardboard kegs and incinerate. Confirm disposal methods with environmental engineer and local regulations. Wash to drain withlots of water. |
| Container Disposal | Containers should be cleaned by appropriate methods and then re-used or disposed in same manner as contents. |

14. TRANSPORT INFORMATION

| | |
|--------------------------|-----|
| UN Number | n/a |
| UN Class | n/a |
| UN Packaging Group | n/a |
| ADR/RID Substance ID No. | n/a |
| ADR/RID - Class | n/a |

15. REGULATORY INFORMATION

| | |
|---------------------------|--|
| General | Low hazard material, not considered dangerous for carriage. |
| Labeling Information | Harmful |
| EEC (EINECS) No | 203-473-3 |
| R Phases | R-22 |
| S Phrases | S-2 - keep out of reach of children, S24/25 - avoid contact with skin/eyes S36/37 - Wear suitable protective clothing and gloves. S43,16 - In case of fire use sand, earth, alcohol resistant foam or water fog. S46 - If swallowed seek medical advice immediately and show container label. |
| UK regulatory references | Classification, packaging and label regs' 1984. COSHH 1988. |
| EC Annex I Classification | n/a |

16. OTHER INFORMATION

| | |
|-------------------|---------------|
| MSDS first issued | 28-May-99 |
| MSDS data revised | 30 April 2004 |

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9. Heat Pump Settings Sheet

| | | |
|-----------------------------|-------------------------------------|--|
| Introduction | Type of ground arrays | |
| | Ground Arrays purged | |
| Safety information | Ground arrays leak tested @ 5 barg | |
| | Pressure held for 15mins | |
| General product information | Antifreeze quantity & concentration | |
| | Serial Number | |
| Installation | Visual Inspection | |
| | Feet level on floor | |
| Installation schematics | Visual check of site wiring | |
| | Software operating | |
| Installation mechanical | Software errors | |
| | Heating Status | |
| Installation electrical | Ground water pressure | |
| | Underfloor water pressure | |
| Commissioning | Make of underfloor heating | |
| | Manifolds | |
| Fault Finding | Any UFH water pumps | |
| | Control philosophy | |
| Warranty | B01 underfloor return temperature | |
| | B02 ground return temperature | |
| Antifreeze COSH | B03 ground feed temperature | |
| | B04 evaporating pressure | |

Comments:

Installed by:-

Date:-

Tel:-