Energy Technologies

HERCULES

EVI DC Air Source High Temperature Heat Pump

Installation, Maintenance and Control

Technical Manual

Thank you for choosing our air to water heat pump for your heating and or hot water system.

The installation of the heat pump must be undertaken by qualified experienced personnel by following the correct commissioning procedures and annual routine maintenance to achieve the performance and operational lifespan of the heat pump.

If the heat pump is not in use during freezing conditions the system needs to be drained down to avoid risk of damage to the water heat exchanger.

The manufacturer reserves the rights to make any changes as required without notification.

Accessories:

Items	1 x Heat Pump Controller 1 x Technical Manual 1 x Communication Cable

Installer additional items:

Description	Specification	Remark
Power cable	For power supply	See Page 23
Hydraulic pipework and connections	For water inlet and outlet	See page 16

Remarks:

1. The above accessories are the minimum requirements for the correct installation.
2. The installer additional items must be provided according to the system connection requirements, local regulations, and laws.

Contents

Safety Precautions

- Thoroughly read the following safety precautions prior to use.
- Observe these precautions carefully to ensure safety.

⚠	**WARNING**	Indicates a risk of death or serious injury.
⚠	**CAUTION**	Indicates a risk of injury or structural damage.
⚠	**IMPORTANT**	Indicates a risk of damage to the unit or other components.

GENERAL

⚠ WARNING

Energy Technologies Ltd will not be liable for any miss-use, modifications, incorrect refrigerants used, or unauthorised setting changes, that cause any malfunctions, faults, injuries, explosions, fire or any other incident caused by these actions.
Do not use refrigerant other than the type indicated in the manuals provided with the unit and on the name plate.
Use of the incorrect refrigerant may cause explosion, fire damage or pipes to burst either during use, repair, or at time of disposal of the unit. It may also be in violation of applicable laws.
Do not install the unit in a place where oil, steam, organic solvents, corrosive gases, acidic / alkaline or sprays containing sulphur are used frequently.
Do not modify any component or safety feature of the unit or make unauthorised setting changes.
To reduce risk of fire or explosions, do not use volatile or flammable substances as a heat carrier.
To reduce the risk of burns or electric shock, do not touch exposed pipes or wires.
To reduce the risk of shorting, current leakage, electric shock, malfunctions, smoke, or fire, do not splash water on electrical parts or components.
To reduce the risk of electric shock, injury, malfunctions, smoke, or fire, do not operate the switches / buttons or touch other electrical parts with wet hands or tools.
To reduce the risk of electric shock, injury or malfunction from the fans or other rotating components, stop the operation of the unit, always turn off the at the main isolator, before cleaning, undertaking maintenance or inspecting the unit.
To reduce the risk of injury, keep children, unauthorised/untrained persons away while installing, inspecting, maintenance or undertaking repairs to the unit.
To reduce the risk of burns, or frost bite, do not touch the refrigerant pipes or refrigerant circuits, components with bare hands during operation.
This appliance is not intended for use by any unauthorised, or untrained persons at any time.
Keep the space well ventilated.
Always use the correct circuit breaker rating size and or fuse with the correct current rating.
Use of the incorrect circuit breaker size or fuse rating may result in malfunction, fire or explosion.
If any abnormalities are detected such as burning smells, unusual noises, stop the plant operation, turn off the power supply, and contact Energy Technologies Ltd. Continuing operation may result in malfunction, electric shock, damage to the equipment, fire or explosion.
Properly install all covers and panels on the terminal control box to keep dust, debris and moisture out. Dust, debris, moisture accumulation may result in malfunction, electric shock, smoke, fire and damage to the equipment.
Contact Energy Technologies Ltd for the proper disposal of the unit.

⚠ CAUTION

Do not operate the unit without panels and safety guards properly installed.
To reduce the risk of injury, do not sit, stand, or place objects on the unit.
Do not connect the makeup water pipe directly to the potable water pipe. Connecting these pipes directly may cause the water in the unit to migrate into the potable water and cause health problems.
To reduce the risk of adverse effects on plants and animals, do not place them where they are directly exposed to discharge air from the unit.

Do not install the unit on or over things that are vulnerable to water damage
Condensation may drip from the unit. Consider mounting on support frame with condensate drain tray and pipe condensate water to nearest drain.
To prevent environmental pollution, dispose of cleaning solutions according to the local regulations.
The water heated by the heat pump is not suitable for use as drinking water or for cooking it may cause health problems or degrade food.
In areas where temperature drops to freezing during the periods of non-use, drain the water out of the pipes or fill the pipes with anti-freeze solution. Not doing so may cause the water to freeze, resulting in burst pipes and damage to the unit or the components.
The model of heat pump unit described in this manual is not intended for use to preserve food, animals, plants, precision instruments, or artwork.
To reduce the risk of injury, do not touch the heat exchanger fins or sharp edges of components with bare hands.
Always wear correct PPE when touching electrical components on the unit.
Several minutes after the power is switched off, residual voltage may still cause electric shock.
To reduce the risk of injury, do not insert fingers or foreign objects into air inlet/outlet grills
To reduce the risk of injury, wear correct PPE when working on the unit.
The use of acidic or alkaline water or water high in chlorine may corrode the unit or the pipes, causing water leakage and resultant damage to the components
In areas where temperature can drop low enough to cause the water in the pipes to freeze, maintain operation of the unit to prevent the water from freezing causing damage to pipe systems and components. The installation of a 500-litre buffer with a 3-port valve arrangement is one method to allow the defrost cycle during nighttime periods to operate. Another option is to install a plate exchange separating the heat pump circuit from the main existing systems which than can be filled with glycol anti-freezing agent to protect the heat pump. Good practice should be given to installing to all external pipework fitted with trace heating to prevent pipework from freezing.
Periodically inspect and clean the water circuits as part of Planned Preventive Maintenance program. Dirty, contaminated water in the system will compromise the unit performance, cause corrosion, blockages and result in malfunction or damage to components

INSTALLATION

⚠ WARNING

Do not install the unit where there is a risk of leaking flammable gas, this may cause fire or explosion.
Properly dispose of the packing materials, danger to children and animals and may damage the environment.
The unit should be installed only by personnel trained and skilled competent periods accredited by Energy Technologies Ltd who familiar with in working with refrigerant based technologies, according to the instructions detailed in the Installation/Operation Manual
Improper installation may result in refrigerant leakage, water leakage, injury, electric shock, or fire.
Any additional parts must be installed by qualified personnel authorised by Energy Technologies Ltd.
Take appropriate safety measures against wind gusts and earthquakes to prevent the unit from toppling over and causing injury.
Periodically check the installation, unit, and support frame for damage.
The unit is to be installed horizontal, and level and it is recommended that the installed on a suitably designed support frame / base that can is designed to take the weight of the unit. If not installed horizontal and level it may cause the unit to not operate correctly, cause malfunction or damage components.
Remove all packing materials and check to make sure that you have all components and items before disposal of packaging items.
As an anti-freeze, use ethylene glycol or propylene glycol diluted to the specified concentration.
The use of other types of anti-freeze solution may cause corrosion and resultant water leakage. The use of flammable anti-freeze may cause fire or explosion.

PIPE INSTALLATION

⚠ WARNING

To prevent risk of explosion do not make any hot joints with refrigerant in the refrigerant circuit.

⚠ CAUTION

Check that no other substance or refrigerant other than specified R-513A is always used. If the incorrect refrigerant or any other substances are used it may cause fire or explosion.
To prevent damage from condensate water, install condensate drainpipe correctly insulated and drained to the nearest safe to use drainage point.
All piping works should be performed by a qualified skilled competent person in accordance with Health & Safety process and procedures, British Standards, Codes, regulations, and as instructions detailed in this manual. Incorrect piping may cause, injury, leakages, malfunction, and damage to components.
Check for refrigerant leakages after completing installation.
Check for water pipework leakages after completing installation and make sure all valves are open, and system is fully vented of all air.
When multiple units are installed together (Cascade configuration) the header pipe must be a minimum of 1.5 times larger than the connection size to the units.

ELECTRICAL INSTALLATION

⚠ WARNING

All electrical installation work including electrical components such as cables, isolators, circuit breakers, etc to be in accordance with all Health & safety processes and procedures, regulations, British standards, IEE Regulations and codes.
All electrical works should be performed by qualified skilled competent electricians, in accordance with the instructions detailed in this manual
Properly secure all cables and provide adequate slack in the cables to prevent putting any stress on the terminals.
To prevent the risk of injury, electric shock, the electrical system is be turned off, isolated, and disconnected while working on the unit and electrical systems.
All cables, components, isolators, circuit breakers etc to be correctly sized to suit current load capacity and length of cable runs etc. Incorrect selected equipment may cause electric shock, injury, malfunction, smoke and fire.
All exposed bare cable ends are only permitted inside the terminal block. If exposed outside the terminal block may cause electric shock, injury and could come in contact with each other causing malfunction, injury, damage to equipment, smoke and fire.
Correct earthing (Grounding) must be always provided. Do not connect the earthing wire to a gas pipe, water pipe, lightning rod or any system such as telephone wires etc. Incorrect earthing may cause electric shock, injury, malfunction, smoke, fire due to electrical noise interference.
Ensure that all control cables are separated from any power carrying cables and or use screened control cables to prevent any interference, which may cause the unit malfunction, and damage to components.
Ensure all cables are kept away from the refrigerant pipes and any other parts, especially sharp edges, to prevent risk of current leakage, wire breakage, shock, injury, smoke and fire.
Clean out any debris or detritus from the unit to prevent causing any risk of electrical shock, injury, shorting, malfunction and damage to components

TRANSPORTATION AND REPAIRS

⚠ WARNING

Lift the unit by using a safe method preventing any damage to the unit, injury to persons while lifting and or handling the unit into place.
The unit should be moved, disassembled, or repaired only by a qualified competent persons authorised by Energy Technologies Ltd. Do not modify or alter the unit. Improper repair or unauthorised modifications may result in refrigerant leakage, water leakage, injury, electric shock, malfunction, damage to components, fire or explosion.
After disassembling the unit or making repairs, replace all components as they were originally installed. If unsure for whatever reason, contact Energy Technologies Ltd for assistance. Failing to reinstate all components may result in leakage, electric shock, injury, malfunction, damage to components, fire or explosion.
If any cables or components are damaged these must be replaced which may require new items to be provided contact Energy Technologies Ltd. Some components may require a new item replaced by the manufacturer.

⚠ CAUTION

Before lifting and plant handling prepare a safe works method statement and use correct lifting and handling equipment to prevent injury, damage to the unit.
To reduce the risk of shorting, electric shock, malfunction, fire. Do not touch the circuit boards with tools or with your hands, and do not allow dust, debris to accumulate on the circuit boards.

⚠ IMPORTANT

To avoid damage to the unit, use appropriate tools and equipment to install, inspect or repair the unit.
Do not unnecessary change the settings or touch other parts in the refrigerant circuit. Doing this may change the operation mode causing malfunction or damage to components.
To prevent the risk of malfunctions and or damage to components use the unit within the operating range
Do not switch on or off the main power supply in a cycle shorter than 10 minutes. Use the control system to shut down the unit operation. Short cycling may damage the components, such as motors, compressors, and circuit boards.
To maintain optimum performance and reduce the risk of malfunctions keep the air pathway clear.
When locating the unit ensure that the correct spaces are provided for ventilation and maintenance.
If acoustic barriers and or enclosures are required, the correct spacing for ventilation and maintenance is to be provided. Contact Energy Technologies Ltd who can provide acoustic solutions.
Take appropriate measures against electrical noise interference (Harmonics) when installing the heat pump in hospitals or facilities with radio communications capabilities.
Other external sources of inverter, high frequency medical, or wireless communications equipment as well as power generators may cause the heat pump system to malfunction. The heat pump has been thoroughly tested for compliance with Harmonic and flicker including EMC.
To ensure continual operation of the unit, check the anti-frost protection cycle is working and if any glycol anti-freeze is to be added to the system that the correct concentration is used only
Check the water system is filled, vented, operating correctly, flow rates, and water quality is being maintained correctly.
To reduce the risk of electrical power capacity shortage, always use a dedicated power supply circuit.
Check control systems are all operating correctly, check for any damaged control or monitoring devices or any controls not functioning correctly.
Check the remote control and monitoring facility is working correctly and check the mobile App is linked to the heat pump and functioning correctly.

PART 1. GENERAL

1.1. Technical Specifications Main Components

Model		Hercules 42	Hercules 85	Hercules 120	Hercules 180
Electrical Systems (V/Phase/Hz)		400 / 3 / 50	400 / 3 / 50	400 / 3 / 50	400 / 3 / 50
Ambient temperature range (°C)		-15 ~ 43	-15 ~ 43	-15 ~ 43	-15 ~ 43
A7W30-35 (BS EN 14511	Rated heating output @ 7°C (kW)	42	85	120	180
	Input power (kW)	9.9	21.17	28.04	42.25
	COP	4.25	4.25	4.27	4.26
A7W70-80	Rated heating output @ 7°C (kW)	42	85	120	180
	Input power (kW)	25.6	51.14	68.18	102.27
	COP	1.76	1.76	1.76	1.76
A7W70-75	Rated heating output @ 7°C (kW)	42	85	120	180
	Input power (kW	19.53	41.86	55.81	83.72
	COP	2.15	2.15	2.15	2.15
A-4W70-80	Rated heating output @ -4°C (kW)	40	72	96	144
	Input power (kW)	26.5	47.68	63.57	95.36
	COP	1.51	1.51	1.51	1.51
A-4W70-75	Rated heating output @ -4°C (kW)	40	72	96	144
	Input power (kW	22.47	40.45	53.93	80.89
	COP	1.78	1.78	1.78	1.78
SCOP		3.46	3.46	3.46	3.46
Refrigerant		R-513A	R-513A	R-513A	R-513A
Global Warming Product (GWP)		573	573	573	573
Refrigerant Safety Classification		A1	A1	A1	A1
Toxicity Classification		B1	B1	B1	B1
Maximum Outlet Temperature (°C)		80	80	80	80
Maximum Inlet Temperature (°C)		70	70	70	70
Noise level at 1 meter dB(A)		57	68	69	70
Compressor number		2	4	4	8
Compressor control		EVI DC Inverters	EVI DC Inverters	EVI DC Inverters	EVI DC Inverters
Maximum operating current (Amps)		<50	<100	<130	<200
Starting current per compressor (Amps)		<12.0	<12.0	<12.0	<12.0
Air out type		Top Discharge	Top Discharge	Top Discharge	Top Discharge
Fan motor quantity (No.)		2	2	2	6
Air volume flow rate total (l/s)		6,667	13,056	13,056	20,000
External fan static (Pa)		60	60	60	60
Coils		V Banked	V Banked	V Banked	V Banked
Water pipe connections		2*DN65	2 * DN80	2*DN80	2*DN100
Maximum water working pressure (MPa)		1	1	1	1
Circulating water flow rate with 10oC Δt (m^3/h)		3.9	7.7	10.3	15.6
Circulating water flow rate with 5oC Δ t (m^3/h)		7.7	15.5	20.6	31.0
Water side pressure loss (kPa)		≤50	≤50	≤50	≤50
Dimensions (W mm x D mm x H mm)		2020 x 990 x 1950	2200 x 1400 x 2400	2200 x 1400 x 2400	**2700 x 2100 x 2400**
Weight (kg)		650	1150	1500	2300
Certification		CE, G5/5	CE, G5/5	CE, G5/5	CE, G5/5
Colour		Dark Grey	Dark Grey	Dark Grey	Dark Grey

Acoustics

Heat Pump Model	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2 kHz	4 kHz	8 kHz	A-Weighted
Hercules 42 L_p at 1 metre, over hard ground (dB)	*58*	*58*	*55*	*55*	*52*	*49*	*48*	*43*	***57***
Hercules 85 Extrapolated L_p at 1 meter, in free-field conditions (dB)	*69*	*69*	*69*	*66*	*63*	*60*	*68*	*54*	***68***
Hercules 120 Extrapolated L_p at 1 meter, in free-field conditions (dB)	*70*	*70*	*70*	*67*	*64*	*61*	*69*	*55*	**69**
Hercules 180 Extrapolated L_p at 1 meter, in free-field conditions (dB)	*71*	*71*	*71*	*68*	*65*	*62*	*70*	*56*	**70**

Hercules 42

The main components of this heat pump consist of:

- 2 x Compressors.
- 2 x EVI DC Inverters.
- V Bank Air Heat exchanger.
- Water Heat Exchanger.
- 2 x Fan Motors.
- Controller.
- Expansion Valve Assembly etc.
- User Interface Controller.
  Bluetooth connection via Mobile App.
- 485 BMS Port interface (BACnet Open Protocol)
- Vault free contacts (Run & Fault).
- In-built condensation drain trays.

Hercules 85

The main components of this heat pump consist of:

- 4 x Compressors.
- 4 x EVI DC Inverters.
- V Bank Air Heat exchanger.
- Water Heat Exchanger.
- 2 x Fan Motors.
- Controller.
- Expansion Valve Assembly etc.
- User Interface Controller.
  Bluetooth ICloud connection via Mobile App.
- 485 BMS Port interface.
- Vault free contacts (Run & Fault).
- In-built condensation drain trays.

Hercules 120

The main components of this heat pump consist of:

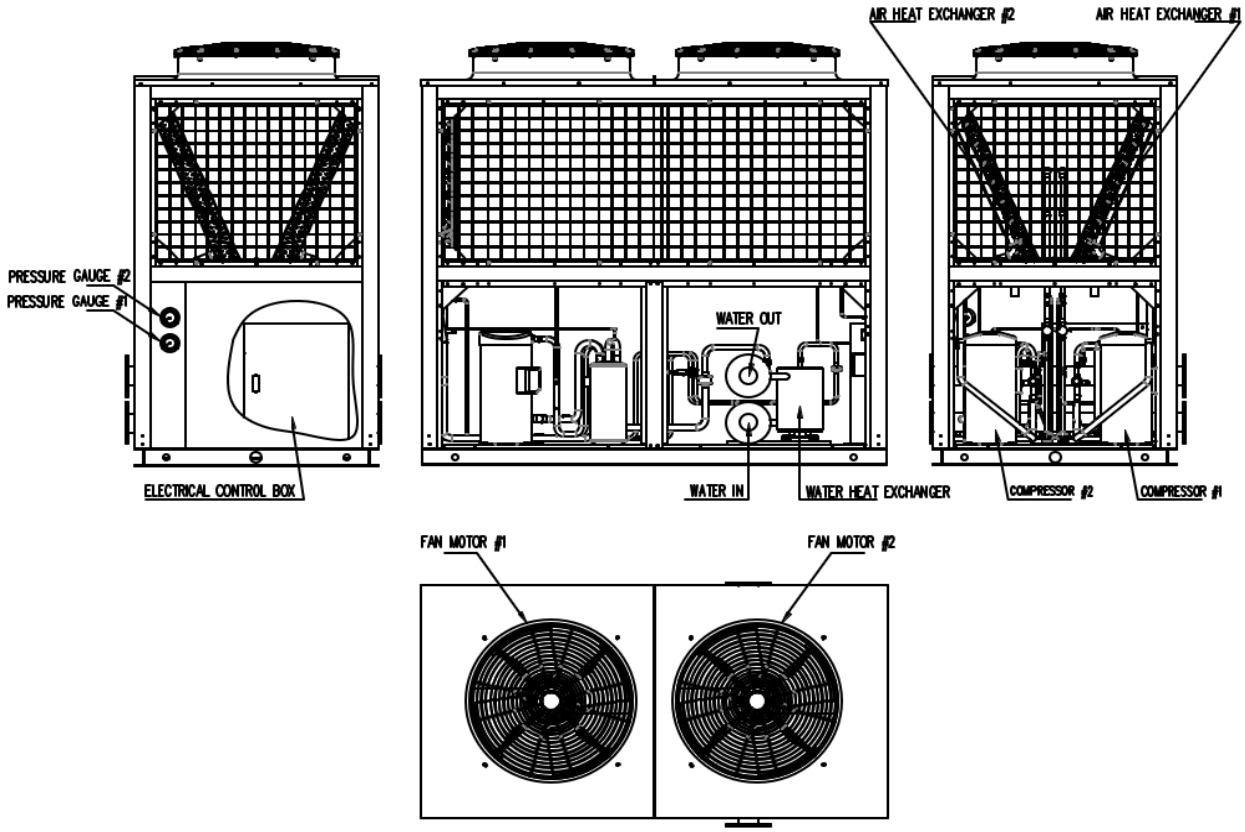
- 4 x Compressors.
- 4 x EVI DC Inverters.
- V Bank Air Heat exchanger.
- Water Heat Exchanger.
- 2 x Fan Motors.
- Controller.
- Expansion Valve Assembly etc.
- User Interface Controller.
  Bluetooth ICloud connection via Mobile App.
- 485 BMS Port interface.
- Vault free contacts (Run & Fault).
- In-built condensation drain trays.

Hercules 180

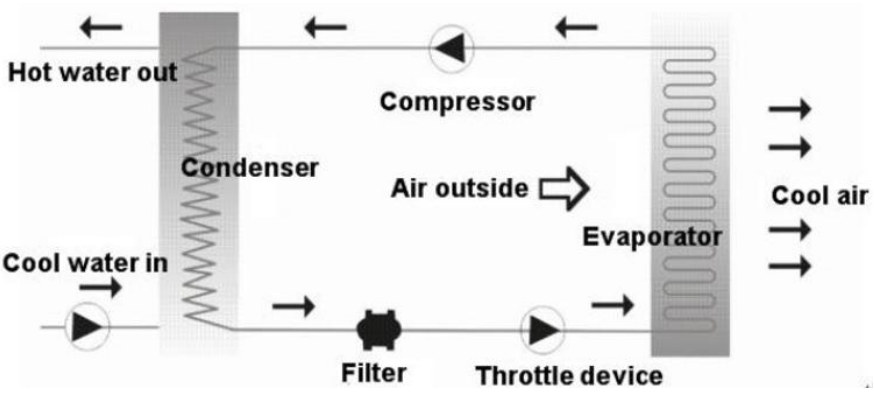
The main components of this heat pump consist of:

- 8 x Compressors.
- 8 x EVI DC Inverters.
- V Bank Air Heat exchanger.
- Water Heat Exchanger.
- 6 x Fan Motors.
- Controller.
- Expansion Valve Assembly etc.
- User Interface Controller.
  Bluetooth ICloud connection via Mobile App.
- 485 BMS Port interface.
- Vault free contacts (Run & Fault).
- In-built condensation drain trays.

1.2. Construction



1.3. Heat Pump operation



1.3.1. Heat Pump Refrigerant Heating Process

Compressed by compressor, low pressure and low temperature refrigerant turns into high pressure and high temperature that then passes through a reverse valve to condenser (Water Heat Exchanger). Heat energy is then transferred to the water side of the heat exchanger and the refrigerant turns back into high pressure and low temperature liquid; this is the basic principle how the outlet water was heated.

The refrigerant, throttled by an expansion valve, expands in volume and changes to low temperature and low-pressure refrigerant into partial liquid and partial gas status.

The liquid gas mixed refrigerant goes into the evaporator “Air Heat Exchanger” the fan system draws air through the fin-tube air heat exchanger so that refrigerant will absorb heat from surrounding air and turn the refrigerant into gas status.

The refrigerant passes through the reverse valve back into the compressor and the cycle repeats again.

1.3.2. Defrost

When the heat pump is in operation during winter conditions, frost may possibly form on the surface of the evaporator coils (V Bank Air Heat Exchanger) which will reduce the performance of the heat absorption.

Activation of the automatic heat pump defrost cycle will depend on the ambient temperature and operating time.

If the defrost program is activated, the heat pump system will reverse to cooling, so that the frost formed on the surface of the coils (fin-tube air heat exchanger) will be melted off. During this process the two fans will be stopped while the defrost cycle is in operation.

When the automatic defrost program has completed the heat pump system will switch back to the heating mode.

1.4. Operating Conditions

Operating requirements

Item	RequirementS
Unit orientation	Upright
External Air temperature	-15° C to +43° C
External Humidity	5% RH ~ 95% RH
Power supply	400V±10%~/3N/50Hz
Latitude protection	1000 meters (unit will derate when above 1000m)
IP rating	IPX4

PART 2. Mechanical Installation

2.1. Transportation, Unpacking, Examination

2.1.1. Unpacking

- The heat pump should be unpacked near the proposed installation location.
- Remove the plywood packaging.
- Remove all protection.
- Remove heat pump from pallet.

2.1.2. Unpacking Checks

- Check the quantity of accessories supplied with the heat pump.
- Check if there is any damage on the heat pump by visual inspection. If any missing accessories or damage has been found, please report to Energy Technologies Ltd by email info@energy-technologies.co.uk.

2.1.3. Transportation and handling

The inclination angle of heat pump should not exceed of 75° to 105° when handling.

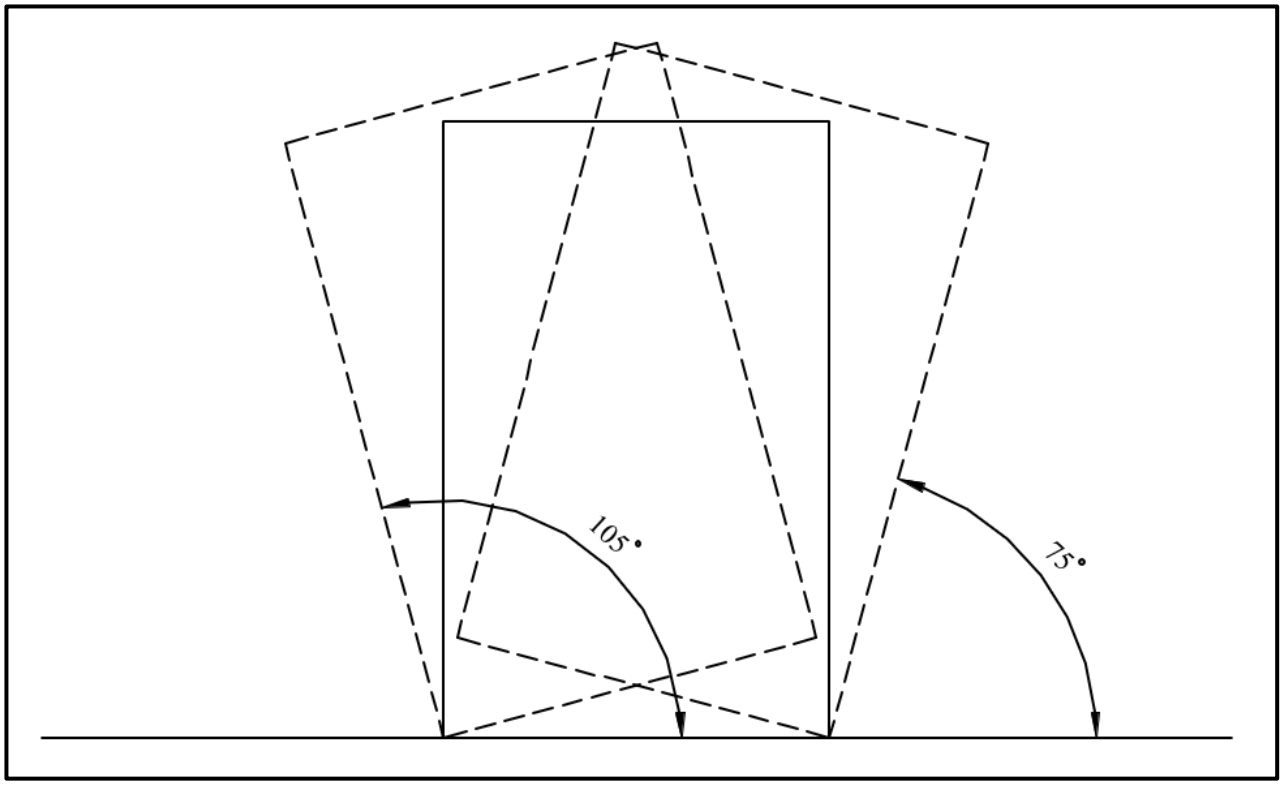


Diagram 1- Maximum tilt angle when lifting

A forklift truck is recommended for the movement of heat pump. If the forklift is not available, alternative plant handling systems can be considered, shown as bellow:

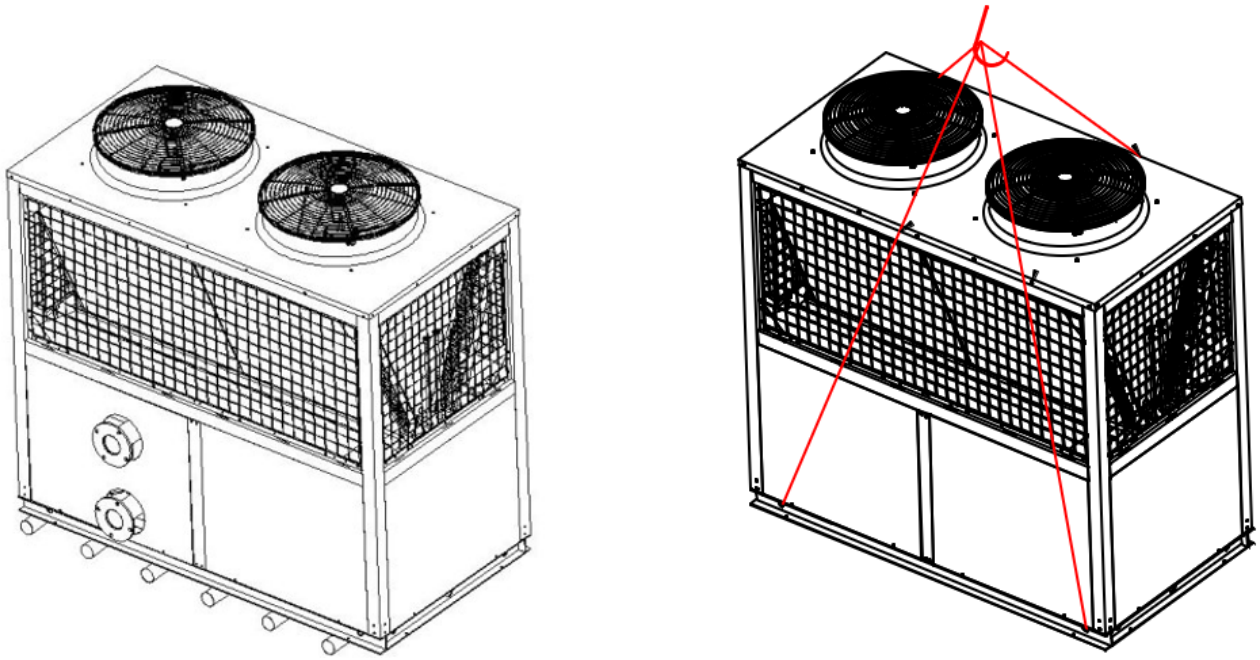


Diagram 2 – Lifting Arrangements.

A Lifting expert is to select the correct rated lifting equipment that is suitable to lift the weight of the heat pump.

WARNING

- No one should stand beneath the heat pump when lifting.
- A lifting frame underneath the heat pump or Spreader Beam arrangement is required including providing protection when using a crane to the lift the heat pump, preventing the risk of any damage to the heat pump.

2.2. Installation

The installation must be carried out by a competent installer, both mechanical and electrically.

Correct installation is critical to achieve the best performance and lifespan of the heat pump. Both the mechanical and electrical instructions included in the manual and the local regulations should be applied.

The heat pump must be installed vertically on level ground, recommended installation using a floor mounted rubber type foot mounting system (big foot).

The installation site should comply with all good practice design requirements. The installation must be carried out according to the project design and correct maintenance space requirements for future safe maintenance.

Minimum ventilation space requirements to be provided to ensure correct air flows and maintenance access.

Consideration and if necessary appropriate measures to be provided to prevent any environmental noise impact.

2.3. Safety Precautions

All necessary earthing to be provided prior to energisation to prevent any accidents. Any modification or repair on the heat pump by the owner, unless suitably qualified, is prohibited.

Maintenance and any repairs on the heat pump to be carried out by the installer or a competent technician with authorisation from Energy Technologies Ltd. Check all power cables are installed correctly from the circuit breaker to electrical terminals on the heat pump.

The heat pump must not be installed near flammable, or volatile environments to prevent the risk fire or explosions. Check the support frame or base to make sure the heat pump has been fasten firmly preventing the risk of toppling causing damage and or injury.

Before undertaking any maintenance or cleaning on the heat pump, the power supply to the heat pump must be isolated to prevent the risk of injury or damage to the heat pump.

Do not touch the exhaust gas pipe inside heat pump system to prevent the risk of scalding.

No flammable or acid liquid should be sprayed to the heat pump.

2.4. Site Installation Location

The location of the heat pump must be suitable to provide adequate space for air flow, access to control panel, maintenance and to allow acoustic barriers to be installed if required. The environment should free of flammable or corrosive conditions which could cause damage to the heat pump or risk of fire and or explosions.

It is recommended that the heat pump should be provided with a suitable fence or acoustic barrier to prevent un-authorised access.

The heat pump must be installed on flat level ground or an adjustable support mounting system to avoid risk of water damage, vibration transmission and noise.

It is recommended that an acoustic assessment and report is provided to ensure compliance with environmental noise obligations.

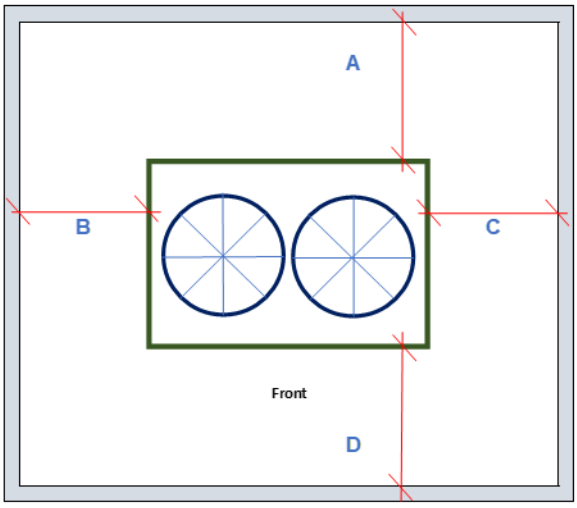
Mounting the heat pump on a big foot type mounting system (adjustable to ensure level installation) allows for managing the condensate water that requires to be drained away from the heat pump, preventing any damage or corrosion. Connections points are provided for condensate drain installations, enabling condensate water to be piped to nearest drainage point.

Heat pumps installed in a multiple arrangement requires enough space separation to avoid air short circulating, unbalance loading and starving units of air for correct operation.

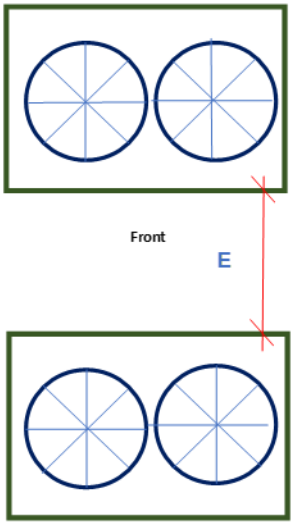
When the heap pump is located on a roof top, big foot type systems are required to be prevent damage to the roof waterproof membrane.

2.5. Space Requirements

Recommended minimum space for ventilation and maintenance.



(Enclosure)



Model	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	F Above Fans (mm)
Hercules 42	600	600	600	800	1000	2000
Hercules 85	800	1000	1000	1000	1000	2000
Hercules 120	1000	1000	1000	1200	1000	2000
Hercules 180	1000	1000	1000	1200	1200	2000

Diagram 3 - Space Requirements

Ensure minimum space is provided for installation, ventilation, and maintenance.
Ensure there is no obstacles located above the top of the discharge fans within 2 meters distance from heat pump fan outlet.

2.6. Piping System Installation Layout

The following piping schematics examples show typical arrangements for connecting the heat pump to a building low temperature hot water (LTHW) heating system and or hot water storage facility. The schematics are provided to assist the installer when considering different end use applications especially when connecting to an existing LTHW heating system.

Each heat pump should be installed with a "**Shunt Pump**" close to the heat pump to ensure in all operations minimum water flow rate is maintained through the heat pump. Double regulating valves should be installed at each heat pump to ensure the design flow rate can be set up by the mechanical commissioning engineer to ensure the designed delta T°C between water outlet and inlet is achieved.

When installing heat pumps in cascade configuration, the main flow and return water header pipes should be 1.5x larger than water connection specification of the heat pump.
The recommended pipe system configuration to be based on a Reverse Return System.

It is suggested that stainless-steel pipework and fittings, (copper-based pipe material is equally acceptable) are used for the heat pump pipe circuit, as a minimum up to the connection points (flow and return), into an existing LTHW building system.

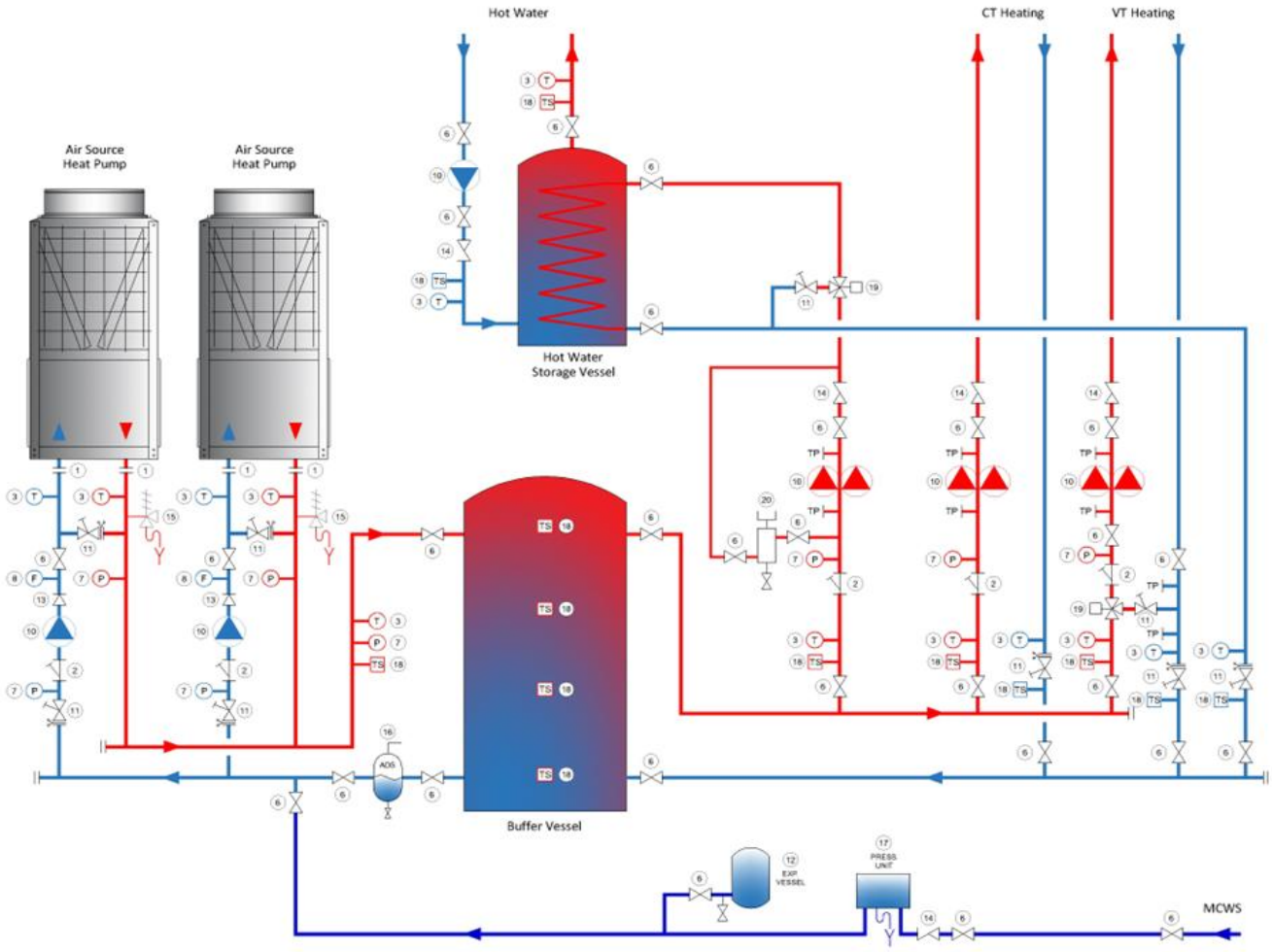
External pipework to be insulated and consideration given to provide trace heating to prevent the risk of freezing up in winter conditions.
Each heat pump needs to be fitted with a strainer minimum 65mm diameter before the inlet heat pump connection.

Schematic Legend

The legend below is to be used in conjunction with the example piping schematics showing a typical arrangement for connecting a heat pump system. It is not intended to be extensive or all-encompassing and will depend on the final requirements that may need to be included for the overall system design.

#	Item	Description
1	Union / Flanged Joint	Required to allow for replacement of equipment
2	Y Type Strainer	Install strainer close to unit to prevent foreign materials from entering water side of heat exchanger
3	Temperature Gauge	Required to check performance and monitor the operation of the unit
4	Air Vent Valve	Install automatic air venting valves to all high points
5	Drain Point	Install drain valves to all low points so that water can be drained out of system for servicing
6	Isolating Valve	Required to allow for isolation of parts of the system and replacement or cleaning of the flow adjuster
7	Water Pressure Gauge	Recommended for checking the system pressure status
8	Flow Switch	Required to protect the unit
9	Flexible Coupling	Recommended to prevent noise and vibration from the pump being transmitted
10	Pump	Pump large enough to compensate for the total water pressure loss and supply sufficient water to the unit
11	Regulating Valve	Required to set up the correct water flow rates for the unit
12	Expansion Vessel	Required expansion tank and water fill point
13	Non-Return Valve	To prevent black flow.
14	Check Valve	To prevent black flow.
15	Pressure Relief Valve	Required to prevent system over pressurisation.
16	ADS	Air Dirt Separator required to collect any dirt and automatically release air from the system.
17	Press Unit	Pressurisation Unit required to maintain minimum system design operating working pressure.
18	TS	Temperature Sensor connected to BMS to monitor water temperatures.
19	Three Port Valve	Required for water temperature control.
20	Dosing Pot	Water Treatment Dosing Pot required to allow routine system water treatment.

2.6.1. Piping Arrangement 1



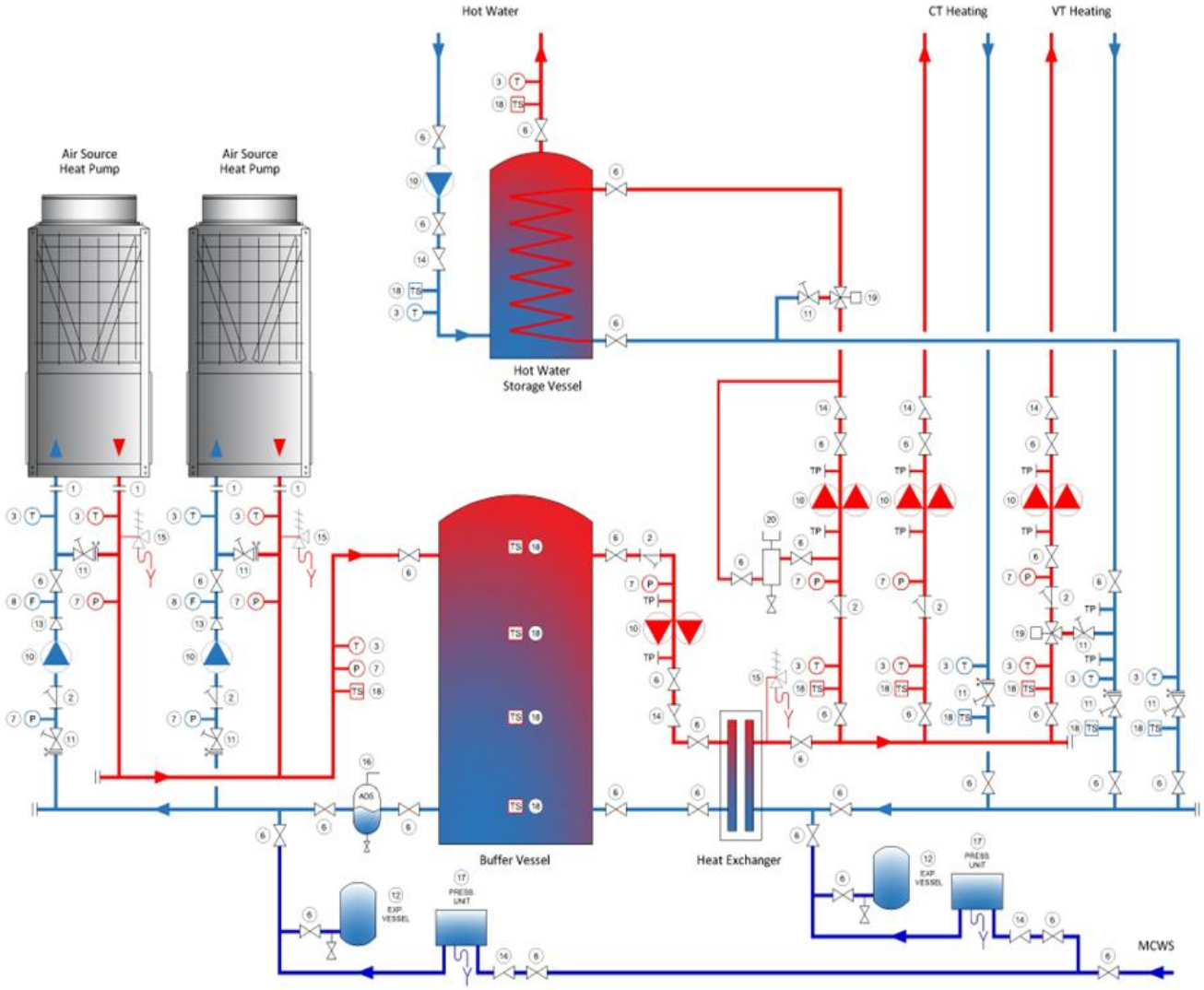
Schematic 1. Heat Pump piped directly into a new building Low Temperature Hot Water (LTHW) heating system.

Ideally the control system should seek to maintain the average temperature of the buffer tank at 70°C plus.

This schematic is typically suitable for a completely new building where the heating system has been recently constructed with new materials and has been fully flushed, cleaned fully in accordance with the relevant and legislative water quality guidelines undertaken by a specialist cleaning company, provided with the correct compatible type of corrosion inhibitor, and including automatic air separator equipment.

Each heat pump should be installed with a “Shunt Pump” close to the heat pump to ensure in all operations minimum water flow rate is maintained through the heat pump. Double regulating valves should be installed at each heat pump to ensure the design flow rate can be set up by the mechanical commissioning engineer to ensure the designed delta T°C between water outlet and inlet is achieved.

2.6.2. Piping Arrangement 2



Schematic 2. Heat Pump piping arrangement with plate heat exchanger separating heat pump circuit from existing building (LTHW) heating system.

Ideally the control system should seek to maintain the average temperature of the buffer tank at 70°C plus.

Due to our very low noise heat pump design enables the opportunity to run the heat pump during the off-peak electrical period (low-cost tariff) to pre heat the buffer and hot water storage tanks making ready for building system start up.

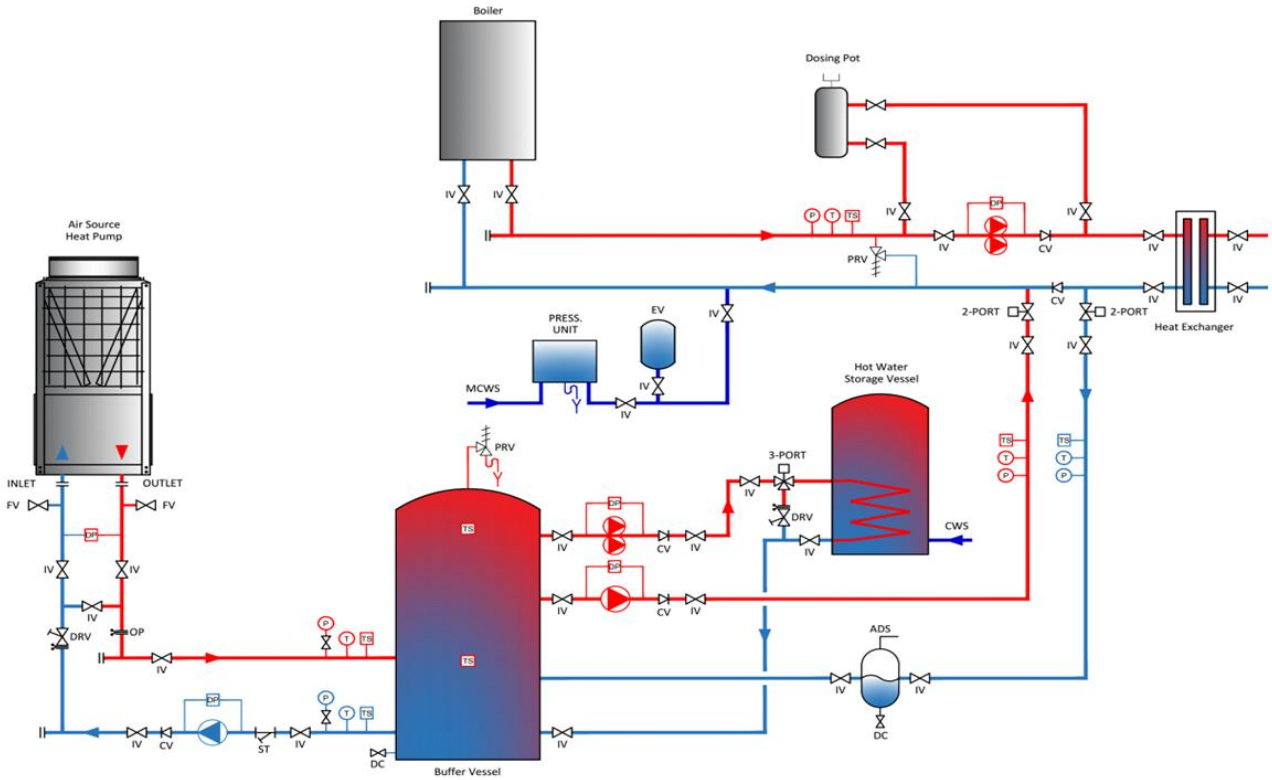
The hot water tank should be fitted with a suitable rated coil at the bottom of tank to ensure the end user always had a full tank of hot water available. Solar thermal coil if used should be located above the heat pump hot water heating coil.

Using a plate heat exchanger to separate the new heat pump installation from the existing building systems avoids the risk of water quality contamination, fouling and any issues that might exist with venting the existing heating system.

Separating the heat pump circuit with a plate heat exchanger from the main building LTHW piping system, allows for the simple introduction of anti-freeze (glycol-based product) to the heat pump closed loop system providing additional protection to the risk of freezing the heat pump and pipework system during the winter periods.

Each heat pump should be installed with a “Shunt Pump” close to the heat pump to ensure in all operations minimum water flow rate is maintained through the heat pump. Double regulating valves should be installed at each heat pump to ensure the design flow rate can be set up by the mechanical commissioning engineer to ensure the designed delta T°C between water outlet and inlet is achieved.

2.6.3. Piping Arrangement 3



Schematic 3. Heat Pump, Boiler Hybrid piping arrangement with plate heat exchanger separating heat pump circuit from existing building (LTHW) heating system

Schematic 3 is a practical solution when installing a hybrid heat pump and boiler system connected to an existing building LTHW heating system. The hybrid system allows the heat pump to act as lead heating source whilst the boiler provides heating boost facility when weather demands exceed the kW rated heating capacity of the heat pump.

Ideally the control system should seek to maintain the average temperature of the buffer tank at 70oC plus.

Due to our very low noise heat pump design enables the opportunity to run the heat pump during the off-peak electrical period (low-cost tariff) to pre heat the buffer and hot water storage tanks making ready for building system start up.

The hot water tank should be fitted with a suitable rated coil at the bottom of tank to ensure the end user always had a full tank of hot water available. Solar thermal coil if used should be located above the heat pump hot water heating coil.

Using a plate heat exchanger to separate the new heat pump installation from the existing building systems avoids the risk of water quality contamination, fouling and any issues that might exist with venting the existing heating system.

Separating the heat pump circuit with a plate heat exchanger from the main building LTHW piping system, allows for the simple introduction of anti-freeze (glycol-based product) to the heat pump closed loop system providing additional protection to the risk of freezing the heat pump and pipework system during the winter periods.

Each heat pump should be installed with a “Shunt Pump” close to the heat pump to ensure in all operations minimum water flow rate is maintained through the heat pump. Double regulating valves should be installed at each heat pump to ensure the design flow rate can be set up by the mechanical commissioning engineer to ensure the designed delta T^{o}C between water outlet and inlet is achieved.

2.6.4. Buffer Tank Sizing Guidance

Our recommended guide for buffer tank sizing is based on **12** to **15 litres stored water per kW rated heating capacity of the heat pump.**

Maximum using 15 litres.

- Hercules 42 1 x **630 litres**
- Hercules 85 1 x **1260 litres**
- Hercules 120 1 **x 1800 litres**
- Hercules 180 1 **x 2700 litres**

Selecting the correct size of buffer tanks provides many benefits, start-up of heating system to reduce response time and defrost cycles in winter periods ensuring optimum operating efficiency.

2.7. Water Quality

Pay careful attention to the system water quality. When the circulating water quality is poor, the water heat exchanger can develop scale, leading to a reduction in output capacity and the possible corrosion of the heat exchanger.

Ensure any new or existing pipework is suitably flushed, cleaned and treated in accordance BSRIA Guidelines BS 8552 with the before connecting to the heat pump. It is imperative that foreign objects, such as welding fragments, sealant particles, or rust, do not enter the heat pump or any other equipment.

Routine maintenance should be put in place to ensure the continued performance of the heat pump and LTHW system. It is recommended that a water quality specialist is consulted about water quality control methods before using anti-corrosive solutions for water quality management.

2.8. Installation checkpoints prior to starting up Heat Pump

- ☐ Ensure that there is enough space around the heat pump to carry out maintenance.
- ☐ Check that the heat pump been installed level and secured to the base.
- ☐ Check that the piping system has been connected, filled with water and valves all set open and fully vented.
- ☐ Check that the condensate drainage pipework been connected and discharge away from the heat pump.
- ☐ Check that all connections are tightened ready for operation.
- ☐ Ensure that the surrounding area has been cleaned of all debris, dust, and any waste materials.
- ☐ Check all electrical and control systems have been connected, tested, made safe and ready for starting up.

PART 3. Electrical Installation

3.1. Electrical

- The 3-phase power supply required for the heat pump must comply with the standards, codes and specification listed on heat pump unit nameplate.
- Earthing to be installed in accordance with the latest applicable regulations.
- The electrical wiring must be carried out by qualified electrician and connected to the heat pump as per the wiring diagram on the heat pump.
- All electrical installations to comply with the latest applicable electrical regulations, including providing all necessary circuit breakers and local isolators.
- Power cables and controls cables to be segregated, or use screened control cable, to prevent any interference, voltage jumps etc.
- All the cables or wires should not touch the refrigerant piping or valves.
- Careful inspection and testing to be completed after electrical installation, before turning on the circuit breaker and energizing the heat pump.
- Wi-Fi 4G point to be provided at each heat pump to allow remote monitoring and adjustments.

The communication / controls cables that connects the controller panel and power supply must NOT be tied together, or close to any other device that could cause any interference. It must be kept separate, with a distance of at least 30cm and / or use screened control cable.

3.1.1. Example Control Panel

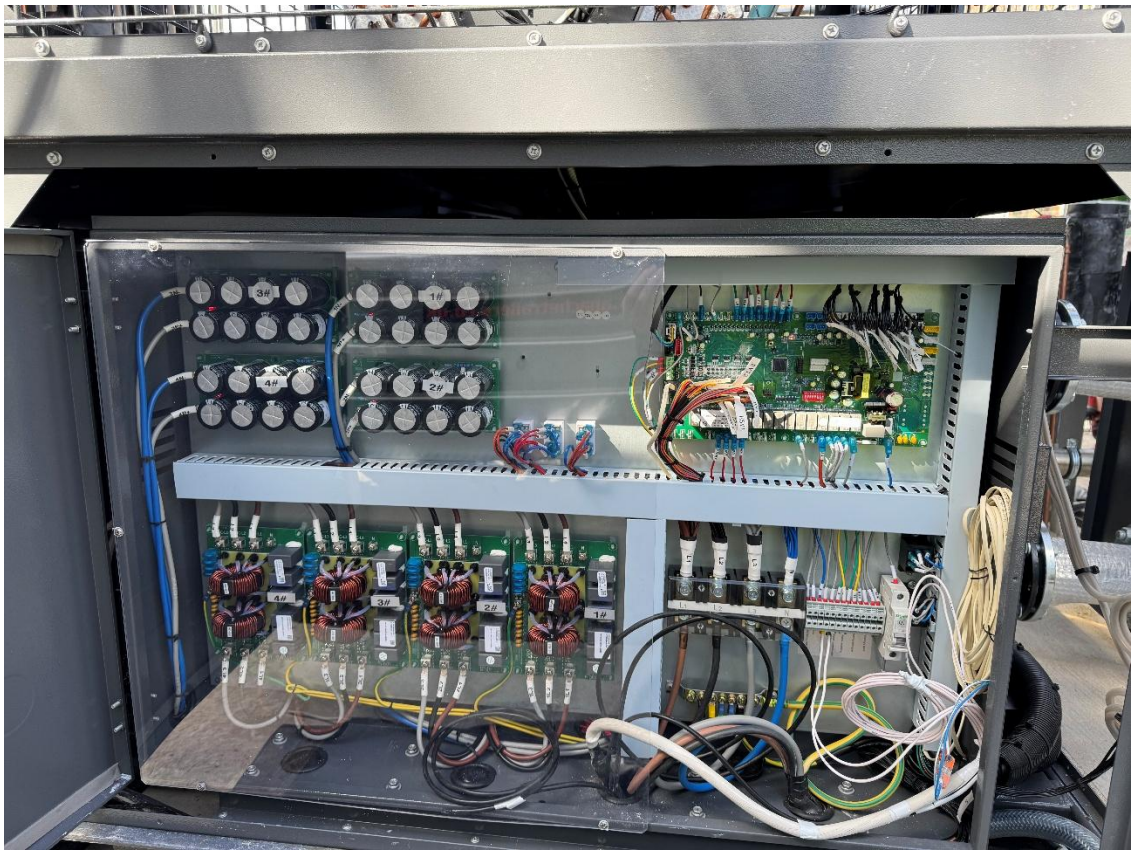


Diagram 4 – Control Panel

3.1.2. Cable specification

Cable sizing chart for guidance only.

Contractor to select power and earthing cables in accordance with BS7671

Hercules Model	Power Supply	Breaker Rating (Amps)	50m Length Power Cable Specification 6% Voltage drop (mm2)	Grounding Wire Specification (mm2)
Hercules 42	415V / 3N-50Hz	50	25	16
Hercules 85	415V / 3N-50Hz	100	25	16
Hercules 120	415V / 3N-50Hz	130	35	25
Hercules 180	415V / 3N-50Hz	200	70	35

Table 1 - Minimum Electrical Power Cable Sizes

3.2. System wiring

3.2.1. Wiring requirements

Additional electrical circuits must not be connected to either the electrical connection box or the control panel, otherwise the magnetic interfering may cause failure or damage to the heat pump controls or PCB. This will also invalidate the warranty.

The 240V/1/50Hz electrical power is available either in electrical box or control PCB. When connecting power and control cables maintain separation or use screened cable. The cable of LCD controller should not tie together with the power cable.

Local isolators must be installed for each heat pump.

The installer must select the correct size cables based on the relevant applicable electrical regulations, considering length or cable run and minimum size required.

3.2.2. Wiring

Connect the earth wire to the electrical box in the appropriate location (marked with a symbol) and make sure it is screwed tightly.

Connect the LCD controller and its cable according to the wiring diagram, then fix the LCD controller panel inside the housing.

Thermally conductive silicone should be applied to both the sensor pocket on the hot water vessel and the surface of the water tank sensor. Insert and fasten the water tank sensor inside the sensor pocket to prevent it becoming lose.

Install an appropriately sized externally rated isolator switch in a suitable position close to the heat pump where power cable goes to the heat pump.

Connect an appropriately sized and specified cable between the isolator and the heat pump Through the power cable hole, connect the power cable and grounding wire to the heat pump.

All cables must be securely fixed with appropriate cable fixing systems.

Connect the electrical power cable to the Live and Neutral points in the power supply terminal in the control panel and check that the connections are correct and tight before energizing the heat pump.

3.3. Checkpoints

- ☐ Check the correct electrical power supply has been provided to meet the heat pump electrical specification requirements.
- ☐ Check that all cables are terminated, secured and tight.
- ☐ Check the heat pump is correctly and effectively connected to the earthing system.
- ☐ Testing of all electrical systems to be completed prior to energization.
- ☐ Check customer Wi-Fi 4G point working with strong signal.

PART 4. Start up.

Note: Before turning on the heat pump, electricity must be connected to the heat pump 24 hours ahead, to heat up the compressor oil, otherwise it may lead to compressor to be damaged

4.1. Pre-commissioning start up checks.

- ☐ Check all electrical systems and ensure they have been tested.
- ☐ Check all pipework systems are installed, filled with water, tested, and fully vented.
- ☐ Check all valves are fully opened and the system has been flushed, cleaned and treated.
- ☐ Before turning on the heat pump, electricity must be connected to the heat pump 24 hours ahead of operation, to heat up the compressor oil, otherwise it may lead to the compressor being damaged.
- ☐ Shunt Pump / double regulating valves all set up for the flow rate to each heat pump commissioned for designed delta T^{o}C between water outlet and inlet temperatures requirements

4.2. Check list.

Checkpoint	Description	Yes	No
Site installation	Has the Heat Pump been installed level and secure?		
	Is there sufficient air flow around the unit?		
	Is there enough space for maintenance?		
	System visually inspected?		
Pipe System	Are the pipe connections compliant?		
	Is the system pressure correct?		
	Is the pipework installation complete?		
	Is the air vented from the system pipework?		
Electrical System	Circuit breaker turned on?		
	Earthing complete and tested?		
	Is the cable specification compliant?		
	Is there a local isolator installed?		
	Has the circuit breaker been set up?		
	Are the current and voltage compliant?		
	Are all the connections tight and secure?		
	Al safety systems ready and set?		
	Is the controller correctly connected?		

4.3. Starting up

The battery must be installed inside the controller before it is installed in the on position. Without the battery installed the timer will reset when the electricity comes each time affecting the timer operation.

Note: There is a 1-minute compressor delay for protection purposes when heat pump is required to restart.

- ☐ Check the User Interface controller is displaying, and the buttons are working and in good condition.
- ☐ Check indicators are on and showing in good health (no error messages).
- ☐ Start up the heat pump via the operation on the User Interface controller.
- ☐ Check water flow rates are working as per design.
- ☐ Check water temperature difference (5~10°C) between water in and out.
- ☐ Check the discharge fans are running, and cool air is being discharged.
- ☐ Check the condensate drain is working.
- ☐ Check for noise and vibration levels ensure these are not excessive.
- ☐ Check there is no refrigerant leakage.

PART 5. User Interface Controller

5.1. Interface Panel

Picture 1 – User Interface Controller

User Interface
Control Panel

5.1.1. Key switching

There are a total of 6 touch screen buttons:

- ON/OFF
- Return, OK
- Up / Increase Values
- Down / Decrease Values
- Settings, Reset
- Password

Note: User interface controller has Bluetooth Wi-Fi inbuilt enabling connection with Huilian Smart Mobile App. Customer Wi-Fi 4G point at each heat pump to be active to enable remote access.

5.1.2. Icon description

ICON	DESCRIPTION
	On / Off button
	Return
	Scroll Up to select parameters, and increase values
	Scroll Down to select parameters, and decrease values
	Settings, reset
	Password (If required setting)

SYMBOL	ICON DESCRIPTION
IDLE	STAND BY
OPEN	START UP
RUN	PLANT RUNNING
STOP	PLANT STOPPED
DEFR	DEFROST
ERR	FAULT
PREH	PRE-HEATING (WARMING UP)
ATFZ	ANTI FREEZE
SNOW	REMOVE SNOW
ITLK	INTERLOCK
Cool	COOLING
Heat	HEATING
AUTO	AUTOMATIC
Hot W	HOT WATER
NOW	CURRENT STATUS
SET	SET UP
Now	CURRENT
Quer	INQUIRE (INVESTIGATE)
Menu	MENU
Mode	MODE
CtrlMode Set	CONTROL MODE SET
Ret	RETURN
Ent	ENTER
Q Status	STATUS QUERY
Q Clock	CLOCK SETTING
Q Versio	VISION QUERY
RST	RESET

5.2. Startup

Starting up the heat pump and settings.

Temperature setting shown on the interface controller and Huilian Smart mobile App are based on **inlet water** temperature.

Example setting up.

- Inlet water temperature set at 70oC (or less)
- Outlet water temperature will be 80oC

Note every 1oC outlet water temperature is set lower than maximum 80oC the COP will increase by minimum 3%

Pump flow rates.

Hercules 42
In-built paddle type flow switch minimum setting 3.6 m3/hr

- 3.9 m3/hr = between inlet and outlet water temperature 10oC delta.
- 7.7 m3/hr = between inlet and outlet water temperature 5oC delta.

Hercules 85
Inbuilt paddle type flow switch set minimum setting 7 m3/hr

- 7.7 m3/hr = between inlet and outlet water temperature 10oC delta.
- 15.5 m3/hr = between inlet and outlet water temperature 5oC delta.

Hercules 120
Inbuilt paddle type flow switch set minimum setting 10 m3/hr

- 10.3 m3/hr = between inlet and outlet water temperature 10oC delta.
- 20.6 m3/hr = between inlet and outlet water temperature 5oC delta.

Hercules 180
Inbuilt paddle type flow switch set minimum setting 10 m3/hr

- 15.6 m3/hr = between inlet and outlet water temperature 10oC delta.
- 31.0 m3/hr = between inlet and outlet water temperature 5oC delta.

Shunt pumps and double regulating valves installed at each heat pump to ensure water flow rates for delta T°C between water outlet and inlet are set up as required design.

Hercules Shunt Pump Run Time Settings.

- BMS pump prestart run time before BMS enable air source heat pump to start is to be set at **minimum 30 seconds.**
- BMS pump over run time after air source heat pump has been shut down to be minimum of **120 seconds to 300 seconds** to ensure compressor heat control management.

The air source heat pump is designed with stepped load soft start EVI DC inverter-controlled compressors. Upon enable signal from the BMS the startup cycle time will take 20 seconds to startup each compressor. Each compressor will start up individually and ramp up before the next compressor is started to minimise electrical starting current.

Fault free contacts are provided for BMS connections for **"run and fault"** monitoring.
BACnet open protocol BMS 485 interface port provided to enable direct BMS interface connection.

The startup interface includes the Countdown Interface after power on and the main Interface after countdown.

5.2.1. Start Up

First item to check is the paddle flow switch on the inlet to the heat pump.

- Isolate the power supply at the control panel and local rotary isolator.
- Remove heat pump pipe connection access panel.
- Remove cover off paddle flow switch.
- Check shunt pump has been set up for desired flow rate.
- Check paddle flow switch is moving adjust if necessary to until visually or electronically measured to ensure paddle flow switch is working.
- Replace paddle flow switch cover
- Replace access panel
- Turn on power supply to heat pump.

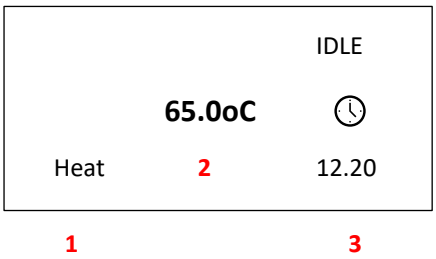
First step Turn on user interface controller panel, press the on/off icon for 3s

1 2 3

First screen can be switched between Chinese and English by pressing the < up > or < down > key.

1. When the icon in the upper left corner is " 中 ", it means that the language is Chinese.
2. When the icon in the upper left corner is “En ", it means that the language is English.
3. IDLE means Standby.

5.2.2. Setting Heating Mode.



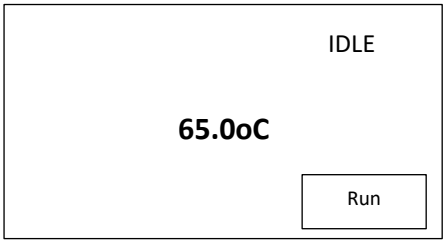
1. Select operating mode of the unit:

   When "operation mode" = heating, the "Heat" is displayed

2. Setting Water Inlet Temperature Required.

   Select inlet water temperature (return), the system return temperature is displayed
   Water outlet temperature will be based on pump flow rate setting and delta required between water inlet and outlet water temperature.
   When "–" is displayed, this indicates a probe failure or measurement is out of range. Directly press the <Up> or <Down> key to modify the temperature value.

3. Timing clock setting status has the timing icon ◷ indicating the timing function in use.



When the unit is not in fault, the current system clock will be displayed, Run will be displayed.

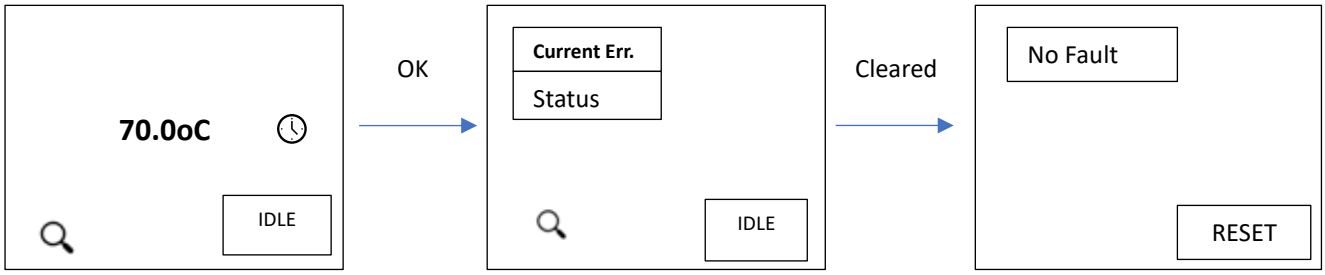
5.3. User Interface Panel.

5.3.1. Troubleshooting

When a fault occurs on the main user interface panel it will show as a red triangle with the symbol  in the centre.

To restart the heat pump, go to the user interface panel and follow the steps below

- **Step 1** Select hit < Return symbol >
- **Step 2** Select <curr error> hit return symbol again this will show the fault.
- **Step 3** Select <Reset> (3) this will clear the fault, and the heat pump will restart



Step 1 **Step 2** **Step 3**

Step 1 will open the menu which will show several items to choose from.
Step 2 Scroll to select the "current error". This will indicate the current fault, including module, fault number and fault name.
Step 3 Press the "Reset" to clear the fault, the screen will go back to normal setting and the unit will start back up.

If there is a still a fault, the current fault will continue to be displayed, and the unit will not start back up. This will require further investigation to find the fault.

Investigate all parts of the installation, pumps, pressurisation and expansion systems, control valves, air vents and system filled with water including any Building Management Systems (BMS) to check that another part of the system is in fault preventing the heat pump from starting.

If the fault preventing the heat pump from starting back up is external of the heat pump the relevant party will need to be notified.

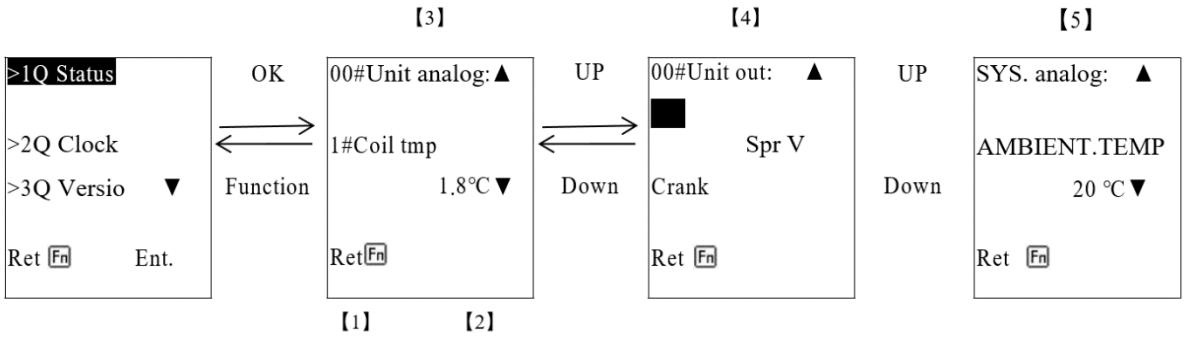
If the fault is found to be part of the heat pump a repair or replacement of faulty item will be required, contact Energy Technologies Limited. Contact details can be found on the last page.

5.3.2. Error Codes

Error code	Fault name
Power alarm	Power failure
EEPOM data err	EEPROM Data fault
External alarm	External interlock failure
Mode set err	Mode setting error
Air pump OL.	Air conditioning pump overload
Air flow lack	Air conditioning water flow is insufficient.
Air wat lack T.	The temperature difference between water in and out is too large.
Ambient T.err	Ambient temperature probe failure
Sys.evap.out T	System air conditioning water outlet temperature probe fault
Sys.evap.in T.	System air conditioning backwater temperature probe fault
Cool amb. HI	The ambient temperature is too high in Refrigeration condition.
Cool amb. LO	The ambient temperature is too low in Refrigeration condition.
Heat amb. HI	The ambient temperature is too high in heating condition
Heat amb. LO	The ambient temperature is too low in heating condition.
Para item OV	The number of parameters is super bound.
Commu error	Communication failure
1#comp LP	1#Compressor press low pressure
1#comp HP	1#Compressor press high pressure
1#Comp OV	1#Compressor failure
1#Comp.HT.	1#Compressor exhaust temperature is too high
1#SuctionT.err	1#Compressor inspiration temperature probe failure
1#Evapng.T.err	1#Compressor temperature probe behind the expansion valve has failed
1#Coil T.err	1#Compressor fender temperature probe fault
1#ExhaustT.err	1#Compressor exhaust temperature probe fault
1#Comp.curr.lo	1#Compressor current is too low
1#Coil T.high	1#Compressor coil temperature is too high
1#ExhaustT.hi	1#Compressor exhaust temperature is too high
1#Comp.curr.hi	1#Compressor current is too high
1# SH err	1#Compressor abnormal suction overheat
1#EVI suc err	1#Compressor EVI inhale probe malfunction
1#EVI evp err	1#Compressor EVI evaporation probe failure
1# ex T. low	1#Compressor exhaust temperature is too low
1#Emerg defrost	1#Compressor emergency defrosting is frequent
1#EWD except	1#Compressor the ambient temperature and the coil temperature are abnormal
1#Invt.comm.err	1#Compressor frequency converter communication fault
1#Invt. err	1#Compressor frequency converter fault
1#Comp prot	1#Compressor protection

5.3.3. Status Query

Enter the user setting interface and select < Status query > to enter:



Interface Panel Symbol	Description
Q Status	Status Query
Q Clock	Clock Query
Q Versio	Version Query
Time Set	Timing Settings
F Senior	Advanced Features
Coil Tmp	Fin Temperature
Unit analog	Analog
Out	Output
4W	Four Way
#Spr V	Squirt
Crank	Crankshaft
SYS	System
AMBIENT TEMP	Ambient Temperature

Annotation Description:

【1】The <MODE> key to return to the previous interface.

【2】None

【3】Displays the analogue information of the corresponding module.

【4】Displays the running status of the output device of the corresponding module. When displayed in **reverse colour** this indicates that the device is currently outputting. If it is displayed **normally**, it means that there is currently no output from this device.

【5】Displays the analogue information of the system.

PART 6. Operation and Maintenance

6.1. Operation

The operational ambient temperature of heat pump ranges from -15ºC to 43°C

The heat pump will automatically defrost when ambient temperatures drop to freezing conditions. The defrost time may last up to 10 minutes. During this period, the fans will stop running, and the compressors will switch to defrost mode.

The heating capacity of heat pump system will vary according to ambient air temperatures. When ambient temperature drops, the heating capacity will also be reduced.

There is 3-minute delay to the compressor during periods when the heat pump is stopped, and another startup is required.

WARNING:

In the event of power failure, or the heat pump is undergoing routine maintenance, or if the heat pump is to be turned off for a long period of time during cold wintertime periods, it is critical to drain out all the liquid inside water heat exchanger when the ambient air temperature drops to below four degrees Celsius, to avoid the risk of freezing up the heat exchanger. Failure to do this can cause significant damage to the heat pump.

6.1.1. Restarting the Heat Pump after maintenance

Refer to Section 4 for heat pump start-up.

Before the heat pump is reconnected to the electrical system after a long period being isolated, it is critical to undertake a thorough process of visual inspection and if necessary, testing.

- ☐ Check the exterior condition of heat pump and clean any dust, dirt, or debris off the heat pump.
- ☐ Check the pipework system is fully vented, filled with water and all valves are open ready for start-up.
- ☐ Make sure all cables are connected tightly.

6.1.2. Water Quality

Suitable water quality maintenance should be put in place to ensure the continued output performance of the heat pump. When the circulating water quality is poor, the water heat exchanger can develop scale, leading to a reduction in output capacity and the possible corrosion of the heat exchanger.

Ensure the connected system pipework is suitably dosed with the appropriate inhibitor in accordance with the relevant industry standards before connecting to the heat pump. It is recommended that a water quality specialist is consulted about water quality control methods before using anti-corrosive solutions for water quality management.

6.2. Maintenance and Repairs

Before undertaking any maintenance or repairs on the unit, ensure it is isolated both mechanically, via suitable isolating valves, and electrically both at the unit itself and the local isolator.

6.2.1. Electrical system maintenance

- ☐ Undertake any statutory electrical testing.
- ☐ Check circuit breaker settings.
- ☐ Check contactor for its functionality.
- ☐ Clean, using a soft brush or dried compressed air, any electrical parts, and controllers to remove any dust or debris.
- ☐ Check terminals for tight connection.

6.2.2. Refrigeration system maintenance

- ☐ Monthly checks should be carried out to see if all systems are working correctly.
- ☐ Planned Preventative Routine Maintenance regime should be undertaken once every 6 months.

6.2.3. Connected pipework system maintenance.

It is important that suitable and sufficient planned preventative maintenance is put in place to ensure the correct operation of the connected pipework system. Whilst this is not directly part of the heat pump operation, any degradation of the connected pipework system could cause the heat pump to suffer from reduced output or cause permanent damage. Pipework system maintenance should typically include but not be limited to:

- Cleaning any strainers
- Ensure correct water quality.
- Ensure all gauges, probes, alarms, or sensors are fully operational.
- Ensure correct operation of all valves.

Note: Specialists in pipework system maintenance should be engaged to ensure full compliance with all relevant industry standards. This manual does not set out these requirements.

6.2.4. V Bank Coil Heat Exchanger (Air Heat Exchanger)

The Air Heat Exchanger is made of hydrophilic aluminium fins and copper tubes. When the heat pump is operating, air flow will go through the heat exchanger and small particles of dirt might stick on to the surface of the heat exchanger, eventually this will lead to insufficient heat exchange rate, reducing the operating efficiency.

It is critical to including routine maintenance to keep clean the coils to maintain optimum efficiency of the heat pump.

- ☐ Directly wash the heat exchanger with water and or brush down the finned tubes to assist in maintaining clean coils.

6.2.5. Titanium tube-in-Shell Heat Exchanger (Water Heat Exchanger)

Cleaning of the heat exchanger can be done by flushing the system with (high velocity) water.

However, limescale scale can form due to regional water hardness. In this event suitable de-scaling chemicals should be used to avoid significant scale build up. The frequency of this should be determined by the user in accordance with the local water quality.

6.2.6. Replacement of compressor

During routine inspection and maintenance, special attention is required to.

- Check circuit breakers are set up and operating correctly.
- Check the high- and low-pressure switches are working correctly.

Picture 2 - Compressor Gauges

- Normal compressor operating pressure 1.5 to 2.5MPA
- High pressure limit set at > 3.0 MPA
- Low pressure limit set at < 1.5MPA

The replacement of a compressor must be carried out by a qualified technician using proper precautions and protection.

The chance of a compressor motor failure is low if the electrical systems have been correctly designed, installed, and commissioned. The most likely cause for compressor failures will be due to a mechanical fault due to lack of lubrication.

Planned preventative routine inspection and maintenance is essential to prevent faults and failures. In the event of a compressor failure, it is important to check if the failure is caused by mechanical or electrical fault.

6.2.6.1. Mechanical fault.

If there is a mechanical problem, please check to see if you can rotate the motor. In the event of a failure the compressor will need to be replaced. It is important to identify the cause of the failure to prevent future failures caused by the same issue. The refrigeration system must be thoroughly cleaned out before replacing with another new compressor.

6.2.6.2. Electrical fault.

An electrical fault can be judged by smell, visual inspection, and testing. If the motor or compressor has burnt out, the compressor oil will become black and acidic, in this case cleaning thoroughly out the inside the refrigeration system must be done.

Note:

If the refrigeration system is not thoroughly and professionally cleaned before replacing with a new compressor, this will lead to another failure of the new compressor and invalidate the warranty.

When compressor is burnt out, the drier filter must be replaced, the expansion valve must be checked, if it is jammed it is critical to replace expansion valve. The replacement of compressor and cleaning of refrigeration system must be carried out by qualified technician.

6.2.6.3. Procedure for replacing Compressor.

- Turn off electrical power supply and physically disconnect.
- Connect the manifold to the service valve on suction pipe to enable recycling of the refrigerant.
- Disassemble the compressor and electrical connections.
- Release the suction and exhaust gas copper pipe.
- Remove the failed compressor.
- Clean refrigeration system.
- The rubber plug on the suction and exhaust pipe of the new compressor must not removed before being ready to braze the copper pipe joint. When the rubber plug is removed, and exposed to air, the copper pipes must be jointed via brazing within 15min.

- Locate the new compressor in position, connect the copper pipe and braze, connect cables.
- Vacuum the system and charge with R-513A refrigerant according to the volume listed on the nameplate. Vacuum time should not be less than 60 minutes and nitrogen injected for pressure testing, maintained at pressure for minimum of 10 minutes.
- Carry out a pre-inspection of the heat pump checking everything is connected and ready for starting.
- Check electrical isolations before turning on the electrical power, start the heat pump and observe until fully running.

Note:

- Refrigerant must be recycled and disposed in accordance with the regulations and law.
- Refrigerant released to air is harmful to environment.

6.3. Fault finding and rectification.

When identifying a heat pump fault or issue, use the table below to assist in fault finding and rectification. If this list has been exhausted and the heat pump is still not working disconnect the heat pump and contact Energy Technologies Ltd for further inspection and solution.

Status	Fault	Possible cause
3-Phase problem	Lack of phase or wrong phase	Check power supply cable.
Disconnect of water flow switch	Water flow switch failed. Insufficient water flow, air in return pipeline, water pump failed or lack of water.	Replace flow switch, clean Y-Filter, and pipeline, vent out the air. Check and recover the water pump Fill water and make sure it is full.
High pressure switch failure	High pressure switch failed, Insufficient water flow, System jammed, sensor damaged.	Replace high pressure switch and /or increase water flow. Check and reset.
Low pressure switch failure	Low pressure switch failed, Lack of refrigeration Evaporator dirty or block	Replace the switch. Check leakage and refill refrigerant. Clean evaporator / remove blockage.
Overheat in exhaust gas pipe	Lack of refrigerant. System seized.	Check leakage and refill refrigerant. Check and remove the failure
Communication failed	Plug and socket loose. Cable broken.	Check and tighten. Replace the cable.
Sensor failure	Plug and socket loose. Sensor not in place. Sensor short. Sensor broken	Check and tighten. Secure the sensor. Replace the sensor or cable. Replace the sensor.
Heat pump not operating	Power failure. Power cable loose. Tripped breaker.	Make sure incoming power is available. Tighten power cable. Reset breaker
Water pump operates but water flow is not good. Noise from water pump	Shut-off valve not opened. Air in the pipe system. Filter blocked	Check valve open. Make sure system is full. Vent out the air. Clean or replace filter.
Low heating capacity	Lack of refrigerant. Insulation on system pipework is poor / incomplete. Evaporator dirty or blocked. Filter blocked.	Check and refill refrigerant. Insulate the pipework. Clean evaporator and remove blockage. Clean Y-Filter.
Compressor doesn't work	Power failure. Power cable loose. AC contactor on compressor failed. Compressor over-heat or over current. Liquid in compressor.	Check incoming power supply. Tighten power cable. Replace contactor. Replace compressor.
Compressor making a noise	Compressor part broken.	Check expansion valve. Replace compressor.
Fan not working	Fan screw loose. Fan motor burnt out. Fan capacitor failed. Fan AC contactor damaged.	Tighten screw. Replace motor. Replace capacitor. Replace AC Contactor.
Compressor works but HP not heating	Refrigerant leak. Compressor failed.	Check and refill refrigerant. Replace compressor.

Hercules Remote Control and Monitor App.

Google Link.

http://play.google.com/store/apps/details?id=com.punp.palmtophuillian&=en_US

Energy Technologies Limited - Sole Agent UK, Europe.

Services provided.

- Supply

Optional.

- Commissioning
- Maintenance
- Design
- Installation
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