



M - T e c h
i n d u s t r i a l

Heat Pump Installation and Service Manual

Commercial Direct Heating Heat Pumps – ECDH Series

Document number:	MTHP-0011
Revision:	2
Status:	Approved
Author:	HC Lartz
Release Date:	November 2019

CONFIDENTIAL

Proprietary Class 2

© Copyright 2019 by M-Tech Industrial (Pty) Ltd

CONTROLLED COPY

Issued by Configuration Management Centre, M-Tech Industrial (Pty) Ltd

CHANGE HISTORY

Configuration Control	
Project Title:	Enerflow commercial direct heating heat pump operating, installation and service manual.
Created by (author):	Hendri Lartz
Original creation date:	01/04/2015

Template No: MTGEN-REP rev 4

Revision History			
Revision	Date	Author	Description of Changes
1	04/11/2015	Izak Potgieter & Gerrit Botha	
1A	22/02/2018	MN Ras	Updating of document
2	26/11/2019	MN Ras	Approved for release

Authorisation			
Action	Signature	Name and Position	Date
Reviewed		MN Ras Engineer	
Reviewed		W Schlebusch Operational Manager	
Approved		M van Eldik Business Unit Manager	

Original Signed Copy at CMC

The Author, together with the Principal Reviewer, takes responsibility for the technical correctness of the contents and recommendations of this document.

Enerflow Commercial Direct-Heating Air Source Heat Pumps – ECDH Series

Heat Pump Installation Manual



**PLEASE READ THIS MANUAL BEFORE OPERATING OR
INSTALLING THE HEAT PUMP**

Abstract

This document provides instructions on the operation, installation and servicing of the Enerflow commercial range of direct heating air source water heating heat pumps.

Table of contents

1	Definitions, Terms, Acronyms and Abbreviations	7
1.1	Cautions and warnings	7
1.2	Acronyms and abbreviations	8
2	References.....	8
2.1	Applicable documents and data	8
3	Safety	8
3.1	Installer's roles and responsibilities	8
3.2	Supervision of Work.....	8
3.3	Safety Devices	9
3.4	Working on Live Equipment.....	9
3.5	Fire Precautions.....	9
3.6	First Aid (Sub-Regulation 3- General Safety Regulations).....	9
3.7	Transport	10
3.8	Site installation layout plan	10
3.9	Working in a confined space	10
3.10	Working in an elevated position.....	11
3.10.1	Ladders.....	11
3.11	Safe lockout procedure.....	11
3.12	Tools and equipment	12
3.13	Notices and Signs.....	13
3.14	General Health and Safety Environment Guidelines.....	13
4	Installation details.....	15
4.1	Drainage and condensation.....	16
4.2	Plumbing installation requirements.....	16
5	Piping Installation	16
5.1	Heat pump connections	17
5.2	System isolation valves:	18
6	Electrical Installation	19
6.1	Heat pump breaker and cable sizes	19
6.2	Heat pump power cable and control connection	19
6.3	Heat pump electrical connections.....	22
6.3.1	General Information.....	22
6.3.2	Power Supply.....	23
6.3.3	Grounding and overcurrent protection.....	23
6.3.4	Controller PC board settings	23
6.3.5	Controller PC board settings	23
7	Heat pump commissioning and operation.....	24

7.1	Rights and responsibility	24
7.2	Heat pump site acceptance test	24
7.3	Heat pump operation	24
7.3.1	The LCD controller functions include:.....	24
7.4	Installer functions.....	25
NOTE: All pre-set settings are reverted to the original factory default settings. The password function will be disabled. Please ensure that the heat pump unit is set up correctly.		25
7.4.1	Manual/forced defrosting	25
7.4.2	Heat Pump heating or chilling mode This section should be used only to revert back to heating mode if chilling mode was accidentally selected by the user.	26
7.5	Troubleshooting	26
7.5.1	Problems and corrective action	27
8	Wiring Diagrams.....	33

1 Definitions, Terms, Acronyms and Abbreviations

1.1 Cautions and warnings

Symbol	Description
	Warning: It is the responsibility of the installer to install the heat pump according to the instructions detailed in this manual. The installer shall ensure that the health and safety of any other person in the area or site near where the heat pump is installed are not endangered by his conduct or activities when installing the heat pump.
	Warning: This heat pump is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge.,
	Warning: Ensure that the electrical installation complies with local standards and regulations. This heat pump shall be installed in accordance with the national wiring regulations as contained in SANS10142.
	Warning: Ensure that the plumbing installation complies with local standards and regulations. This heat pump shall be installed in accordance with the national regulations as contained in SANS10254 and SANS1352.
	Caution: Installation and maintenance shall only be performed by qualified personnel who are familiar with local codes and regulations.
	Warning: Ensure that the electricity/power supply is switched off before any installation work begins. Note that electric shock is dangerous and can cause death.
	Warning: Do not turn the heat pump off and immediately on again. Allow 30 seconds for the refrigerant pressure to equalize to prevent damage to the unit.
	Caution: There may be some sharp edges on the heat pump that may cause injury.
	Caution: Note that the heat pump contains rotating fans that may cause injury if the protective grid is removed. Ensure not to touch or work on the unit while in operation.

1.2 Acronyms and abbreviations

Acronym/Abbreviation	Description
°C	Degree Celsius
COP	Coefficient of Performance
GSR	General Safety Regulations
HP	Heat pump
PPE	Personal Protective Equipment
WB	Wet bulb temperature
DB	Dry bulb temperature
EDB	Electrical Distribution Board

2 References

2.1 Applicable documents and data

M- Tech industrial is an ISO 9001:2015 certified company

This installation manual was compiled firstly to comply with the South African legislation, national and municipal standards and regulations. If it is found that there are conflicting requirements between the contents of the installation manual, the first shall apply.

The following documents and data are applicable:

Reference number	Title
[1] Occupational Health and Safety Act and Regulations	85 of 1993
[2] The wiring of premises; Part 1: Low-voltage installations (<1000V)	SANS 10142-1: latest edition
[3] Water supply and drainage for buildings: Part 1: Water supply installations for buildings	SANS 10252-1: latest edition

3 Safety

This section provides minimum guidelines regarding common safety concerns and risks which are applicable during a heat pump installation and operation.

3.1 Installer's roles and responsibilities

A safety culture is imperative during the installation of heat pumps. Certain health and safety precautions are required and need to be taken into consideration. The installer and his assisting personnel, shall ensure that the installation complies with the Occupational Health and Safety Act and Regulations 85 of 1993 (OHSA) and local standards, bylaws and regulations as listed in section 2, and the installer and his assisting personnel shall have sufficient knowledge of the requirements of the aforementioned Act and applicable standards and regulations.

3.2 Supervision of Work

The installation work shall be done under strict supervision and with enforced discipline in order to comply with the above-mentioned Occupational Health and Safety Act and Regulations 85 of 1993 (OHSA) and local standards, bylaws and regulations as listed in section 2.

The installer shall consult and liaise with various tradesmen, e.g. tradesmen responsible for plumbing, electrical and/or civil actions at the site. Where construction sites are part of the installation, the installer shall consult and liaise with the designated responsible person.

The installer and his assisting personnel shall ensure that the working environment or area is kept clean at all times without any components, tools, equipment and/or redundant material lying around that may cause unsafe working conditions for the installer or other persons.

Good housekeeping shall be practised at all times without any compromise.

3.3 Safety Devices

No person shall intentionally or recklessly interfere with, damage or misuse anything which is provided in the interest of health or safety of the user.

Tampering with any safety devices are not allowed at any time.

3.4 Working on Live Equipment

Only authorized and competent persons shall work on live equipment (i.e. power tools) and shall wear the applicable Personal Protective Equipment (PPE) at all times.

The appropriate PPE shall be used when working on live machinery, in close proximity to live electrical machinery or electrical machinery which has been switched "off" but not locked out whilst work is being performed on it. Such work shall only be permitted if a specific safe work procedure exists and is used after the installer and his assisting personnel have been trained properly in the use of it. The use of PPE shall be according to sub-regulation 5 of the General Safety Regulations.

3.5 Fire Precautions

All welding and brazing work shall only be done in well-ventilated areas by a competent person who received the required training, wearing the correct PPE at all times. The use of PPE shall be according to sub-regulation 5 of the General Safety Regulations.

Because of the risk of fire, a fire extinguisher shall be available in close proximity (in plain sight within a radius of 3 meters) at the area/site where the work is being performed. The equipment shall be in good working condition at all times and properly checked for any damage by the user before use. If working on an elevated position the fire extinguisher shall be placed at the base of the ladder or elevated platform.

The installer and his assisting personnel shall be trained and competent to use the fire extinguisher correctly in the event of a fire.

Care and precautionary measures shall be taken to ensure that no fires can result from flying sparks due to grinding.

3.6 First Aid (Sub-Regulation 3- General Safety Regulations)

The installer shall ensure that prompt first aid treatment is available to all personnel when doing the installation in case of injury or emergency. One or more persons shall be trained on how to provide first aid help and shall be available at all the times during the installation. If more than 20 persons are helping with installing the units, a First Aider with a valid certificate shall be present

As a minimum, the first aid box shall be stocked with the sufficient content based on the nature of possible injuries that may occur during the installation activities, including the mandatory content as listed in Annexure A of the OHS 85 of 1993, GSR.

*Note: Keep the direct emergency number of either site first responders or of the local first responders on your toolboxes and equipment or placed visibly on site. The emergency contact numbers should be distributed among working personnel to ensure it is easily accessible in case of emergency.

National emergency centres might not be familiar with your area and will take valuable time confirming your location. Local first responders might form part of a national organisation such as Netcare 911 or ER24 but one can obtain their direct line on request.

3.7 Transport

The installer and his assisting personnel shall ensure that all vehicles used for the transportation of the heat pump equipment and assisting personnel are roadworthy and suitable for the purpose of use. The driver shall have a valid driving license and follow the rules of the road at all times. All vehicles shall be checked daily before the commencement of work for defects and roadworthiness.

Suitable equipment in good condition shall be used to secure the heat pump to the transporting vehicle. Special care shall be taken to secure the equipment properly to ensure equipment stays in place during transportation.

3.8 Site installation layout plan

Before the installation can commence, the installer shall compile a site layout plan for the specific site, area or structure where the units will be installed. The plan shall provide a clear description of the site, area or structure and define the layout of the hot water system where the units will be installed.

The stability of the site, area or structure where the unit will be installed shall be taken in consideration and shall comply with required standards, for example, the wall structure shall be strong enough to sustain the heat pump's weight. The installation shall be done without causing any health and safety hazards or risks during installation or after

The site installation layout plan shall help to identify risks and hazards to which persons may be exposed during the installation and afterwards during the use of the unit. These risks and hazards shall be mitigated, reduced or controlled by using a documented plan of safe working procedures if the situation necessitates it. A monitoring and review plan for issue-based risks and hazards may be necessary afterwards.

The process shall include the identification of the required PPE needed to protect all persons involved and measures shall be taken to ensure it is used at all times during the installation.

3.9 Working in a confined space

The installer and his assisting personnel may be required to work in a confined space when connecting the heat pump to a storage vessel. The temperatures within these confined spaces could reach high levels and is a health and safety risk.

According to General Safety Regulation (GSR) sub-regulation, 5 confined spaces may only be entered after the air inside the confined space was tested and evaluated by a competent person who is certified in writing that the air in the confined space is safe and shall remain safe for the duration of the work. All necessary safety precautions as stipulated in this sub-regulation shall be taken.

3.10 Working in an elevated position

Work done in elevated positions shall be performed safely from a ladder or scaffold as the situation may require, or from a position where measures were taken to ensure the person is placed in a safe position as if he was working on a scaffold.

In general, when work is performed above a height of 1.9m a safety harness is used if safety rails are non-existent. In this aspect where installation work is performed in elevated positions, requirements of Sub-regulation 10 (Fall Protection) of the Construction Regulation () shall be taken into consideration. A fall protection plan, including a fall arrest plan, shall be in place as required.

3.10.1 Ladders

According to GSR; Sub-regulation 13A all ladders shall be constructed of a sound material and suitable for the purpose for which it is to be used. Also, it shall be fitted with non-skid devices at the bottom ends or hooks or similar devices at the upper ends of the stiles. The ladder shall be lashed or held secured by a second person whilst being used to ensure the stability of the ladder is safe under all conditions at all times.

No damaged ladder shall be used for installation work!

See an example of a ladder inspection checklist below.

		YES/NO
1	Are all portable and fixed ladders clearly and permanently marked with a number?	
2	Are all portable ladders in good condition, without bends, cracks or other damage?	
3	Are all portable ladders equipped with non-skid devices at the bottom and fitted with hooks or suitable devices at the upper ends?	
4	Are all rods or bars forming the steps of the portable ladder secured by appropriate devices?	
5	Are all rods or bars forming the steps of the portable ladder properly fitted into the stiles?	
6	Are any rods or bars forming the steps of the portable ladder damaged or missing?	

3.11 Safe lockout procedure

The installer shall inspect the area or site where the installation will be done to be worked on and identify all potentially hazardous energy sources and the detail of each source. This includes electrical and water reticulation systems.

Before the installation can commence, all these potentially hazardous energy sources shall be locked-out by making use of a documented safe lockout procedure approved by a knowledgeable designated person. This procedure shall be compiled by a trained and competent person with required knowledge of the sources.

The installer and his assisting personnel shall familiarise themselves and understand the risks, hazards and methods required for safe lockout actions to shut down and safely control each of the energy sources.

He shall be responsible to ensure prevention of any unexpected release of dangerous energy in the form of water (pressure) or power (electricity) during the installation; whenever the equipment is installed, tested, maintained and/or repaired.

After every lockout action was performed, the necessary steps shall be taken to confirm the section was successfully locked out under the direct supervision of the installer or site manager.

No work shall commence before the energy sources were successfully locked out!

3.12 Tools and equipment

The installer shall supply "fit for purpose" tools, equipment and devices required to perform the installation. He shall be responsible to ensure that his assisting personnel, shall use, maintained and keep in an in good working condition all tools, equipment and devices to ensure compliance with the requirements of relevant Act and regulations.

No tools, e.g. hand tools such as spanners, screwdrivers and electrical tools such as hand drills, grinders, shall be used if not inspected beforehand!!

A general checklist with minimum requirements is available below for hand tools and portable electrical equipment:

		YES/NO
1	Is an inventory kept for all tools issued to employees?	
2	Are all hand tools that require handles equipped with proper handles?	
3	Are the chisels or punches with mushroom heads?	
4	Are tools clean, well maintained in sound condition and no defects visible?	
5	Are all tools stored in an accessible location without creating a hazard?	
6	Are toolboxes available to carry tools into the working area or site?	
7	Are all employees trained in the proper use of all tools in their area of work; are Safe Work Procedures available as required for specific tools?	
8	If necessary, are guards fitted to tools were necessary for such a manner that the use of the tool does not obstruct the action of the user leading to injuries to the user and damage to the tool?	
9	Is all portable electrical equipment in a sound condition with no visible	

		YES/NO
	defects or damaged?	
10	Are all the cords of portable electrical equipment safe, free from dangerous joints or knots and in a sound condition with no visible defects or damaged?	
11	Are plugs correctly wired and in a sound condition with no visible defects or damages?	
12	Are any switches broken or otherwise in a hazardous condition?	
13	Are all portable electrical equipment identified with a unique identification number and proof of regular inspection available?	
14	Is a register kept of all portable electrical equipment identified with a unique identification number?	
15	Are defective portable electrical equipment identified and removed to prevent any unintended use?	
16	Is all equipment tagged indicating the date of the next inspection and is the current condition status still valid (not expired)?	
17	If portable electric leads or extension cords are used, are they; not lying in mud or water pools, not posing a tripping hazard, showing any signs of damaged or knotted wire, fitted with a plug which is in good condition and wired correctly?	

Notices and Signs

All applicable warnings, notices and signs, e.g. at areas or site where PPE shall be used, shall be displayed in- and outside the working area or site; all shall be visible to all assisting personnel and visitors.

A site permit shall be acquired and displayed outside of the working area or site if applicable. The working area shall be clearly defined and indicated to all persons working, visiting or passing by the installation area or site.

3.13 General Health and Safety Environment Guidelines

According to Section 14 of the OHS Act, each and every person is responsible for his / her own safety, as well as the safety of other persons that may be affected by his / her actions or omission of actions.

He/she shall comply with the following when or where applicable:

- Lockout, test and/or arrangement for the lockout of energy sources and the test for zero potential hazards and risks before work, maintenance or repairs may commence on any machinery.
- Not taking shortcuts - always follow the safety procedure.
- Stop and ask if he/she is not sure.
- Use the correct tools for the task; ensure that all tools are in good working condition.
- Report all unsafe acts and conditions to the supervisor. This is mandatory!
- Take notice that no horseplay is permitted.

- Be aware that the use of PPE is compulsory in demarcated areas: basic PPE can be overall, protective gloves, hardhat, eye protection, safety shoes and hearing protection. Know that additional PPE may be needed in some cases.
- Not wear loose-hanging clothes that may be caught in rotating equipment.
- Long hair hanging loose shall be considered a risk when working on moving machinery or with some tools.
- Not work on moving equipment. This is strictly prohibited.
- Follow the correct procedure when entering confined spaces.
- Wear a safety harness when working on elevated positions where no safety rails above 1.9 m are available
- Ensure pressure is relieved in vessels and pneumatic systems before any work, maintenance or repair can commence. This is mandatory!
- Report any deviations from regulations immediately to the supervision.
- Not tamper with any safety devices.
- Replace guards immediately after work, maintenance or repair was completed on equipment.
- Ensure all movable ladders are in good working condition, fitted with non-skid devices at the bottom to prevent slipping.
- Place ladders securely on the supporting surface at the right angle and no spillages are present before ascending with both hands;
- **NO PERSON IS ALLOWED TO WORK ON A LADDER IF HE IS NOT ASSISTED BY A SECOND WORKER HOLDING THE LADDER!!**
- Use barrier tape and applicable warning signs to close off areas where potential hazards and risks may exist.
- Ensure that all people are trained regarding health and safety aspects and the proof is available.
- Formally handover the area or site after the installation is completed; the signing of all necessary documentation, especially the hand over certificate by the relevant parties shall be performed.

4 Installation details

All the heat pumps are designed and manufactured to operate in normal weather conditions without any additional weather protection. Because of this, there is no need to build a roof over the unit. To ensure the heat pump functions as required and efficiently, an inspection shall be performed to choose the appropriate location of where the heat pump must be installed. The installation criteria reflect the minimum clearances, but each installation should still be evaluated.

The following needs to be taken into account:

1. The installation area shall have good ventilation and the air inlet/outlet must not be obstructed.
2. The installation area shall have good drainage and built on a good foundation.
3. No accumulated pollutants like aggressive gas, dust, sand, leaves etc. shall be present.
4. For ease of maintenance and troubleshooting:
 - a. No obstacles around the HP should be closer than 1m.
 - b. No obstacles which may hinder air flow around the HP should be higher than 2m.
5. It is recommended that the distance between the heat pump and hot water storage vessels is within a 10m radius.
6. Sufficient system water pressure shall be present. A minimum pressure of 200kPa (2 Bar) and a maximum pressure of 500kPa (5 Bar) are required for the heat pump. If the minimum pressure is not met a booster pump shall be required for the system.
 - a. **Note: The water pressure shall also be compatible with all other equipment in the hot water system.**
 - b. **Note: The heat pumps can function on low-pressure systems, but the system shall be approved by the manufacturer.**
7. Sufficient power supply and quality shall be available at a rated voltage of 400V 50Hz.
 - a. Operating voltage should be within 10% of rated voltage.
 - b. HP must be earthed for safety purposes.
8. It is recommended that sufficient space is available around and on top of the heat pump. The discharged air from the heat pump shall not be able to short circuit back to the heat pump air inlet. Figure 1 below shows the minimum clearance around units with side discharge fans, top discharge fans, and front discharge fans. Figure 2 shows a photo of a typical heat pump installation.

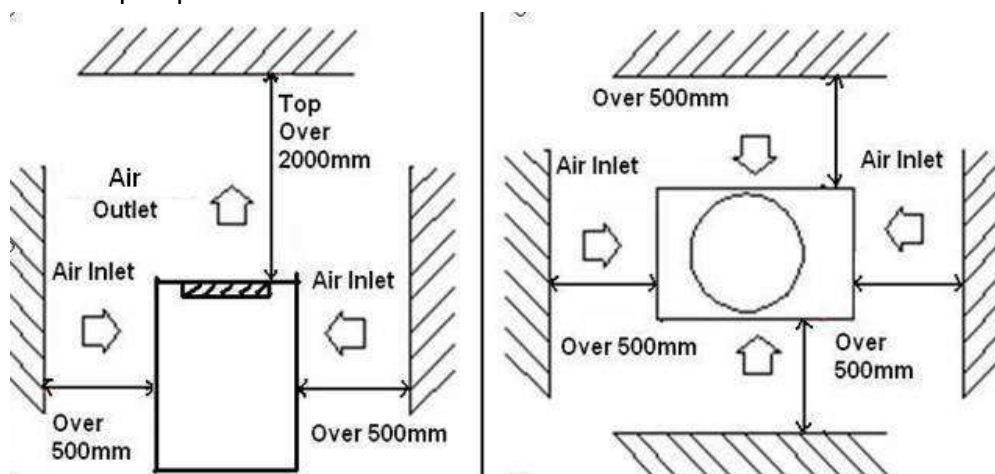


Figure 1: Minimum clearance around a heat pump for side discharge, top discharge and front discharge respectively.



Figure 2: Photo of a heat pump installation.

4.1 Drainage and condensation

Condensation will occur from the evaporator when the unit is running and drain at a steady rate, depending upon ambient air temperature and humidity. The more humid the ambient conditions, the more condensation will occur. The units are equipped with drip trays to collect rainwater and condensation. Keep the drain holes, located in the drip tray clear from debris at all times.

4.2 Plumbing installation requirements

1. When water supply exceeds 500[kPa] (5 Bar) a pressure reducing valve shall be installed on the cold water supply to the hot water system.
2. Ensure each part is connected to the heat pump with flexible joints and installed with an isolating valve.
3. Ensure plumbing have been inspected for water leakage before operation commences.
4. Insulate all pipes with proper lagging as per the national requirements, and if required cladding, to prevent heat loss.
5. Install a drain valve at the lowest part of the system to enable draining of the system.
6. Install a non-return valve on the water outlet connection to prevent possible back syphoning when water pump stops.
7. To reduce back pressure, pipes must be installed horizontally where possible.

5 Piping Installation

The piping and vessel installation shall only be done or supervised by a qualified plumber and in all cases, the installation should be done in accordance with the national appropriate standards (i.e. SANS 10254). The appropriate certification shall be obtained after the installation has been completed (i.e. Plumbing COC)

A typical heat pump piping installation is shown in Figure 3. Obviously, the heat pump shall be connected in parallel with the hot water storage vessel. This configuration uses the heat pump as a primary heater and in-tank heaters as a backup when required. When more than one heat pump is installed the additional heat pumps are also connected in parallel to the vessel and other heat pump units. In the case where a backup in-line heater is used instead of in-tank elements, the in-line heater will also be installed in parallel with the heat pump(s).

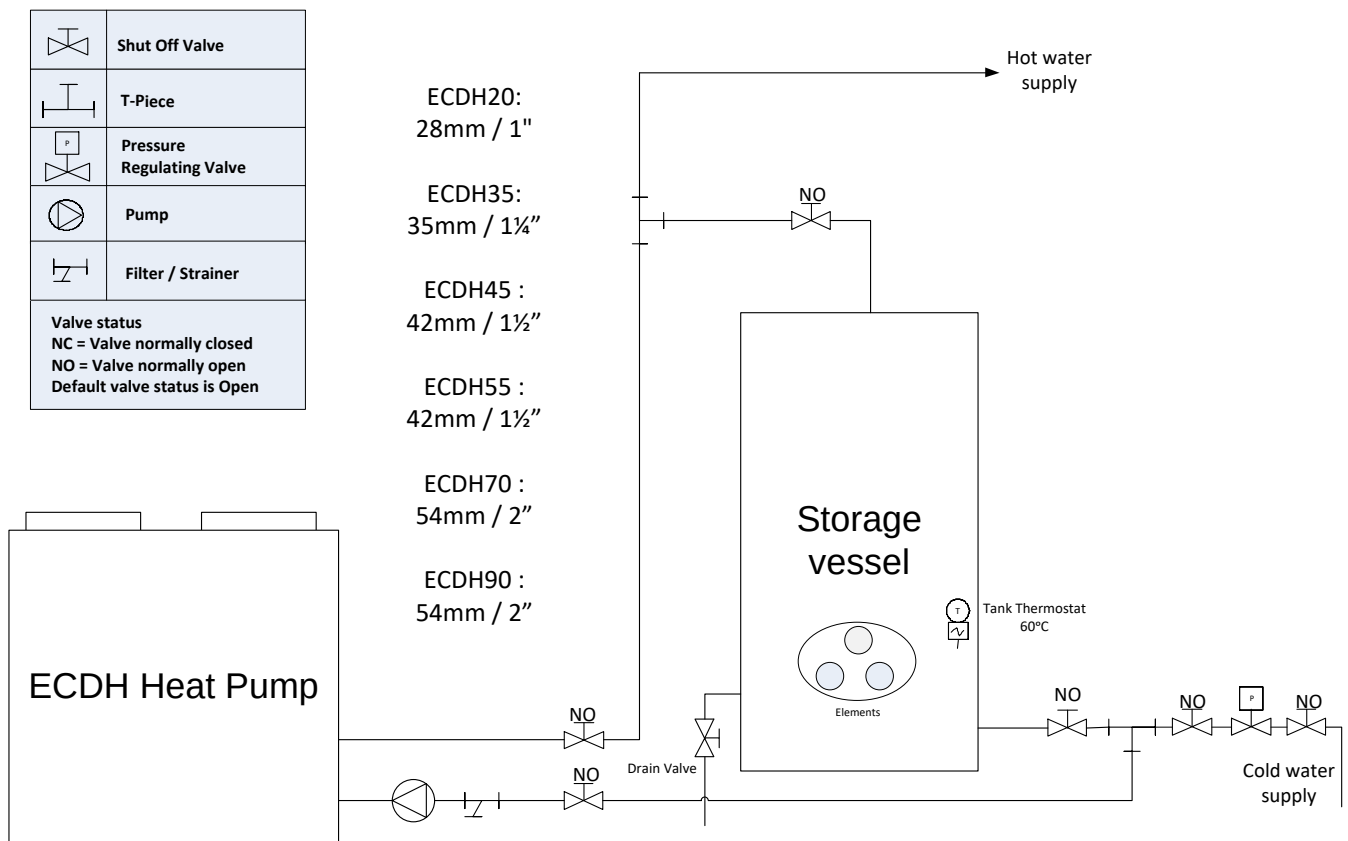


Figure 3: Schematic of pipe layout with a heat pump.

If additional vessels are installed all vessels shall be connected in a series configuration with each other and in parallel with the heat pumps and in-line heater. Parallel lines may be installed to bypass a vessel in case of failure; however, these lines shall be fitted with an isolation valve that is kept in the normally closed position. M-Tech Industrial can be contacted to assist with a pipe layout diagram showing connections to all required vessels or equipment within the system.

5.1 Heat pump connections

The water pipe connections on the heat pump are labelled “IN” and “OUT” as in Figure 4. If the ports are not labelled the lower port shall be the “IN” port and the higher port shall be taken as the “OUT” port. The water pipe from the bottom of the vessel is connected on the “IN” pipe of the heat pump and the water from the “OUT” pipe on the heat pump is connected on the pipe on the top of the vessel, also known as the hot water supply.



Figure 4: Heat pump water inlet and outlet.

The connection sizes and the recommended water pipes sizes from the heat pump to the hot water storage vessel are also listed in **Table 1** as well as **Figure 3: Schematic of pipe layout with a heat pump**. These pipe sizes are only applicable when the heat pump is located in a 10m radius from the storage vessel and if only one heat pump is connected on the water line. When the heat pump unit is located further away than the 10m radius, a proper water pipe sizing has to be done. M-Tech Industrial can be contacted to help with the design and pipe sizes.

Table 1: Heat pump water pipe and connection sizes.

Heat pump model	Connection size	Pipe Sizes
ECDH20MT	28mm	1"
ECDH35MT	35mm	1 ¼"
ECDH45MT	42mm	1½"
ECDH55MT	42mm	1 ½"
ECDH70MT	54mm	2"
ECDH90MT	54mm	2"

The heat pump water pump shall be installed on the inlet line positioned outside the heat pump (except for the ECDH20MT that has an internal water pump). This water pump is used for circulating the water from the storage vessel to the heat pump and back to the storage vessel. The water pump shall be electrically connected to the heat pump at the designated point in the control panel. The heat pump is equipped with a water flow control valve that is pre-set during the factory acceptance test. This valve may not be adjusted from the default setting of between 55 and 60°C without the direct written permission of M-Tech Industrial.

5.2 System isolation valves:

The system shall have a hot feed isolation valve (**isolation valve after the hot water vessels and heat pump piping**) to ensure the heating plant can be isolated without draining the building or water supply pipes. This is especially important in multi-storey buildings as the height will place the hot water system under pressure even if the water supply to the hot water system is isolated. The system shall also be fitted with an isolation valve in the cold water supply line to the system (**isolation valve before the hot water vessels and heat pump piping**) to ensure the system can be isolated from the supply water. If a **ring main** system is installed an isolation valve shall be installed on the ring main as well.

6 Electrical Installation

The electrical installation shall only be done or supervised by a qualified electrician and in all cases, the installation should be done in accordance with the national appropriate standards (i.e. SANS 10142-1). The appropriate certification shall be obtained after the installation has been completed (i.e. electrical COC).

6.1 Heat pump breaker and cable sizes

Table 2 below provides breaker and cable sizes for heat pumps installed **within 30 meters** of the electrical distribution board (EDB). The breakers shall be of type "Curve 1" or "Curve D" to handle direct online motor start-up.

It is important that proper breaker sizing and selection is determined by a qualified electrician for each installation. **SANS 10142-1 THE WIRING OF PREMISES** shall be used to determine the sizing and shall be used as the authoritative document if any conflict exists between this document and the regulation. The electrician shall take into account proper breaker cascading, the voltage drop due to cable length and maximum cable current-carrying capacity for the type and size of the cable being used. The Electrician shall further take into account the environment of the cable path for each installation.

M-Tech industrial can be contacted to assist with the breaker and cable sizing.

Table 2: Heat pump breaker and cable sizes (**Cable length less than 30 meters for EDB**).

Heat pump	Rated power input	Currently used for sizing @ 50Hz	Curve 1 Motorised Breaker size	Cable size - Copper 4 core (Armoured)*
ECDH20MT	3.9 kW	13A (400Vac)	20A (3-pole)	4mm ² x 4C + Earth
ECDH35MT	7.8 kW	23A (400Vac)	32A (3-pole)	4mm ² x 4C + Earth
ECDH45MT	9.5 kW	27A (400Vac)	40A (3-pole)	6mm ² x 4C + Earth
ECDH55MT	11.6 kW	33A (400Vac)	50A (3-pole)	10mm ² x 4C + Earth
ECDH70MT	15.3 kW	44A (400Vac)	50A (3-pole)	10mm ² x 4C + Earth
ECDH90MT	18.9 kW	54A (400Vac)	63A (3-pole)	16mm ² Error! Reference source not found.

***NOTE:** The cable shall have a higher rating than the breaker to ensure cable protection.

6.2 Heat pump power cable and control connection

Figure 5 indicates the electrical cables that shall be connected to the heat pump to be operational. There are only 3 cables necessary for the heat pump to be able to operate, the fourth cable is used when the fault signal is utilized to activate backup heating systems or illuminate a fault light inside a control room or on a control system:

1. Power supply cable: As described in Table 2, this cable supplies the heat pump with the main electrical power to operate.

Note: This cable is electrically powered and can cause electric shock (400VAC, 50Hz).

2. Water pumps power supply cable: Except for the ECDH20, all other heat pumps in this range require an external 3-phase water pump to be installed. A power cable needs to be installed from the heat pump at the indicated connection points to the water pump.

Note: This cable is electrically powered and can cause electric shock (400VAC, 50Hz).

3. Control temperature probe cable. The control probe cable relays the tank temperature is below/above the set point activating/deactivating the heat pump respectively.

Note: This cable is a signal cable only but should be protected in a conduit to ensure it isn't damaged which poses a risk of electrocution.

4. Fault signal cable: This cable enables the heat pump to activate a backup heater in the event that the heat pump is not able to operate. This cable is not a requirement for the heat pump to operate but it is recommended that a backup heating system is connected to the heat pump's control

Note: This cable is electrically powered and can cause electric shock. (230VAC)

The heat pump has the ability to send a fault signal in the unusual event that it is unable to operate OR if the ambient temperature reduces to below a set temperature in the heat pump's control system (For more information see the ECDH user manual MTHP-0012 which can be obtained from M-Tech Industrial (Pty) Ltd).

The backup system called in the event of failure shall be self-sufficient with regards to temperature control and electrical supply.

Note: This output signal is not sufficient to be used as an electrical power supply to the electric elements. This signal shall only be used as a control signal to a relay or contactor activating the power supply from the EDB to the elements.

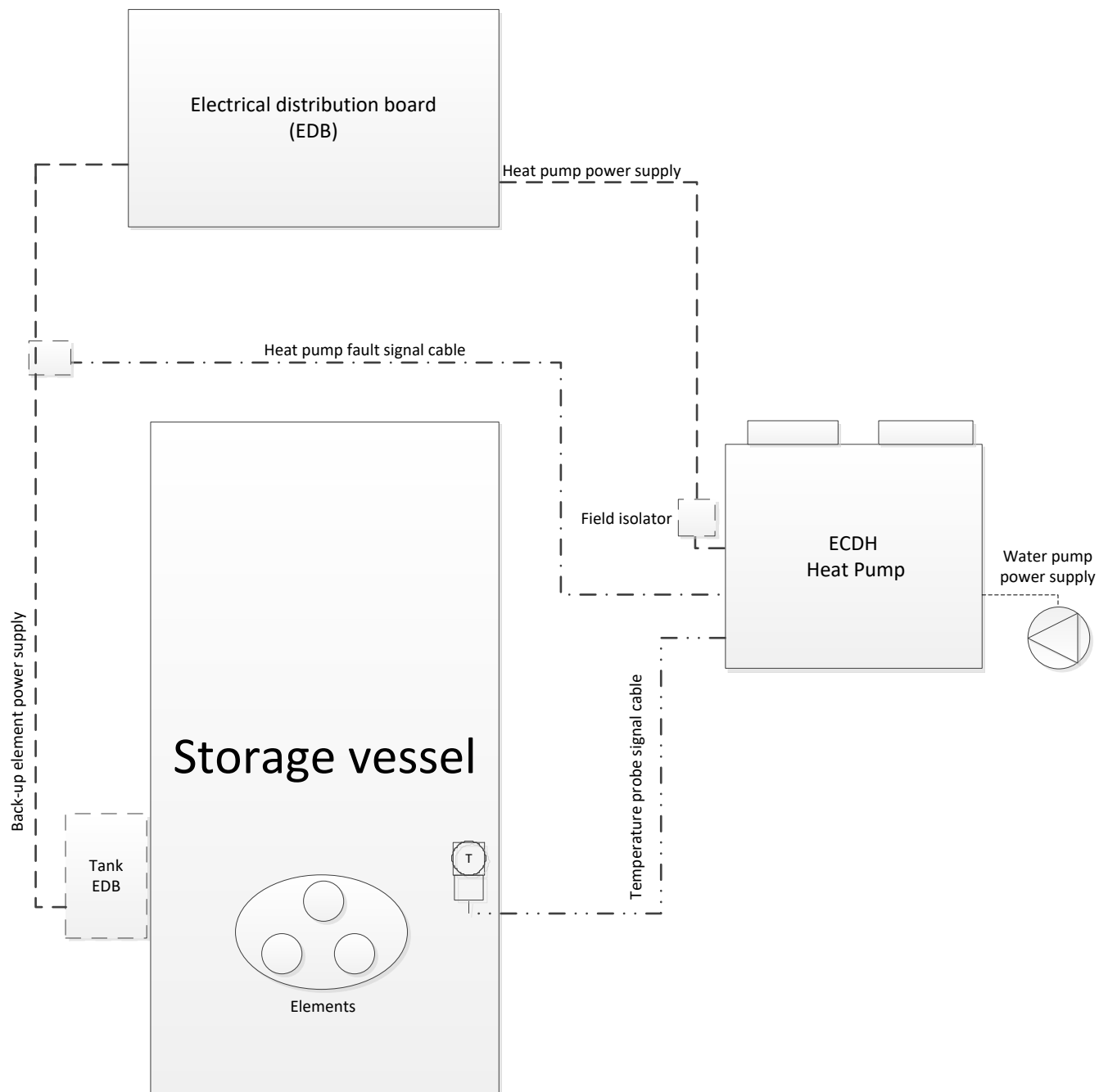


Figure 5: Power supply and control illustration.

6.3 Heat pump electrical connections

WARNING —Risk of electrical shock.

Ensure that all high voltage circuits are disconnected and locked out before connecting the heat pump installation. Physical contact with these circuits could result in death, by electrocution or serious injury to users, installers or others due to electrical shock and may also cause damage to property. Always follow the electrical lockout procedure as detailed in Section 3.11 above.

CAUTION: Label all wires prior to disconnection when servicing the heat pump. Wiring errors can cause improper and/or dangerous operating conditions or phase rotation. Check and ensure proper operation/rotation after servicing.

NOTE: Only trained, competent and certified personnel are allowed to work with electrical wiring and connections.

6.3.1 General Information

Each heat pump shall have its own supply cable with the thickness as required by national regulations as described in section 6.1. Each heat pump shall have its own breaker sized according to national regulations as described in section 6.1. Wiring connections shall be done according to the wiring diagram found on the inside of the heat pump access panel or see the manual supplied with the heat pump. The heat pump shall be grounded/earthed to comply with local standards and requirements. A grounding lug is provided on the inside of the heat pump electrical compartment (see the following figures).

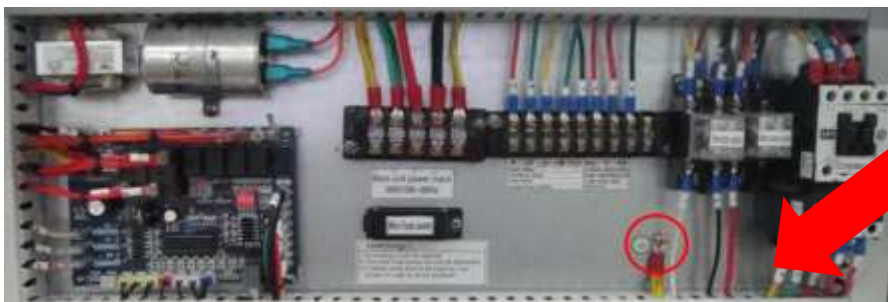


Figure 6: Single System – ECDH20MT.



Figure 7: Dual system three phase – ECDH35MT; ECDH45MT.

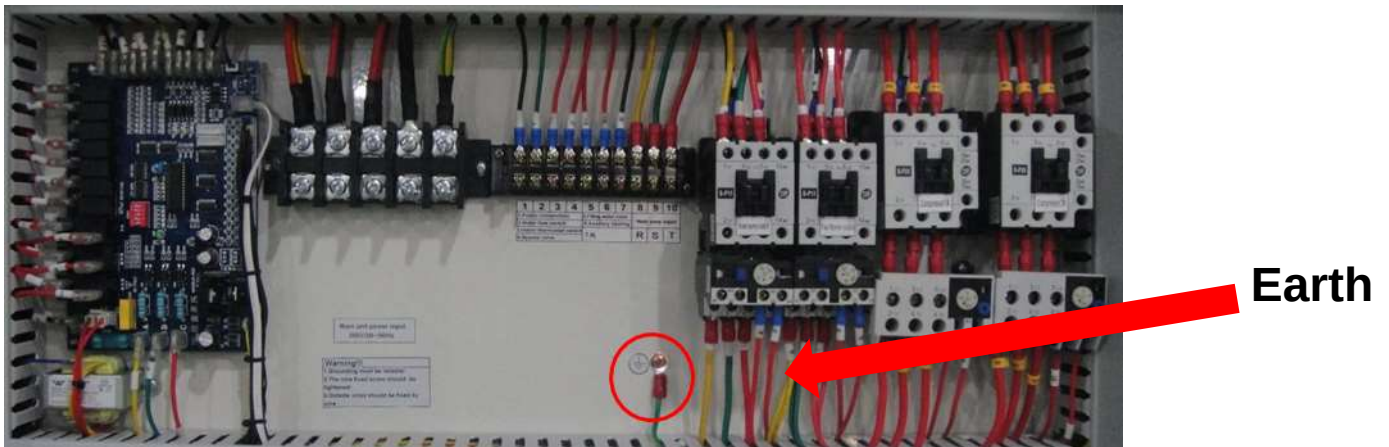


Figure 8: Dual system three phase - ECDH55MT; ECDH70MT; ECDH90MT.

6.3.2 Power Supply

- If the supply voltage is too low or too high, it can cause damage and/or result in unstable operation of the heat pump unit due to current spikes/dips on startup.
- The acceptable start-up and operating voltage range shall be within $\pm 10\%$ of the rated voltage. When heat pump units are installed in parallel, ensure that the voltage difference between these units is within $\pm 2\%$ of each other. The voltage difference between phases of a three-phase power supply should be within $\pm 2\%$.
- Ensure that the cable specifications meet the correct requirements for the specific installation. The distance between the installation site and mains power supply will affect the cable thickness. Follow the local electrical standards and guidelines to select the correct cable size, circuit breakers and electrical isolators as described in section 6.1.

6.3.3 Grounding and overcurrent protection

In order to prevent electrical shock in case of water leakage from the unit, install the heat pump according to local electrical standards and guidelines.

- Do not interrupt the voltage supply to the heat pump on a regular basis as this may result in a shorter life expectancy of components such as the compressor, fan motors and water pump.
- When installing overcurrent protection, ensure that the correct current rating is met for the specific installation.
- The compressor, fan motors and water pump on the ECDH series may have AC-contactors and thermal overload protection. Therefore, in the process of installation and debugging, firstly measure the current on each of these components and then ensure that the thermal overloads are set correctly.

6.3.4 Controller PC board settings

The pins shall not be changed without written confirmation from M-Tech Industrial. Failure to obtain written confirmation shall void the warranty on the heat pump.

6.3.5 Controller PC board settings

For more information on the connections to the heat pump, please see the wiring diagrams at the end of the manual.

7 Heat pump commissioning and operation

7.1 Rights and responsibility

Before a heat pump is accepted for stock purposes or installation, the unit shall be inspected for any defects or damage that may have occurred during shipment and whether all parts are complete. If any damage is evident or any part lacking, please notify M-Tech Industrial in writing immediately with photo evidence to avoid any disappointment. Installing the heat pump will serve as acceptance of the heat pump in the condition that it was received.

In case of any defects or damage, repairs shall only be done by an authorized M-Tech Industrial representative. Written authorization may be obtained from M-Tech Industrial for minor repairs of defects or damages by a representative of the client.

Failure to comply with the above shall render the warranty null and void!

7.2 Heat pump site acceptance test

At first, the heat pump start-up shall be completed by following the Site Acceptance Test procedure (SAT). The SAT document is used to commission the heat pump without damaging the heat pump. The SAT document shall be followed step by step ensuring that each step is successfully completed before the next step is started.

Failure to comply with the above shall render the warranty null and void!

To complete the SAT the following items will be required:

1. Phillips star screwdriver
2. Small shifting spanner.
3. Electrical multi-meter with a valid calibration certificate with an AC current measurement functionality.
4. Temperature sensor with a valid calibration certificate capable of measuring a pipe's temperature accurately.

M-Tech Industrial can be contacted to assist with any questions regarding the SAT.

Note: The SAT document is not a replacement for a plumbing or electrical certificate of conformance (COC). These documents shall be obtained by the installer as required by the applicable laws and regulations.

7.3 Heat pump operation

The safety requirements and operational detail are given within an operational manual supplied with the heat pump. The operational manual shall be given to the client as it contains important information required for operating the heat pump on a day to day basis. It further describes the functions of the LCD controller used to determine the heat pump operational state.

7.3.1 The LCD controller functions include:

1. Unlocking the LCD controller.
2. Changing the required temperature.
3. Checking on the system temperatures to determine the system status.

4. Changing parameter settings to the factory values.
 *Note: The parameters are preset before delivery and it shall only be restored to these settings if they were changed.
5. Switching the heat pump between running and standby mode.
6. Setting the time of the heat pump for timer purposes.
7. Changing the timer settings.
8. Identifying error codes.
9. Setting an installer password.
10. Starting a manual or forced defrost.

7.4 Installer functions

The following LCD functions are not described in the operational manual. If the installer by accident activates the password function on the unit, the password shall be removed as described below:

Forgotten/reset password

If the password was accidentally activated the installer/agent can deactivate the password by resetting all pre-set settings on the controller. It is important to ensure the parameter settings are correct if these steps were followed as all pre-set settings will be reverted to the default settings.

Make sure that the lock symbol "  " is shown on the display and press the "setting" key until an audible tone is heard and the display backlight is lit. Release the key. The clock will now display "00:" and the heat pump unit will be unlocked and reset.

NOTE: All pre-set settings are reverted to the original factory default settings. The password function will be disabled. Please ensure that the heat pump unit is set up correctly.

7.4.1 Manual/forced defrosting

Although this heat pump features an automatic defrosting function, a manual defrosting function enables the user to activate defrost in the unlikely event that the automatic function was not successful.

Ensure the keypad is unlocked. Set the heat pump to running mode, if the heat pump unit isn't already in running mode. This will display the heat symbol. Allow the heat pump to start up and run for at least 10 minutes before starting a manual defrost.

Press the "▼" key for more than 8 seconds until an audible tone is heard, and release the key. The heat pump will be in defrosting mode and the "  " symbol will be displayed.



Note: Do not defrost the heat pump for more than 8 minutes at a time. Allow the heat pump to run for at least 10 minutes between each manual defrost cycle.

7.4.2 Heat Pump heating or chilling mode

This section should be used only to revert back to heating mode if chilling mode was accidentally selected by the user.

This function will alternate the heat pump between "**Heating**" mode and "**Chilling**" mode. However, the heat pumps are factory fitted with direct heating valves which disable their ability to function in chilling mode. The controller however still gives the user this choice of selection.

Setting the heat pump to chilling mode may result in damage to the heat pump which is not covered by the warranty. Care should be taken to ensure the heat pump is not operated in chilling mode.

Heating mode:  In heating mode, the heat pump will function as a water heater, ensuring that the water in the tank is kept to the set water temperature.

Chilling mode:  In the chilling mode, the heat pump will cool the water functioning as a water chiller, ensuring that the water in the storage vessel is kept at a set water temperature. In the chilling mode, the temperature can be adjusted from 7°C to 30°C.

Make sure the keypad is unlocked. The heat pump unit must display either the **Heating symbol**  or **Chilling symbol** . Now press the "▲" key, until an audible tone is heard, and release the key. The heat pump will be in either heating mode or chilling mode, and the corresponding symbol will be on display.

7.5 Troubleshooting

Use the following troubleshooting information to resolve issues/problems with the unit.

Take Note: this action is performed at the installers own risk

M-Tech Industrial may be contacted to resolve any fault that cannot be resolved by the installer.



WARNING - Risk of electrical shock.

Ensure that all high voltage circuits are disconnected before commencing heat pump installation. Contact with these circuits could result in death or serious injury to users, installers or others, due to electrical shock and may also cause damage to property.

DO NOT open any part of the heat pump as this may result in electric shock.

Keep your hands, clothing, hair and body parts clear of the fan blades to avoid injury.

If you are not familiar with your heat pump:

- DO NOT** attempt to adjust, service or troubleshoot the unit without consulting M-Tech Industrial.
- PLEASE** read the complete installation and/or user guide before attempting to operate, service or adjust the heat pump.

IMPORTANT: Isolate the main power supply using a documented and approved lock-out procedure prior to any service or repair.

7.5.1 Problems and corrective action

Table 3: Troubleshooting, problems and corrective action

NO	Problem	Possible Cause	Corrective Action	
1	Error code 01E or 02E	1. Absent phase or phase rotation or voltage imbalance among the 3 phases occurred on the mains power supply.	1. Ensure that incoming phase rotation is correct. If faulty, use a phase rotation meter or check incoming phase coding to assist.	
			2. Test to check for absent phase, make sure that the circuit breakers are switched ON or check the cable connection.	
			3. Test for voltage imbalance, if not balanced, check cabling and connections.	
		2. Controller or PC board faulty (phase rotation protection damaged).	Replace the PC board and/or controller.	
2	Error code 03E	1. Water flow switches faulty.	Replace the water flow switch.	
		2. Connection cable damaged or disconnected.	Replace the connection cable or reconnect the cable.	
		3. Controller or PC board faulty.	Replace the PC board and/or controller.	
3	Error code 05E/07E	1. Measured water tank water temperature < actual water tank water temperature.	a) The water tank water temperature sensor and the PC board are not compatible.	Use the correct sensor.
			b) The water tank temperature sensor is not in the correct position.	Position the sensor correctly.
		2. The Y shaped filter is blocked or jammed resulting in lower water flow.	Clean the filter.	
		3. The plumbing is blocked or the valves are damaged or closed.	Repair or replace the plumbing and/or valves.	
		4. Too much air in the plumbing results in a reduction in flow rate.	1. Remove air lock from the system.	
			2. Make sure that the circulation pump is working correctly.	
		5. Circulation pump faulty.	a) Circulation pump damaged.	Repair or replace circulation pump.
			b) The circulation pump is too small or the distance from the heat pump is too far.	Install correct circulation pump for a specific application or shorten the distance between circulation pump and/or the heat pump/other equipment.
		6. Excessive refrigerant charge volume.	Charge the correct volume of refrigerant specified on the label.	
		7. Control cable of the high-pressure switch damaged or disconnected.	Replace the damaged cable or reconnect.	



NO	Problem	Possible Cause	Corrective Action
		8. The high-pressure switch cannot be reset.	Replace the high-pressure switch.
		9. The input of the high-pressure sensor is shorted with common, error code 05E is still displaying.	Replace the PC board.
		10. The refrigeration system is blocked (by ice or dirt).	Find the cause of the blockage and clean dirt out. Check to defrost for ice and clean.
4	Error code 06E/08E	1. Refrigerant leakage.	Detect leakage and repair. Vacuum, charge refrigerant and start heat pump.
		2. Control cable of the high-pressure switch damaged or disconnected.	Replace the damaged cable or reconnect.
		3. The low-pressure switch cannot be reset.	Replace the low-pressure switch.
		4. The input of the high-pressure sensor is shorted with common, error code 05E is still displaying.	Replace the PC board.
		5. The refrigeration system is blocked (by ice or dirt).	Find the cause of the blockage and clean dirt out. Check to defrost for ice and clean.
5	Error Code 09E	1. The controller cable damaged or disconnected.	Replace damaged controller cable or reconnect.
6	Error Code 11E	1. Incorrect installer/agent control password.	Enter the correct control password.
7	Error Code 12E/13E	1. Insufficient refrigerant charge volume.	Charge the correct volume of refrigerant specified on the label.
		2. Compressor discharge temperature sensor faulty or damaged.	Replace the compressor discharge temperature sensor.
		3. PC board damaged.	Replace the PC board.
8	Error Code 15E	1. Water tank water temperature sensor damaged.	Replace the water tank water temperature sensor.
		2. Water tank water temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean water tank water temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC Board faulty or damaged.	Replace the controller or PC Board.
9	Error Code 16E/17E	1. Defrost temperature sensor faulty or damaged.	Replace the defrost temperature sensor.
		2. Defrost temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean defrost temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC board is faulty or damaged.	Replace the controller or PC board.
10	Error code 18E/19E	1. Compressor discharge temperature sensor faulty or damaged.	Replace the compressor discharge temperature sensor.
		2. Compressor discharge temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean compressor discharge temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC board faulty or damaged.	Replace the controller or PC board.
11	Error code 21E	1. Ambient temperature sensor faulty or damaged.	Replace the ambient temperature sensor.
		2. Ambient temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean ambient temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC board faulty	Replace the controller or PC board.



NO	Problem	Possible Cause	Corrective Action
		or damaged.	
12	Error code 22E	1. Return water temperature sensor faulty or damaged.	Replace the return water temperature sensor.
		2. Return water temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean return water temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC board faulty or damaged.	Replace the controller or PC board.
13	Error code 25E	1. Water level switch connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean water level cable connection to the PC board.
		2. Water level switch cable damaged.	Replace the cable.
		3. The controller and/or PC board faulty or damaged.	Replace the controller or PC board.
14	Error code 27E/28E	1. Outlet water temperature sensor faulty or damaged.	Replace the outlet water temperature sensor.
		2. Outlet water temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean outlet water temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC board faulty or damaged.	Replace the controller or PC board.
15	Error code 29E/30E	1. Compressor suction temperature sensor faulty or damaged.	Replace the compressor suction temperature sensor.
		2. Compressor suction temperature sensor connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean compressor suction temperature sensor and wrap it with insulation tape.
		3. The controller and/or PC board faulty or damaged.	Replace the controller or PC board.
16	Error code 31E	1. Water pressure switch connector (plug) disconnected and/or oxidized due to damp or water.	Reconnect or clean water pressure cable connection to the PC board.
		2. Water pressure switch cable damaged.	Replace the cable.
		3. The controller and/or PC board faulty or damaged.	Replace the controller or PC board.
17	Error code 35E	1. Compressor overcurrent.	1. Check if the incoming voltage supply is too low, if so, repair.
			2. Check if the compressor is overloaded and repair.
			3. Check whether the thermal relay is damaged, if so, replace.
18	The heat pump is not heating.	1. User incorrect operation and/or parameter settings.	1. The water tank water temperature setting is set too low and the desired temperature cannot be reached. Reset the water tank water temperature to the correct range.
			2. The difference between the required water tank water temperature and the heat pump restart temperature (L2) is too big. Reset by reducing the value of L2.
			3. Timer function has been set to a Reset the timer.



NO	Problem	Possible Cause	Corrective Action	
			specific ON and OFF time, which does not allow sufficient time for the heat pump to operate.	
			4. No electrical power supply to the heat pump (no display on the controller).	1. Check and ensure that the circuit breaker is ON.
				2. Test voltage on the PC board L/N/G connectors.
		2. Problem with controller or PC board.		3. If power is not restored, replace the cable.
			a) The temperature displayed is more than 45°C.	Check the water tank water temperature sensor, replace if faulty.
			b) PC board is damaged due to burnt relays.	Check and find the cause, find faulty relay(s) and replace.
19	The slow increase in water tank water temperature.	1. Insufficient refrigerant.		1. Check for leakages, if found, repair and re-charge refrigerant as per volume specification on the label.
				2. If no leakage was found, re-charge refrigerant as per volume specification on the label.
		2. The heating capacity of the heat pump is insufficient.		Increase the size or number of heat pump units.
		3. Serious residue/dirt occurred on the heat exchanger.		Clean the heat exchangers.
		4. The evaporator coil is dirty or jammed and this will affect the heat exchange efficiency.		Clean the evaporator coil.
		5. Poor design of insulation.		It is recommended to use an insulation cover.
		6. The length of the pipes are too long and/or improperly insulated.		1. If the length of the pipes cannot be re-done, ensure well-insulated piping.
				2. Increase the size and number of heat pump units.
20	The controller displays "00".	1. The controller cable damaged or disconnected.		Reconnect or replace controller cable and wrap it with insulation tape.
		2. PC board damaged.		Replace the PC board.
21	No display on the controller.	1. Mains power supply is abnormal.	a) The mains power supply cable is disconnected or damaged.	Reconnect or replace the mains power supply cable.
			b) The main power supply voltage is	Check and ensure that the mains



NO	Problem	Possible Cause	Corrective Action	
			lower than 175 V.	power supply cable length and thickness are within the specifications, if not replace with a thicker cable to ensure less voltage drop.
		2. PC board power cable is disconnected or the fuse is burnt.	Reconnect PC board cable or replace the fuse.	
		3. PC board transformer is damaged.	Replace the PC board transformer.	
		4. The controller cable damaged or disconnected.	Reconnect or replace controller cable and wrap it with insulation tape.	
		5. PC board damaged.	Replace the PC board.	
22	The fan does not operate.	1. Fan motor capacitor damaged (under this circumstance the fan motor will overheat).	Replace the fan motor capacitor.	
		2. The motor windings have been burnt.	Replace the fan motor.	
		3. The display is ON but heat pump unit is not in running mode/ON.	Press the power button and turn on the heat pump unit.	
		4. Fan motor relay damaged.	Check and replace if damaged.	
		5. No fan motor output from PC board.	Replace the PC board.	
		6. Fan motor cable disconnected or damaged.	Reconnect or replace fan motor cable.	
23	The compressor does not operate while the fan is working.	1. Compressor capacitor damaged (under this circumstance the compressor motor will overheat).	Replace the compressor capacitor.	
		2. Compressor connecting cable is burnt.	Replace compressor connecting cable.	
		3. The compressor windings have been burnt.	Replace the compressor.	
		4. The compressor is jammed.	Replace the compressor.	
		5. AC contactor does not work.	a) The AC contactor winding is damaged or contractor is jammed and cannot close.	Replace the AC contactor.
			b) The main power supply voltage is lower than 175V.	Check and ensure that the mains power supply cable length and thickness are within the specifications, if not replace with a thicker cable to ensure less voltage drop.
			c) No compressor relay output from the	Check and/or replace



NO	Problem	Possible Cause	Corrective Action	
			PC board.	compressor relay or PC board.
		6. Thermal relay damaged (O/L).	Replace the thermal relay.	
		1. The fan is not working.	Refer to problem description #22.	
		2. Insufficient refrigerant or the refrigeration system is blocked.	1. Find the cause of the blockage and clean ice off.	
			2. Check for leakages, if found, repair and re-charge refrigerant as per volume specification on the label.	
			3. If no leakage was found, re-charge refrigerant as per volume specification on the label.	
24	Frost or ice.	3. The defrost parameter is not set correctly.	Reset the defrost parameter to the correct value.	
		4. The defrost sensor is not placed correctly.	Replace the defrost sensor to the correct position.	
		5. The 4-way valve cannot be reversed (the winding is damaged or the valve cannot be correctly reversed).	Check the 4-way valve to find the cause replace the winding or the 4-way valve.	
		6. The controller is damaged.	Replace the controller.	
		7. The refrigeration system has a problem.	Check and repair refrigeration system.	

8 Wiring Diagrams

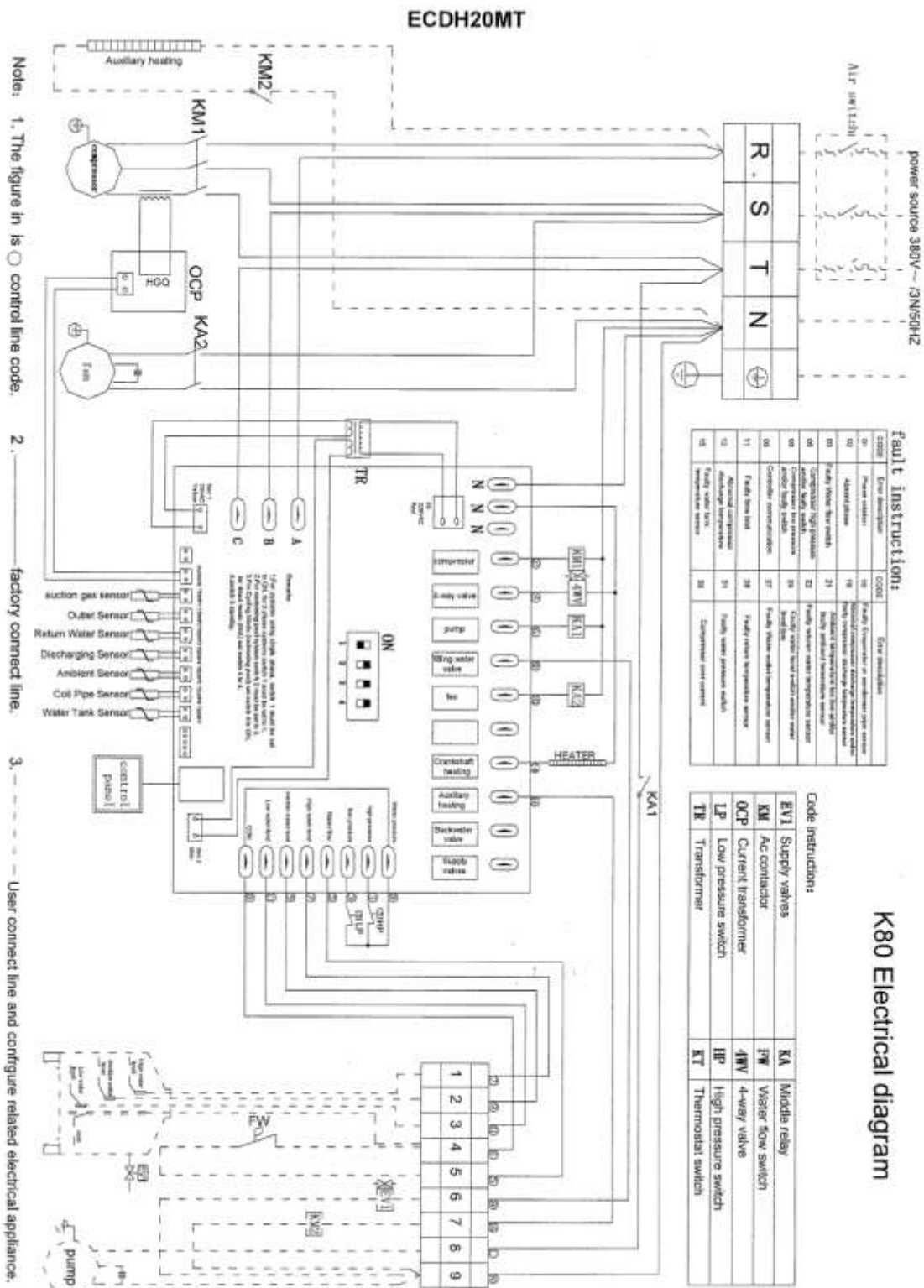


Figure 9 - ECDH20MT

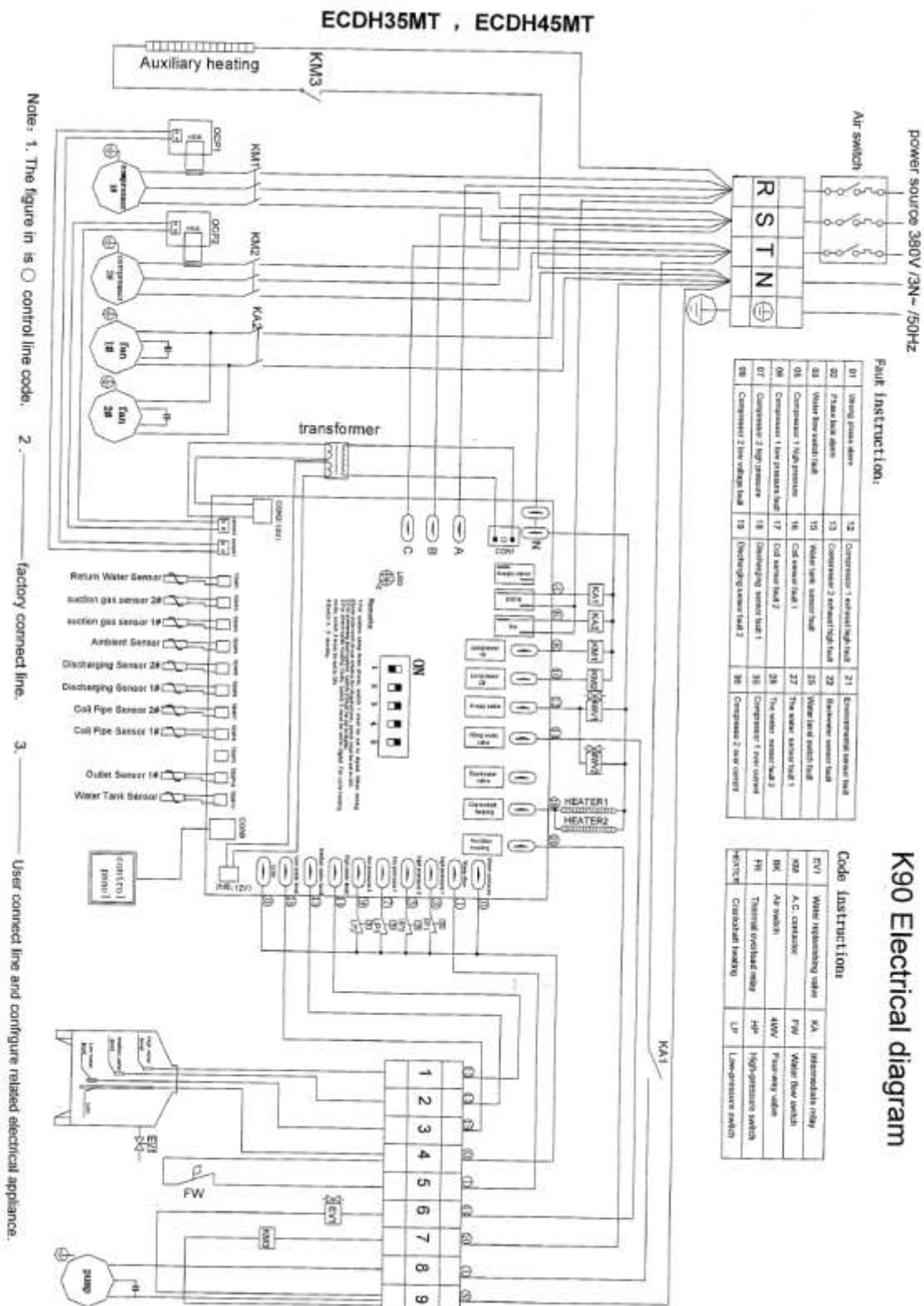


Figure 10 - ECDH35MT and ECDH45MT

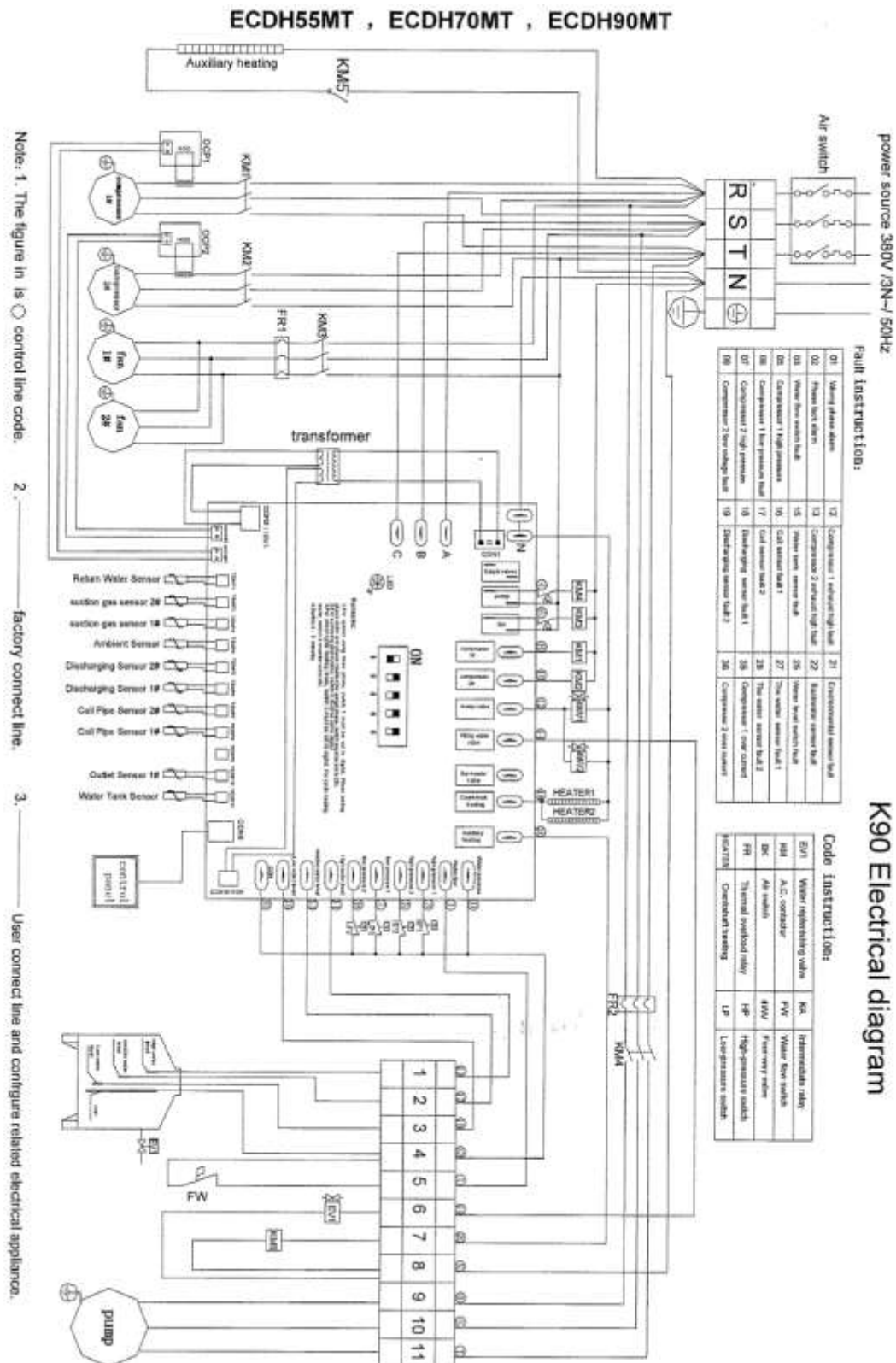


Figure 11 - ECDH55MT, ECDH70MT and ECDH90MT