Elm

Standard & Low Noise

75/60kW

105/70kW

Planner Manual

PD-Elm-03

Version: 2.1

Contents

1 General Specifications

1.1 Features and benefits

1.1.1 Energy Efficiency

The unit has been evaluated for performance and reliability against stringent industry standards, ensuring consistent, verified results.

SCOP - Achieves a high Seasonal Coefficient of Performance of 4.1*

Energy Label A++: Designed to exceed typical regulatory requirements for energy labeling, reducing overall operational costs and environmental impact.

Uses natural refrigerant R290 (GWP 3) for minimal environmental impact and long-term F-gas compliance.

1.1.2 Functionality

Boiler Matching Temperatures: With flow and return temperatures of up to 80/70°C the Elm can act as direct boiler replacement.

Wide Operating Range: Suitable for a broad range of outdoor temperatures, from extremely low ambient conditions to warmer climates. This flexibility ensures year-round heating reliability.

Minimum/Maximum Outdoor Temperatures: -15°C to +40°C

Minimum/Maximum Flow Water Temps: From 35°C up to 80°C

Standard (SN) and Low-Noise (LN) acoustic packages

Compatible with weather-compensated control and 0-10 V or BACnet temperature/ capacity inputs.

1.1.3 Modular design

Cascade Operation: Multiple units can be linked together to increase total capacity or provide redundancy. The system's modular architecture allows for phased installations or expansions.

Load-Sharing Logic: When multiple heat pumps operate in multiplex mode with a Clade multi-unit controller, run-hours and capacity demands are automatically balanced, optimizing efficiency and extending equipment life.

1.1.4 Technology

DC inverter technology on compressors and fans: Ensures precise load matching, smoother ramp-ups, and more stable temperatures. Reduces energy consumption and noise by adjusting speed according to actual demand.

Electronic expansion valve: Maintains optimal refrigerant flow for higher efficiency and better control of discharge/evaporating temperatures, enhancing reliability and performance.

Large Surface Flat-Bed Hydrophilic coil: Allows moisture to drain off smoothly, reducing potential ice build-up and improving heat transfer.

Integrated Controls: With colour HMI, data-logging, remote connectivity and leak-detection safety circuit.

* Average Climate, Flow 35°C, inlet 25°C

2 Technical Specification

2.1 Standard and Low Noise Unit Technical Specifications

2.1.1 Minimum and Maximum kW output:

Model	Min Compressor kW (-10°C)	Max Compressor kW (+7°C)
Elm 75/60 kW	51.0	77.1
Elm 105/70 kW	68.1	102.8

Structure: Built on a heavy-duty FeZn 15/10 galvanized steel frame, the Elm unit offers rigidity and longevity. The core chassis is designed for quick installation and stable placement, featuring integrated lifting eyes and forklift slots that streamline transport while ensuring reliable, vibration-resistant operation once sited.

Paneling: Durable yet service-friendly paneling encases all sides of the heat pump. Each panel is insulated to help maintain internal operating temperatures, reduce sound transmission, and enable easy access for routine checks and component replacements.

Internal exchanger: Internally a brazed stainless-steel plate heat exchanger maximises heat transfer and resists corrosion.

External exchanger: Designed for high thermal efficiency, the advanced fin-and-tube coil system maximises heat transfer while maintaining compact dimensions. Key features include copper tubing for superior conductivity, aluminium fins for enhanced airflow.

Fans: The Elm Heat Pump incorporates powered axial fans, featuring ECblue motor technology for maximum efficiency and precision airflow control, IE5 efficiency-class motor for energy savings, ultra-quiet operation for reduced noise pollution, smart speed modulation to adapt to varying load demands.

Refrigeration circuit: Single-loop, propane (R290) charge with multi-point electronic leak detection and automatic safety routine. Oversized suction line accumulators protect the inverter compressor during low-load operation.

Electrical Panel:I P54 control enclosure housing Clade controller with BACnet/IP, Modbus-TCP, and Cloud remote connectivity. Onboard diagnostics, data-logging, and predictive-maintenance alerts are standard.

2.2 Refrigerant Information

2.2.1 Characteristics of R290 refrigerant

The Elm range of heat pumps manufactured by Clade Engineering Systems are equipped with propane (R290). Propane is classified as an A3 refrigerant (low toxicity but highly flammable) and must be handled in accordance with flammable gas safety guidelines.

Propane is odorless in its pure form and is heavier than air. If released in an enclosed or low-lying area, it can accumulate and form a flammable mixture with air. All personnel involved with specification, installation, operation, and maintenance of these units must be fully qualified, competent, and hold any certifications required for work on flammable refrigerants.

Propane is listed with two GWP values to the difference between its theoretical warming impact and its practical behaviour in the atmosphere. Its theoretical GWP, as defined by the IPCC, is approximately 3 and represents propane's inherent ability to absorb infrared radiation, assuming it behaves like long-lived greenhouse gases such as CO_2. However, in real-world applications, propane breaks down rapidly in the atmosphere, typically within two weeks, due to reactions with hydroxyl radicals. This short atmospheric lifetime means it does not accumulate and has a negligible long-term climate impact. As a result, its adjusted GWP over a 100-year timeframe is approximately 0.02, reflecting its true environmental impact in practical use.

Each unit is evacuated and pre-charged at the factory with the correct amount of R290, so no additional charge is required. The refrigerant charge can be found on the PED label.

In the event of component failure or a leak, the system should be stopped immediately. The remaining charge must be reclaimed or vented in a safe, controlled manner, observing all local regulations for flammable refrigerants. See the system maintenance manual for service valve access points and isolation procedures. Once repairs have been made, the system must be thoroughly evacuated and re-charged with the specified quantity of refrigerant as recorded on the PED label.

Model (SN + LN)	Refrigerant (Kg)	Equivalent CO_2 tons (tCO_2e)
Elm 60/75kW	5.1	0.015
Elm 70/105kW	6.0	0.018

Physical characteristics of the R290 refrigerant	
Safety class (ISO)	A3 (Low toxicity, Highly flammable)
GWP (kg.CO_2e)	3
Low flammability limit (LFL) (Kg/m^3 @ 60°C)	~0.038 (varies with temperature)
Burning velocity (BV) (cm/s)	~46
Boiling point (°C)	-42
GWP (100 yr ITH)	0.02
ODP (Ozone Layer Depletion)	0
Self-ignition temperature (°C)	470

2.2.2 Gas Leak Detection

The Elm heat pump is supplied with full leak detection safety systems. The design of the heat pump includes enhanced tightness joints and the refrigerant circuit is a sealed system. The design also separates electrical equipment to protect the system from any sources of ignition.

In the unlikely event of component failure or a leak the heat pump will detect a gas escape and shut down operation. Electrical systems will power down at 20% of the LFL (Lower Flammable Limit) except for the ventilation fan within the heat pump housing. The fan will continue to operate to remove any gas from the housing, ensuring any remaining charge is vented to atmosphere in a controlled manner.

The system will require a manual reset in the event of a gas leak shut down event. This prevents the system from automatically restarting until the cause of the leak or leak alarm is fully investigated and resolved.

See system maintenance manual for access points and isolation procedures. Once the issue has been rectified the system would need to evacuated and re-charged with the correct amount of refrigerant as recorded on the PED label.

⚠ **WARNING**

The designer/installer must consider adequate protection for gas escapes

2.2.3 Hazardous Area Classification (HAC)

We hereby declare that the hazardous area classification for the space above the Elm has been assessed and calculated in accordance with the requirements of:

BS EN IEC 60079-10-1: Explosive atmospheres – Part 10-1: Classification of areas – Explosive gas atmospheres

This assessment has determined that the area directly above the heat pump qualifies as a Zone 2 hazardous area, defined as:

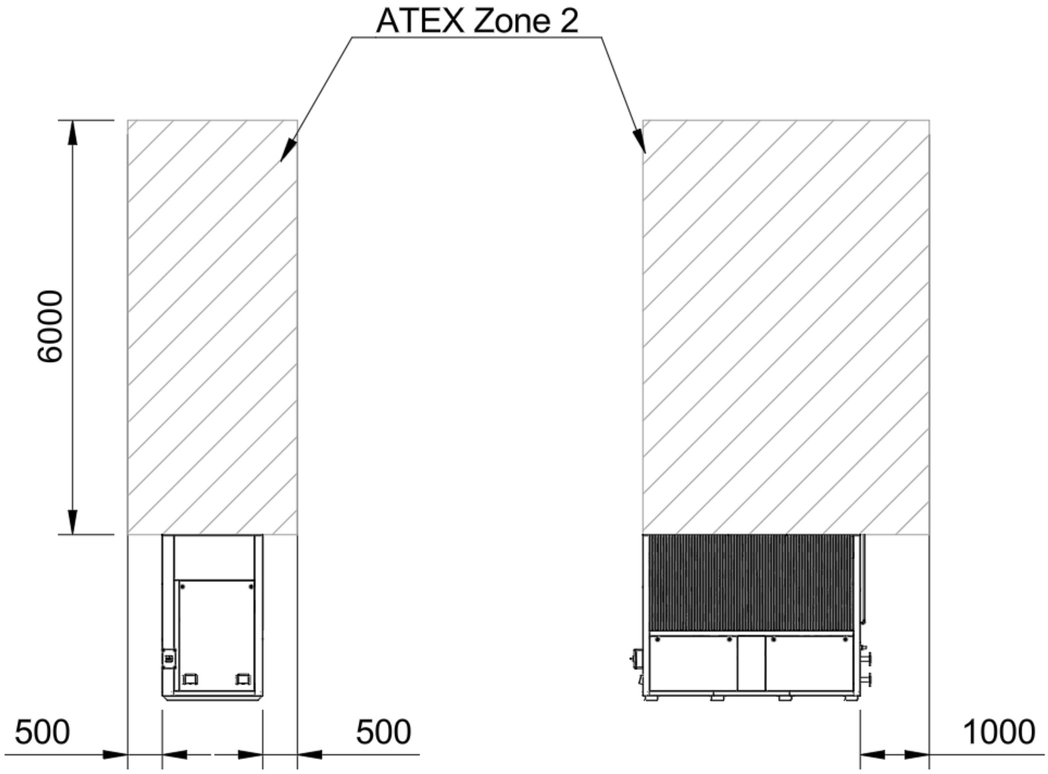
"An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, will persist for a short period only."

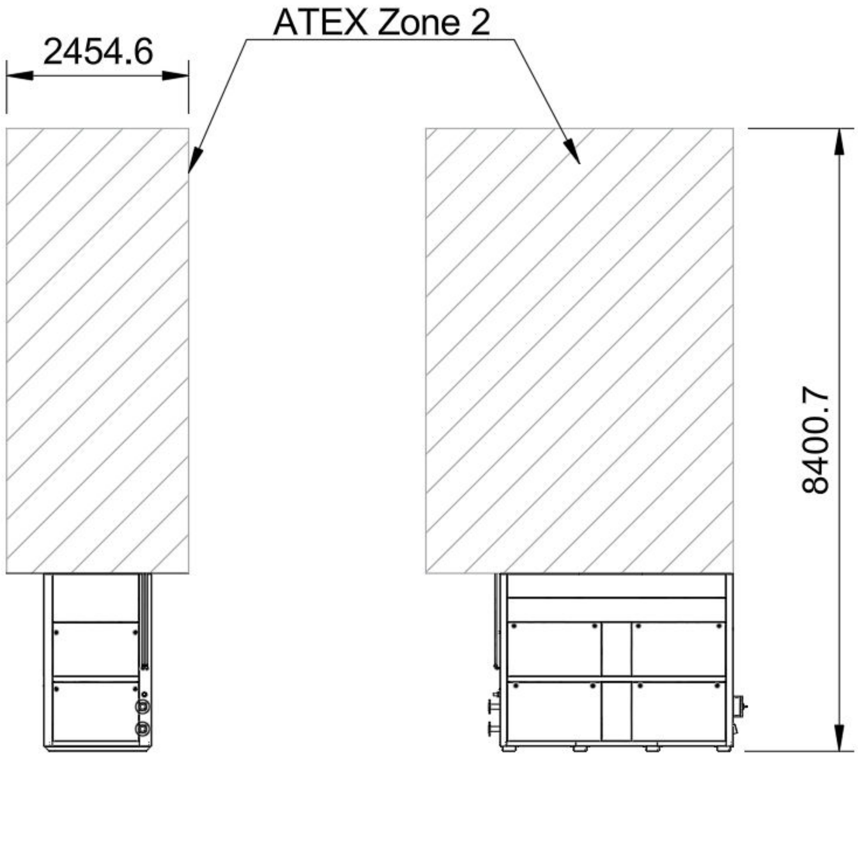
The classification was based on the following considerations:
- Identification of potential sources of release of flammable refrigerants or gases.
- Evaluation of ventilation conditions and dispersion characteristics.
- Estimation of the frequency and duration of potential explosive atmospheres.
- Application of qualitative and, where appropriate, quantitative methods as outlined in BS EN IEC 60079-10-1 and relevant industry codes.

All relevant documentation, including hazard identification, zone extent drawings, and supporting calculations, has been compiled.
.
This declaration affirms that the classification has been carried out by competent personnel and that the installation complies with applicable UK legislation, including the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR).

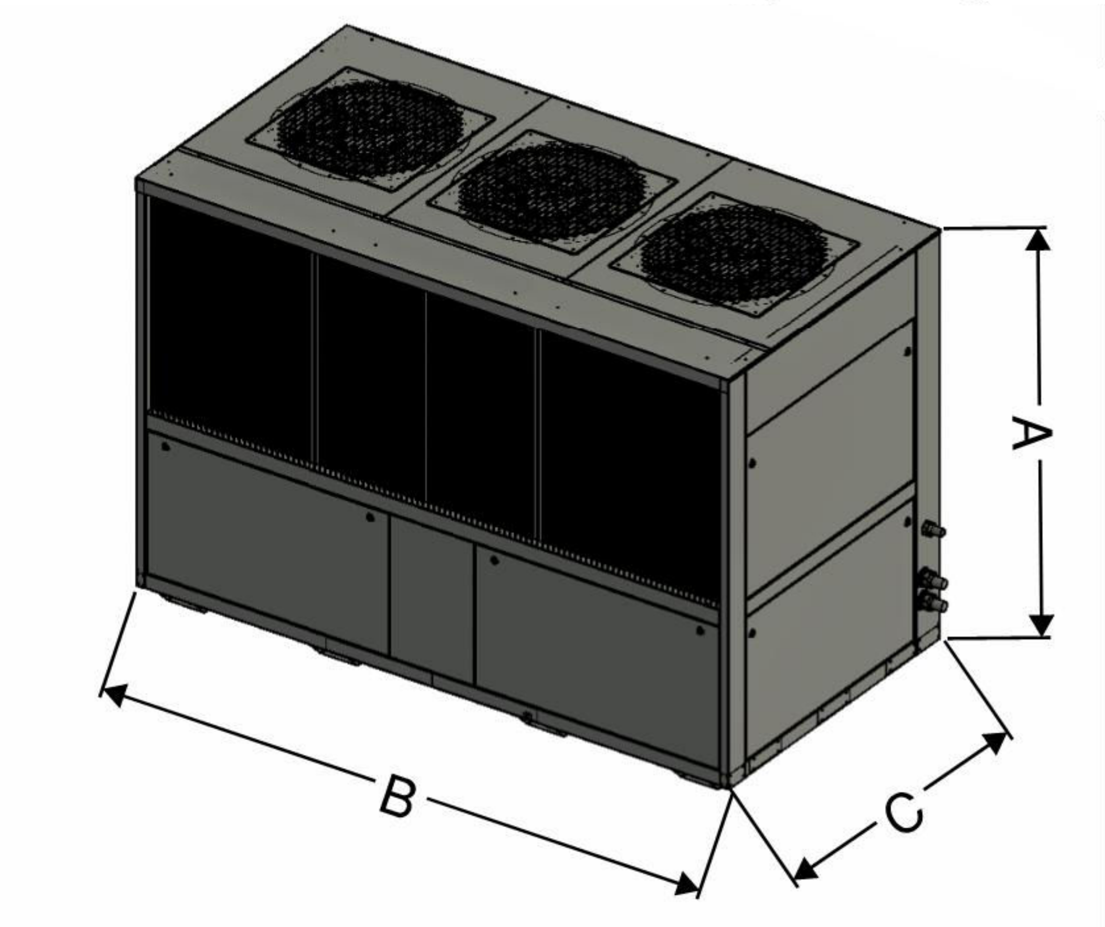
As PRVs are located on the top of the unit and fans expel gas upwards there is no ATEX zone around the sides of the unit.

The Zone 2 requirements can be seen in the images below:



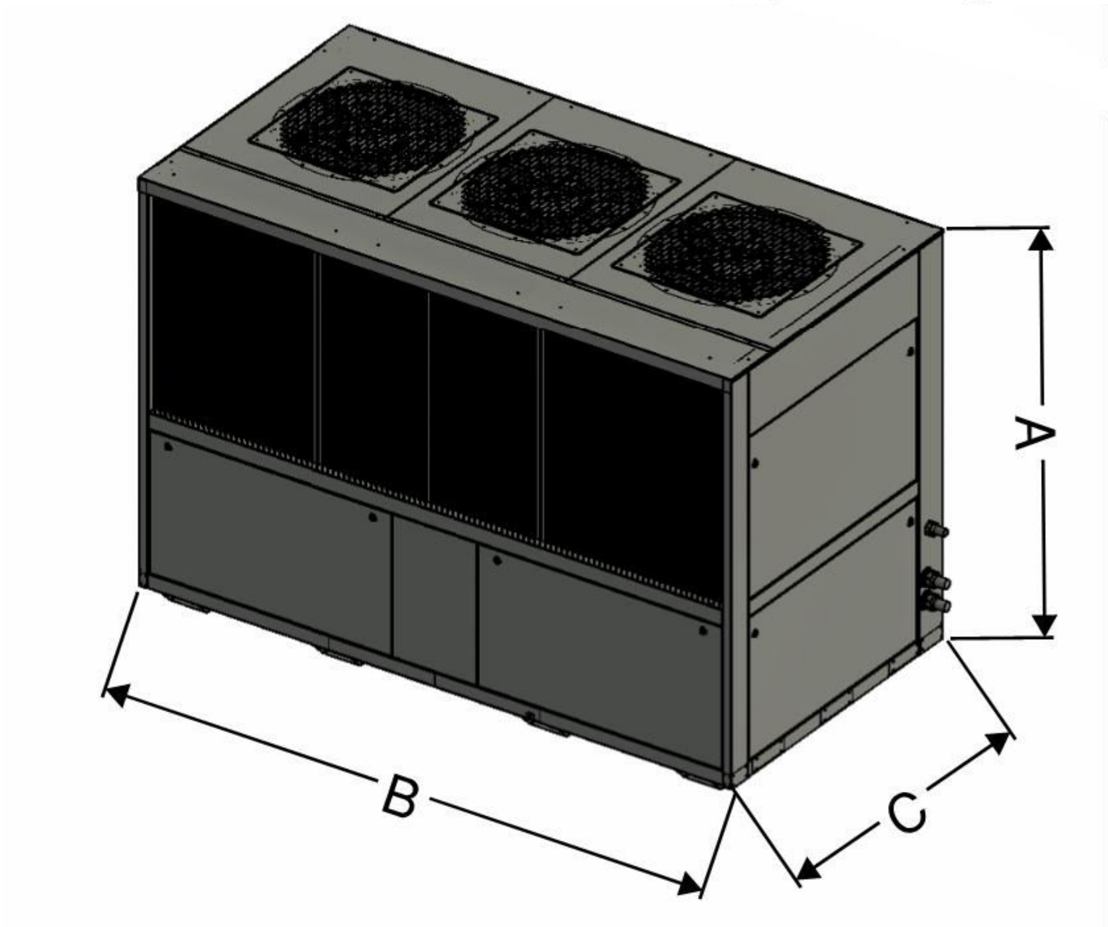


2.3 Dimensions Standard Nosie



Unit	Height 'A' (mm)	Length 'B' (mm)	Width 'C' (mm)	Operating Weight (kg)	Shipping Weight (kg)
Elm 75/60kW SN	2057	2354	1455	1268	1238
Elm 105/70kW SN	2057	3144	1455	1348	1308

2.4 Dimensions Low Noise

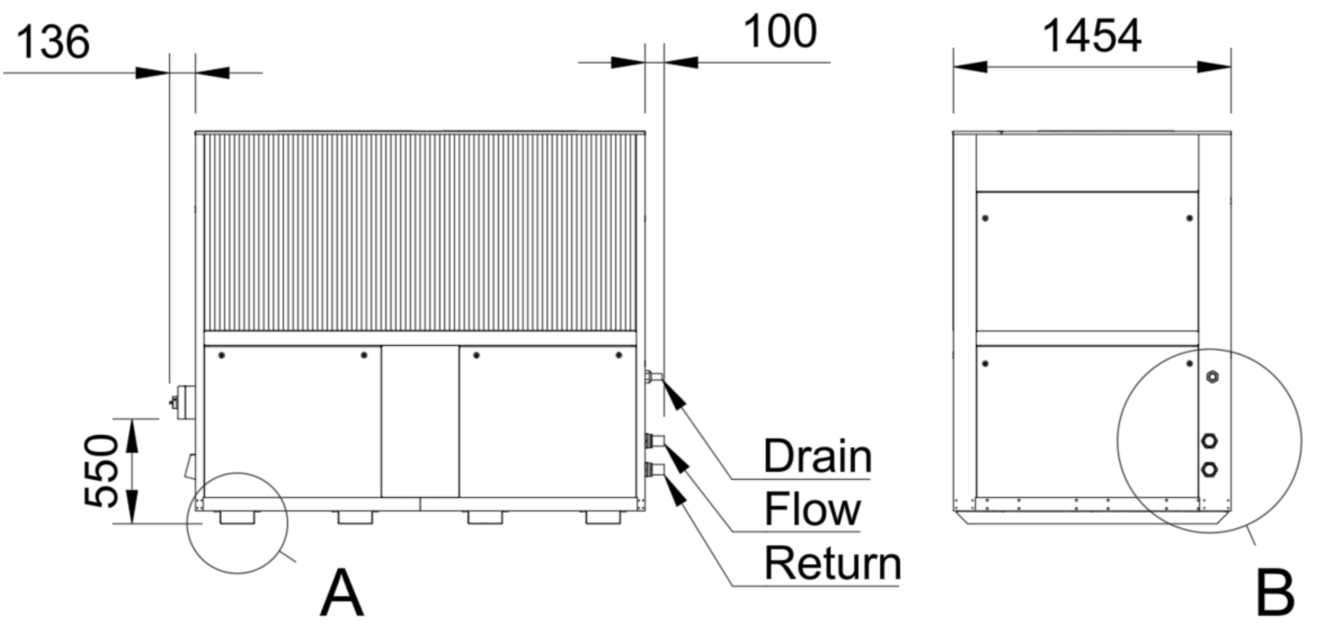


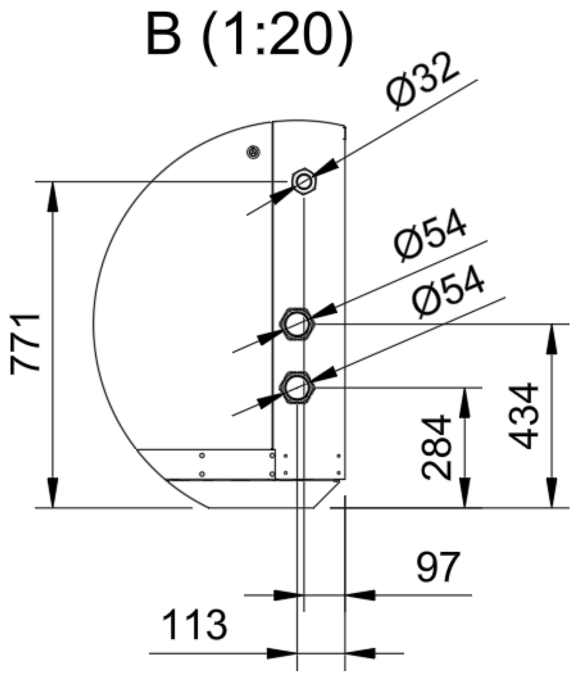
Unit	Height 'A' (mm)	Length 'B' (mm)	Width 'C' (mm)	Operating Weight (kg)	Shipping Weight (kg)
Elm 75/60kW LN	2400	2354	1455	1590	1560
Elm 105/70kW LN	2400	3144	1455	2175	2140

2.5 Service Connections

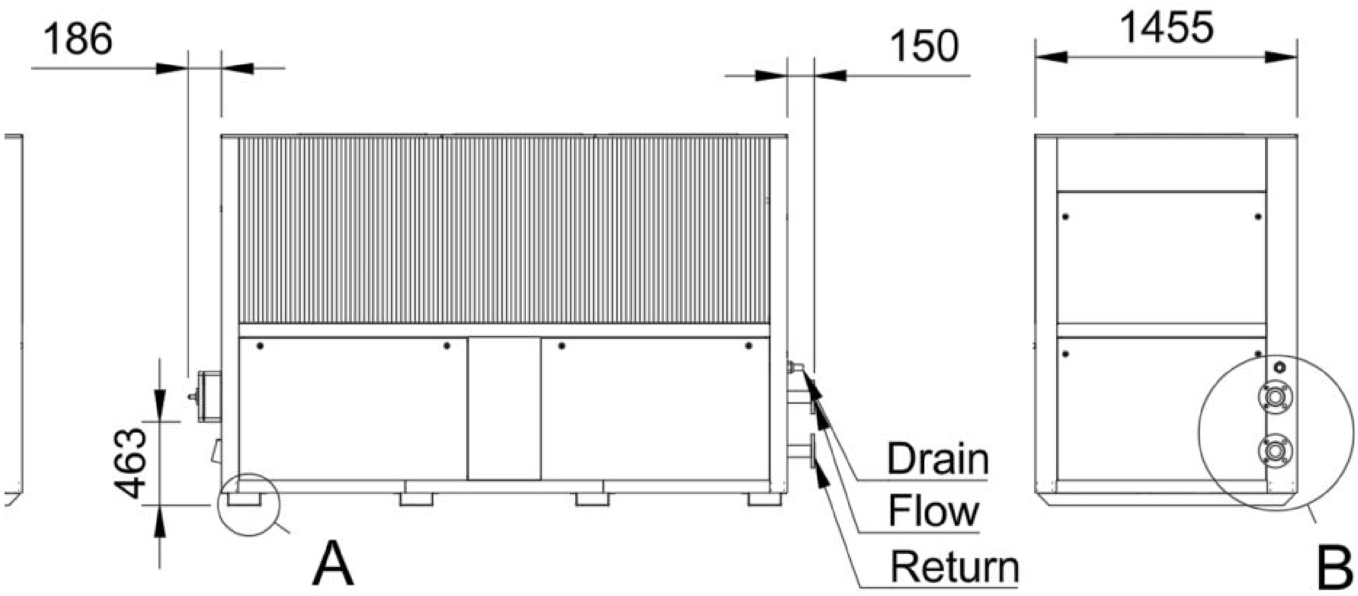
When selecting a location for the unit(s) consideration of the service connection positions is required. All water service connections are located on the right hand side panel of the heat pump and electrical on the left hand side panel of the heat pump.

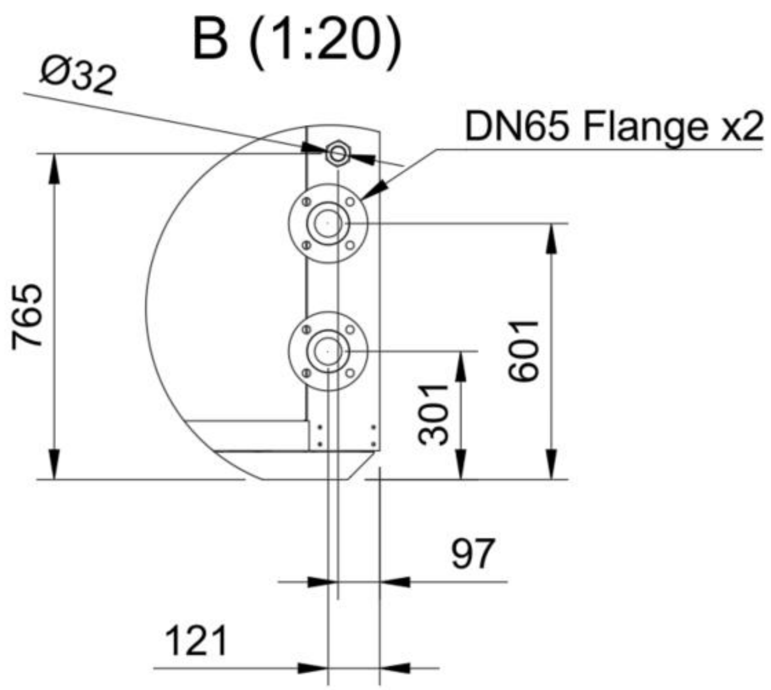
2.5.1 Elm 75/60 (SN + LN) kW





2.5.2 Elm 105/70 (SN + LN) kW

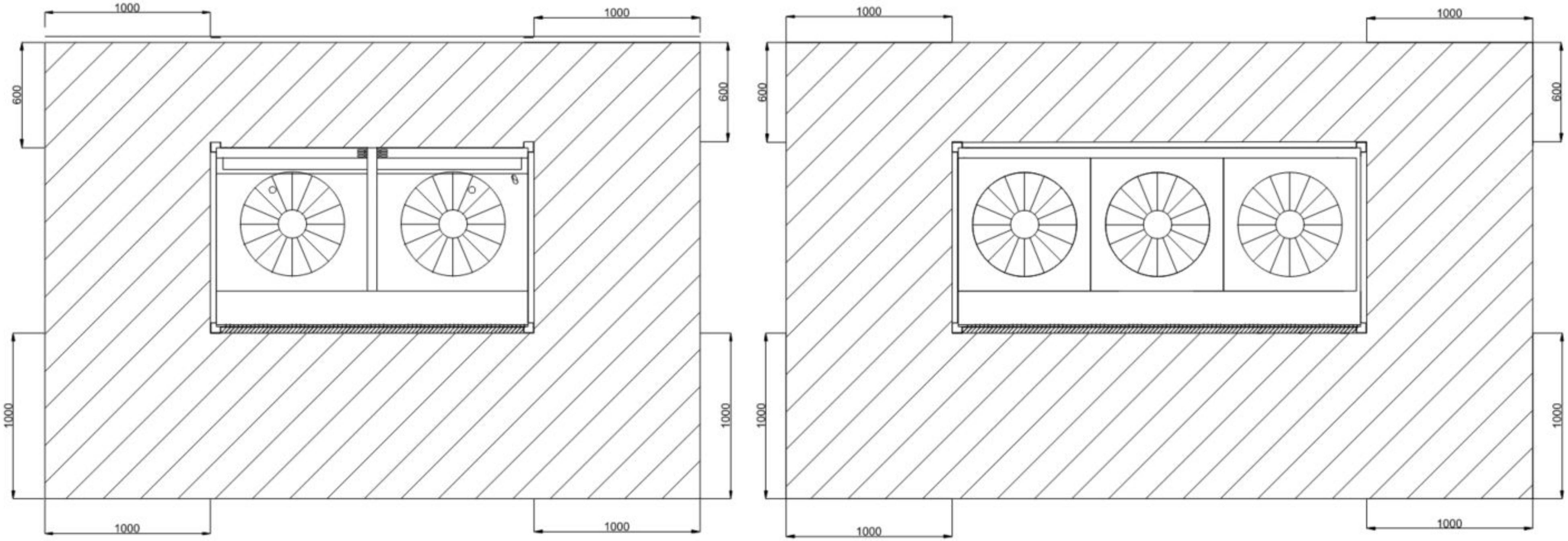




2.6 Installation Space Requirements

It is essential that the space requirements detailed in this section are strictly followed. Inadequate clearance will restrict airflow and compromise unit performance. Insufficient space will also obstruct access for routine maintenance, repairs, or replacement of components, which may result in warranty being void. Particular attention must be given to the electrical cabinet side of the unit. Clearance here must also account for “bounce-back” space, which is a health and safety requirement to ensure safe working conditions during servicing.

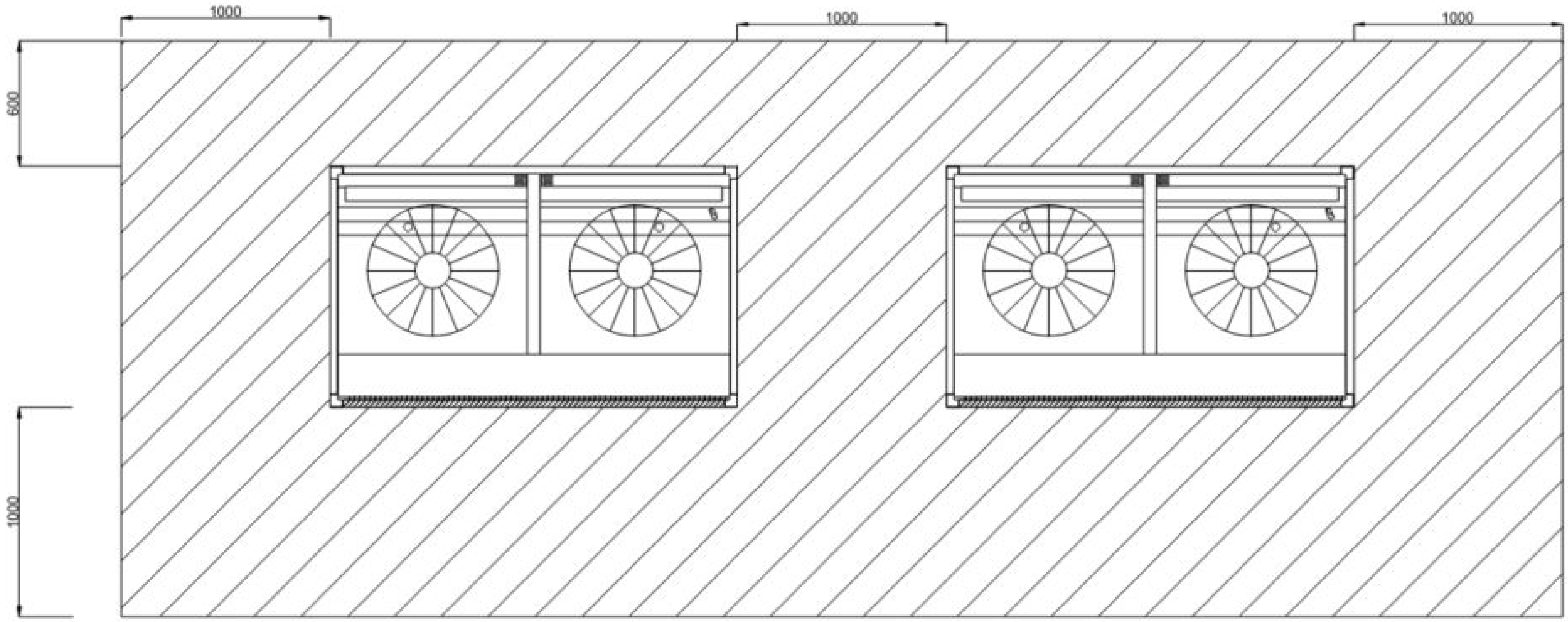
2.6.1 Single Unit Installation



Note. 1 Meter around front and sides to be kept clear to allow access to heat pump, and 0.6 meters at the back of the unit away from other units or walls, shown in hatched region.

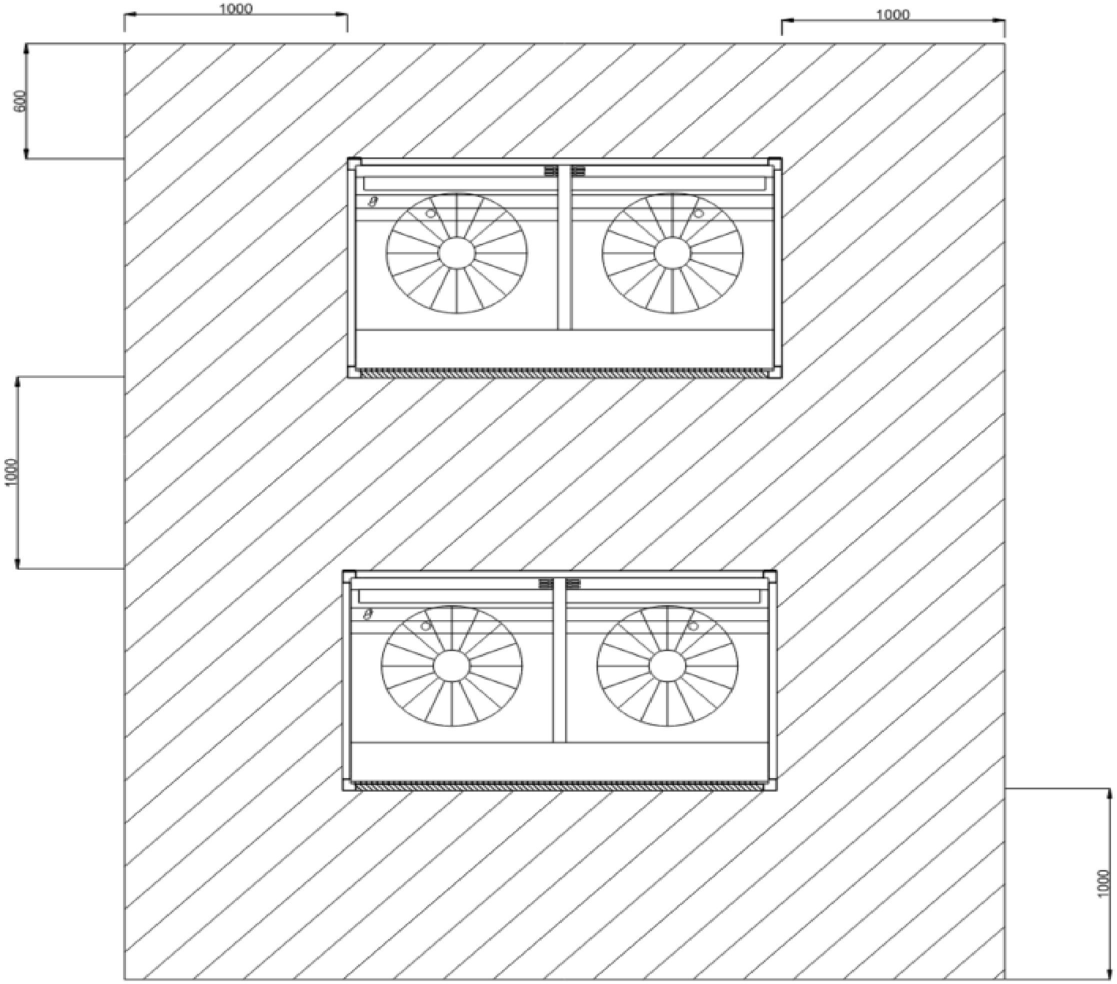
2.6.2 Multiple Unit Installation

When installing multiple units, make sure to take into consideration factors such as providing enough space for people to pass through, ample space between blocks of units, and sufficient space for airflow. Side by side installation, allow access to side of each unit for access.



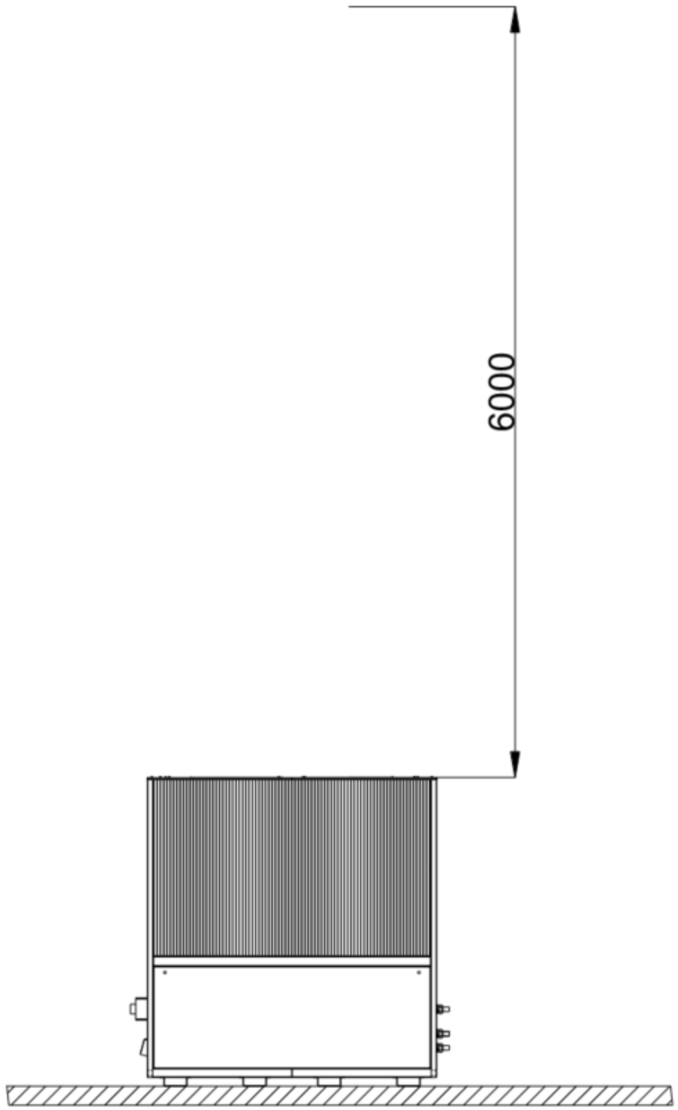
Note. 1 Meter around front and sides to be kept clear to allow access to heat pump, and 0.6 meters at the back away from other units or walls, shown in hatched region.

Units can be placed front to back, ensuring there is 1000mm between the front and back of the units. Please ensure no pipework runs over or across the equipment's access panels, as this can hinder routine inspections and servicing. Likewise, the unit should not installed beneath a dedicated shelter or roof.



Note. 1 Meter to be kept clear
to allow access to heat pump,
shown in hatched region.

2.6.3 Vertical Clearance



3 Technical Data

3.1 Performance Data

Elm Range (SN + LN)			75/60kW	105/70kW
Heating performance data to EN14825 (A-5/W80) 10K TD				
Rated heating output		kW	59.4	77.1
Power Consumption		kW	33.7	45.2
Current Input		A	57.3	76.8
Coefficient of Performance (COP)			1.76	1.75
Seasonal Coefficient of Performance (SCOP)			1.95	1.94
Heating performance data to EN14825 (A7/W80) 10K TD				
Rated heating output		kW	78.6	102.4
Power Consumption		kW	37.8	50.4
Current Input		A	64.3	85.5
Coefficient of Performance (COP)			2.08	2.07
Seasonal Coefficient of Performance (SCOP)			1.95	1.94
Temperature Range	Minimum Inlet water temp		20°C	
	Maximum Outlet water temp		80°C	
	Outdoor temp range		-15°C to 40°C	

3.1.1 Variable Supply SCOP/SPFs

To increase system performance water flow temperature can be varied based on external ambient temperature. The related SCOP or SPF (seasonal performance factor) can be seen in the table below.

Elm Range	75/60	105/70
SCOP - Variable Supply Temp - W65 (1)	**3.32**	**3.20**
SCOP - Variable Supply Temp - W55 (1)	**3.73**	**3.60**
SCOP - Variable Supply Temp - W45 (1)	**3.98**	**3.84**
SCOP - Variable Supply Temp - W35 (1)	**4.34**	**4.18**

(1) COP figures provided in this table are calculated in line with EN14825 at the stated ambient conditions and design water flow and return temperatures. Figures shown relate to specific design conditions which in physical application may vary significantly due to changes and fluctuations in conditions such as ambient temperature, humidity and fluctuations to system temperatures, flow rates etc. As such all COP figures are subject to variation and should be taken as maximum achievable instantaneous figures at the design condition.

3.2 Construction Table

Elm Range		Elm 75/60kW	Elm 105/70kW
REFRIGERATION SIDE			
Compressor Type	-	Reciprocating	
Compressor Qty	Pcs.	1	
Refrigerant	-	Propane (R290)	
Refrigerant Circuits	Pcs.	1	
Variable speed drive (VSD)	Pcs.	1	1
Refrigerant charge	kg	5.0	6.0
No. evaporators	Pcs.	1	
Evaporators Type	-	Flat bed	
Fin Material	-	AL/MG	
Defrost Type	-	Hot Gas	
Defrost medium	-	R290	
Electrical supply	-	3~ 400V 50 HZ	
DIMENSIONS & NOISE			
Elm Low Noise			
Colour	-	RAL7016 Anthracite	
Unit Weight (empty)	kg	1560	2140
Unit Weight (operational)	kg	1590	2175
Sound Power Level $L_{W(A)}$ (dB)	dB	67	68
Elm Standard Noise			
Colour	-	RAL7016 Anthracite	
Unit Weight (empty)	kg	1238	1308
Unit Weight (operational)	kg	1268	1348
Sound Power Level $L_{W(A)}$ (dB)	dB	80	81
Access			
Minimum free space side	mm	1000	1000
Minimum free space front	mm	1000	1000
Minimum free space back	mm	600	600
Minimum free space above	mm	6000	6000
WATER SIDE			
Type of internal exchanger		Stainless steel plate heat exchanger	
Exchanger Water content	l	13.5	13.5
Connections waterside Flow/Return	DN	54mm Copper	67mm Copper
Factory pressure test rating	PN	6	
Connections waterside Pressure Rating	PN	6	
Control Methodology		PICV	
Pressure Drop (A7/W80) 10K TD	kPa	97.3	80.2
Water flow rates			
Nominal dT 10 K	l/s	1.82	2.46
Minimum Water Flow Rate	l/s	0.61	0.82
Minimum water volume in heating	l	1400	1679
Total internal water volume	l	23.3	29.1

FANS SECTION			
Fans type	-	Axial fans	
N° fans	pcs	2	3
Standard air-flow	m^3/h	22680	33840
Additional Static Pressure Available	Pa	0	0
Fan regulation	-	0-10V	
Fan Power Input	kW	2.8	4.2
ELECTRCIAL SECTION (W80 10K TD)			
Total Absorbed Power (at 7°C ambient)	kW	36.3	47.7
Total Current per phase	A	59.3	81.1
Starting Method	-	Soft Start	
Max Starting Current	A	33.3	44.5
Total kVA	kVA	44.5	59.3
Electrical supply	-	3~ 400V 50 HZ	
Communication protocol	-	BACNET over IP (optional extra)	
IP-Class	-	IP54	

3.4 Noise

Noise attenuation is built into the Low Noise (LN) Elm heat pump. The LN heat pump is designed with upgraded housing to minimise noise. Standard Noise (SN) Elm units have no additional attenuation to the evaporator fans or housing.

To reduce the transmission of vibration and associated noise through pipework and structural elements, flexible connections must be used on all water connections to the unit. Proper isolation and support of attached pipework is also essential to minimise operational noise.

External fixings to the housings, such as pipe supports, fencing, or brackets, will adversely affect vibration and noise performance and are not recommended.

3.4.1 Noise Calculation

Noise details are detailed below for the Birch heat pump Range. The A-weighted sound power levels LwA shown below are declared in accordance with BS EN ISO 4871:2009. Measurements were performed using the BS EN ISO 9614-1:2009 sound-intensity method (survey grade). The “Sound Pressure at 10 m” values actual site sound pressures will vary with distance, screening, reflections, and background noise.

Elm Range	Elm 75 / 60		Elm 105 / 70	
	Standard	Low Noise	Standard	Low Noise
Sound Power Level, $L_{W(A)}$ (dB) (1)(2)	80	67	81	68
Sound Pressure Level at 10m (dB) (3)	48	35	49	36
Uncertainty (dB)	4	4	4	4

Unit	Octave Band Centre Frequency (Hz)									
	63	125	250	500	1000	2000	4000	8000	Lin	(A)
75/60 SN Lw (dB)	90	94	76	76	70	62	57	48	96	80
75/60 LN Lw (dB)	78	79	65	62	60	53	49	42	84	67
105/80 SN Lw (dB)	91	95	77	77	71	63	58	49	97	81
105/80 LN Lw (dB)	79	80	67	64	62	55	51	43	85	68

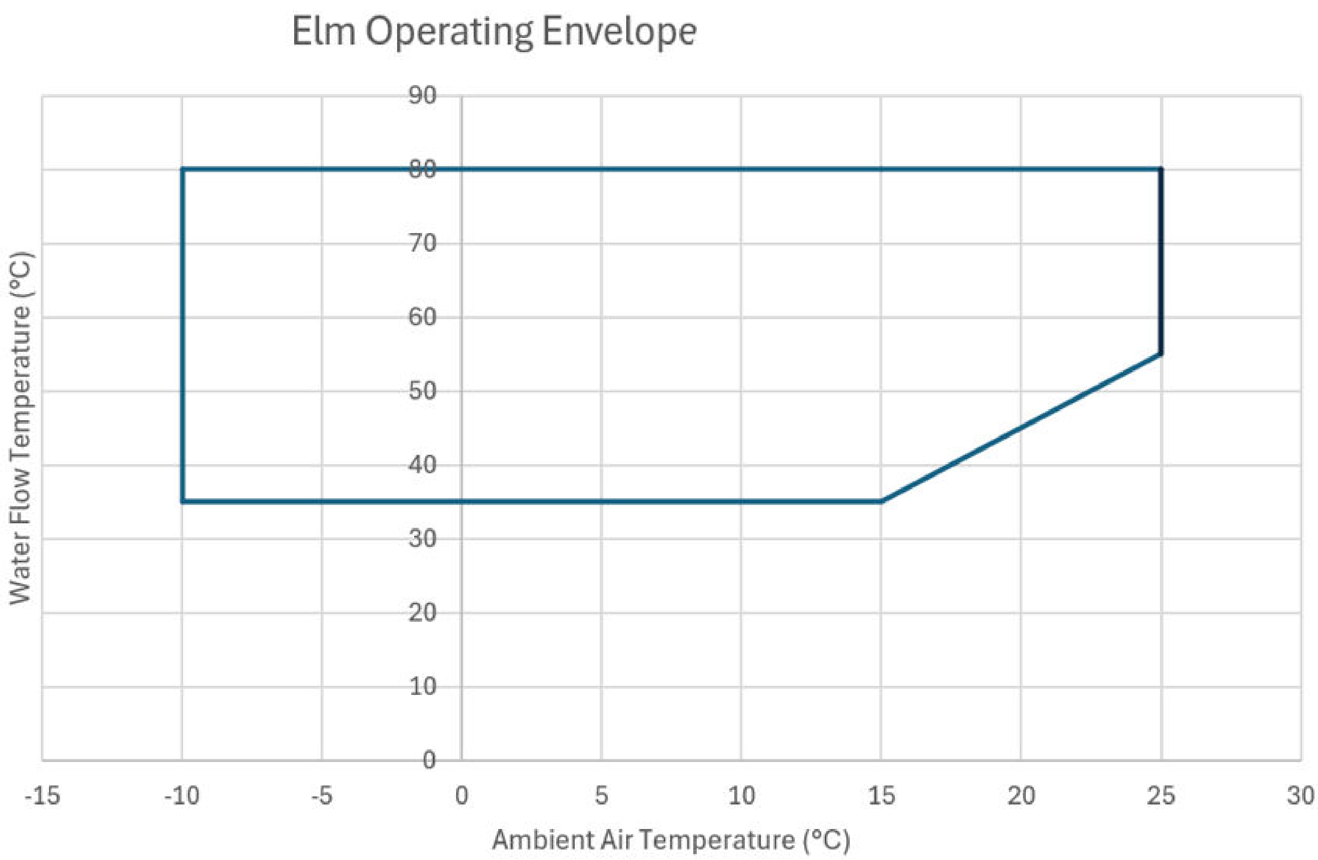
(1) The sum of a measured noise emission value and its associated uncertainty represents an upper boundary of the range of values which is likely to occur in measurements
(2) The sound levels refer to a unit operating under conditions that guarantee a thermal capacity equal to that declared at an outdoor air temperature of 7°C DB (6°C WB), according to EN 14825:2022
(3) Assumed 10m parallelpiped sound propagation

3.5 Glycol use correction factors

% propylene glycol by weight		0%	10%	20%	30%
Freezing point	°C	0	-3	-8	-14
Correction factor for flow rate	Nr	1	1.020	1.045	1.074
Correction factor for system pressure drop	Nr	1	1.019	1.042	1.071
Correction factor for unit heating capacity	Nr	1	1.000	1.000	1.001

The correction factors shown refer to water and propylene glycol mixes used to prevent the formation of frost on the exchangers in the water circuit during inactivity in winter. Glycol has no impact on kW output of the Elm units, instead the unit modulates flow rate.

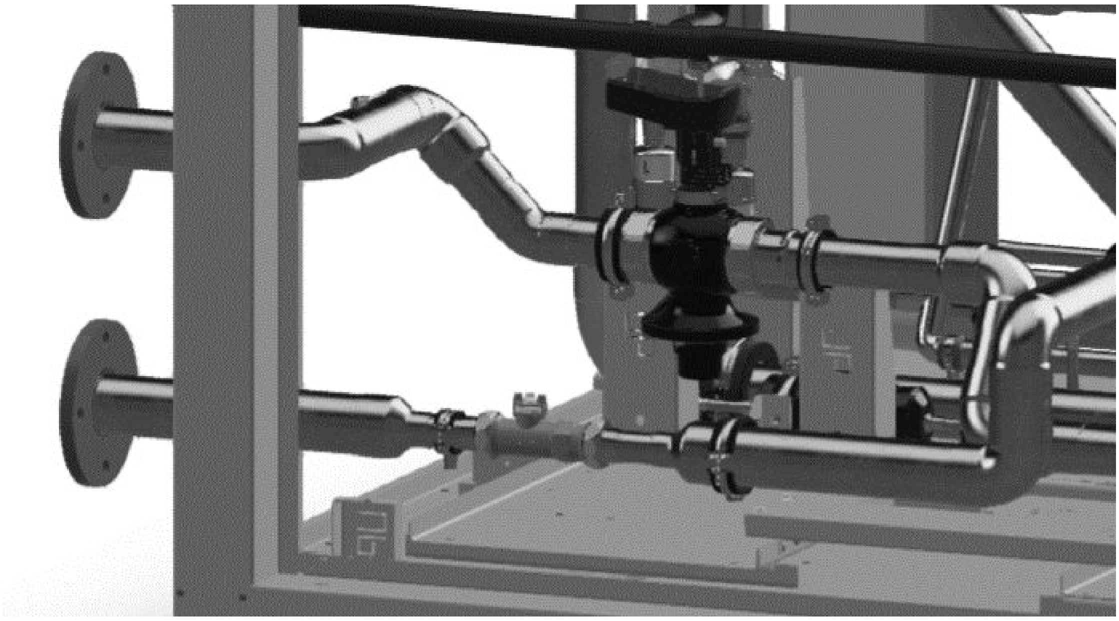
3.6 Operating Ranges



Return temperature range = 20- 70°C

3.7 Pressure Independent Control Valves

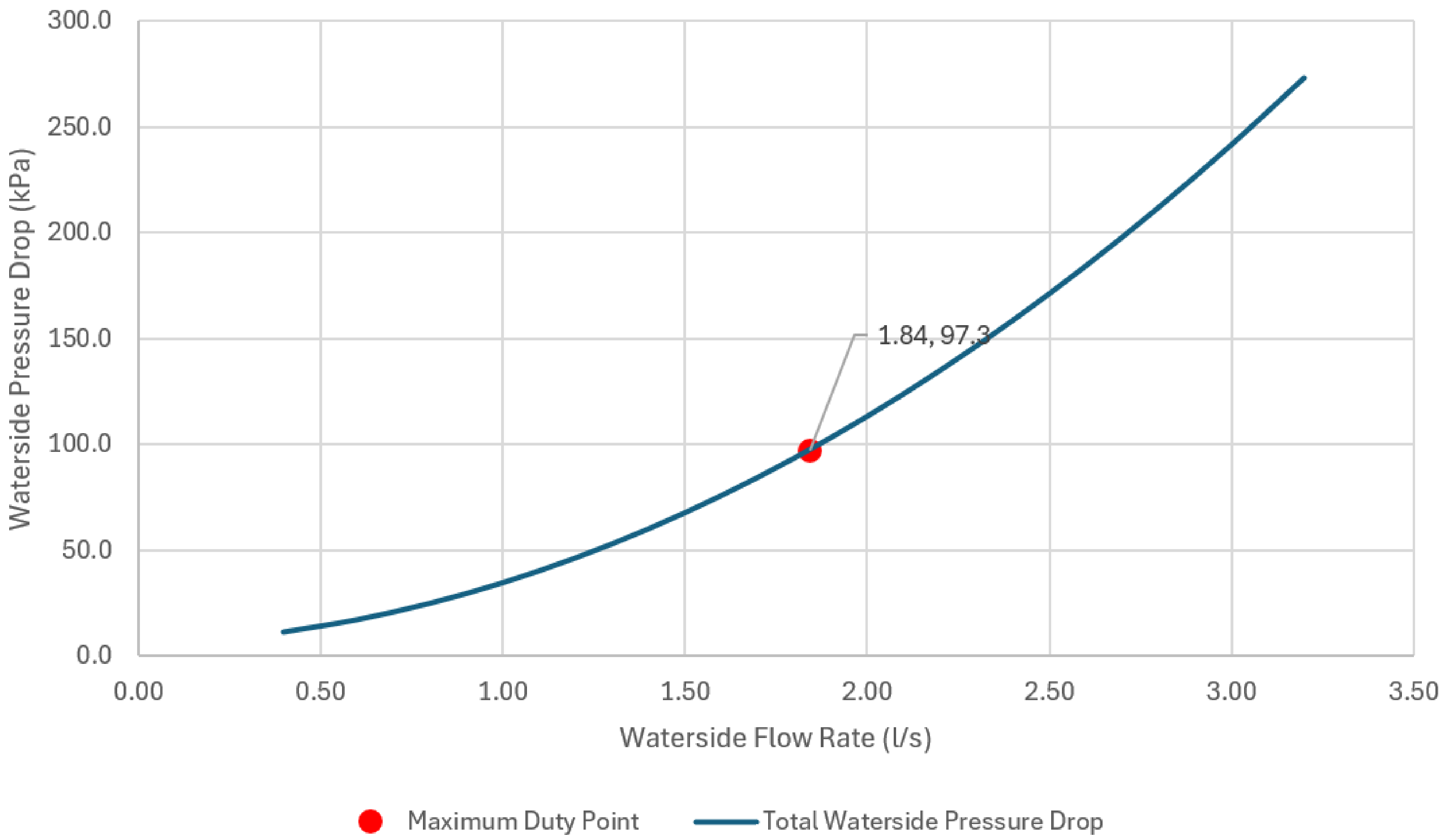
All Elm R290 heat pump systems are equipped with Pressure Independent Control Valves (PICVs) and do not include an internal circulating pump. Instead, the water circulating pump for the system must be sized, sourced, and installed by a third party; Clade does not supply a circulating pump as part of the standard heat pump offering.



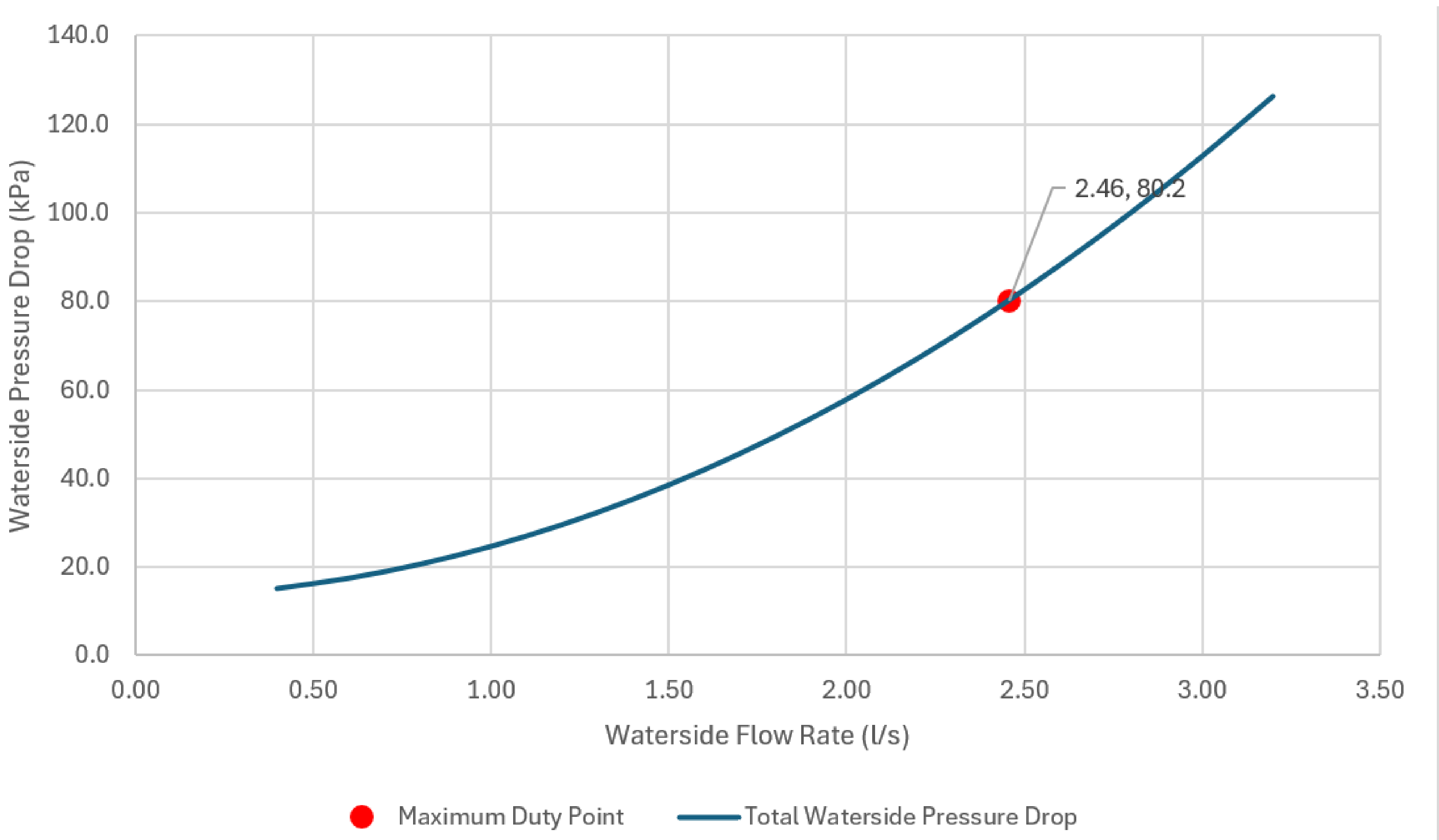
The PICVs are engineered to regulate the flow through the plate heat exchanger by varying the pressure drop across the valve independently of the inlet pressure. This design ensures that the system-side flow balance remains unaffected. Moreover, the design flow rate is directly set in the actuator in built software, eliminating the need for manual valve presetting since the actuator automatically manages the valve’s operating envelope.

3.8 Internal Exchanger Pressure Drops and Admissible Water Flow Rates

Elm Range 75/60 kW



Elm Range 105/70 kW



3.9 Heating Performances

The performance data presented here reflects testing under the controlled parameters outlined in EN 14825 and is intended for ideal conditions only. Actual performance may differ due to variables such as installation specifics, operational settings, and climatic variations. Customers should verify requirements for each individual application, recognizing that local conditions in the United Kingdom can markedly influence real-world results.

These units support two operating modes:

1. **Power Mode:** Heat output remains unrestricted up to outdoor temperatures of 7 °C, offering greater capacity in milder conditions, albeit with increased power input.

2. **Efficiency Mode:** Heat output is capped at conditions equivalent to -5 °C, allowing the electrical demand to remain at the same level as -5 °C operation. This is particularly beneficial for installations where electrical capacity is limited.

3.9.1 Elm Range 75/60 kW

POWER MODE (+7°C CAPACITY CONTROL)																							
Model name	Water Temp (°C)	SCOP	-10°C External			-5°C External			0°C External			5°C External			7°C External			10°C External			15°C External		
			QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP
Elm (SN + LN) 75/60	80/70	1.9	51.9	31.2	1.7	59.4	33.7	1.8	66.9	35.6	1.9	75.1	37.4	2.0	78.6	37.8	2.1	78.6	36.9	2.1	78.6	35.3	2.2
	75/65	2.1	52.4	29.4	1.8	59.7	31.7	1.9	67.5	33.4	2.0	75.9	35.0	2.2	79.5	35.4	2.2	79.5	34.5	2.3	79.5	33.0	2.4
	70/60	2.3	52.9	27.8	1.9	60.2	29.9	2.0	68.1	31.4	2.2	76.8	32.9	2.3	80.5	33.2	2.4	80.5	32.3	2.5	80.5	30.8	2.6
	65/55	2.4	53.5	26.3	2.0	60.8	28.2	2.2	68.9	29.6	2.3	77.8	30.9	2.5	81.6	31.1	2.6	81.6	30.2	2.7	81.6	28.7	2.8
	60/50	2.6	54.1	25.0	2.2	61.4	26.7	2.3	69.7	27.9	2.5	78.9	29.0	2.7	82.8	29.2	2.8	82.8	28.3	2.9	82.8	26.9	3.1
	55/45	2.8	54.9	23.8	2.3	62.1	25.3	2.5	70.6	26.3	2.7	80.0	27.4	2.9	84.0	27.5	3.1	84.0	26.6	3.2	84.0	25.1	3.3
	50/40	3.0	55.6	22.7	2.5	62.9	24.0	2.6	71.6	24.9	2.9	81.2	25.8	3.1	85.3	25.8	3.3	85.3	25.0	3.4	85.3	23.5	3.6
	45/35	3.2	56.5	21.7	2.6	63.7	22.9	2.8	72.6	23.6	3.1	82.4	24.4	3.4	86.7	24.4	3.6	86.7	23.5	3.7	86.7	22.0	3.9
	35/30	3.6	58.5	20.1	2.9	65.7	21.0	3.1	72.7	21.6	3.4	72.7	19.4	3.8	72.7	18.4	4.0	72.7	17.6	4.1	72.7	16.4	4.4
	30/20	3.9	59.4	19.3	3.1	66.6	20.1	3.3	76.0	20.6	3.7	86.6	20.9	4.1	91.2	20.8	4.4	91.2	19.9	4.6	91.2	18.5	4.9
	25/20	4.0	60.4	18.5	3.3	67.6	19.3	3.5	72.7	19.6	3.7	72.7	17.0	4.3	72.7	16.0	4.5	72.7	15.2	4.8	72.7	14.0	5.2

EFFICIENCY MODE (-5°C CAPACITY CONTROL)																							
Model name	Water Temp (°C)	SCOP	-10°C External			-5°C External			0°C External			5°C External			7°C External			10°C External			15°C External		
			QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP
Elm (SN + LN) 75/60	80/70	1.9	51.9	31.2	1.7	59.4	33.7	1.8	59.4	32.3	1.8	59.4	30.6	1.9	59.4	29.6	2.0	59.4	28.9	2.1	59.4	27.5	2.2
	75/65	2.0	52.4	29.4	1.8	59.7	31.7	1.9	59.7	30.2	2.0	59.7	28.6	2.1	59.7	27.6	2.2	59.7	26.9	2.2	59.7	25.6	2.3
	70/60	2.2	52.9	27.8	1.9	60.2	29.9	2.0	60.2	28.4	2.1	60.2	26.8	2.2	60.2	25.8	2.3	60.2	25.1	2.4	60.2	23.8	2.5
	65/55	2.4	53.5	26.3	2.0	60.8	28.2	2.2	60.8	26.7	2.3	60.8	25.1	2.4	60.8	24.2	2.5	60.8	23.4	2.6	60.8	22.2	2.7
	60/50	2.5	54.1	25.0	2.2	61.4	26.7	2.3	61.4	25.2	2.4	61.4	23.6	2.6	61.4	22.6	2.7	61.4	21.9	2.8	61.4	20.7	3.0
	55/45	2.7	54.9	23.8	2.3	62.1	25.3	2.5	62.1	23.8	2.6	62.1	22.2	2.8	62.1	21.2	2.9	62.1	20.5	3.0	62.1	19.3	3.2
	50/40	2.9	55.6	22.7	2.5	62.9	24.0	2.6	62.9	22.5	2.8	62.9	20.9	3.0	62.9	19.9	3.2	62.9	19.2	3.3	62.9	18.0	3.5
	45/35	3.1	56.5	21.7	2.6	63.7	22.9	2.8	63.7	21.3	3.0	63.7	19.7	3.2	63.7	18.7	3.4	63.7	18.0	3.5	63.7	16.8	3.8
	35/30	3.6	58.5	20.1	2.9	65.7	21.0	3.1	65.7	19.5	3.4	65.7	17.8	3.7	65.7	16.9	3.9	65.7	16.2	4.1	65.7	15.0	4.4
	30/20	3.8	59.4	19.3	3.1	66.6	20.1	3.3	66.6	18.5	3.6	66.6	16.9	3.9	66.6	15.9	4.2	66.6	15.2	4.4	66.6	14.0	4.8
	25/20	4.1	60.4	18.5	3.3	67.6	19.3	3.5	67.6	17.7	3.8	67.6	16.0	4.2	67.6	15.0	4.5	67.6	14.3	4.7	67.6	13.1	5.2

3.9.2 Elm Range 105/70 kW

POWER MODE (+7°C CAPACITY CONTROL)																							
Model name	Water Temp (°C)	SCOP	-10°C External			-5°C External			0°C External			5°C External			7°C External			10°C External			15°C External		
			QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP
Elm (SN + LN) 105/70	80/70	2.0	72.6	42.4	1.7	81.4	45.3	1.8	90.2	47.3	1.9	100.5	49.6	2.0	104.8	50.1	2.1	104.8	49.2	2.1	104.8	47.3	2.2
	75/65	2.1	73.1	39.9	1.8	82.1	42.6	1.9	91.4	44.6	2.0	102.0	46.7	2.2	106.6	47.1	2.3	106.6	46.2	2.3	106.6	44.4	2.4
	70/60	2.3	73.6	37.7	2.0	82.8	40.2	2.1	92.7	42.1	2.2	103.5	43.9	2.4	108.3	44.3	2.4	108.3	43.4	2.5	108.3	41.6	2.6
	65/55	2.5	74.2	35.7	2.1	83.6	38.1	2.2	94.0	39.8	2.4	105.1	41.4	2.5	110.0	41.7	2.6	110.0	40.9	2.7	110.0	39.1	2.8
	60/50	2.6	74.9	33.9	2.2	84.4	36.0	2.3	95.3	37.6	2.5	106.6	39.0	2.7	111.7	39.3	2.8	111.7	38.5	2.9	111.7	36.7	3.0
	55/45	2.8	75.5	32.2	2.3	85.3	34.2	2.5	96.6	35.6	2.7	108.1	36.8	2.9	113.4	37.0	3.1	113.4	36.2	3.1	113.4	34.5	3.3
	50/40	3.0	76.3	30.6	2.5	86.2	32.4	2.7	97.9	33.7	2.9	109.6	34.8	3.2	115.1	34.9	3.3	115.1	34.1	3.4	115.1	32.4	3.6
	45/35	3.2	77.0	29.2	2.6	87.1	30.9	2.8	99.2	32.0	3.1	111.1	32.9	3.4	116.8	32.9	3.5	116.8	32.2	3.6	116.8	30.4	3.8
	35/30	3.7	78.7	26.9	2.9	89.2	28.3	3.2	102.1	29.2	3.5	114.5	29.8	3.8	116.3	28.4	4.1	116.3	28.1	4.1	116.3	26.4	4.4
	30/20	3.9	79.5	25.7	3.1	90.0	27.0	3.3	103.4	27.7	3.7	115.9	28.2	4.1	122.1	28.0	4.4	122.1	27.3	4.5	122.1	25.6	4.8
	25/20	4.3	80.2	24.7	3.3	90.9	25.8	3.5	104.6	26.4	4.0	116.3	24.3	4.8	116.3	25.1	4.6	116.3	24.5	4.8	116.3	22.7	5.1

EFFICIENCY MODE (-5°C CAPACITY CONTROL)																							
Model name	Water Temp (°C)	SCOP	-10°C External			-5°C External			0°C External			5°C External			7°C External			10°C External			15°C External		
			QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP	QH (kW)	PI (kW)	COP
Elm (SN + LN) 105/70	80/70	1.9	26.0	15.6	1.7	29.7	16.9	1.8	29.7	16.1	1.8	29.7	15.3	1.9	29.7	14.8	2.0	29.7	14.4	2.1	29.7	13.8	2.2
	75/65	2.0	26.2	14.7	1.8	29.9	15.9	1.9	29.9	15.1	2.0	29.9	14.3	2.1	29.9	13.8	2.2	29.9	13.4	2.2	29.9	12.8	2.3
	70/60	2.2	26.4	13.9	1.9	30.1	14.9	2.0	30.1	14.2	2.1	30.1	13.4	2.2	30.1	12.9	2.3	30.1	12.5	2.4	30.1	11.9	2.5
	65/55	2.4	26.7	13.2	2.0	30.4	14.1	2.2	30.4	13.4	2.3	30.4	12.6	2.4	30.4	12.1	2.5	30.4	11.7	2.6	30.4	11.1	2.7
	60/50	2.5	27.1	12.5	2.2	30.7	13.3	2.3	30.7	12.6	2.4	30.7	11.8	2.6	30.7	11.3	2.7	30.7	10.9	2.8	30.7	10.3	3.0
	55/45	2.7	27.4	11.9	2.3	31.1	12.6	2.5	31.1	11.9	2.6	31.1	11.1	2.8	31.1	10.6	2.9	31.1	10.3	3.0	31.1	9.6	3.2
	50/40	2.9	27.8	11.3	2.5	31.4	12.0	2.6	31.4	11.3	2.8	31.4	10.4	3.0	31.4	10.0	3.2	31.4	9.6	3.3	31.4	9.0	3.5
	45/35	3.1	28.2	10.8	2.6	31.8	11.4	2.8	31.8	10.7	3.0	31.8	9.9	3.2	31.8	9.4	3.4	31.8	9.0	3.5	31.8	8.4	3.8
	35/30	3.6	29.2	10.0	2.9	32.8	10.5	3.1	32.8	9.7	3.4	32.8	8.9	3.7	32.8	8.4	3.9	32.8	8.1	4.1	32.8	7.5	4.4
	30/20	3.8	29.7	9.7	3.1	33.3	10.1	3.3	33.3	9.3	3.6	33.3	8.5	3.9	33.3	8.0	4.2	33.3	7.6	4.4	33.3	7.0	4.8
	25/20	4.1	30.2	9.3	3.3	33.8	9.7	3.5	33.8	8.9	3.8	33.8	8.0	4.2	33.8	7.5	4.5	33.8	7.2	4.7	33.8	6.6	5.2

4 Electrical Installation

4.1 Electrical data

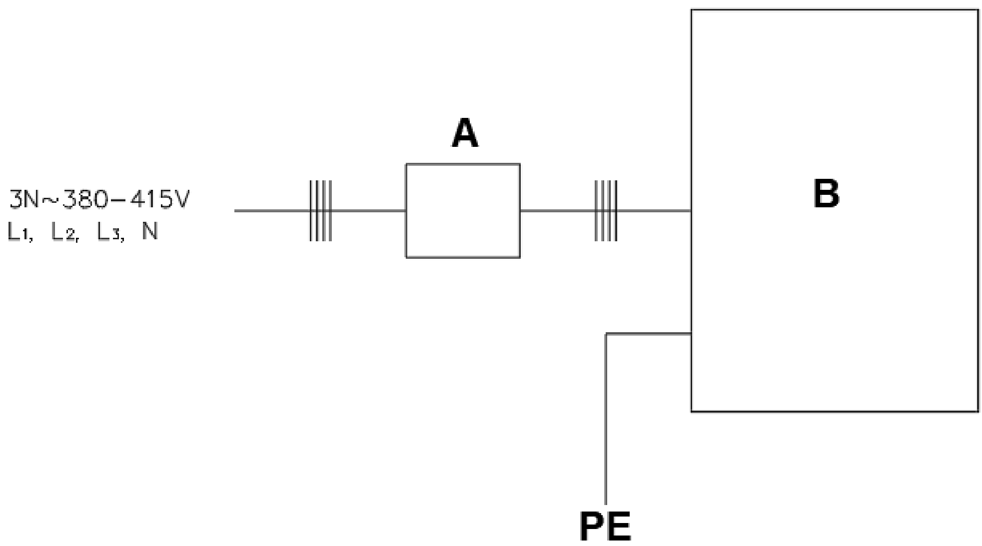
4.1.1 Supply voltage 400/3/50+N

Elm (SN + LN)		75/50kW	105/70kW
F.L.A. - Full load current at max admissible conditions (per phase)			
F.L.A. - Total	A	59.3	81.8
F.L.I. - Full load power input at max admissible conditions			
F.L.I. - Total	kW	36.3	47.7
M.I.C. - Maximum inrush current			
M.I.C. - Total	A	135.0	135.0

Power supply 400/3/50 (+ NEUTRAL) +/- 10%. Maximum Phase Unbalance: 2%.

For non-standard voltage please contact Clade technical office

4.2 Mains Supply Installation



A: Upstream Protection (by others
B: ASHP

4.2.1 Power Supply Details

UNIT (SN + LN)	External power supply		
	Power supply	Switch manual	Internal Breaker
75/50kW	380-415V 3N~ 50Hz	125A (pre mounted)	125A
105/70kW	380-415V 3N~ 50Hz	125A (pre mounted)	125A

Deviating connection lengths and electrical fuses must be calculated according to the country-specific regulations.

Each Elm ASHP requires a dedicated 400/3/50 +N power supply with tolerance ±10% and a maximum allowable phase imbalance of 2%.

- Each unit is supplied with its own local isolator and MCB 10KA C Curve 3 Pole protection device.
- Upstream protection must be provided by the installer and correctly sized to suit the unit's full load and inrush currents (see Section 4.1).
- Cable sizing must consider local climatic conditions, service routes, ambient temperature, installation method, and grouping factors.
- The electrical installation must comply with BS 7671:2018 (IET Wiring Regulations) or the equivalent national wiring regulations in the country of installation.

⚠ **CAUTION**

- Always use correctly rated fuses or breakers. Incorrectly sized protective devices may result in malfunction, overheating, or fire.
- Ensure cables are adequately supported and that no external mechanical stress is imparted on terminations. Loose or stressed connections can cause overheating and arcing.

4.2.2 Maximum Cable Sizes

The maximum cable sizes into the isolators of the unit can be seen below.

Model (SN + LN)	Single or multiple strand wire (mm^2)	Fine strand with sleeve (mm^2)
Elm 75/50kW & 105/70kW	50	50

⚠ **WARNING**

Be sure to use specified wires and ensure no external force is imparted to terminal connections. Loose connections may cause overheating and fire.

⚠ **CAUTION**

Only use properly rated breakers and fuses. Using a protection device of the wrong size may cause the unit to malfunction or set fire.

4.3 Control Connections

Control cable specifications:

Remote controller cable size	0.3 - 1mm^2 Shielded cable recommended to minimise electrical interference.
Cable between units	Cat 6

4.3.1 Terminal Block Arrangement

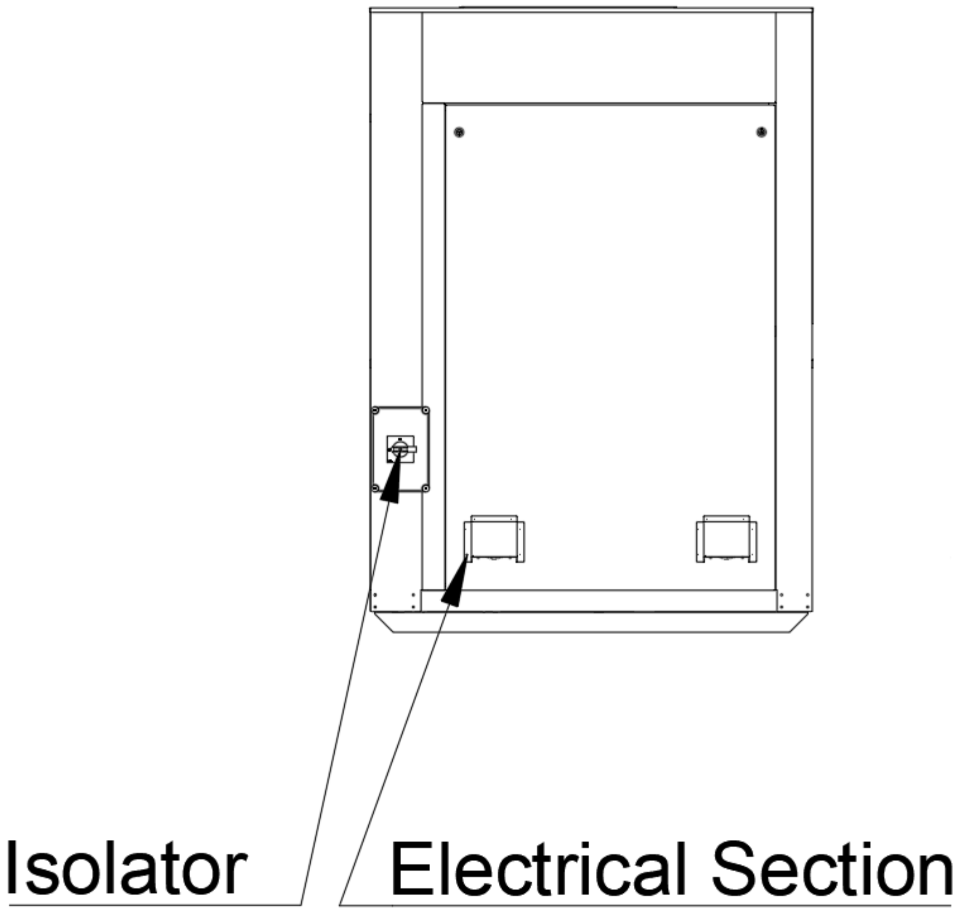
Remove front and side panels to gain access to the electrical controls and cable routes.

⚠ **CAUTION**

Earth tabs must be reconnected prior to refitting access panels

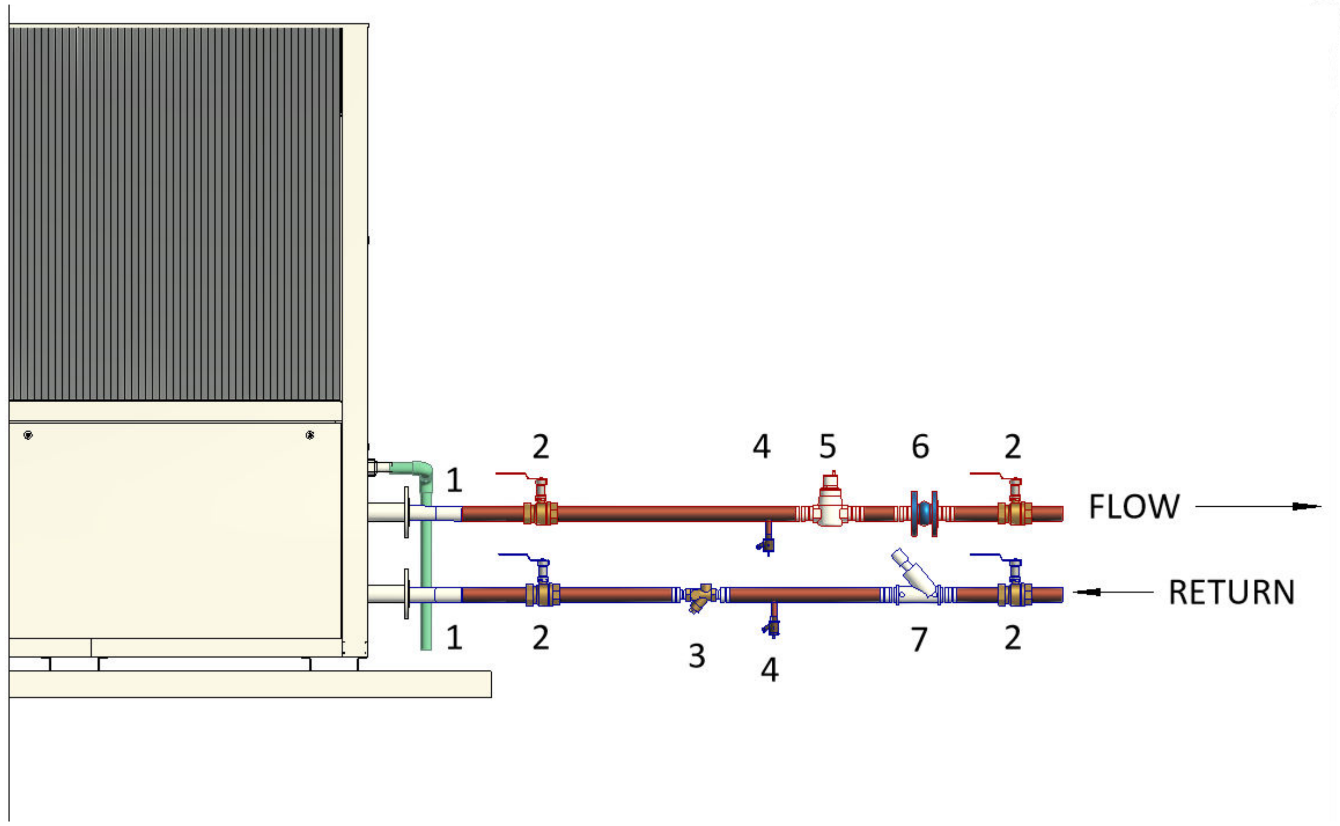
Cable glanding is located to the left-hand side of the unit where a rotary isolator is also provided for electrical connections. This can be seen in the image below. Stuffing glands located to the left-hand side of the unit shall be used for control cable access into the control panel.

- Size all supply cables in accordance with the full load current (FLA) of the unit (see Electrical Data section).
- Tighten all terminals to the torque values specified on the terminal-strip label.

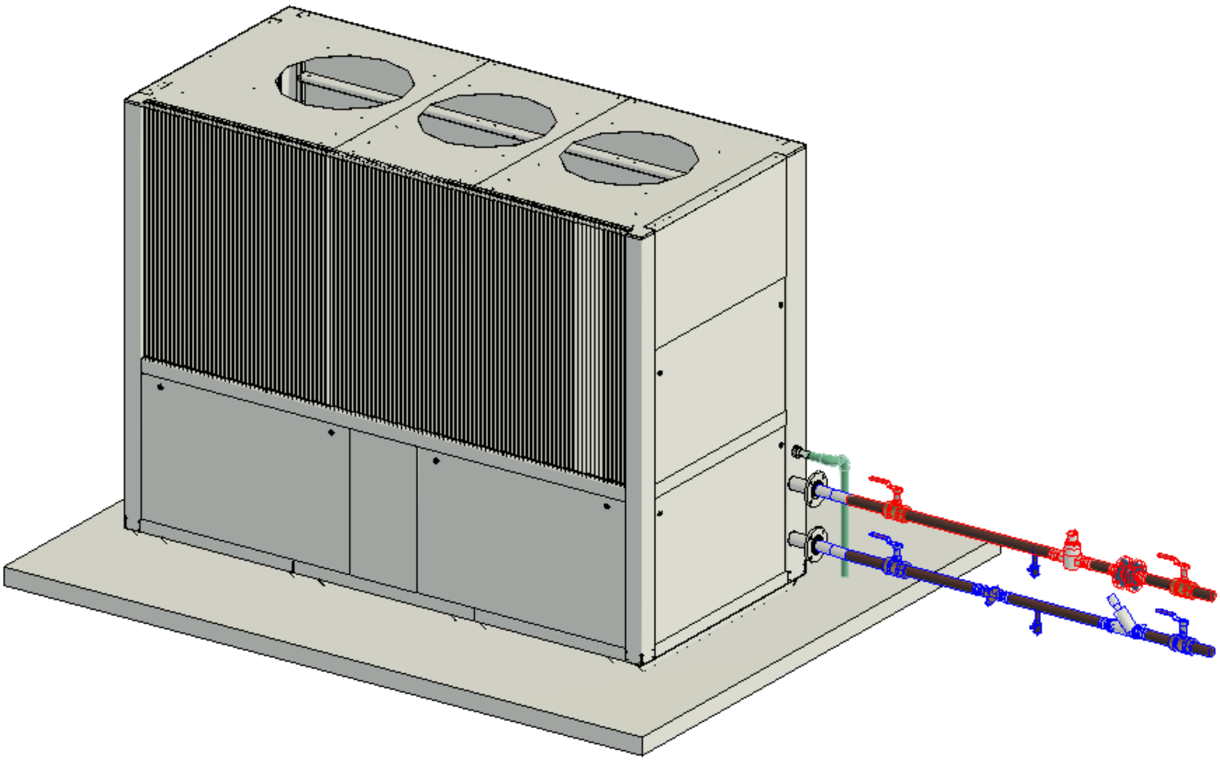


5 Hydraulics

5.1 Piping Connections



1	Flexible joint	Noise/vibration reduction
2	Isolation Valve	Allows for isolation and maintenance
3	Strainer	To remove debris from the system.
4	Drain valve	Allows for drainage during servicing of components
5	Air vent valve	Required to release air accumulating within system
6	Non-return valve	Prevents backflow, ensuring fluid moves in the intended direction.
7	Commissioning set	Used for system balancing, performance testing, and setting operational parameters during commissioning.



5.1.1 Pipe Connection Sizes

Connection Type	Elm 75/60kW	Elm 105/70kW
Heating Flow	54mm Copper - plain end	67mm Copper - plain end
Heating Return	54mm Copper - plain end	67mm Copper - plain end
Condensate	32mm solvent weld waste pipe - plain end	32mm solvent weld waste pipe - plain end

5.2 Minimum Free Flowing Water Content

In order to protect the integral components of the unit the Elm units require a minimum water content on the primary system side. These represent the minimum storage requirements necessary to protect the heat pump and allow for a maximum of six starts per hour.

	75/60kW	105/70kW
Water Volume	1400L	1679L

Please Note: This is the minimum volume to protect the compressor and extend the lifespan of the units. If the units are to be controlled on capacity control, there will need to be more volume in the vessel to allow for stratification control.

5.3 Defrost

The ASHPs come with their own hot gas frost protection cycle. This shuts off the internal LTHW flow through the ASHPs and directs hot gas through the evaporation coils removing any ice build-up. To mitigate the loss of output while in defrost, the system buffer vessel must be sized accordingly.

5.3.1 Optimal Buffer Sizing

While the minimum buffer sizes ensure basic heat pump protection and operational stability, optimally sized buffers enhance system efficiency, reduce cycling frequency, and improve overall performance. Buffer vessel sizing ultimately rests with the system designer however, the following recommendations provide guidance on selecting the ideal buffer capacity to maximise energy efficiency and maintain consistent heating output.

Defrost Cycle Management: Air source heat pumps undergo periodic defrost cycles, during which the heat pump uses hot gas to clear ice from the evaporator. During this period, the buffer vessel provides stored thermal energy to maintain heating supply to the building. The vessel must be sized to cover the full heat load during defrost to prevent temperature drops. Clade recommends a minimum of 30 minutes storage to cover this.

Peak Load Consideration: The buffer volume should accommodate the total peak kWh heating demand of the building while accounting for variations in heat pump output due to defrost.

Building Load Profiles: CIBSE Guide A shows how to perform detailed analysis of building heating load profiles. Factors such as occupancy patterns, thermal mass, and intermittent heating requirements should be evaluated to determine the total time the peak load is required and the necessary storage capacity.

5.3.2 Buffer Design Considerations

To ensure optimal performance and efficiency in heat pump systems, proper buffer vessel design is crucial. A well-designed buffer enhances stratification, maximises usable volume, and provides precise control for charging and discharging cycles. Key aspects of an effective buffer design include:

- **Height-to-Width Ratio**: A buffer vessel should have a minimum height-to-width ratio of 2.5:1. This geometry promotes better thermal stratification by reducing the potential for mixing between layers, ensuring a stable temperature gradient within the vessel.

- **Sparge Pipes**: Increases the useable volume of the vessel.

- **External Combined Headers:** One in one out header based on CIBSE Cp1. Prevents mixing and maintains stratification and is sized to achieve less than 0.3 m/s velocity into the vessel. The header helps maintain stable pressure conditions across both the primary and secondary circuits. This is essential for variable flow systems and avoids issues with fluctuating demand.

- **Temperature sensors:** Five temperature sensors distributed vertically within the buffer need to be distributed properly for precise monitoring and adjustments to maintain optimal conditions. When there are multiple buffers, these need to be spread across the vessels evenly.

5.4 System Pressure

All mechanical/LTHW systems require pressure relief equipment to maintain the safe working condition of the system. This will be designed and specified by the system designer/installer.

5.4.1 Degasser

A degasser is a specialised component installed in the heating system's pipework. In the rare event of a propane leak from the plate heat exchanger into the heating water circuit, the degasser helps mitigate the risk by Separating propane from water and then safely venting the gas.

As the contaminated water circulates through the degasser, the internal pressure drop and design features cause any dissolved propane to come out of solution and form gas bubbles. The separated propane gas is directed to a dedicated vent line that safely discharges it to the outside atmosphere. This prevents the gas from recirculating within the system or accumulating indoors, where it could pose a fire or health hazard.

For systems using propane refrigerant and a plate heat exchanger, it is strongly recommended to install a degasser with an appropriate gas separation and venting mechanism. Ensure the vent line is compliant with EN378 and terminates in a safe, well-ventilated outdoor location.

5.4.2 Safety Valves

Safety valves on the low-temperature hot-water side are compulsory on all Elm installations. Their role is to prevent system pressure from rising above the maximum allowable working pressure, thereby protecting pipework, heat exchangers and ancillary equipment from over-pressure incidents. It is the system designer's or installer's responsibility to select, size and install these valves in accordance with the national standards ensuring correct set pressure, sufficient discharge capacity and proper discharge piping.

5.5 Frost Protection

To prevent freezing of the water circuit, the following frost protection strategy is implemented in all Clade units without internal circulating pumps: When the leaving fluid across the unit falls below 7 °C, the primary circulating pump is enabled. The pump will continue to run until the unit's flow sensor and return sensor detect that the fluid temperature has increased to 10 °C. This control logic assumes that heat is available within the external pipework from trace heating, which must be designed, installed, and maintained by the system designer/contractor.

Trace Heating Responsibility: Clade does not supply or control external trace heating. It is the designer's responsibility to ensure that pipework is correctly insulated and equipped with trace heating to maintain minimum fluid temperature during periods of low ambient conditions or unit inactivity.

When Primary Pumps Are Not Controlled by Clade: If the primary pump(s) are controlled by an external BMS or by-site strategy, Clade cannot guarantee frost protection of the unit. In this scenario, the BMS designer must ensure that the pumps are enabled in synchronisation with the frost thresholds defined above or provide an equivalent strategy to maintain water temperatures above 7 °C. Failure to run the pumps as described may result in localised freezing of the heat exchanger and external pipework, potentially causing permanent damage. Such damage is outside the scope of Clade warranty.

6 Unit Installation

6.1 General notes

6.1.1 Installation criteria:

Accessibility & Space

- Select a location that is safely and easily accessible for maintenance.
- Allow sufficient technical clearance around the unit for its overall dimensions, airflow paths (intake and exhaust), and service access (as specified in this manual).
- Ensure unobstructed airflow by avoiding siting near tall walls, in corners, beneath overhangs, or below ground level where air can stagnate or recirculate.

Structural Support

- Verify that all support points can bear the unit's weight.
- Mount the unit above ground level to facilitate condensate drainage and reduce moisture ingress.
- Align and level all bearing points accurately to prevent vibration and uneven loading.

Environmental Considerations

- Avoid flood-prone areas and account for maximum potential snow levels—ensure snow drift won't block airflow or drainage.
- Protect against debris accumulation (leaves, litter, etc.) on the air coil.
- Avoid siting near strong wind corridors that could impede or exaggerate airflow, and steer clear of nearby heat or pollution sources (e.g. chimneys, flues, vehicle exhausts).
- Prevent cold-air stratification by ensuring intake air remains free-flowing and that expelled air cannot be drawn back in.
- Consult the unit's declared sound power level (dB A) in the technical specifications. Use this to model expected sound pressure levels at neighbouring facades and property boundaries.

Utilities & Drainage

- Confirm that electrical connection runs do not exceed the maximum allowable distance specified by the manufacturer.
- Provide a dedicated condensate drainage system to prevent standing water beneath the unit.
- Ensure water from the unit can be drained properly at all times.

Security & Safety

- If there is a risk of unauthorised access (children, vandalism, wildlife), install appropriate barriers or fencing.
- This unit is designed for outdoor installation only and must not be enclosed indoors.

Final Verification

- After positioning and securing the unit, verify that all space requirements (clearances for airflow, service access, and noise dissipation) outlined in this manual are met.

Adherence to these guidelines will ensure safe installation, effective airflow, and long-term reliability of the outdoor unit.

6.1.2 Structural

- Concrete bases are preferred.
- Raise the base at least 300 mm above ground level to fit hydraulic and electrical connections.
- Check that all supports are level.
- Provide adequate condensate drainage when the unit is in heating mode, ensuring water drains safely away from traffic areas where ice may form.
- Separate the foundation from the building structure to limit noise and vibration transmission.
- Use the factory-provided holes to secure the unit to its foundation.

6.1.3 Positioning

The unit is intended for outdoor use in a permanent, flat orientation, either at ground level or on a roof. In roof installations, verify that the structure supports both the unit's weight and potential maintenance loads.

Minimising vibration:

- Install anti-vibration mounts or neoprene pads under the heat pump support.
- Use flexible joints in the water circuit to reduce transmitted vibration.
- Keep the unit perfectly level.

Key considerations:

- Required service clearances.
- Electrical connection routes.
- Water/hydraulic connection access.
- Potential increases in overall height if optional vibration dampers are used.

6.1.4 Charging lines

Where heat pumps are installed at roof level, ensure that dedicated charging lines are provided. These lines must allow for safe and efficient charging of refrigerant, either during commissioning when pre-charging is not feasible, or for subsequent top-ups during maintenance. The charging lines should be easily accessible from ground or plant level, designed to minimise pressure drop, and clearly identified to avoid confusion with other services.

6.1.5 Pressure Relief Valve Refrigerant Side

PRVs are included on the refrigerant loop within the unit.

6.1.6 Condensate

Heat pumps produce significant condensate from defrost cycles. Route condensate away from areas where frozen water could pose hazards. Use a downward-sloping drainpipe to prevent ice buildup. In colder climates, consider trace heating cables to prevent freezing.

6.1.7 Freezing Prevention

In event of pump power failing, it is essential to protect all external pipework and equipment from ice formation. Install self-regulating trace heating cables beneath the insulation on external water lines to maintain fluid temperatures above 0 °C, even when the air temperature drops to -25 °C. After commissioning, verify under worst-case conditions that inlet and outlet pipe temperatures remain above freezing. Where trace heaters alone may not suffice, use one or more of the following measures—particularly if outdoor temperatures hover around 0 °C—to avoid permanent damage (which voids warranty):

- Mix the system water with an appropriate concentration of antifreeze glycol.
- Install electric heating cables directly under the insulation on all exposed piping.
- Drain down and isolate the system during extended shutdown periods.

Select self-regulating heaters to prevent local hot spots or overheating, and always ensure adequate control and monitoring of pipe temperatures.

6.2 Water quality

6.2.1 New Systems

Before commissioning any new installation, remove the circulator and thoroughly flush the entire system to clear out welding residue, waste, sealants, mineral oils, and other preservatives. Only then should you fill the system with clean, high-quality tap water.

6.2.2 Existing Systems

When replacing or adding a heat pump to an existing system, first drain and flush all pipework before installing the new unit. Flush each section separately, paying special attention to areas prone to debris build-up due to reduced flow, then refill with clean, high-quality tap water. If the water is still unsuitable, install an appropriate filter, such as a coarse (mesh) filter for larger debris or a finer tissue filter for smaller particles.

6.2.3 Water Filter

- Use a filter of ≥30 mesh at the water inlet, positioned for easy cleaning.
- Never remove the filter, as doing so invalidates the warranty.

6.2.4 Exclusions

Warranty coverage does not extend to damage caused by limescale, deposits, or impurities from the water supply, nor to issues stemming from improper system cleaning.

6.2.5 Anti-freeze Solutions

Adding antifreeze increases system pressure drop, and only inhibited (non-corrosive) glycol compatible with the circuit should be used. Do not use different glycol mixture (i.e. ethylene with propylene).

% PROPYLENE GLYCOL BY WEIGHT	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
Freezing temperature (°C)	-1.6	-3.3	-5.1	-7.6	-9.6	-12.7	-16.4	-21.1	-27.9	-33.5
Safety temperature (°C)	-7.0	-8.0	-10.0	-13.0	-15.0	-18.0	-21.0	-26.0	-33.0	-39.0

6.2.6 Minimum Water Quality Requirements for Elm Units

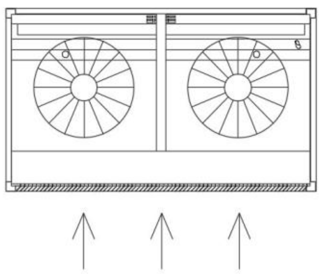
The water system should be maintained to BS 8552. Below is an extract of the figures the minimum performance requirements for on site analysis for closed systems.

Parameter	Typical level in system	Lower detection limit of method (A, B)	Resolution of method (A, B)	Uncertainty of method (A, B)
Conductivity (µS/cm)	100 to 3,000	100	10% MV	20% MV
pH (pH units)	5 to 11	n/a	0.1	0.2
Dissolved oxygen (mg/L O_2)	0.1 to 10	0.1	0.1	0.2
Total alkalinity (mg/L $CaCO_3$)	20 to 500	10	10% MV	20% MV
Total hardness (mg/L $CaCO_3$)	20 to 500	10	10% MV	20% MV
Ammoniacal nitrogen (mg/L N)	1 to 50	0.5	0.5	1.0
Nitrite (NO_2) [c]	0 to 1,000	10	10% MV	20% MV
Molybdate (mg/L MoO_4) [c]	0 to 1,000	10	10% MV	20% MV
Sulfate (as mg/L SO_4) [c]	20 to 200	10	10% MV	20% MV
Total iron (mg/L Fe)	0 to 10	0.2	0.2	0.5
Soluble iron (mg/L Fe)	0 to 10	0.2	0.2	0.5
Total copper (mg/L Cu)	0 to 5	0.2	0.1	0.2

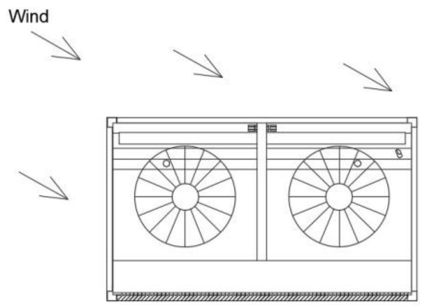
6.3 Protection Against Winds

Protection against the effects of wind should be considered when installing a unit. Whilst the design and operation of unit is designed for the effects of moderate winds, consistent and strong wind will affect the performance of the unit.

Consider the protection of the unit from direct wind across the front grille of the unit. The unit can be orientated to ensure the front on the unit faces away from direct winds as shown below:



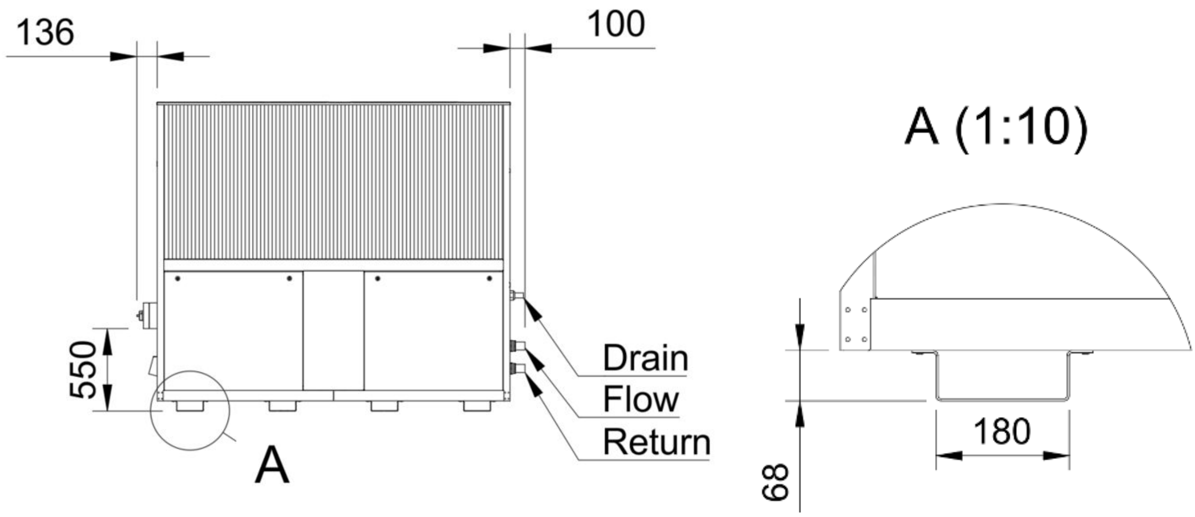
Design air flow direction (air intake grille)

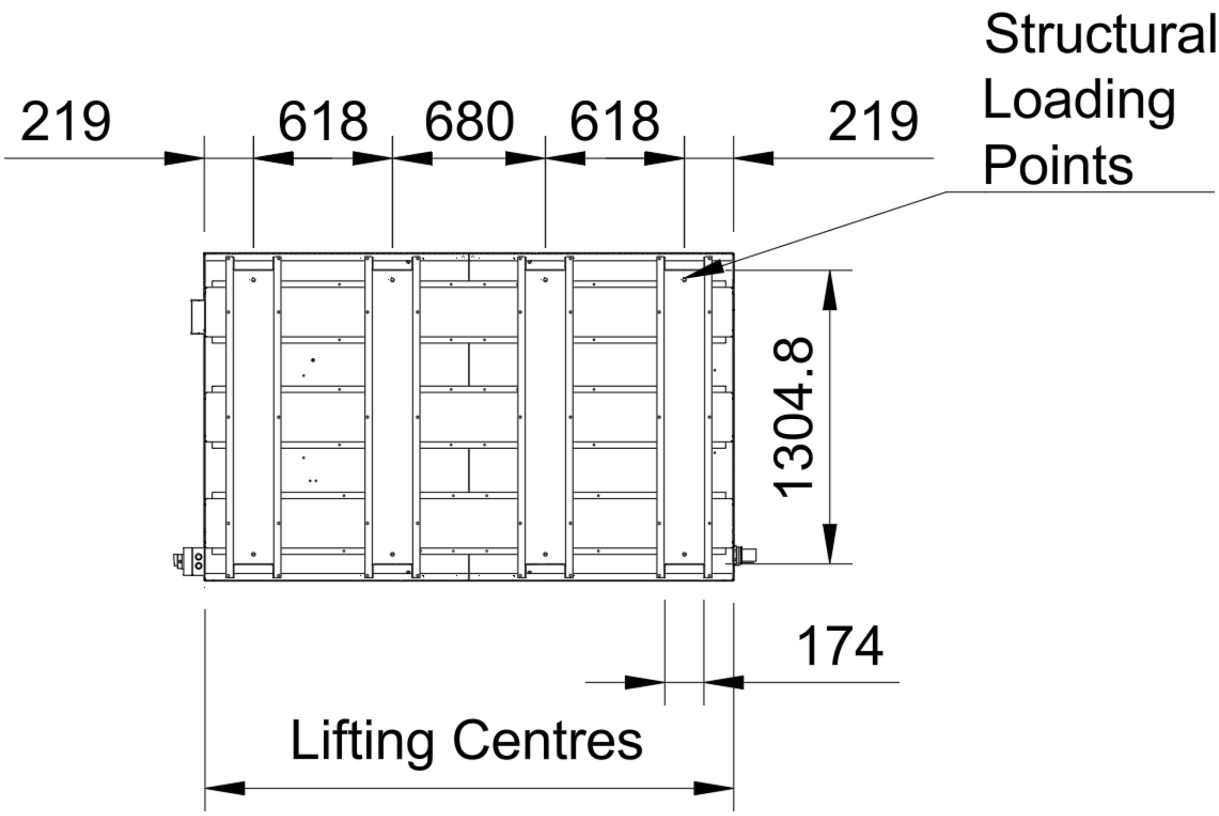


Air intake protected from direct wind

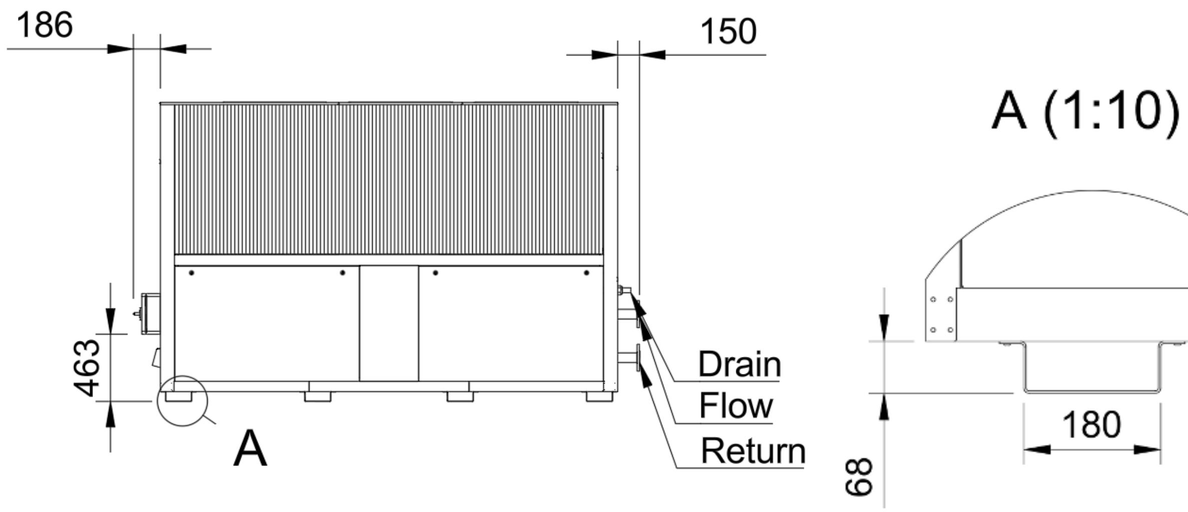
6.4 Lifting Centers and Structural Loading Points

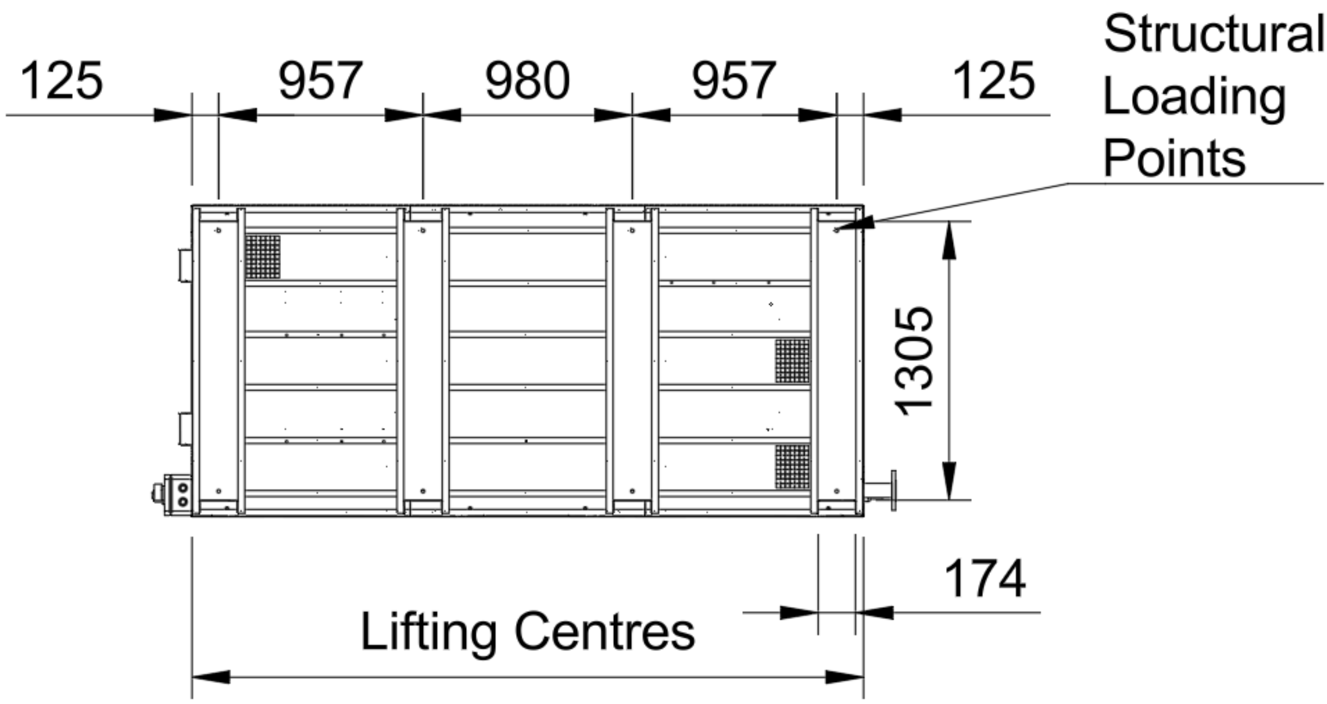
6.4.1 Elm 75/60 (SN + LN) kW





6.4.2 Elm 105/70 (SN + LN) kW





7 System Configuration

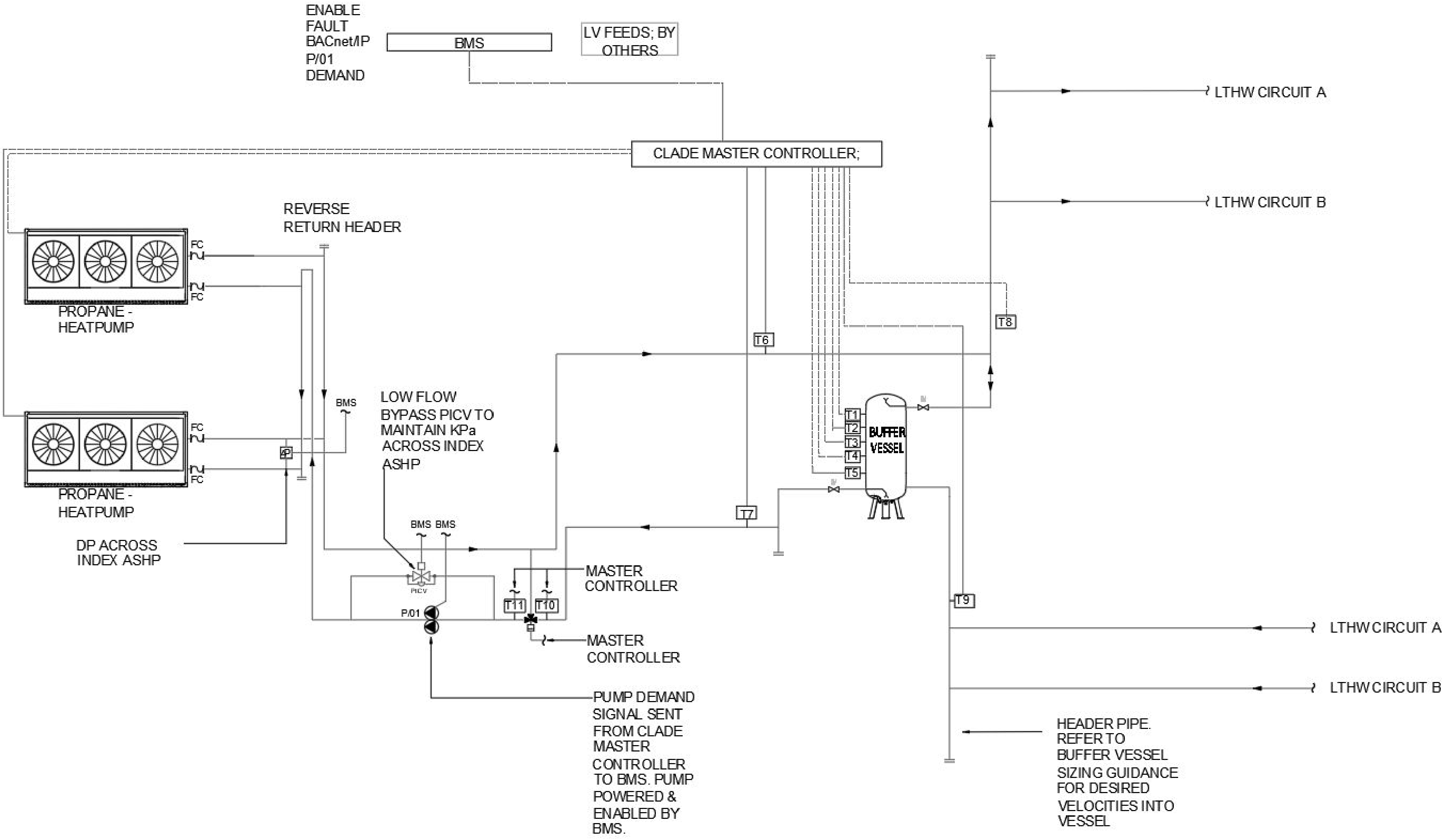
7.1 System Schematics

The unit must be installed in a configuration that allows correct hydraulic balance between primary and secondary systems. It is recommended that a buffer vessel is installed in the following configuration, allowing each system to operate independently at different flow conditions.
It is important that the secondary system is designed to operate at the correct flow and return temperatures. For detailed schematics please refer to Clade's example standard schematic.

The Elm can be used for heating and DHW applications and combined systems.
Buffer temperature sensors can be used to modulate heat pump output, see Section 8 for further details of controls.

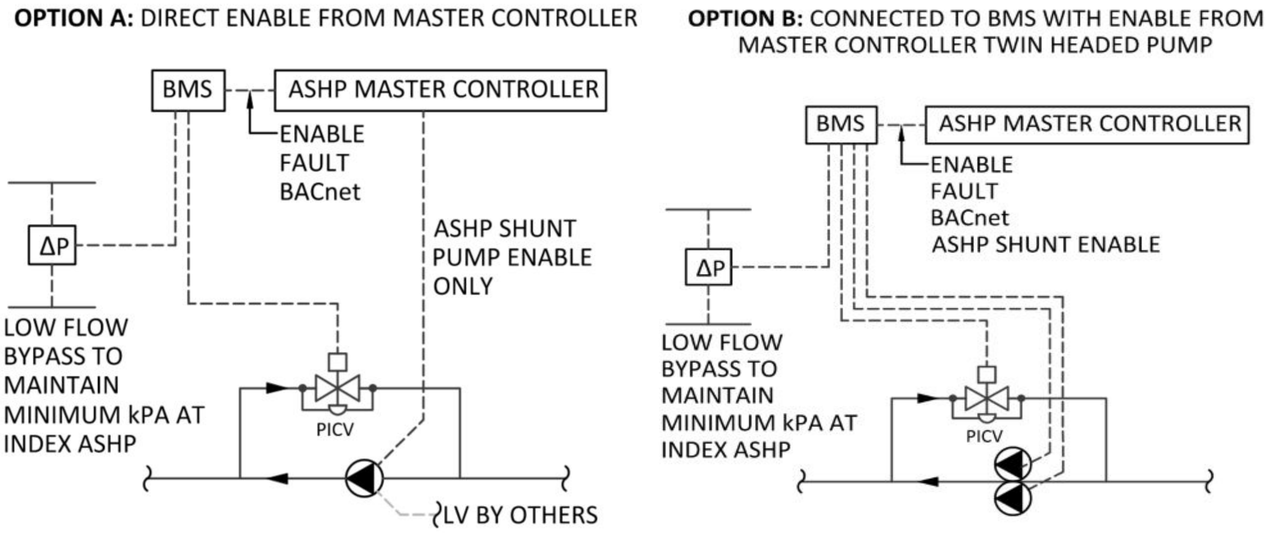
Multiple ASHP units are to be connected in a reverse return configuration to ensure equal flow distribution across all units. Even flow distribution across ASHPs enhances system efficiency and prolongs equipment lifespan.

7.1.1 General Arrangement



7.1.2 ASHP Shunt Pump and Low flow Bypass

The primary ASHP shunt pump can be controlled via an enable via the Clade controller (option A) or via the BMS (option B) with an enable from the Clade controller. Option B is mandatory for twin-head duty/standby or duty/assist pump sets, as the Clade controller provides only one enable output and cannot manage automatic head change-over:



Please note: Pump motor power circuits shall be provided, protected and wired by others; the Clade controller supplies control signals only.

The primary circulation pump shall be fitted with a dedicated low-flow bypass loop incorporating a pressure-independent control valve (PICV) sized based on the system's minimum bypass flow requirement. This configuration ensures that, under minimum pump speed and flow conditions, the hydraulically most distant air-source heat pump module still experiences the requisite ΔP and volumetric flow rate for stable operation at its lowest modulation point.

8 Controls

8.1 Individual Heat Pump Controls

Each heat pump is equipped with its own integrated, independent control system. It is designed to maintain a constant temperature differential (ΔT) between flow and return. The standard flow temperature can be set between 35 °C and 80 °C. Heating capacity and flow temperature are automatically regulated based on the return temperature, with ΔT set at 10K.

8.1.1 Off/On Switch

The Off/On switch selects the operation of the heat pump. Selecting the on position will start the heat pump. Selecting the Off position will instigate a stop sequence and stop the heat pump from running. The heat pump will continue to run for a short period until it has completed the stop sequence.

⚠ **CAUTION**

The Off/On switch should not be used in an emergency. Any emergency isolation should be carried out at the local isolator.
The inverter should be fully discharged, prior to removal of the compressor terminal box cover.

8.2 Control Type

There are three options for the method of control on the heat pump (multiplex, BMS & local control). These will be described in the following sections.

8.3 Multiplex Controls

8.3.1 Multiplex Control

Multiplex control should be used when the heat pump is to be controlled by a Clade Multi Heat Pump Controller. This enables the control of the heat pump by the Clade controller which can operate multiple heat pumps.

NOTE: Should the return water temperature go above 70°C, this will initiate a high return water fault and shut down the heat pump instantly.

The Clade controller generates a single demand signal (0-100%) and apportions it across the connected heat pumps to stage units in/out in line with instantaneous load.

Target A - Buffer energy state.

Multi-point sensing within the buffer vessel (typical probes T1-T5) is used to estimate the vessel's usable thermal charge. An internal weighting and normalisation routine produces a Buffer Charge Index. As the vessel approaches its calibrated "full" condition (accounting for stratification), the index tapers so that additional capacity is requested progressively less aggressively.

Target B - return protection.

The controller monitors either the common heat-pump return or the lowest vessel sensor (typically T5) against a protected maximum return limit. The deviation below this limit generates a Return Temperature Assist signal via a calibrated proportional slope with built in damping. This biases capacity upward when return water is comfortably below the limit, and backs capacity off as the limit is approached.

Blending of targets

The demand signal is derived from a proprietary mapping that blends the Buffer Charge Index with the Return Temperature Assist. The resulting demand (0-100%) is divided across the available heat pumps to determine staging increments for each unit.

The strategy maintains a slight bias toward higher flow on the heat pump circuit so that hotter supply water is continuously pulled through the buffer and blended with the system return. This steadily raises the vessel's usable charge while keeping source-side returns within the safe operating envelope. If the monitored return approaches the protected limit, capacity is progressively reduced, and may be suspended, to prevent sending excessively hot water back to the heat pumps.

An optional, selectable weather compensation function is available within the controller. By progressively lowering the flow temperature in response to higher outdoor temperatures, this mode optimises seasonal efficiency and delivers higher coefficients of performance.

Clade Multi Heat Pump Controller will be installed as a standalone unit. The heat pumps will connect to the Clade controller by CAT6 cable between the two units, installed by the contractor as below.
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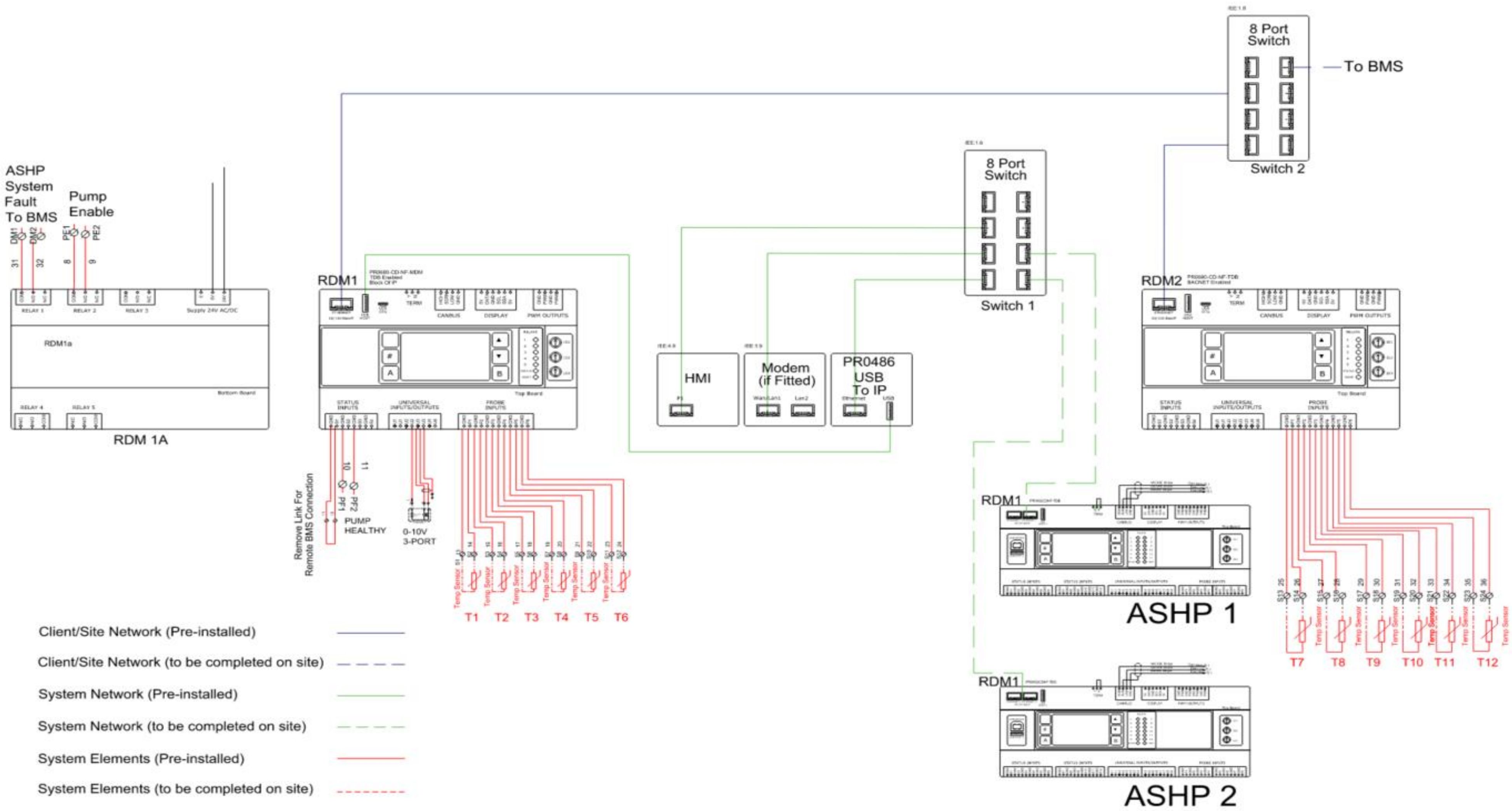
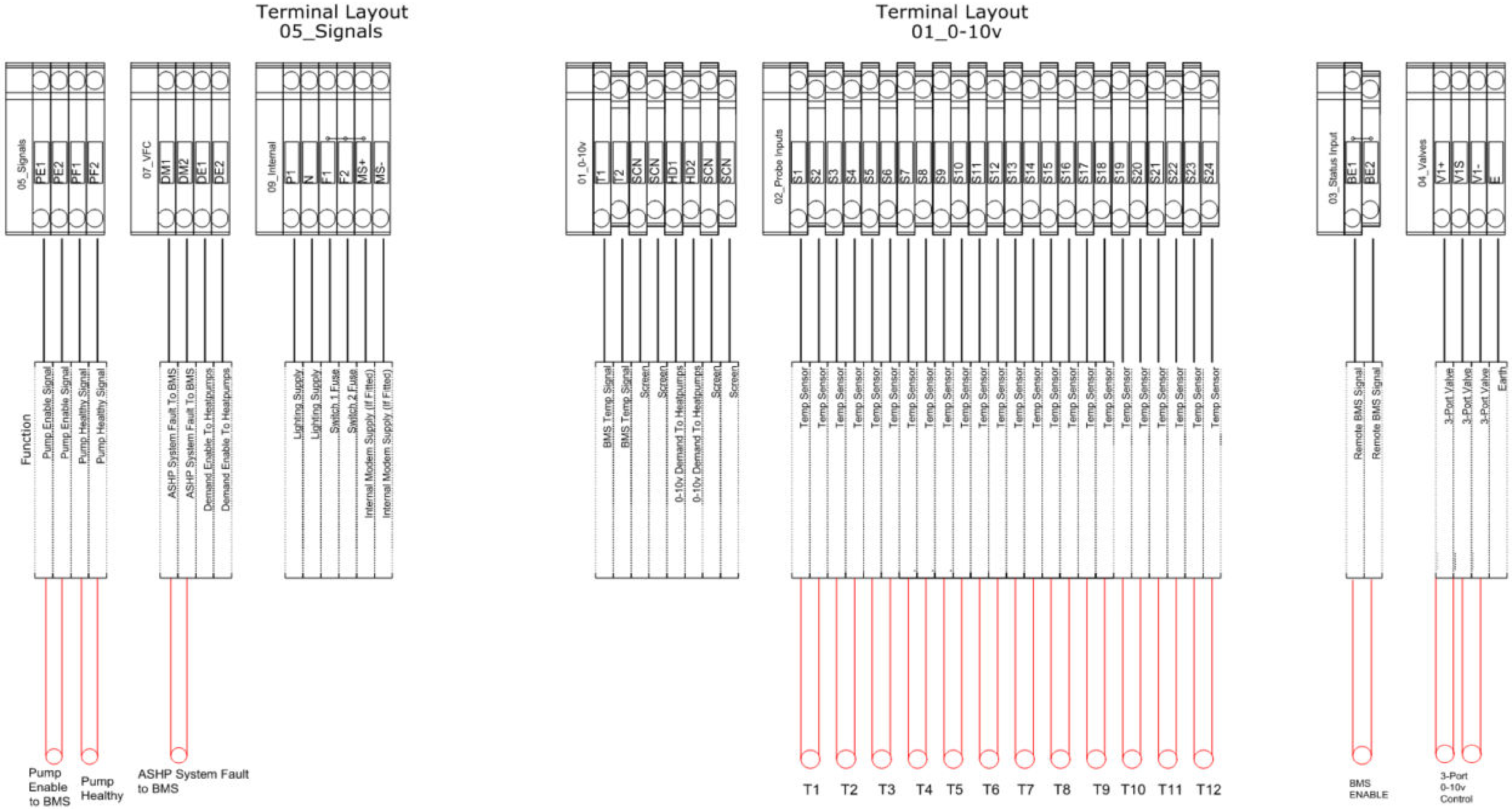
8.3.2 Multiplex System Network Diagram

Clade Multi Heat Pump Controller



Terminal Layout



8.3.3 Heat Pump Data

A single connection to the Clade controller is all that is required to access all connected heat pump data. If the client wishes to monitor or log this data via their Building Management System, the controller can be integrated through its BACnet interface. The table below details the data points available via the BACnet connection from the Clade controller:

Clade Multi Heat Pump Controller (large)				
Device Name		**BACnet**		
Inst.-No.		**280028**		
Obj. Type	**Object Name**	**Description**	**Unit**	**Read/Write**
BO	obj_1	System Healthy	On=Healthy / Off=Fault	Read
AO	obj_2	Ambient Temp	ºC	Read
AO	obj_3	ASHP Target Temp	ºC	Read
AO	obj_4	Heating Demand	%	Read
AO	obj_5	T1 Temp	ºC	Read
AO	obj_6	T2 Temp	ºC	Read
AO	obj_7	T3 Temp	ºC	Read
AO	obj_8	T4 Temp	ºC	Read
AO	obj_9	T5 Temp	ºC	Read
AO	obj_10	T6 Temp	ºC	Read
AO	obj_11	T7 Temp	ºC	Read
AO	obj_12	T8 Temp	ºC	Read
AO	obj_13	T9 Temp	ºC	Read
AO	obj_14	T10 Temp	ºC	Read
AO	obj_15	T11 Temp	ºC	Read
AO	obj_16	T12 Temp	ºC	Read
AO	obj_17	HP1 Status	*See Status Table	Read
AO	obj_18	HP1 P11 Flow Temp	ºC	Read
AO	obj_19	HP1 P12 Return Temp	ºC	Read
AO	obj_20	HP2 Status	*See Status Table	Read
AO	obj_21	HP2 P11 Flow Temp	ºC	Read
AO	obj_22	HP2 P12 Return Temp	ºC	Read
AO	obj_23	HP3 Status	*See Status Table	Read
AO	obj_24	HP3 P11 Flow Temp	ºC	Read
AO	obj_25	HP3 P12 Return Temp	ºC	Read
AO	obj_26	HP4 Status	*See Status Table	Read
AO	obj_27	HP4 P11 Flow Temp	ºC	Read
AO	obj_28	HP4 P12 Return Temp	ºC	Read
AO	obj_29	HP5 Status	*See Status Table	Read
AO	obj_30	HP5 P11 Flow Temp	ºC	Read
AO	obj_31	HP5 P12 Return Temp	ºC	Read
AO	obj_32	HP6 Status	*See Status Table	Read
AO	obj_33	HP6 P11 Flow Temp	ºC	Read
AO	obj_34	HP6 P12 Return Temp	ºC	Read
AO	obj_35	HP7 Status	*See Status Table	Read
AO	obj_36	HP7 P11 Flow Temp	ºC	Read
AO	obj_37	HP7 P12 Return Temp	ºC	Read
AO	obj_38	HP8 Status	*See Status Table	Read
AO	obj_39	HP8 P11 Flow Temp	ºC	Read
AO	obj_40	HP8 P12 Return Temp	ºC	Read
***Status Table**				
0=Off				
1=Heating				
2=Defrost				
3=Satisfied				
4=Initialising				
5=Fault				
6=Not Present				
7=Offline				

8.4 BMS Control

This control type must be selected when it is intended to control the heat pump from an independent BMS.

Selecting BMS will allow the heat pump to operate on a 0-10V input signal from the BMS, overriding the local return temperature control.

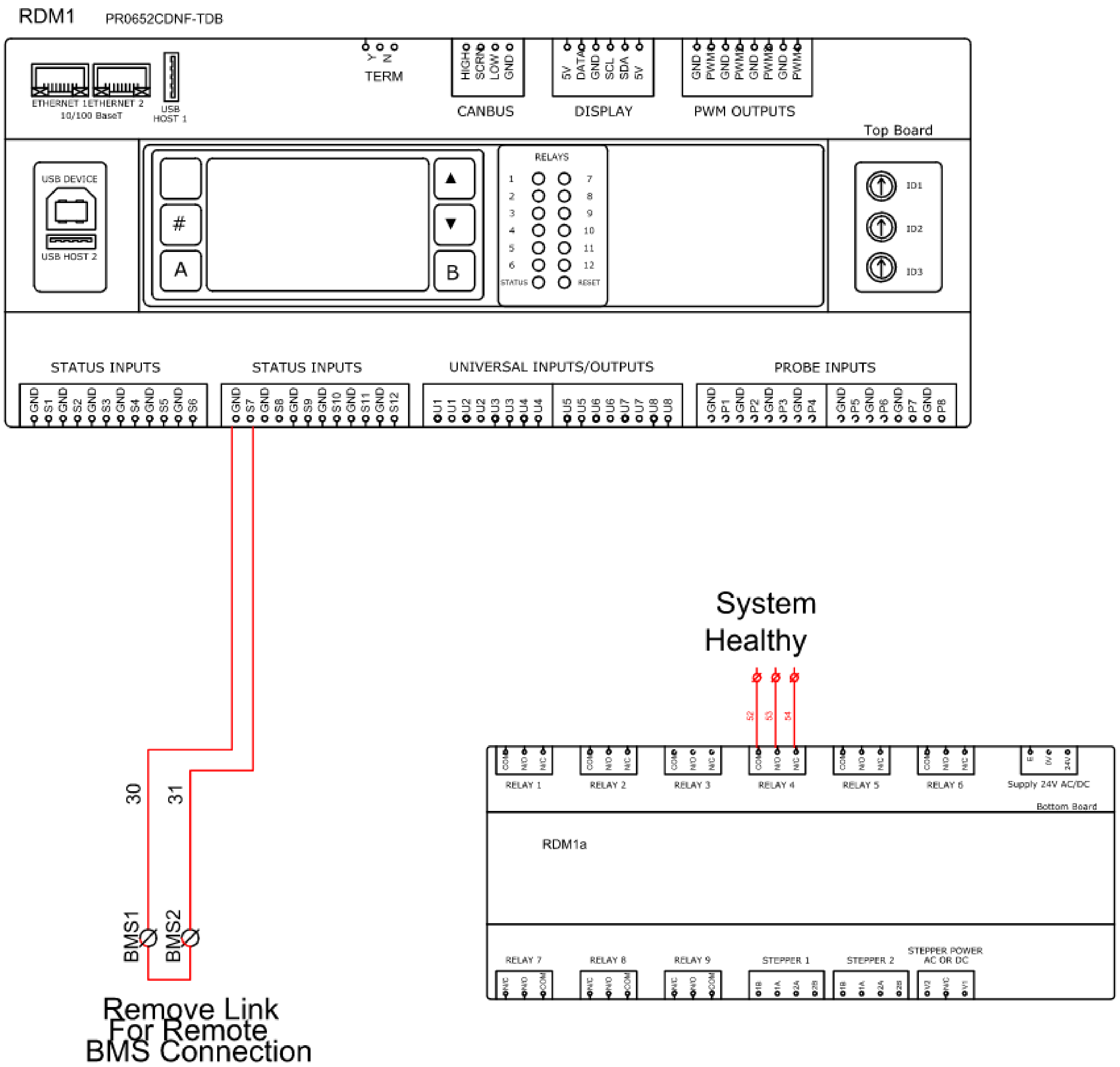
A 0-10V signal allows the heat pump to be controlled to a desired capacity (QH) based on a percentage of maximum capacity.

NOTE: Maximum capacity will alter dependent on ambient temperatures. Therefore, the minimum QH at 2V (50%) at -5ºC will be less than the minimum capacity during times of warmer ambient conditions. When sizing and selecting buffer vessels the low demands of the building need to be considered in conjunction with minimum turn capacity of the heat pump. Published capacities at 7ºC ambient temperatures are deemed as maximum capacities.

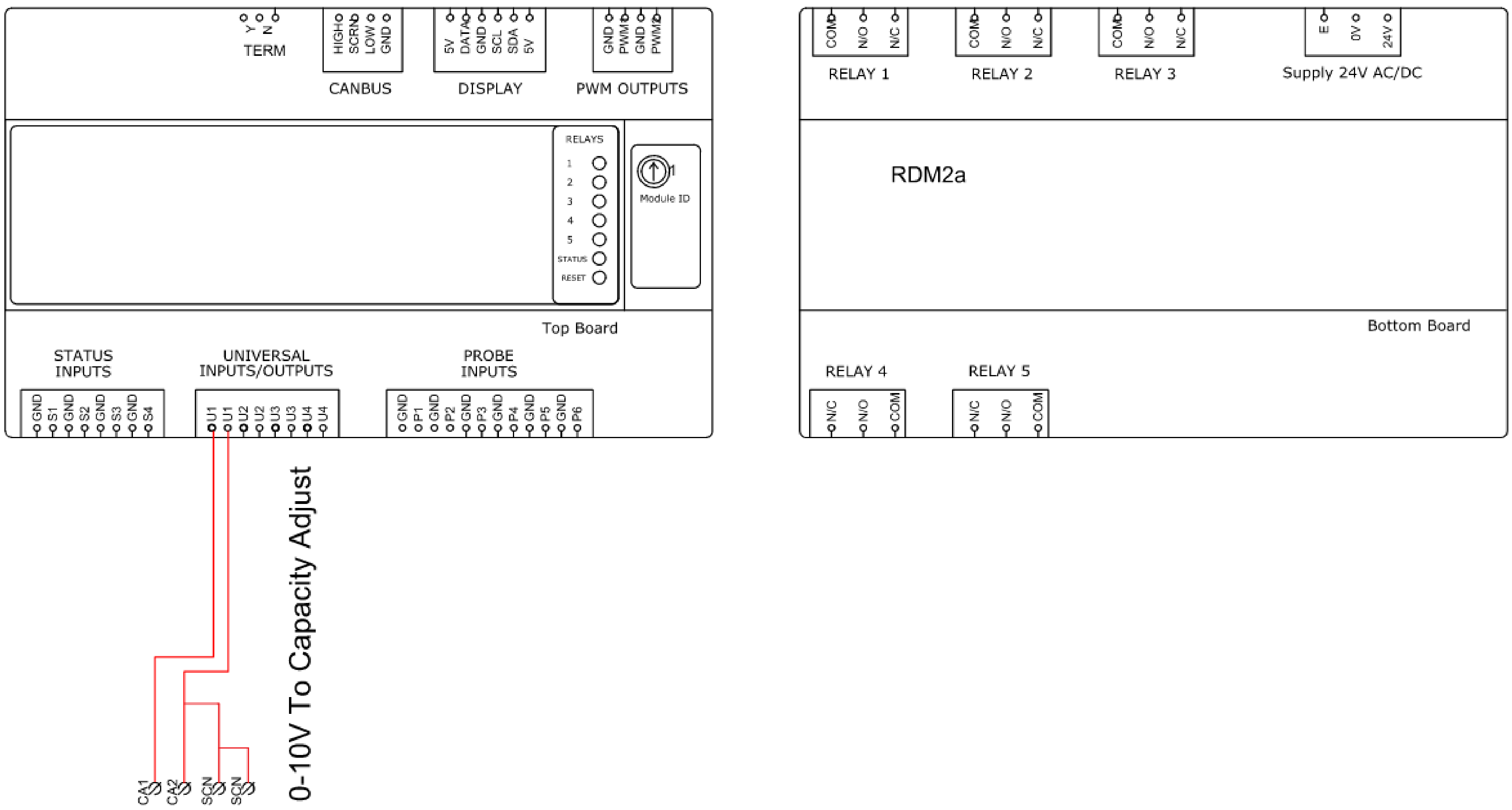
The table below denotes the controls associated with a 0-10V signal:

Voltage Signal	Status
0-0.9	Fault
1-1.9	Off
2	Capacity Control (50-100%)
3	
4	
5	
6	
7	
8	
9	
10	

NOTE: The function will not be available when operating as a multiplex installation using the Clade controller

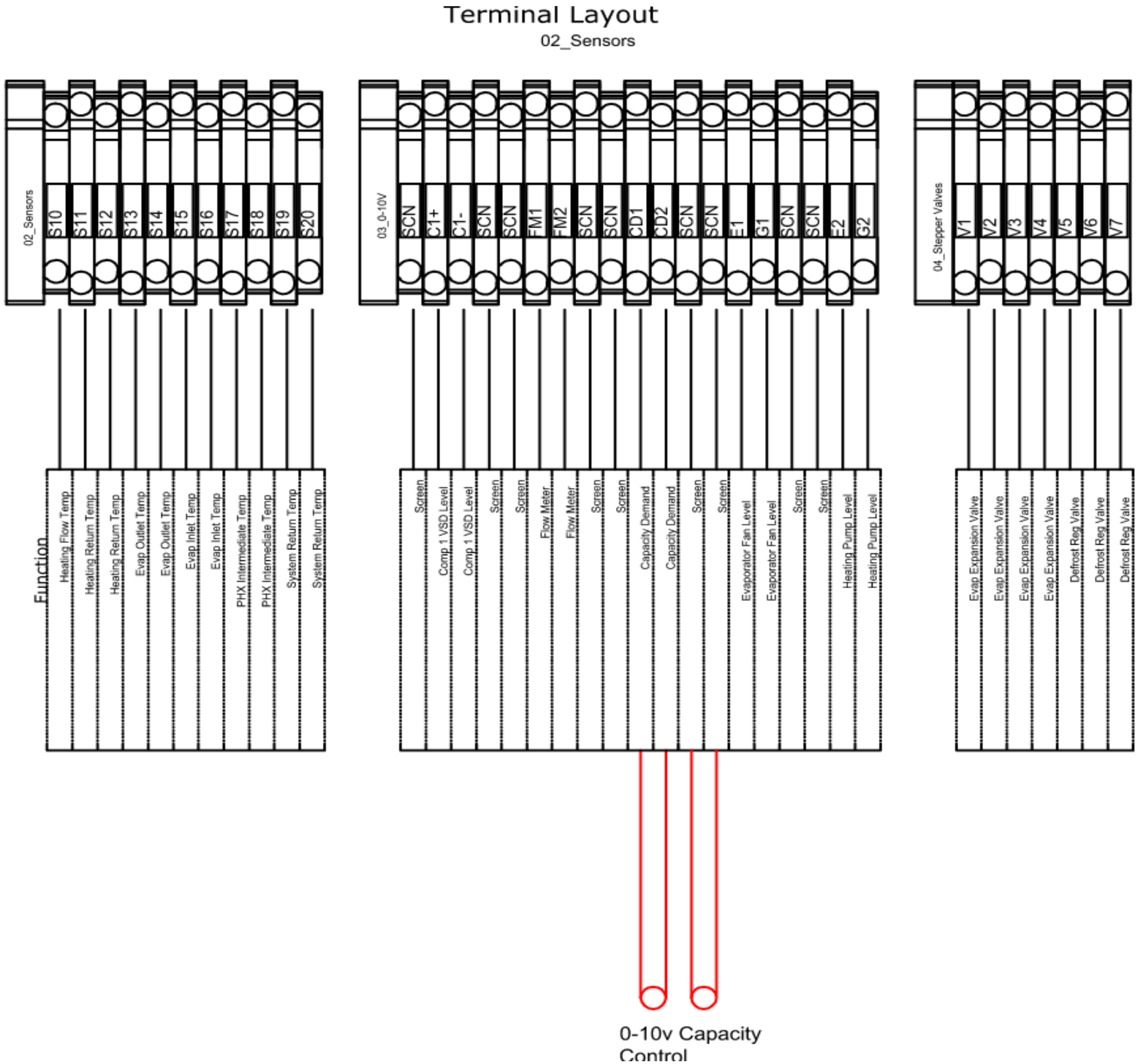


RDM1
PR0652CDNF-TDB
ETHERNET 1
ETHERNET 2
10/100 BaseT
USB HOST 1
TERM
CANBUS
DISPLAY
PWM OUTPUTS
Top Board
USB DEVICE
USB HOST 2
RELAYS
STATUS
RESET
ID1
ID2
ID3
STATUS INPUTS
STATUS INPUTS
UNIVERSAL INPUTS/OUTPUTS
PROBE INPUTS
30
31
BMS1
BMS2
Remove Link
For Remote
BMS Connection
System
Healthy
RELAY 1
RELAY 2
RELAY 3
RELAY 4
RELAY 5
RELAY 6
Supply 24V AC/DC
Bottom Board
RDM1a
RELAY 7
RELAY 8
RELAY 9
STEPPER 1
STEPPER 2
STEPPER POWER
AC OR DC



TERM
Y
N
CANBUS
HIGH
SCRN
LOW
GND
DISPLAY
5V
DATA
GND
SCL
SDA
5V
PWM OUTPUTS
GND
PWM1
GND
PWM2
RELAYS
1
2
3
4
5
STATUS
RESET
Module ID
Top Board
STATUS INPUTS
GND
S1
GND
S2
GND
S3
GND
S4
UNIVERSAL INPUTS/OUTPUTS
U1
U1
U2
U2
U3
U3
U4
U4
PROBE INPUTS
GND
P1
GND
P2
GND
P3
GND
P4
GND
P5
GND
P6
0-10V To Capacity Adjust
CA1
CA2
SCN
SCN
RELAY 1
RELAY 2
RELAY 3
COM
N/O
N/C
Supply 24V AC/DC
E
0V
24V
RDM2a
Bottom Board
RELAY 4
RELAY 5

Terminal Layout

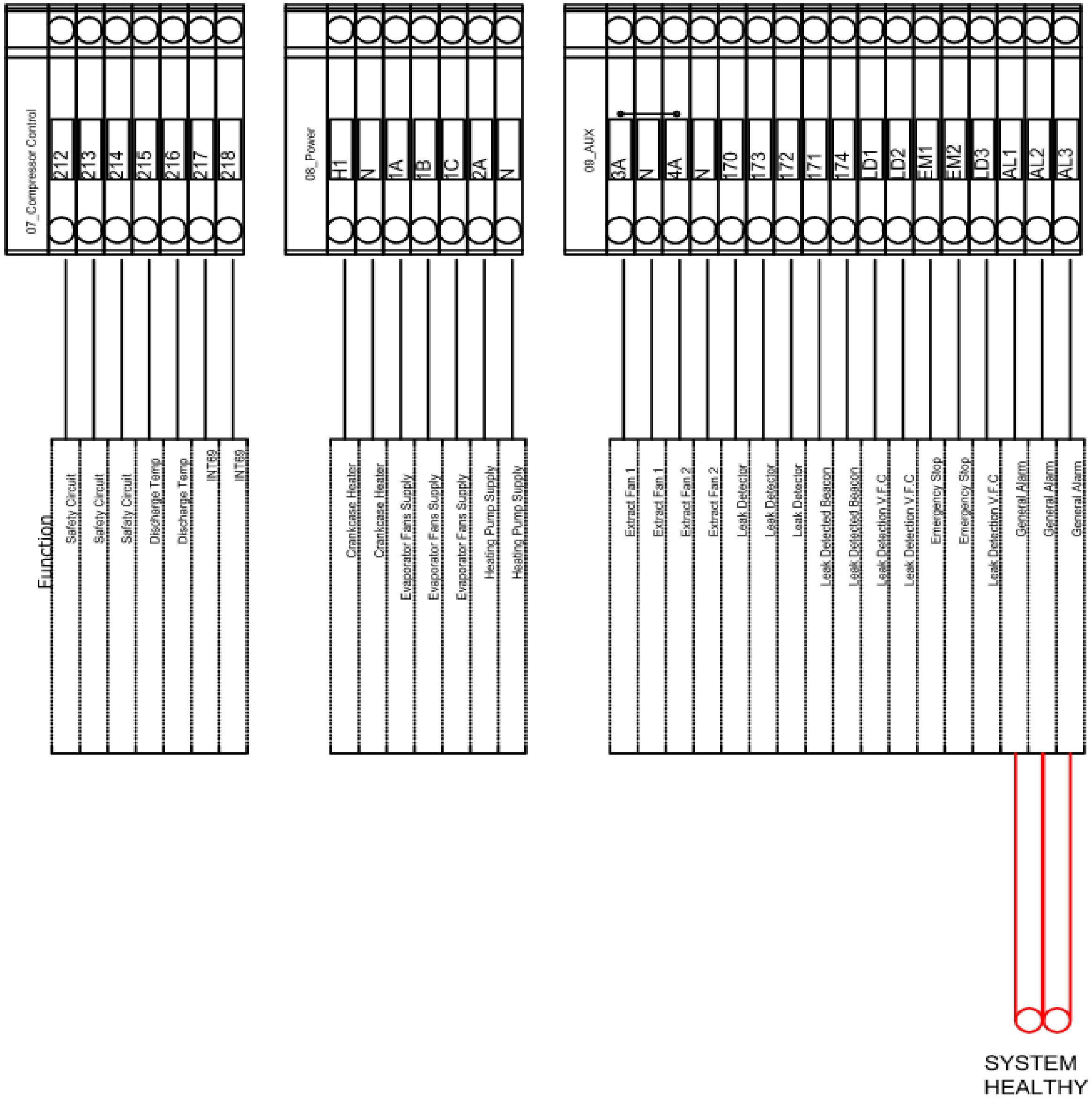


Terminal Layout

04_Stepper Valves

Terminal Layout

07_Compressor Control



8.5 Local control

Selecting LOCAL control means the heat pump will control without any external control signals. This should be selected when there is no BMS 0-10V capacity control input or Clade Multi Heat Pump Controller input. Selecting this control type means the unit will operate on return temperature control.

Flow Temperature and Return Temperature Control

When the return water temperature rises into the designated delta-temperature (ΔT) range, the heat pump automatically reduces its heat output. This reduction lowers the pump's flow rate while still maintaining the desired flow temperature. Conversely, if the return water temperature drops, the heat pump's heating capacity increases, thereby increasing the flow rate to maintain a constant flow temperature.

High Return Water Condition

If the return water temperature increases further—resulting in a temperature difference that is less than 3K (i.e., ΔT - 3K relative to the flow temperature)—the system will trigger a high return water stop condition. In this state, the heat pump switches to a 'Satisfied' status, indicating that the required heating has been met. The heat pump will resume its normal 'Heating' mode once the return water temperature drops enough so that the temperature difference exceeds the reactivation threshold of ΔT +2K.

CLADE

Head Office & Registered Office
Bristol & Bath Science Park, Dirac Crescent, Emersons Green, BRISTOL BS16 7FR

The Technology Centre
Unit R3 Gildersome Spur Industrial Estate, Stone Pits Lane, Morley, LEEDS LS27 7JZ