Kensa Heat Pumps
A KENSA GROUP COMPANY

Plant Room Heat Pump

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1. Introduction—a message from the Managing Director

Kensa Heat Pumps 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 arrange a commissioning visit. 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 Heat Pumps Ltd

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

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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 Heat Pumps
Mount Wellington
Chacewater
Truro
Cornwall
TR4 8RJ
Tel 01872 862140
www.kensaheatpumps.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 available on request.

3. General Product Information

This manual explains how to install 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 Plantroom 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).

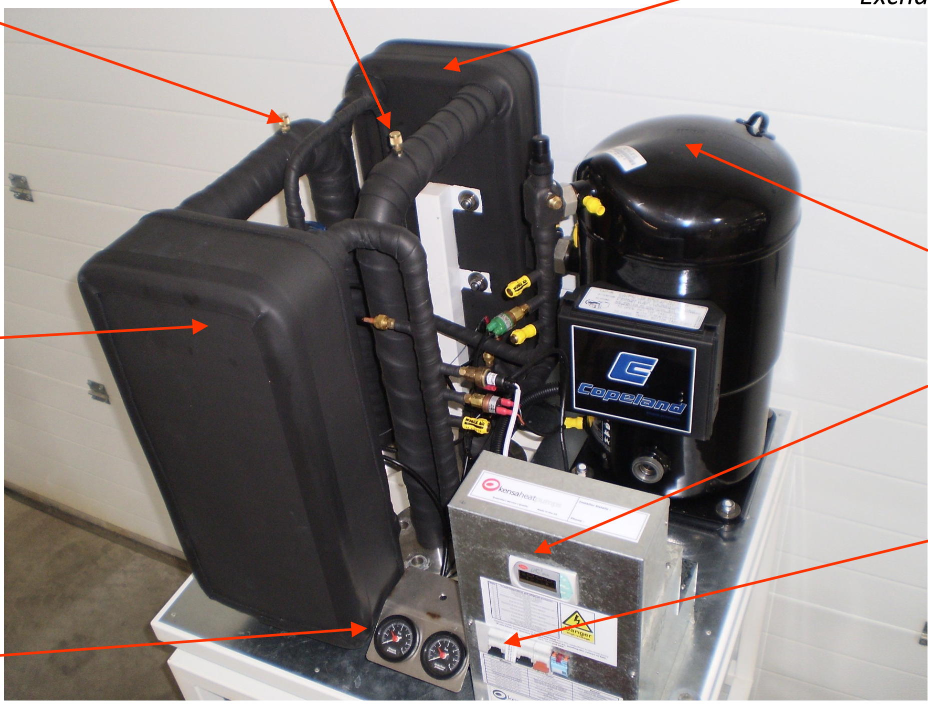

Fig 1. The internals of a heat pump

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

Thermal Output	Ground Design Flow Rate	Ground Design Flow Rate	Ground Design Flow Rate	Ground pressure drop at design	Output Design Flow Rate	Output Design Flow Rate	Output Design Flow Rate	Output pressure drop at design
kW	l/s	l/m	m^3/h	kPa	l/s	l/m	m^3/h	kPa
25	1.14	68.50	4.11	11.1	1.25	74.70	4.48	13
30	1.46	87.40	5.24	17.0	1.58	95.00	5.70	12.2
40	1.76	105.6	6.34	23.6	1.87	112.0	6.72	16.9
50	2.25	135.2	8.11	25.2	2.46	147.0	8.86	19.5
60	2.80	167.8	10.07	21.8	3.06	183.5	11.01	17.0
75	3.46	207.4	12.44	31.7	3.75	224.9	13.49	25.5

Design flowrates are based on ground temperatures of 0°C in and –4°C out of the heat pump and 30°C and 35°C for the load side.

Thermal Output	Model Reference	Power supply rating	Max running Current	Typical running current	Typical starting current	Recommended Power supply cable size	Power input	Nominal dry weight	Dimensions	Connection size
kW	No.	Amps	Amps	Amps	Amps	mm	kW	Kg	HxWxD	mm OD
25	P250X	32	21	13	57	4	6.46	200	1750x800x900	DN40 PN10/16
30	P300X	32	25	14	75	4	8.04	250	1750x800x900	DN40 PN10/16
40	P400X	40	32	18	89	6	9.65	280	1750x800x900	DN40 PN10/16
50	P500X	50	41	23	101	10	12.8	300	1750x800x900	DN40 PN10/16
60	P600X	60	52	29	112	10	15.9	330	1750x800x900	DN40 PN10/16
75	P750X	70	63	36	140	16	19.0	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. Table 3.2 provides recommended cable sizes.
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. Flow switches should be installed to prevent operation in non-flow situations.
6. 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 if 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.

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.

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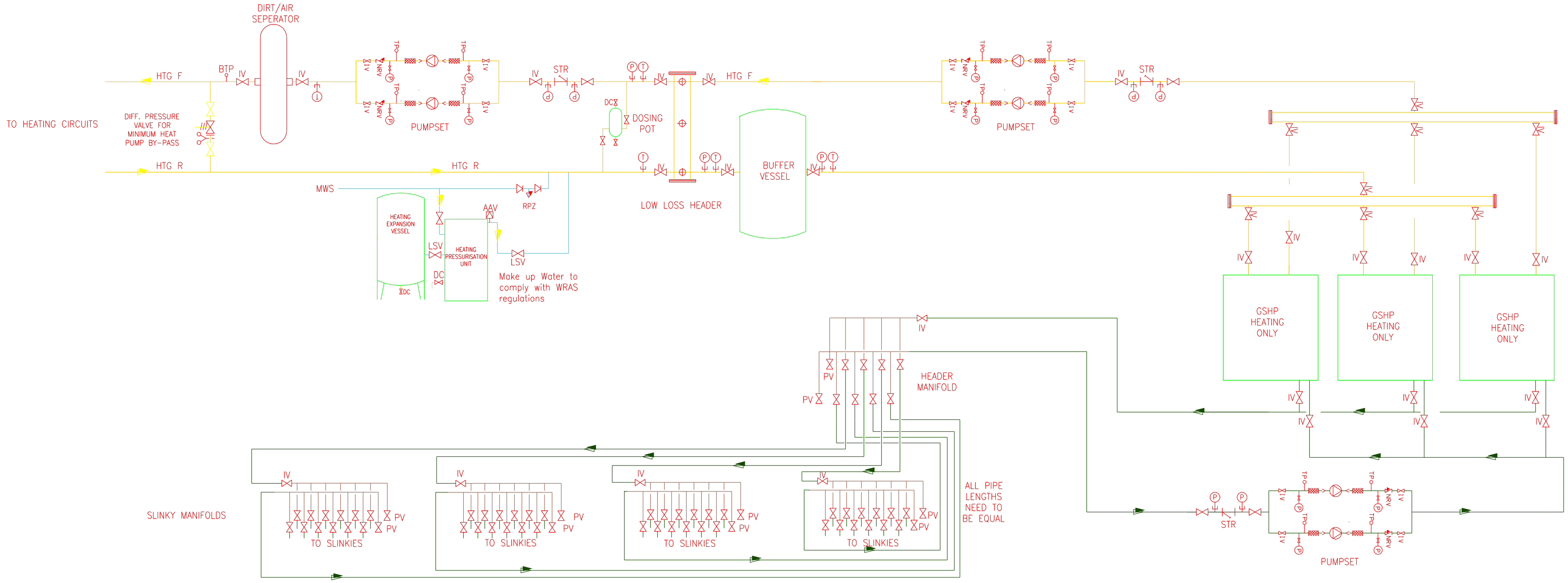
Anti-vibration "Bellows" must be used to isolate the heat pump from any vibration within the connecting pipework.



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. For reverse cycle units glycol needs to be added to the distribution side (20%, -10C).

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 if 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.

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.

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 (minimum 22%, Refractive index 1.356) is added to the cooling and heating circuit fluid to avoid freezing of the fluid in cooling mode. Failure to do this will invalidate the warranty.

Abbreviations

2PCV - 2 port control valve
3PDV - 3 port diverting valve
AAV - Automatic air vent
CHW F– Chilled water flow
CHW R– Chilled water return
HTG F - Heating flow
HTG R - Heating return
GSHP - Ground source heat pump

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

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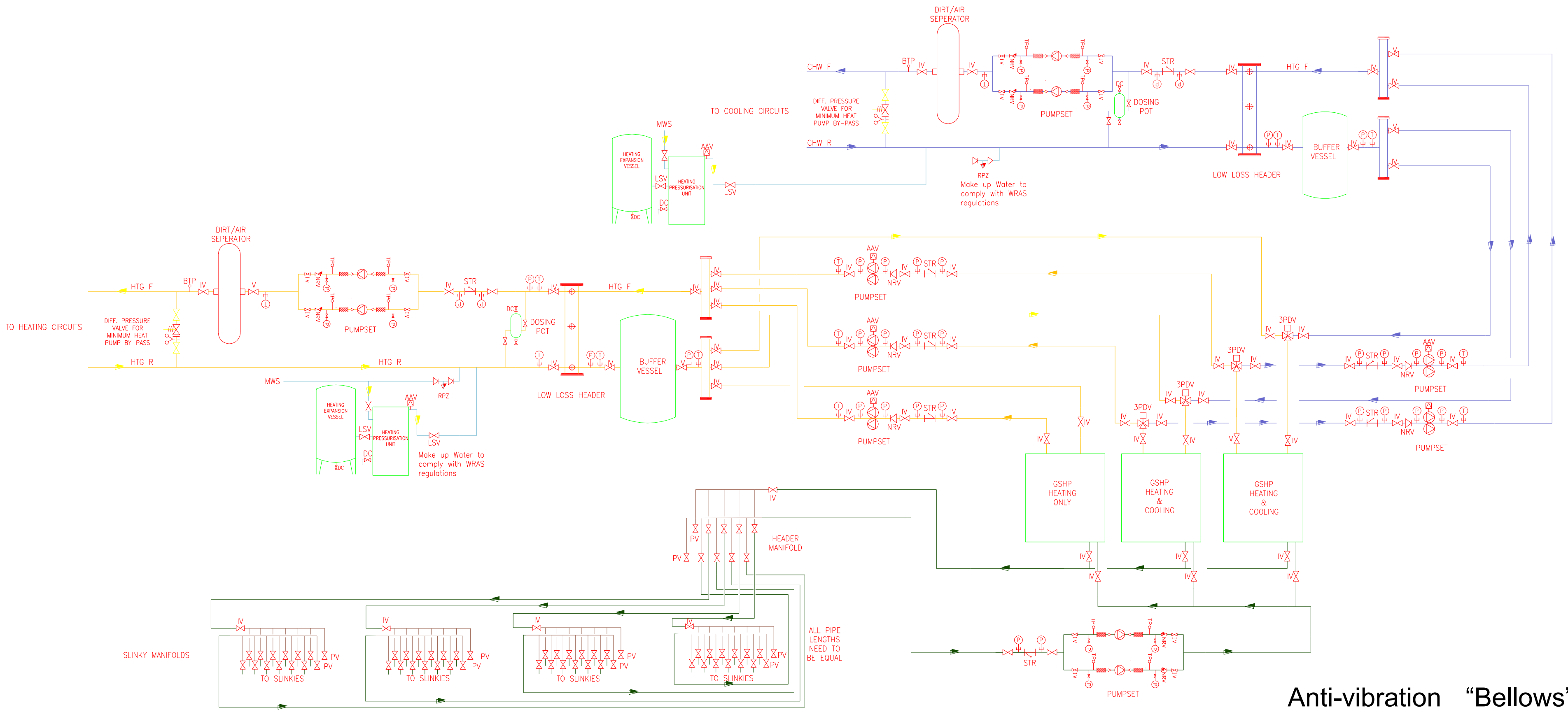


Anti-vibration “Bellows” must be used to isolate the heat pump from any vibration within the connecting pipework.

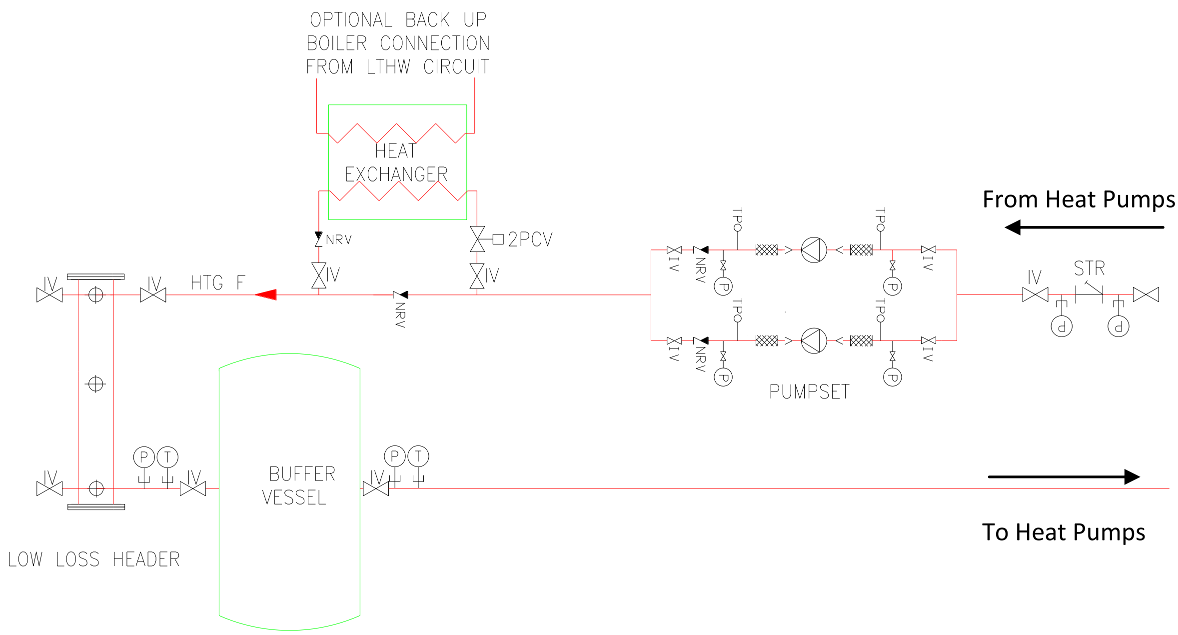
Fig 3 Typical commercial heating and cooling schematic

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. Care must be taken when setting up the BMS, as it may take some time for the system to come up to temperature.

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

It is recommended that the BMS/Instrumentation Engineer contact Kensa if unsure on any aspects of the control of the system, i.e. Regarding:-

- Time delays
- Expected temperatures
- Compressor run-times
- Compressor starts per hour.
- etc

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. It is important that anti-vibration mountings or "bellows" are used.

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

Ensure that the appliance does not stand on the electrical supply cable. If the supply cable is damaged, it must be replaced.Position the appliance on a firm, level and substantial concrete base that will absorb vibration well away from any occupied rooms

Ensure all pipes and wires are adequately supported where necessary, pipes are properly insulated and concentrations of inhibitor/antifreeze (where added) are correct. Connections should be vibration isolated by the use of bellows and have appropriate air vents and isolation valves. The appliance and any metal pipes should also be properly earthed.

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

Do not use the appliance as a shelf.

4.5.2 Recommend clearances

Remember to consider any future maintenance or removal requirements as a return to base might be required if an on -site repair is not feasible.

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.

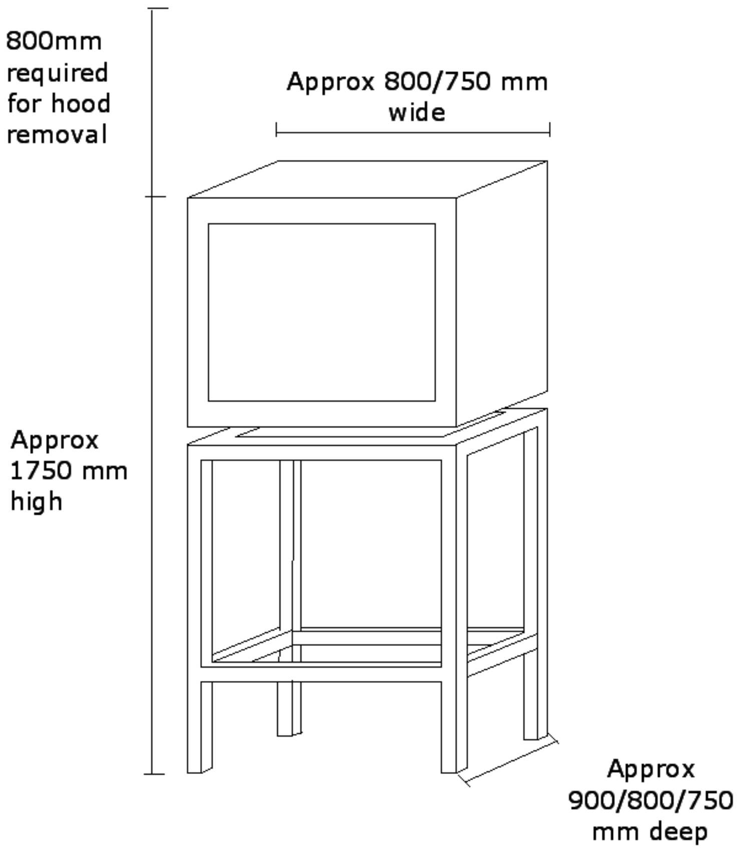


Fig 5 Heat Pump clearances

4.5.3 Installation of the heat pump

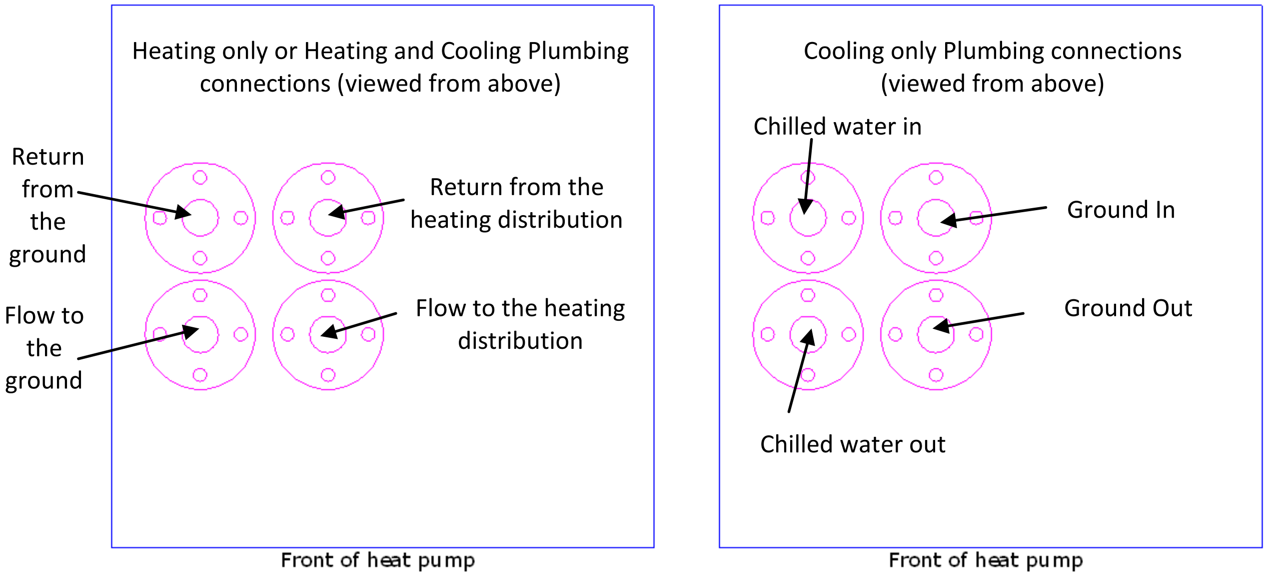
Ideally the heat pump should be placed next to an external wall allowing easy access to the externally mounted ground array manifold. Any pipes internal to the building must be insulated with vapour barrier insulation such as Armaflex. It is not recommended that the ground or header array manifold is 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 and Kensa can supply suitable chambers on request. If an underground manifold is used all joints must be electro-fusion type.

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 BMS wires from under the unit into the control box and connect them to the terminals required, (see electrical installation section).
viii. Check and rectify any leaks that may be in the plumbing system. It is advisable that a pressure test is carried out to ensure the system is leak free.
ix. 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.
x. Phone Kensa to arrange for the commissioning of the unit. Do not switch the unit on without talking to Kensa first.



Flange sizes are DN40 PN10/16.

Warning: This unit must not be run without a minimum of 20% glycol and inhibitor in the chilled water circuit or the warranty will be invalidated.

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

4.6 Electrical installation

Any electrical connections must be in accordance with current IEE regulations and carried out by a suitably qualified person.

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 cover plate.

Fig 9 Position of hex screws on the electronics cover plate

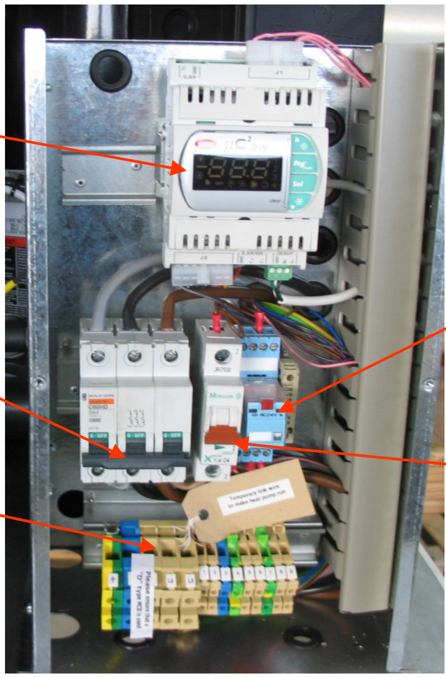


Fig 9 Electrics box with the front removed

Cables should enter the unit from below using the cable entry ports provided. An external isolation switch should be wired into the circuit to provide local isolation of the electrical supply as required.

The following sections detail the standard wiring connections. The heat pump should be set up in conjunction with the BMS on commissioning.

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

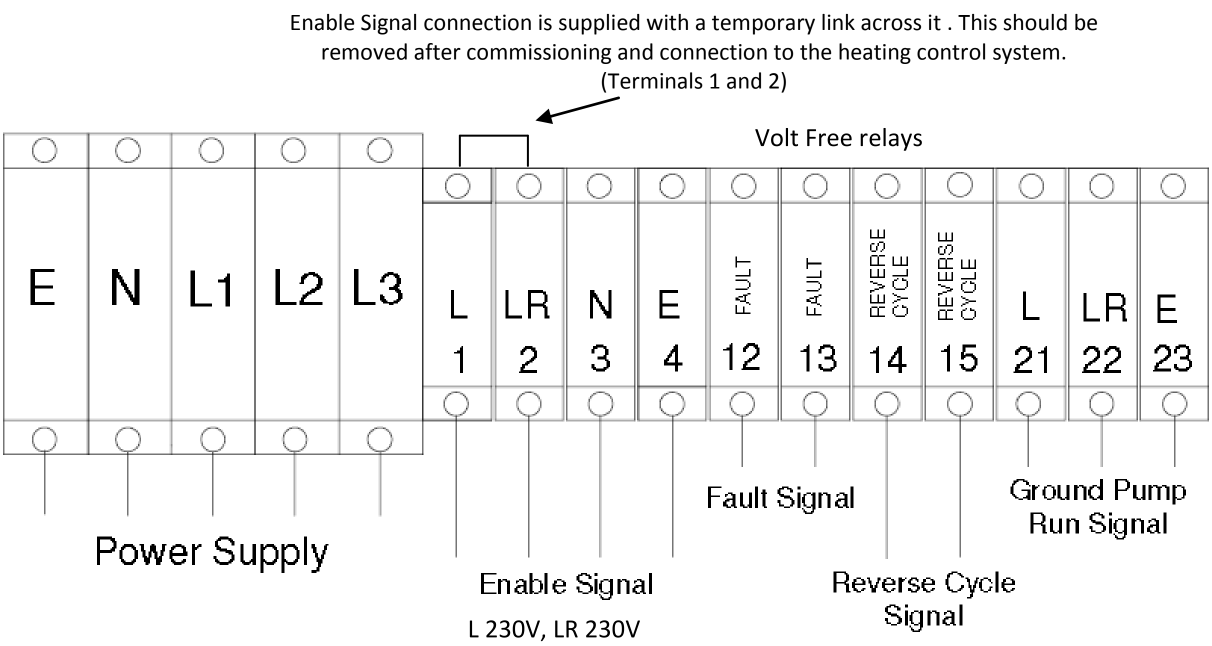


Fig 10 Heat pump wiring—Three phase power supplies

It is also important that there is an interlock on the ground pump flow linked to the run signal for the heat pump, particularly if the control of the unit is via a BMS system.
There are two common types of control to interlock the run enable signal to the ground pump flow:-

- A flow sensor, of which there are two common types the first being an internal sprung switch, and the second an ultrasonic sensor type.
- The differential between two pressure sensors, one before the ground circulation pump and one after.

5. Setting to Work

After all mechanical and electrical work has been completed, the following 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. For large diameter pipework i.e. 63mm upwards, two pumps in parallel may be 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 SPE1200SS (part no. 051012200). (For large systems a larger pump maybe required and advice can be sought from Kensa.) The Clarke SPE1200SS 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 SPE1200SS purge pump

The Clarke SPE1200SS can achieve as much as 5 bar pressure against a closed valve, so ensure the connections to the pump and manifold are robust.

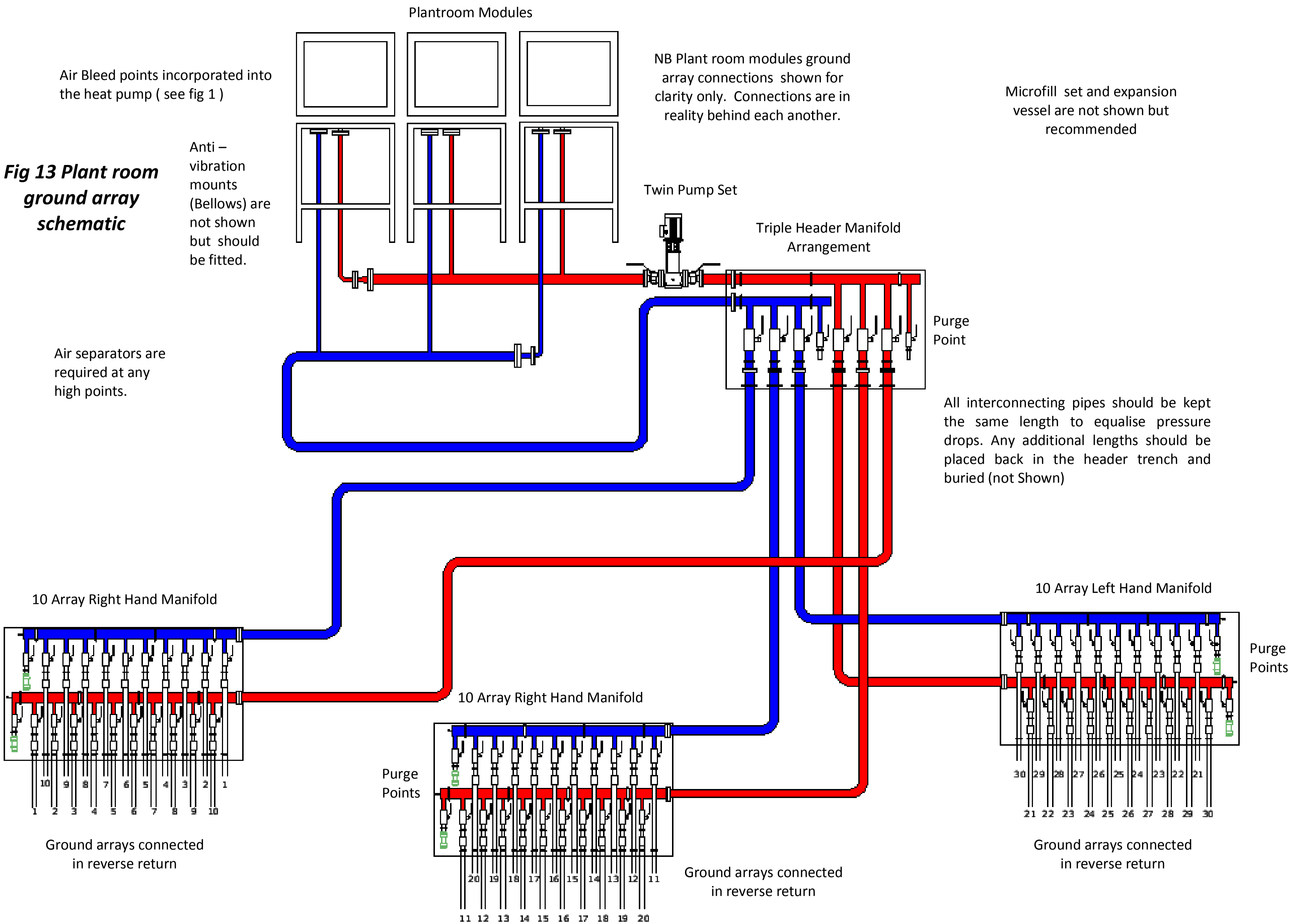
On large commercial projects it is also advisable that automatic air vents are fitted, in the header system, at high points where air could collect, make up sets and pressurisation systems. Air bleed points are also on the top of the heat pump via the Schrader valves.

5.1.1 Purging procedure for multiple slinkies/ground arrays.

i. Remove any 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 SPE1200SS 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. For additional help a You-Tube video is available at http://www.youtube.com/watch?v=f3Ig6z9H47o

Fig 13 Plant room ground array schematic



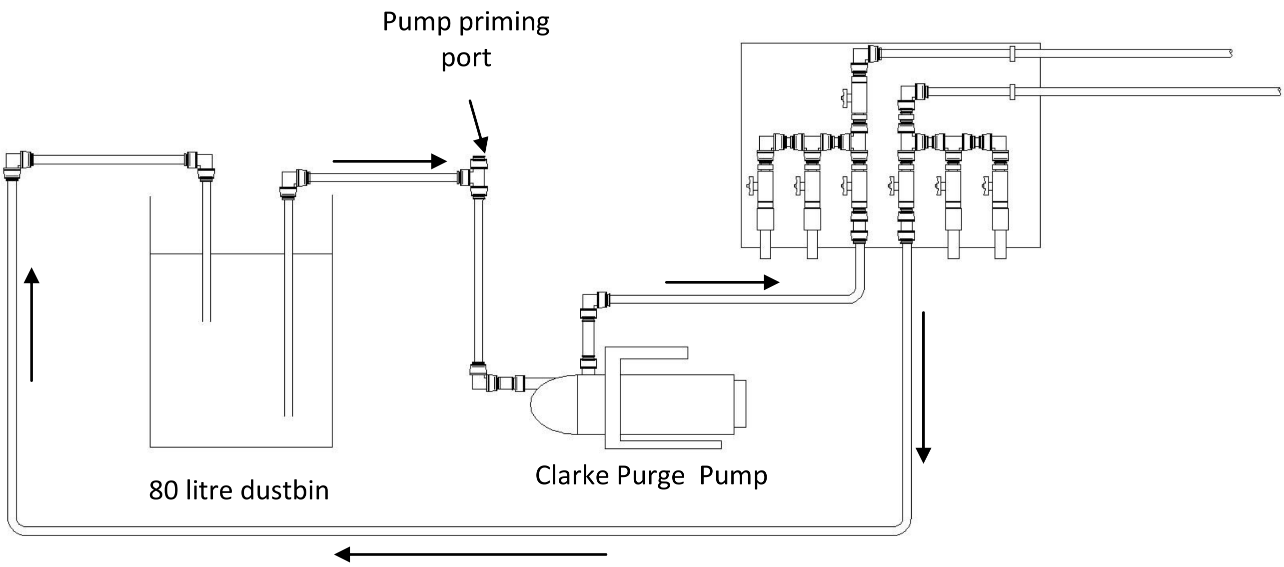


Fig 14 Slinky purging kit connected to a manifold

iii. Place a filter 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

ground array manifold needs to be purged using the same procedure. Larger than 63mm headers may require a larger pump or a number of pumps in parallel.

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. Depending on the size of the system a larger pump maybe required. 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. After the air has been removed it is advisable that **before** the antifreeze is added the system is leak tested to BS805 Section 11.3.3.4. (See 5.1.3), if this didn't occur when the ground arrays were installed.

5.1.3 Adding antifreeze /inhibitors

The antifreeze provides protection to the heat pump (and contains an inhibitor and anti-bacterial agents) 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 (at least 22% concentration by volume , Refractive index 1.356). 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.

5.1.4.1 Pressure Testing in accordance to BS805 Section 11.3.3.4

In accordance with MCS Guidelines, leak tightness (pressure) testing has to follow the EN 805 prescriptions in section 11.3.3.4. This test should be carried out after the ground arrays have been purged but before the antifreeze is added. For polyethylene (PE) tubes, the pressure testing has to be carried out as a 'compression test'. An overpressure (inside-outside) is applied to the pipe over the whole length. This

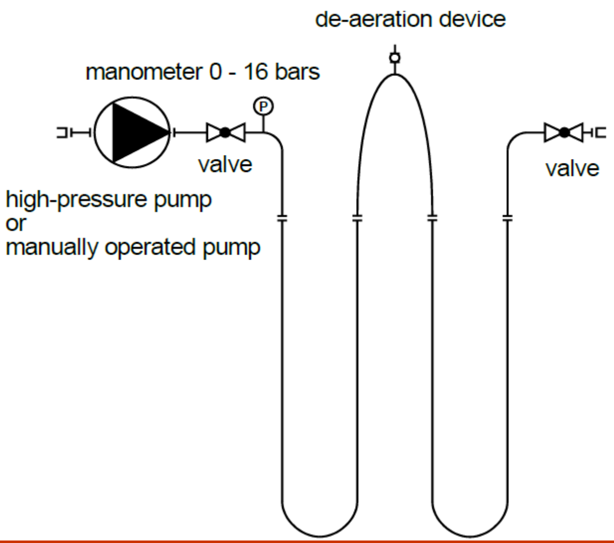


Fig 17 Leak Tightness Configuration

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step inflates slightly the PE pipe over its whole length. Then a sudden pressure drop of around 10% of the testing pressure is applied. This pressure drop allows the pipe to compress again. If the pipe is tight, a pressure increase is measured. This test should only be carried out on the ground arrays with the heat pump isolated from the test.

To perform such a test, the following equipment is needed:
- A high-pressure pump or a manually operated pump
- 2 stop valves
- 1 manometer 0 -16 bar
- A de-aeration device (if any point of the ground array is at a high point where air can collect)

Test procedure in detail (Fig. 18):

- 1 h Idle period. No overpressure is applied to the tube . ①
- Apply the test pressure. For PE100/PN16/SDR11 ground arrays this should be > 7.5 barg. If the heat pump is within the pressure test this should be less than 10 barg. For other materials follow the manufacturer's specification ②
- 10 min Keep up pressure test ③
- 1 h Idle period. The tube is going to expand over the whole length
- Pressure measurement. The pressure drop may not exceed the manufacturer‟s specifications ④
- Sudden pressure drop of at least 10% of the test pressure ⑤
- 10 mins. First pressure measurement ⑥ A
- 20 mins. Second pressure measurement ⑥ B
- 30 mins. Third and final pressure measurement ⑥C

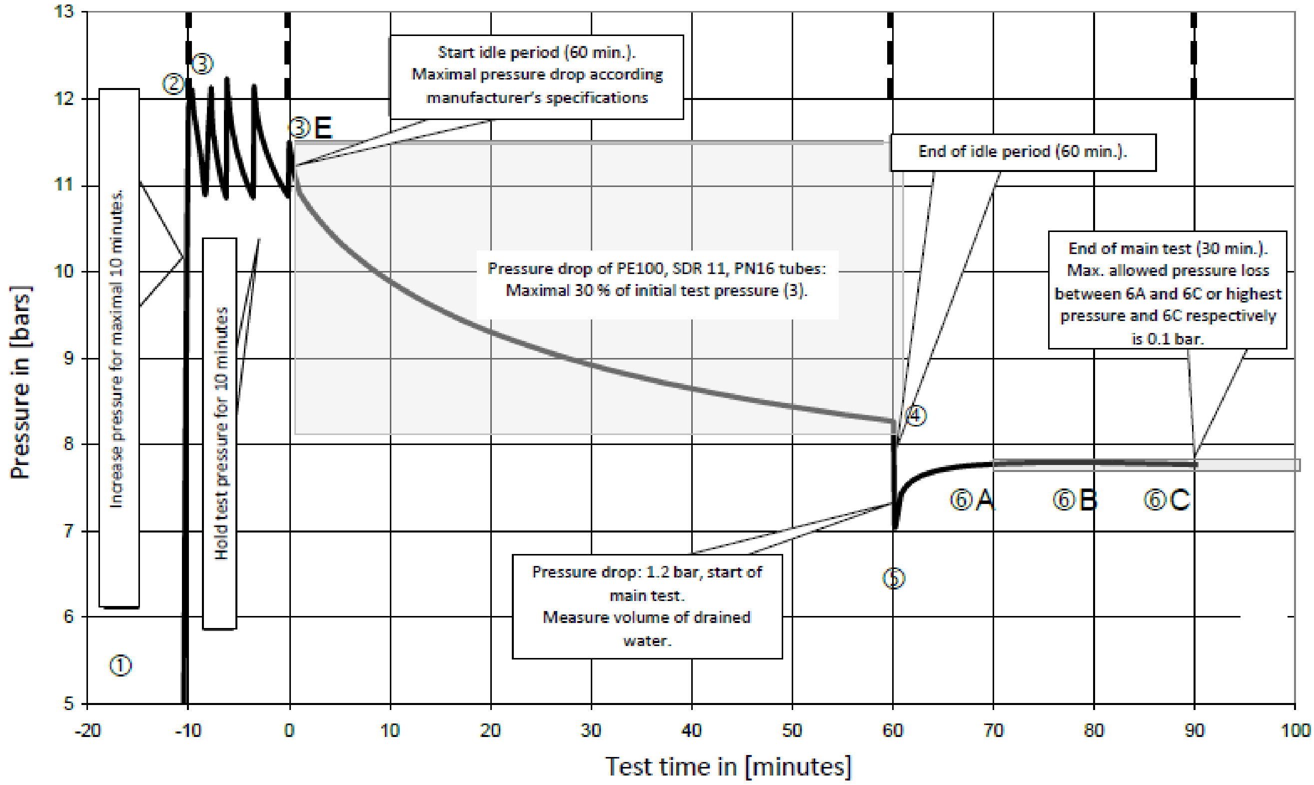

Fig 18 Graphical Test Procedure

The ground array has passed the test if the pressure difference (pressure drop) between (6)C and (6)A does not exceed 0.1 bar.

The test should not be conducted in cold weather, when there is a risk of freezing.

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 22% or a protection level of –10°C (Refractive index 1.356). 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 19.

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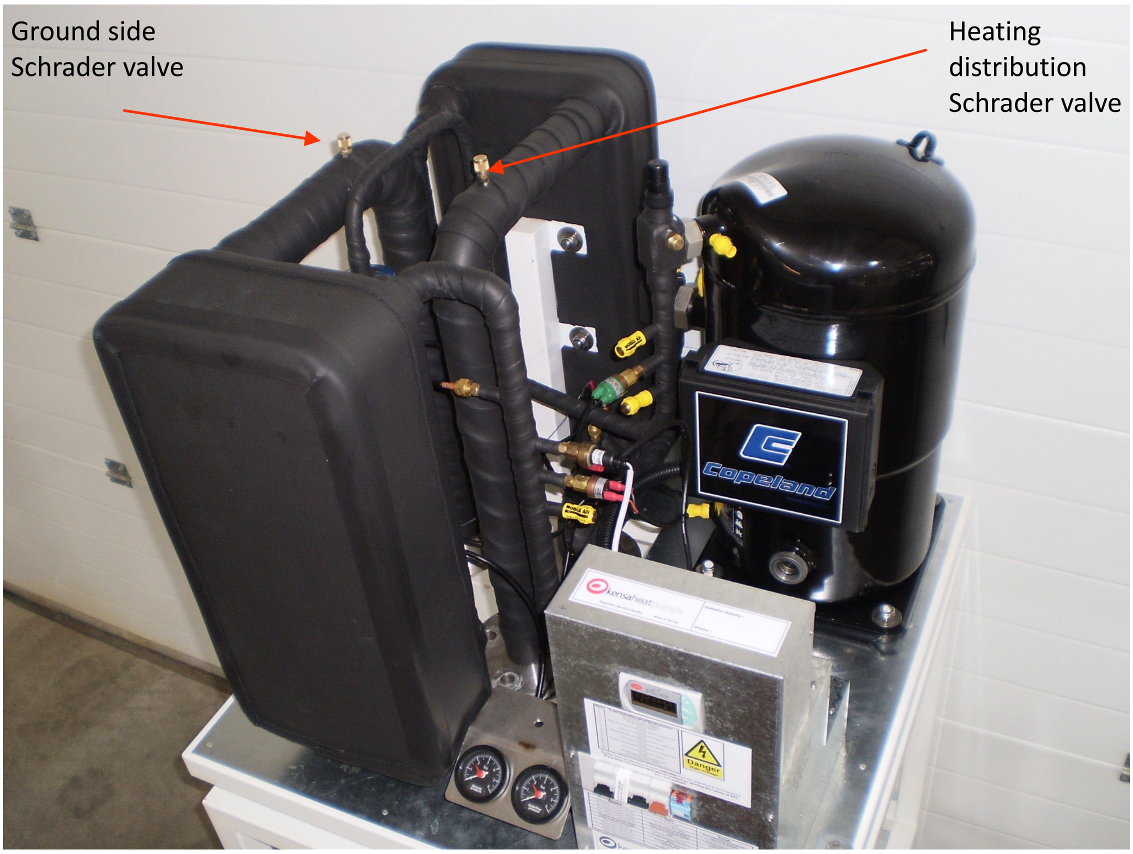


Fig 19 Location of heat pump schrader valves (Bleed Points)

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 Heat pump.
ii. Follow the manufacturer's procedures for purging the heating system.
iii. For any systems that involves cooling, antifreeze (approximately 22% ,Refractive index 1.356) must be added to the distribution load side.
iv. Remove the cap from the heating bleed port and depress the Schrader valve using a small screw driver, as shown in Fig 19
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/door 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. Remove the door by turning the lock with a screwdriver, opening and lifting off.
iii. Check that the ground pressure gauge reads at least 1.8 bar. If the pressure is lower than this, increase the pressure until the gauge reads at least 1.8 bar, at which point a "click" will be heard.
iv. Check that the heating distribution system pressure gauge reads at least 1.8bar. 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.
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. The external water pumps should be controlled via the ground pump relay within the heat pump or BMS system, however it is important that an interlock is wired into the system to avoid the compressor running when the water pumps are not operational. Shortly after operating this MCB, the compressor contactor should engage. **DO NOT operate the compressor MCB until Kensa Heat Pumps 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 should be carried out by a Kensa commissioning engineer and a heat pump commissioning certificate and report issued on completion. Please contact Kensa Heat Pumps to book a commissioning visit.

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.

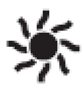
n.b. the numbers above refer to the points below.

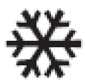
Fig 20 Heat pump display

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, however should be checked against the underfloor design temperature.

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. However in the actual temperatures should be taken from the heat emitter design.

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 (Max).

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 pass-code is 11 and not changeable.

1 On the controller within the heat pump, press and hold SEL and PRG together until 0 is displayed.
2 Using the UP arrow increase the displayed number to 11
3 Press SEL (S-P is displayed)
4 Press SEL and -/- is displayed
5 Press the UP arrow until -r- is displayed
6 Press SEL and r01 is displayed
7 Press the UP arrow until r03 is displayed
8 Press SEL
9 The return water temperature setpoint is displayed
10 Press the UP or DOWN arrows to change the setpoint
11 Press SEL
12 Press PRG twice until S-P is displayed
13 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 BMS for heat pump operation	Programme BMS 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 make up system needs to be operated.
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 19). Check that the water pumps are operational .
Display flashes fault code LP	Low gas pressure in machine. Can occur simultaneously with an A1 alarm.	Check that the water pumps are operational. 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.	No action
	Insufficient antifreeze added and heat pump frozen.	Allow heat pump to defrost and add the correct antifreeze quantity. Do not run the compressor until the unit has been defrosted.
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 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

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7.0 Warranty

The Kensa Planroom Ground Source heat pump is designed and built to the highest standard and as such is guaranteed for 5 years for parts from the date of commissioning or 5 ½ years from the date of manufacture (excluding the electrical components), whichever is shorter. Electrical components are guaranteed for 2 years for parts from the date of commissioning or 2 ½ years from the date of manufacturer, whichever is shorter.

7.1 Terms and Conditions.

7.1.1 Persons covered by the Warranty

The Warranty applies to the original purchaser and any subsequent owner of the item.

7.1.2 Validity period of the Warranty

The guarantee period (excluding electrical components) is five years calculated from the commissioning date stated on the commissioning certificate or 5 ½ years from the date of manufacture, whichever is shorter. For the electrical components it is 2 years from the commissioning date stated on the commissioning certificate or 2 ½ years from the date of manufacture, whichever is shorter.

7.1.3 Scope

Kensa Heat Pumps Ltd warrants to the original purchaser (“Buyer”) that all parts (“Parts”) of the Kensa Plantroom Ground Source Heat Pump, excluding accessories, shall be merchantable and free from defects in materials and workmanship appearing under normal working conditions.
Kensa Heat Pumps Ltd will, at its option and without charge to the Buyer, replace or repair any Parts which cause the Kensa Plantroom Ground Source Heat Pump to be inoperable; however, if Kensa Heat Pumps Ltd elects to provide replacement Parts, it shall not be obligated to install such replacement Parts and the Buyer shall be responsible for all other costs, including, but not limited to, shipping fees and expenses.
The warranty applies to faults originating inside the item.
Units installed not in line with the O&M required clearances are return to base repair only.

7.1.4 General exceptions

Compensation is not provided for:
- consequential losses
- damage caused by normal wear and tear, inadequate maintenance or care
- damage caused by freezing
- damage of the unit due to non-approved or incorrect quantities of antifreeze being used in the ground side, incorrect flowrates or air in the system
- damage caused by power surges, incorrect supply voltage or lightning strikes.
- cost of inspecting, adjusting or cleaning the item, unless this relates to damage that is eligible for compensation
-minor damage (e.g. scratches and marks) that does not affect the operation of the item
-damage covered by insurance
-indirect damage
-loss or damage caused by gross negligence or intent, misappropriation, fraud or similar crime against property, breach of trust or fraudulent conversion.
-products that have been: altered; subject to misuse, negligence, accidental damage, abnormal use or service; operated or installed in a manner contrary to Kensa Heat Pumps Ltd published or written instructions.
-products subjected to abrasion or corrosion

-products operated in connection with any liquid source that contains impurities which are corrosive to copper
-products operated in a temperature range inconsistent with Kensa Heat Pumps Ltd's published or written recommendations

7.1.5 Care of Duty

The product must be handled with normal care and attention to minimise the risk of damage or loss.

7.1.6 In the event of Damage

The installing contractor ("Contractor"),or, if the installing Contractor is not available, Kensa Heat Pumps Ltd must be notified of any damage immediately and no later than six months after you first became aware of the damage. The commissioning certificate received on installation should be appended to the claim. If a claim for compensation is made after the deadline specified above or if a commissioning certificate cannot be produced, the guarantee shall not apply.

7.1.7 Replacement Parts

Kensa Heat Pumps Ltd's warranty obligations with respect to replacement parts are identical to those with respect to original parts; provided, however, in no event shall the warranty term for such replacement parts extend beyond the term established by the commencement date (i.e. commissioning date) of the warranty under which Kensa Heat Pumps Ltd was obligated to provide such replacement parts. Kensa Heat Pumps Ltd shall have the right to retain possession or dispose of any parts replaced by it.

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8. Heat Pump Settings Sheet

Type of ground arrays	
Ground Arrays purged	
Ground arrays leak tested to BS805	
Antifreeze quantity & concentration	
Serial Number	
Visual Inspection	
Feet level on floor	
Visual check of site wiring	
Software operating	
Software errors	
Heating Status	
Ground water pressure	
Heating system water pressure	
Control philosophy	
B01 underfloor return temperature	
B02 ground return temperature	
B03 ground feed temperature	
B04 evaporating pressure	

Comments:

Installed by:-

Date:-

Tel:-

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