

Installation,
operating
and maintenance

NEOSYS HYDROLEAN MWC

Air cooled chillers (NEOSYS)

Water cooled chillers (HYDROLEAN & MWC)

20 > 1000 kW



CHILLER-IOM-1309-E



AIR COOLED, WATER COOLED CHILLERS AND SPLIT UNITS

INSTALLATION OPERATION MAINTENANCE MANUAL

Ref : CHILLER-IOM-1309-E

The present manual applies to the following chiller versions:
NEOSYS range: NAC-NAH
HYDROLEAN range: SWC-SWH-SWR
MWC range: MWC-MRC

INSPECTIONS AND REQUALIFICATION ACCORDING PRESSURE EQUIPMENT DIRECTIVE MUST FOLLOW THE LOCAL REGULATIONS WHERE THE UNIT IS INSTALLED.

Our company is a member of the Eurovent Certification Program, all LENNOX chillers are tested and rated in accordance with Eurovent certification program	
Our products comply with the European standards	

All the technical and technological information contained in this manual, including any drawing and technical descriptions provided by us, remain the property of LENNOX and must not be utilised (except in operation of this product), reproduced, issued to or made available to third parties without the prior written agreement of LENNOX.

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**You must read and be familiar with this operating manual prior to commission the chiller.
Please closely follow the instructions.**

We would like to stress the importance of training with respect to the correct handling of the chiller.
Please consult LENNOX on the options available in this field.
It is important that this manual is stored in a permanent location in the vicinity of the chiller.



IMPORTANT GENERAL INSTRUCTION

This manual contains important instructions regarding the commissioning of the chiller. It also includes important instructions to prevent personal injury and damage to the machine during operation. Furthermore, in order to promote fault-free operation of the chiller, maintenance information has been included.

Please do not hesitate to contact one of our employees should you require further information on specific chiller subjects.
Order related documentation will be forwarded under separate cover.

This documentation consists of:

- **CE declaration.**
- **Operating manual for control system.**
- **Installation Operating manual**
- **Wiring diagram**
- **Refrigerant flow diagram**
- **Unit detail are given on unit nameplate.**

The data published in this manual is based on the most recent information available. It is supplied conditional to later modifications.
We reserve the right to modify the construction and/or design of our chillers, at any time, without prior notification or obligation to adapt previous supplies accordingly.



***Any work on the Chiller should be carried out by trained and licensed competent technician.
The following risks are present on the unit:***

- ***Risk of electrical shock***
- ***Risk of injury from rotating parts***
- ***Risk of injury from sharp edges and heavy weight***
- ***Risk of injury from high pressure gas***
- ***Risk of injury from high and low temperatures components.***

***It is expected that all works on equipment be carried out in accordance with all local standards and norms.
It is expected that all works are carried out with good working practices.***

All units are compliant with the following Directives, Norms and Standards:

- 97/23/CE Pressure Equipment Directive
- 2006/42/CE Machinery Directive
- 2006/95/CE Low Voltage Directive
- 2004/108/CE Electro Magnetic Compatibility Directive
- EN 378-2 Norm - 2009 - Refrigerating systems and heat pumps - Safety and environmental requirements
- The European Restriction of the Use of Certain Hazardous Substances (RoHS)

SAFETY RELIEF (NEOSYS, MCW and MRC ranges)

This equipment is protected with safety pressure relief calibrated at 42,7 bar g and safety pressure switch calibrated at 42 bar g. Do not overcome this operating pressure.

IMPORTANT NOTICE**All work on the unit must be carried out by a qualified and authorised employee.**

Non-compliance with the following instructions may result in injury or serious accidents.

Work on the unit:

- The unit shall be isolated from the electrical supply by disconnection and locking using the main isolating switch.
- Workers shall wear the appropriate personal protective equipment (helmet, gloves, glasses, etc.).

Work on the electrical system:

- Work on electric components shall be performed with the power off (see below) by employees having valid electrical qualification and authorisation.

EMC DIRECTIVE COMPLIANCE**WARNING:**

This equipment is an "A class" according CEM Directive. In an industrial environment, this device can create radio electrical noise. In this case, the owner can be asked to take appropriated actions.

This applies to all machine installed with nominal amps below <75A:

- The short-circuit rate $R_{sce}=33$ is defined in the EN61000-3-12 standard relative to the harmonics readings on the supply network. The appliances compliant with the harmonic current limits equivalent to $R_{sce}=33$ can be connected in whatever connection point of the main supply system.
- The maximal allowable impedance of the main supply system $Z_{max}=0.051W$ is defined by EN 61000-3-11 standard relative to the voltage variation, fluctuation and flicker readings. The connection to the supply is a conditional connection submitted to the preliminary agreement of the power supply local provider.

Work on the refrigerating circuit(s):

- Monitoring of the pressures, draining and filling of the system under pressure shall be carried out using connections provided for this purpose and suitable equipment.
- To prevent the risk of explosion due to spraying of coolant and oil, the relevant circuit shall be drained and at zero pressure before any disassembly or unbrazing of the refrigerating parts takes place.
- There is a residual risk of pressure build-up by degassing the oil or by heating the exchangers after the circuit has been drained. Zero pressure shall be maintained by venting the drain connection to the atmosphere on the low pressure side.
- The brazing shall be carried out by a qualified brazer. The brazing shall comply with the standard NF EN1044 (Minimum 30% silver).

Replacing components:

- In order to maintain CE marking compliance, replacement of components shall be carried out using spare parts, or using parts approved by LENNOX.
- Only the coolant shown on the manufacturer's nameplate shall be used, to the exclusion of all other products (mix of coolants, hydrocarbons, etc.).

CAUTION:

In the event of fire, refrigerating circuits can cause an explosion and spray coolant gas and oil.

EC Regulation No 842/2006 on fluorinated greenhouse gases

Operators of refrigeration equipments must comply with the 6 main obligations defined in the F Gas Regulation

OBLIGATION	APPLICABILITY
Recovery of F gases during plant servicing and maintenance and at the end of plant life.	All stationary systems
Use adequately trained staff to carry out installation, servicing and maintenance and leakage checking.	All stationary systems
NEW equipment shall be labelled.	All stationary systems
Take steps to prevent F gas leakage and repair detected leakage as soon as possible.	All stationary systems
Regularly check for leakage. 06 kg or more : at least once every 12 months 30 kg or more : at least once every 6 months 300 kg or more : at least once every 3 months	Hermetically sealed systems > 6kg
Keep certain records about refrigeration plant that uses F gases. (refer to the start up and Maintenance Log book at the end of this document)	Stationary systems > 3kg
Fit and check automatic leak detection system.	Stationary systems > 300kg

	Non compliance with these requirements is an offence and liable of financial penalties.
	Moreover, in case of problem it is mandatory to prove to the insurance company that the equipment complies with the F gas Regulation.

The warranty of the chillers is subject to the warranty definitions as agreed upon in the order.

It is expected that the design and installation of the unit utilises good working practices.

The warranty will be legally null and void if:

- ***Service and maintenance have not been executed in accordance with the regulations; repairs have not been carried out by LENNOX personnel or have been implemented without prior written permission by LENNOX.***
- ***Modifications have been made to the equipment without prior written permission by LENNOX.***
- ***Settings and protections have been modified without prior written permission by LENNOX.***
- ***Non-original or other than the prescribed refrigerants or lubricants are used.***
- ***The equipment has not been installed and/or connected in accordance with the installation instructions.***
- ***The equipment is being used improperly, incorrectly, negligently or not in accordance with its nature and/or purpose.***
- ***A flow protection device is not fitted.***

In these circumstances LENNOX is indemnified from any product liability claims from third parties.

In the event of a warranty claim the machine serial number and LENNOX order number must be quoted.

1 - SAFETY

The safety information contained in this manual is provided as a guide for the safe handling of this installation. LENNOX does not vouch for the completeness of this information and can therefore not accept liability for any possible omissions.

In the chillers, heat is being transported by a pressurised refrigerant, with changes in pressure and temperature. For air cooled chillers, fans have been provided to discharge heat into the environment. The protection of operating and maintenance personnel was central in the design of the chiller. Safety features have been included to prevent excessive pressure in the system. Sheet metal parts have been fitted to prevent inadvertent contact with (hot) pipes. For air cooled chillers, the fans are equipped with protective grids and the electrical control panel is completely touch-proof. This excludes some parts operating at a safe voltage (< 24 Volt). The service panels can only be opened using tools.

The electrical control panel is completely touch-proof. This excludes some parts operating at a safe voltage (< 50 Volt). The service panels can only be opened using tools.

Notwithstanding that the chillers are equipped with extensive safety and protection features, the utmost care and attention is needed when carrying out operations on the machine. Furthermore, ear protection should be worn when working on or in the vicinity of the chillers. Operations on the cooling circuit or electrical equipment should be carried out by authorised personnel.

It is essential to follow non exhaustive recommendations hereunder:

- Never work on a unit that is still energized.
- Any manipulation (opening or closing) of a shut-off valve must be carried out by a qualified and authorised engineer. These procedures must be carried out with the unit shut-down.
- Never work on any of the electrical components, until the general power supply to the unit has been cut. During any maintenance operations on the unit, lock the power supply circuit in the open position ahead of the machine. If the work is interrupted, check the lock before resuming the work.
WARNING: Even if the unit has been switched off, the power circuit remains energized, unless the unit or circuit disconnect switch is open. Refer to the wiring diagram for further details.
- For some units, a separate 220V power supply may exist, check the electrical wiring for more informations
- In case of maintenance operations on fans (grills replacement ...) ensure that the power is shut off to avoid automatic restart.
- Before the opening of the refrigerant circuit, check the pressure with manometers or pressure sensors.
- Never leave a unit stopped with valves closed on the liquid line, refrigerant could be trapped and the pressure would rise.
- All installation parts must be maintained by the personnel in charge, in order to avoid material deterioration and injuries to people. Faults and leaks must be repaired immediately. The authorized technician must have the responsibility to repair the fault immediately. Each time repairs have been carried out to the unit, the operation of the safety devices must be re-checked.
- Follow guidance and recommendations given in safety and machine standards such as EN378, ISO5149, etc
- Do not use oxygen to purge lines or to pressurize a machine for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.
- Never exceed the specified maximum operating pressures. Verify the allowable maximum high- and low-side test pressures by checking the instructions in this manual and the pressures given on the unit name plate.
- Do not use air for leak testing. Use only refrigerant or dry nitrogen.
- Do not unweld or flame cut the refrigerant lines or any refrigerant circuit component until all refrigerant (liquid and vapour) has been removed from chiller. Traces of vapour should be displaced with dry air nitrogen. Refrigerant in contact with an open flame produces toxic gases.
- Do not siphon refrigerant
- Avoid spilling liquid refrigerant on skin or splashing it into the eyes. Use safety goggles. Wash any spills from the skin with soap and water. If liquid refrigerant enters the eyes, immediately and abundantly flush the eyes with water and consult a doctor.

1.1 - Safety definition

The water cooled chillers meet the following safety definitions:

- Pr-EN-378-1.
- 2006/42/CE (“Machine Directive”).
- EN-60204-1.
- 2004/108/CE “EMC Directive”.
- Pressure Equipment Directive 97/23/CE.

And is provided with CE markings (on the condition that the necessary options are present) (for further information see II-A declaration).

1.2 - Warning labels

The chiller is marked with the following warning labels to alert to potential hazards (on or near the potentially hazardous part).

High temperatures	Electrical Voltage	Rotating parts	Sharp parts

Regularly check that the warning labels are still in the correct positions on the machine and replace them if necessary.

1 - TRANSPORT - HANDLING

1.1 - Controls and delivery checks

After the unit has been received, when it is ready to be installed or reinstalled, and before it is started up, it must be inspected for damage. On receipt of a new equipment please check the following points. It is the customer's responsibility to ensure that the products are in good working order (fill the check list page 62):

- The exterior has not been damaged in any way.
- The lifting and handling equipment are suitable for the equipment and comply with the specifications of the handling instructions enclosed here-in.
- Accessories ordered for on site installation have been delivered and are in good working order.
- If the unit is delivered with its operating charge of refrigerant, that there has been no leakage (use an electronic detector).
- The equipment supplied corresponds to the order and matches the delivery note.

If the product is damaged, exact details must be confirmed in writing by registered post to the shipping company within 48 hours of delivery (working days).

A copy of the letter must be addressed to LENNOX and the supplier or distributor for information purposes. Failure to comply will invalidate any claim against the shipping company.

Please be reminded that LENNOX is not responsible for off-loading and positioning.

1.1.1: Unit Nameplate

The rating plate provides a complete reference for the model and ensures that the unit corresponds to the model ordered. It states the electrical power consumption of the unit on start-up, its rated power and its supply voltage.

The supply voltage must not deviate beyond +10/-10 %.

The start-up power is the maximum value likely to be achieved for the specified operational voltage. The customer must have a suitable electrical supply. It is therefore important to check whether the supply voltage stated on the unit's rating plate is compatible with that of the mains electrical supply. The rating plate also states the year of manufacture as well as the type of refrigerant used and the required charge for each compressor circuit.

		LGL France 42 rue Roger Salengro 69741 GENAS CEDEX						0038
Type unité: NAH 230D NM4M								
N° de série : 147134_1 1/1								
	Voltage (V)	Phase (Ph)	Fréquence (Hz)	Intensité (A)				
V alim.	400	3	50	Nominal	Démarrage			
V com.	24	1	50	211	337			
			Min		Max			
			BP	HP	BP	HP		
Pression (PS) (bar)			-1	-1	29,5	42		
Température (TS) (°C)			-20	-20	50	110		
Température de stockage (°C)			-30		50			
BP: côté basse pression / HP: côté haute pression								
Puissance (kW)		Charge de réfrigérant (kg)				Dates		
Froid	Chaud	C1	C2	C3	C4	Prod.	Test	
215	252	26	26	0	0	2013	09/04/2013	
Fluide		Groupe fluide				Poids (kg)		
R410A		2				2564		
Ce produit est utilisé pour conditionnement d'air. Contient des gaz à effet de serre fluorés visés par le protocole de Kyoto. Hermétiquement fermés.								

Nota: According to PED, Service Pressure is the maximum allowed pressure and so is equal to the HP pressure switches setting.

1.2 - Storage

When units are delivered on site they are not always required immediately and are sometimes put into storage. In the event of medium to long-term storage, we recommend the following procedures:

- Ensure that there is no water in the hydraulic systems.
- Keep the heat exchanger covers in position.
- Keep protective plastic film in position.
- Ensure the electrical panels are closed.
- Keep all items and options supplied in a dry and clean place for future assembly before using the equipment.

It is strongly recommended to store units in a dry, sheltered place (in particular for units that will be installed indoor).



The unit maximum storage temperature is 55°C. Above this limit risk of refrigerant losses through relief valves.

2 - LIFTING THE UNIT

2.1 - Safety instructions

Installation, start up and adjustment of this equipment can be dangerous if certain system specific factors are ignored, such as operating pressures, electrical components, locations (roofs, terraces and other structures located well above ground level).

Only highly qualified contractors and technicians with sound knowledge of this type of equipment, are authorised to install, start up and service it.

During any service operations, observe the recommendations given on labels or instructions sent with the equipment, as well as any other applicable safety procedures.

- Follow all safety rules and regulations
- Wear protective glasses and work gloves
- Handle heavy or bulky equipment carefully during lifting and moving operations, and when setting it on the ground.

CAUTION: BEFORE EACH SERVICE OPERATION MAKE SURE THAT THE UNIT POWER SUPPLY IS PROPERLY ISOLATED AND LOCKED OUT.

NOTE: SOME UNITS MAY HAVE A SEPARATE 230V CONTROL SUPPLY THAT REQUIRES SEPARATE ISOLATION. PLEASE CHECK THE WIRING DIAGRAM.

2.2 - Handling

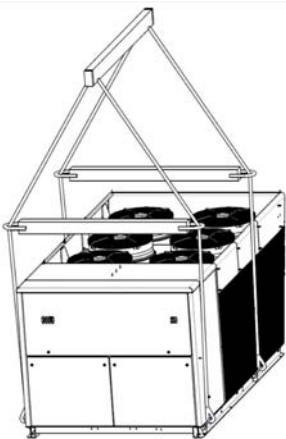
Handling operations must be carried out by qualified personnel. Comply strictly with the lifting instructions as well as with any other applicable safety procedures. Wear protective glasses and work gloves. Unit handling operations must be carried out carefully to avoid jolting the frame, the panels, the electrical box, etc...

NOTE: The heat exchangers of the condensers could be protected from damage during transport by plastic plates. The machine is also wrapped in packing foil. It is recommended to leave this protection in place during any transport and lifting operations, and not to remove the plastic plates until commissioning (take care that the protecting foil wrapping is not blown away!).

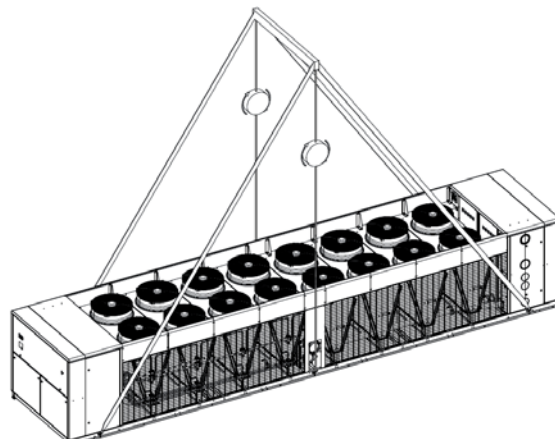
Rubber anti-vibrations mountings (AVM) & factory accessories are to be found in the control panel or in an extra box for shipping. If the unit is mounted on anti-vibration mountings, these should be fitted to the unit before final positioning.

CAUTION: IN CASE OF REINSTALLATION OF THE UNIT, MAKE SURE THAT THE UNIT POWER SUPPLY IS PROPERLY ISOLATED AND LOCKED OUT.

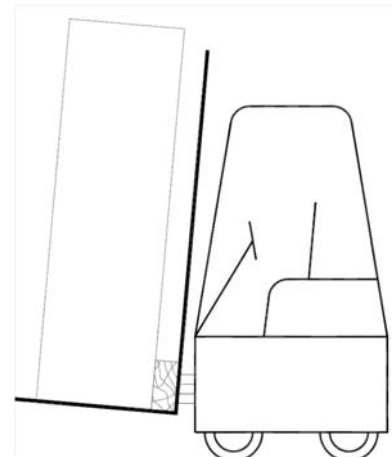
NOTE: SOME UNITS MAY HAVE A SEPARATE 230V CONTROL SUPPLY THAT REQUIRES SEPARATE ISOLATION. PLEASE CHECK THE WIRING DIAGRAM.



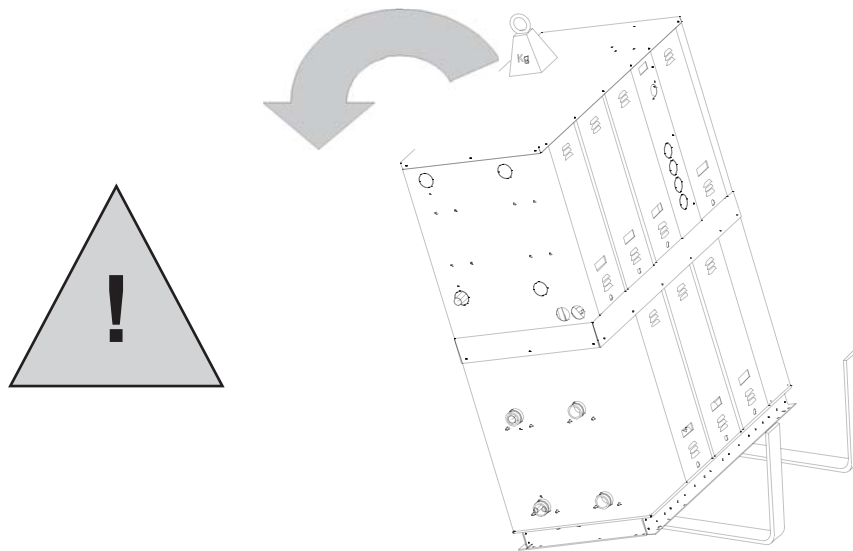
NEOSYS



HYDROLEAN & MWC



WARNING: HYDROLEAN Size 100, 120, 135 and 160 are very narrow and high: there is a risk of the unit tipping over when being handled with a fork lift.



3 - LAY-OUT AND INSTALLATION REQUIREMENTS

The following preparations are important for the installation of the chiller:

- Air-cooled chillers with helicoids fans such as NEOSYS are designed for outdoor installation. Please consult LENNOX prior to implementing other types of installation.
- Water cooled chillers such as HYDROLEAN or MWC are designed for indoor installation. Please consult LENNOX prior to implementing other types of installation.
- For outdoor air cooled chiller, position the chiller where it is less affected by wind (install windbreaks where wind speeds > 2.2 m/s).
- The ground beneath the unit must be flat, level and of sufficient strength to support the weight of the unit with its full liquid charge, and the occasional presence of the usual service equipment.
- In locations exposed to frost, the supporting surface, if the unit is installed on the ground, must be built on concrete stakes extending downwards beyond the normal depth of frost. It is always advisable to build a supporting surface detached from the general building structure to avoid transmission of vibrations.
- On normal applications, unit rigidity and point load positions enable installation to minimise vibrations. Vibration isolators may be used by contractors on installations requiring particularly low vibration levels.



Use of vibration isolators MUST be accompanied by installation of flexible connections in the unit water piping. Vibration isolators must also be secured to the unit BEFORE being attached to the ground. Selection of vibration absorbing isolator capacity is not LENNOX's responsibility.

- The unit must be bolted to the vibration isolators and the latter solidly secured into the concrete slab. Check that vibration isolator contact surfaces fit flush to the floor. If necessary, use spacers or re-surface the flooring, but in all events, make sure that the isolators seat flatly on the supporting surface.
- It is essential that the units be installed with sufficient free space around them to provide easy access to all unit components for servicing and maintenance. For air cooled chiller only: if the air rejected by the condenser encounters any obstacles, it will tend to be recycled by the fans. This will cause an increase in the temperature of the air used to cool the condensers. Obstruction of the air outlet will also impair air distribution across the entire heat exchanging surface of the condenser. Both of these conditions, which reduce the heat exchange capacity of the coils, will cause an increase in condensing pressure. This will lead to a loss of capacity and an increase in compressor power input.
- For air cooled chiller only: to prevent air flow to be reversed due to prevailing winds, units cannot be completely shrouded with a higher, uninterrupted wind shield. If such a configuration cannot be avoided, an air ejection duct could be installed at the same height as the surrounding shield after LENNOX representative written approval.



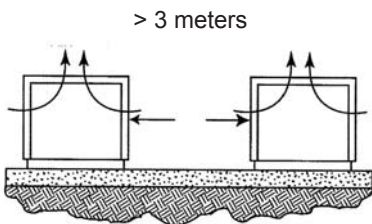
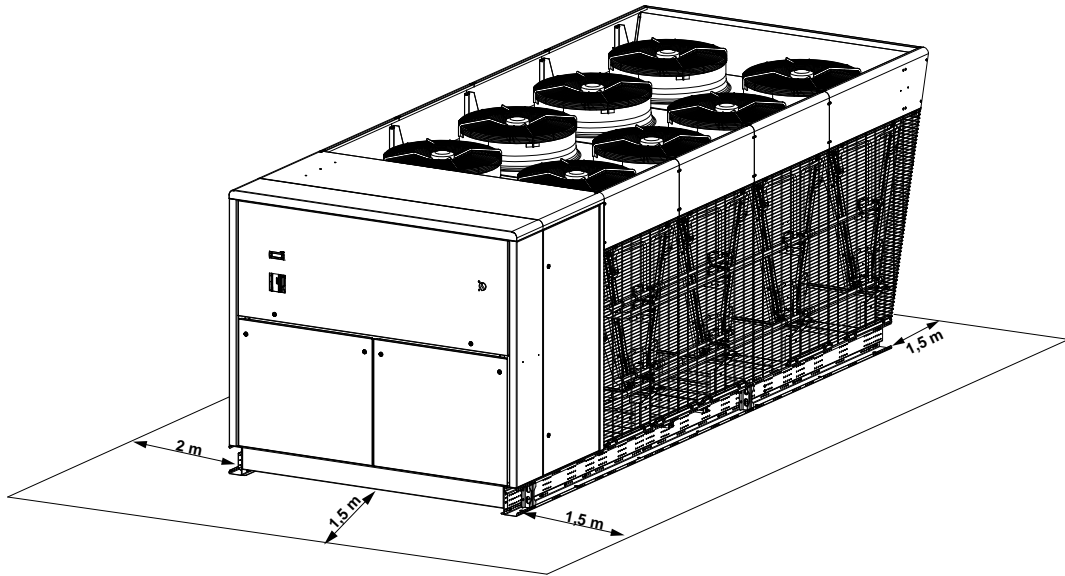
It is important that units must be levelled. Failure to install unit correctly will void warranty.

CLEARANCES DRAWINGS

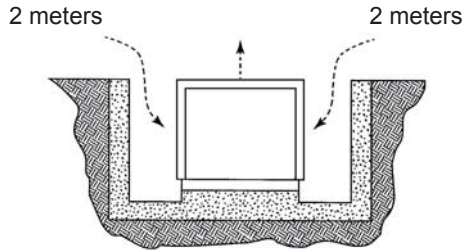
For more details, please consult our Application Guides or the drawings supplied with the unit.

For any chiller, a minimum distance of 1 meter is required for the good opening and servicing of the electrical box. In case of a compressor replacement, 1m is also reasonable to remove it.

NEOSYS



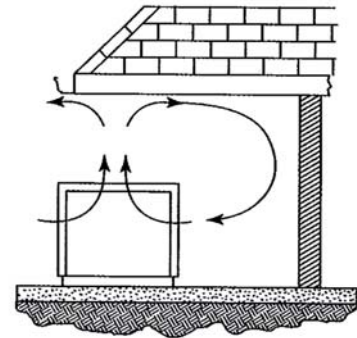
> 3 meters



2 meters

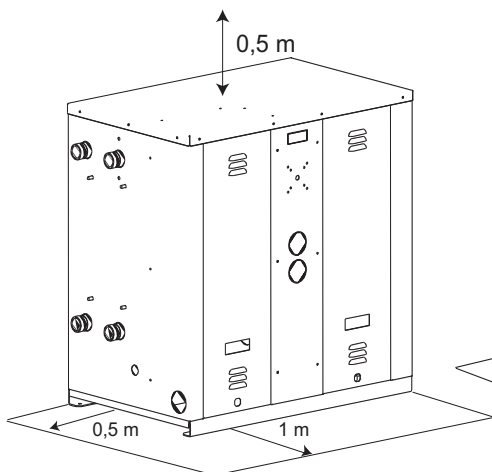
2 meters

Not recommended

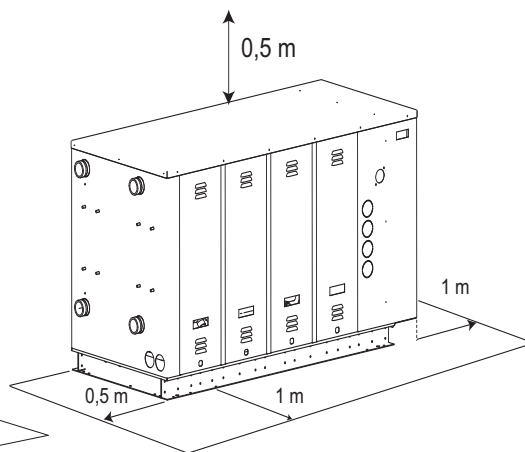


Not allowed

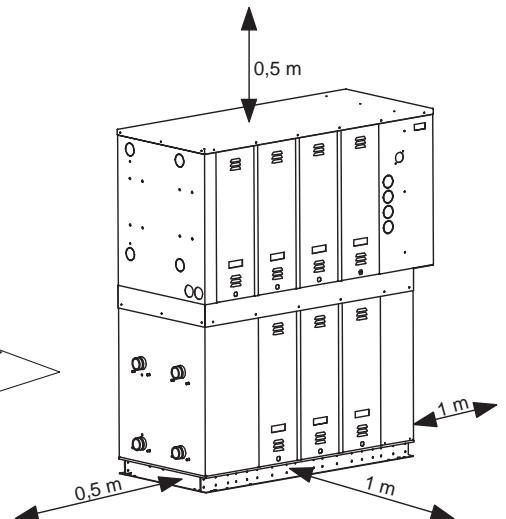
HYDROLEAN 025 ▶ 035



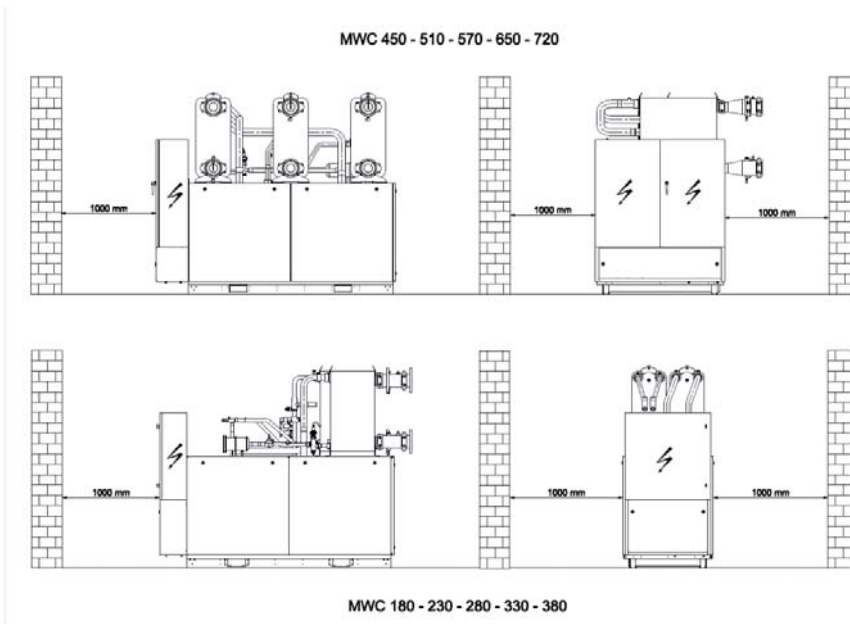
HYDROLEAN 050 ▶ 080



HYDROLEAN 100 ▶ 160



MWC



4 - WATER CONNECTIONS

4.1 - Water connections - Evaporator/Condenser/Desuperheater

Before the system start-up check that the water circuits are connected to the right heat exchangers (e.g. no reversal between evaporator and condenser or between water in and outlets). The water circulating pump will be preferably installed upstream so that the evaporator/condenser will be subjected to positive pressure. Entering and leaving water connections are indicated on the certified drawing sent with the unit or shown in the sales brochure.

The use of a water filter in the water circuit upstream of the heat exchanger is mandatory. These filters must remove all particles with a diameter greater than 1 mm, and must be positioned within 1 meter of the inlet of the exchanger. They may be supplied as an option by the manufacturer.



LACK OF FILTER AT THE INLET OF A PLATE HEAT EXCHANGER WILL MAKE WARRANTY VOID. Hydraulic drawings in Appendices, or supplied with the unit

It is important to follow non exhaustive recommendations hereunder:

- The water pipes must not transmit any radial or axial force to the heat exchangers nor any vibration. (Use flexible connections to reduce the transmission of vibrations.)
- Manual or automatic air bleeders must be installed at all high points in the circuit(s).
- Drain connections must be installed at all low points to allow the whole circuit to be drained.
- An expansion device must be installed to maintain pressure in the circuit(s) as well as a safety device
- Comply with the water inlet and outlet connections shown on the unit.
- Install thermometers in both the entering and leaving water connections.
- Install stop valves, close to the entering and leaving water connections.
- After testing for leaks, insulate all pipe work, to reduce thermal leaks and to prevent condensation.
- If the external water pipes are in an area, where the ambient temperature is likely to fall below 0°C, insulate the piping and add an electric heater. As an option, the internal unit piping is protected.
- Ensure full earthing continuity



CHARGING AND REMOVING HEAT EXCHANGE FLUIDS SHOULD BE DONE BY QUALIFIED TECHNICIANS WITH DEVICES THAT MUST BE INCLUDED ON THE WATER CIRCUIT BY THE INSTALLER. NEVER USE THE UNIT HEAT EXCHANGERS TO ADD HEAT EXCHANGE FLUID.

4.2 - Water analysis

The water must be analysed; the water circuit installed must include all items necessary for treatment of the water: filters, additives, intermediate exchangers, bleed valves, vents, isolating valves etc... depending on the results of the water analysis.



We do not advise operation of the units with open loops which can cause problems with oxygenation, or operation with untreated ground water.

Use of untreated or improperly treated water can cause deposits of scale, algae and sludge or cause corrosion and erosion. It is advisable to call in a qualified water treatment specialist to determine what kind of treatment will be necessary. The manufacturer cannot accept liability for damage caused by the use of untreated or improperly treated water, salt water or brine.

Here are our non exhaustive recommendations given as an indication:

- No NH₄⁺ ammonium ions in the water, they are very detrimental for copper. <10mg/l
- Cl⁻ Chloride ions are detrimental for copper with a risk of perforations by corrosion by puncture. < 10 mg/l.
- SO₄²⁻ sulphate ions can cause perforating corrosion.< 30 mg/l.
- No fluoride ions (<0.1 mg/l).
- No Fe²⁺ and Fe³⁺ ions with dissolved oxygen. Dissolved iron < 5 mg/l with dissolved oxygen < 5 mg/l. Over those values, it means a corrosion of steel which may generate a corrosion of copper parts under deposite of Fe – this is mainly the case with shell and tube heat exchangers.
- Dissolved silicon: silicon is an acid element of water and can also lead to corrosion risks. Content < 1mg/l.
- Water hardness: TH >2.8 K. Values between 10 and 25 can be recommended. This will facilitate scale deposit that can limit corrosion of copper. TH values that are too high can cause piping blockage over time.
- TAC < 100.
- Dissolved oxygen: Any sudden change in water oxygenation conditions must be avoided. It is as detrimental to deoxygenate the water by mixing it with inert gas as it is to over-oxygenate it by mixing it with pure oxygen. The disturbance of the oxygenation conditions encourages destabilisation of copper hydroxides and enlargement of particles.
- Specific resistance – electric conductivity: the higher the specific resistance, the slower the corrosion tendency. Values above 3000 Ohm/cm are desirable. A neutral environment favours maximum specific resistance values. For electric conductivity values in the order of 200-6000 S/cm can be recommended.
- pH: pH neutral at 20°C (7 < pH < 8)

If the water circuit must be emptied for longer than one month, the complete circuit must be placed under nitrogen charge to avoid any risk of corrosion by differential aeration.

4.3 - Antifreeze protection

4.3.1: Use glycol/water solution



ADDITION OF GLYCOL IS THE ONLY EFFICIENT WAY TO PROTECT AGAINST FREEZING

The glycol/water solution must be sufficiently concentrated to ensure proper protection and prevent formation of ice at the lowest outdoor air temperatures expected on an installation. Take precautions when using non-passivated MEG antifreeze solutions (Mono Ethylene Glycol or MPG Mono Propylene Glycol). Corrosion can occur with these antifreeze solutions with oxygen.

4.3.2: Drain the installation



It is important to make sure that manual or automatic air bleeders are installed at all the high points of the water circuit. To enable drainage of the circuit, make sure that drain cocks are installed at all the low points of the circuit. To drain the circuit, the drain cocks must be opened and an air inlet ensured.

Note: air bleeders are not designed to admit air.

FREEZING OF A HEAT EXCHANGER DUE TO COLD WEATHER CONDITIONS IS NOT COVERED BY LENNOX WARRANTY.

4.4 - Electrolytic corrosion



We would like to draw your attention to the problems of corrosion due to electrolytic corrosion caused by an imbalance between earthing points.

AN EXCHANGER THAT IS PUNCTURED BY ELECTROLYTIC CORROSION IS NOT COVERED BY THE UNIT WARRANTY

4.5 - Minimum water capacity



The minimum volume of the chilled water circuit must be calculated with the formula here under. If necessary, install a buffer tank. Proper operation of regulating and safety devices can only be ensured if the volume of water is sufficient. The theoretical volume of the water loop for a proper air conditioning operation can be calculated using the formula hereafter:

Vt → Minimum water content of the installation

Q → Chiller cooling capacity in kW

N → Number of control steps available in the unit

Dt → Maximum acceptable temperature rise (Dt = 6°C for an air conditioning application)

$$V_{\text{mini}} = 86 \times Q / (N \times Dt)$$

This formula is only applicable for air-conditioning installation and must not be used for process cooling where temperature stability is required.

NAC		
Unit size	Number of stages	Mini water volume (l)
200	6	478
230	6	549
270	6	645
300	4	1075
340	6	975
380	5	1089
420	6	1003
480	6	1147
540	6	1290
600	6	1433
640	6	1529
680	10	975
760	10	1089
840	12	1003
960	12	1147
1080	12	1290

NAH		
Unit size	Number of stages	Mini water volume (l)
200	6	478
230	6	549
270	6	645
300	4	1075
340	5	975
380	6	908
420	6	1003
480	6	1147

For MWC/MRC Chiller

Unit Size	Number of stages	Minimum Water volume (l)
180	4	645
230	5	659
280	6	669
330	5	946
380	4	1362
450	6	1075
510	6	1218
570	6	1362
650	6	1553
720	6	1720

Note: the volume of the condenser water loop has no impact on the chiller operation. In heat pump operation (with hot water set point control option), the minimum volume of the condenser water loop must be calculated based on the heating capacity using the same formula.

Glycol correction factors:

Minimum ambient temperature or water outlet temperature	Ethylene glycol %	Pressure drop	Water low	CAPACITIES	
				Cooling	Heating
+5 --> 0°C	10%	1,05	1,02	0,99	0,994
0 --> -5°C	20%	1,1	1,05	0,98	0,993
+5 --> -10°C	30%	1,15	1,08	0,97	0,99
-10 --> -15°C	35%	1,18	1,1	0,96	0,987

Example: 20% glycol instead of water -->: water flow x 1,05; Pressure drop x 1,1; Cooling capacity x 0,98

4.6 - NEOSYS range with hydraulic module - maximum water content

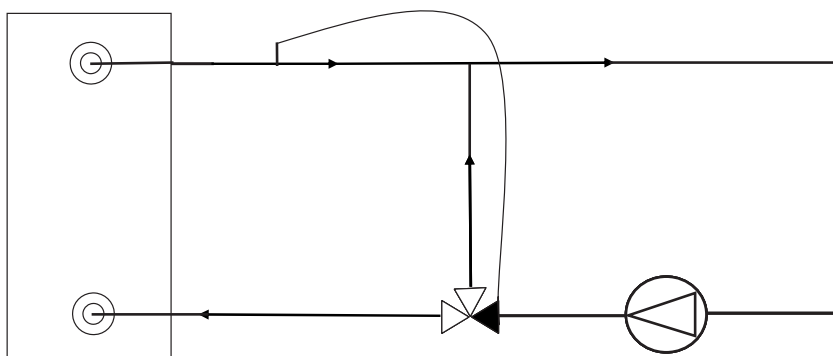
The maximum water content of the installation is determined by the capacity of the expansion vessel. On units fitted with a standard Hydraulic module it is possible to determine the maximum water content of the installation.

NEOSYS unit range	Expansion vessel volume	Pressure in the expansion vessel	Maximum clear water volume (l)		Maximum glycol water volume (l)	
			Static pressure 5 m	Static pressure 10 m	Static pressure 5 m	Static pressure 10 m
200-230-270 300-340-380 420-480 540 600-640	50 l	1,5 bar	5230 l	4180 l	4020 l	3210 l

4.7 - Desuperheater option (NEOSYS only)

The aim of the desuperheater is to recover high temperature heat from the compressor discharge gases by means of a heat exchanger and without condensing. This point is important because in this case, no refrigerant receiver to compensate the volume difference between the gas and liquid phase is then required. Therefore, we recommend mounting a regulating device on the water outlet temperature of the desuperheaters to avoid condensing in the heat exchangers. The heat recovery capacity depends on the operating conditions (the compressor discharge temperature comes from the HP/LP ratio), on the number of compressor running, on the water flow and on the water inlet temperature.

The simplest regulation we recommend is the one on the scheme below: a 3-way valve with a regulation on the desuperheater water outlet temperature (DOT). For instance, with 50/55°C operating conditions: if DOT>50°C, full flow through the desuperheater. If DOT<40°C, a minimum flow below roughly 1/5th of the nominal flow versus operating conditions of the selection table. A better regulation can be achieved by using an inverter driven pump that adjusts the flow to maintain the desired DOT.



	Total heat recovery (at 50/55°C)	Total flow (at 50/55°C)	Pressure drop (at 50/55°C)	Total heat recovery (at 55/60°C)	Total flow (at 55/60°C)	Pressure drop (at 55/60°C)	Total heat recovery (at 50/60°C)	Total flow (at 50/60°C)	Pressure drop (at 50/60°C)
NAC 200	41	7,18	6	32	5,62	4	37	3,26	2
NAC 230	52	9,11	9	43	7,55	6	48	4,22	2
NAC 270	56	9,81	7	44	7,73	8	50	4,40	2
NAC 300	65	11,4	9	52	9,13	6	59	5,19	2
NAC 340	79	13,8	10	64	11,2	6	72	6,34	2
NAC 380	101	17,7	14	83	14,6	10	93	8,18	3
NAC 420	91	15,9	9	73	12,8	6	82	7,22	2
NAC 480	106	18,6	12	86	15,1	8	96	8,45	3
NAC 540	143	25,1	15	118	20,7	11	129	11,4	4
NAC 600	150	26,3	13	122	21,4	9	136	12,0	3
NAC 640	154	27,1	13	125	22,1	9	139	12,3	3
NAH 200	41	7,18	6	32	5,62	4	37	3,26	2
NAH 230	52	9,11	9	43	7,55	6	48	4,22	2
NAH 270	56	9,81	7	44	7,73	5	50	4,40	2
NAH 300	65	11,4	9	52	9,13	6	59	5,19	2

Note: there are 2 superheaters, so the flow per desuperheater is half of the total flow from the table

4.8 - Flow switch



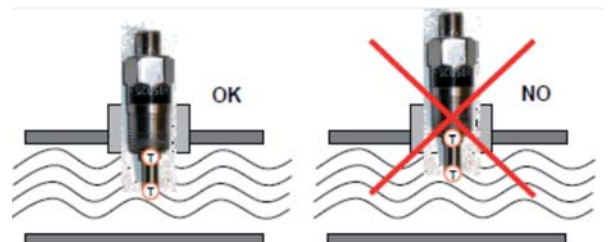
A flow switch must be installed on the evaporator water inlet or outlet, so as to enable detection of water flow through the heat exchanger before the unit is started up. This will protect the compressors against any eventual liquid slugging during the starting phase and prevent accidental ice formation in the evaporator, if the flow of water is interrupted.

Flow switches are available as standard on certain units and always as option. The normally open contact of the flow switch should be connected to the terminals provided to that effect in the unit electrical box. (See the wiring diagram supplied with the unit). The normally closed contact can be used as an indication of a lack of flow condition.

Warranty is void if a flow detection device is not fitted and connected to the LENNOX control panel.

ELECTRONIC FLOW SWITCH

NEOSYS and MCW units are fitted with an electronic flow switch as standard. This flow switch is made of stainless steel and has no moving parts. It detects flow in the water loops by measuring the temperature difference between the heated tip and the base of the probe. It is therefore absolutely mandatory to ensure that the base of the measuring element is correctly placed in the water flow



For electronic flow switch, the presence of glycol may affect the setting, please check setting while charging the unit with glycol.

5 - ELECTRICAL CONNECTIONS

First of all, make sure that power supplies from the building to the place where the unit is installed are properly established and that wire gauges are in keeping with the start up and running currents. Check tightness of all electrical connections. You **MUST** make absolutely certain that the power supplies applied to the power and control circuits are those for which the electrical panel was manufactured. A main isolator switch must be inserted between the end of the power supply cable and the unit to enable total isolation of the latter when necessary. Chillers are usually supplied with a main isolator switch. If not it is available as an option.



WARNING

Wiring must conform to applicable regulations. The type and location of fused isolators must also conform to regulations. For the sake of safety, install them where they can be seen and in easy reach of the unit. Units must have full earthing continuity.



IMPORTANT

Operation of a unit with the wrong power supply or with excessive phase imbalance constitutes abuse and is not covered by the LENNOX warranty. If phase imbalance exceeds 2 % for voltage and 1 % for current, contact your local electricity company immediately before powering up the unit.

Be also careful with power factor correction. Central excessive correction (>0.95) may generate transitory phenomena which could damage motors and contactors during starts and stops. Check the instantaneous voltage during those sequences. In case of doubt, contact LENNOX technical support for any power factor correction.

6 - SOUND LEVELS

Liquid chillers can be a significant source of noise in refrigeration and air conditioning systems.

Account is taken of technical constraints, both in design and manufacturing, sound levels cannot be improved much further than specified. Sound levels must therefore be accepted for what they are, and the area surrounding the chillers should be treated as necessary. The quality of installation can either improve or decrease initial sound characteristics: it may be necessary to provide further treatment such as sound-proofing or installation of screens around units installed externally.

The choice of the location for the installation can be of great importance: reflection, absorption, transmission of vibrations.

The type of unit support is also very important: inertia of the room and the structure of the walling, interfere with the installation and its behaviour.

Before taking any other steps, first determine whether the sound level is compatible or not with the environment, what it is perfectly justifiable and that these measures envisaged will not cause unreasonable cost.

Determine what level of sound proofing is necessary on the equipment, the installation (silencer, vibration isolators, and screens) and on the building (reinforcement of flooring, false ceilings, and wall coverings).

It may be necessary to contact an engineering office that specialises in sound abatement.

7 - CONNECTION OF SPLIT UNITS

Connections between the unit and the condenser must be made by a qualified refrigeration engineer and require several important precautions.

Especially, the shape and dimensions of the hot gas lines must be carefully designed to ensure proper oil return (oil is carried off by entrainment) in all cases and prevent liquid from returning into the compressor when the compressor is stopped. All rising discharge lines must have oil traps installed as on the drawing below. Above 6m height difference, install additional oil traps.

If the unit is designed to run at reduced capacity, the pipe sizes must be calculated so that gas velocity is also sufficiently high when the unit is operating at capacity reduction. So double discharge lines must be installed with the best diameter size selections for about 2/3rd of the total capacity for the bigger line and about 1/3rd of the total capacity for the smaller line. Use enough pipe line supports and design the lines to avoid hydraulic rams. The total pressure drop in the liquid line must not result in a change in phase. The total liquid line pressure drop estimate must include those generated by the filter drier, moisture sight glass and the solenoid valve. Select remote condensers with at least 3°C subcooling.

Non application of these design precautions will cancel the compressor warranty.

We recommend following ASHRAE recommendations.

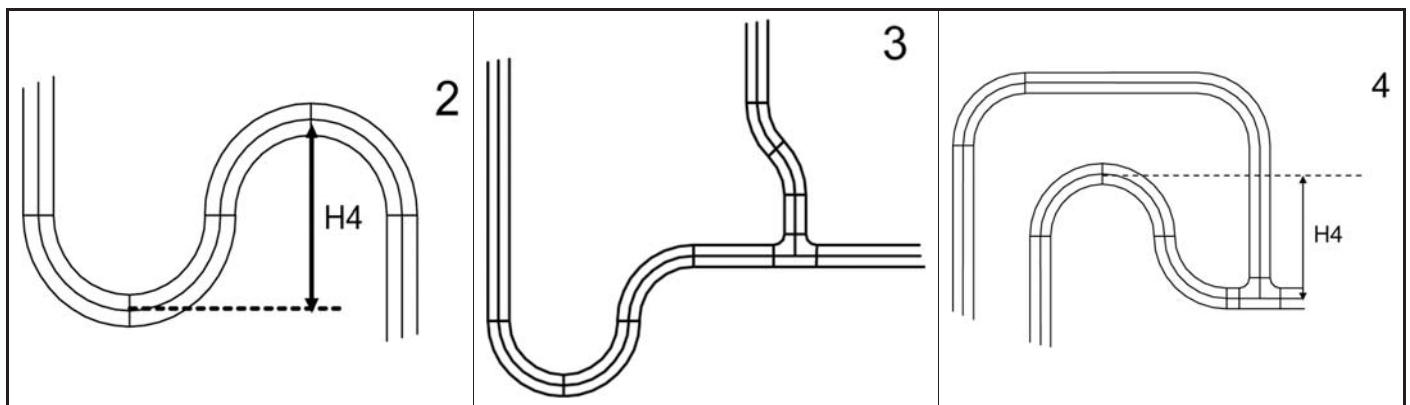
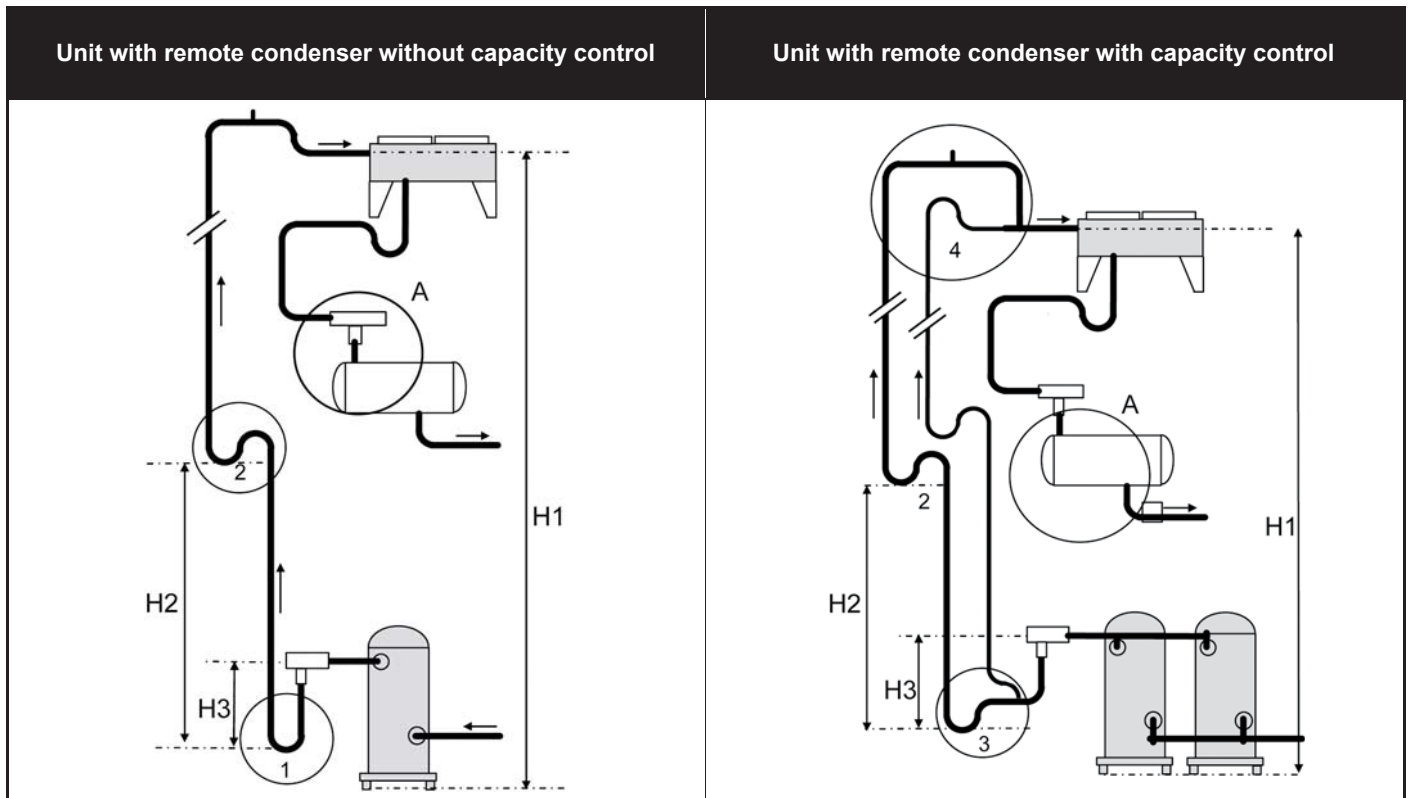
We also recommend to add a liquid receiver to allow proper unit operation. The design must be done according to the pipe length and the range of operation. This liquid receiver must be equipped with all necessary check valves and fittings to avoid risks of liquid migration.



WARNING

Be careful to remove from the circuit prior to cut or unbrazed any piping

Units with remote condenser



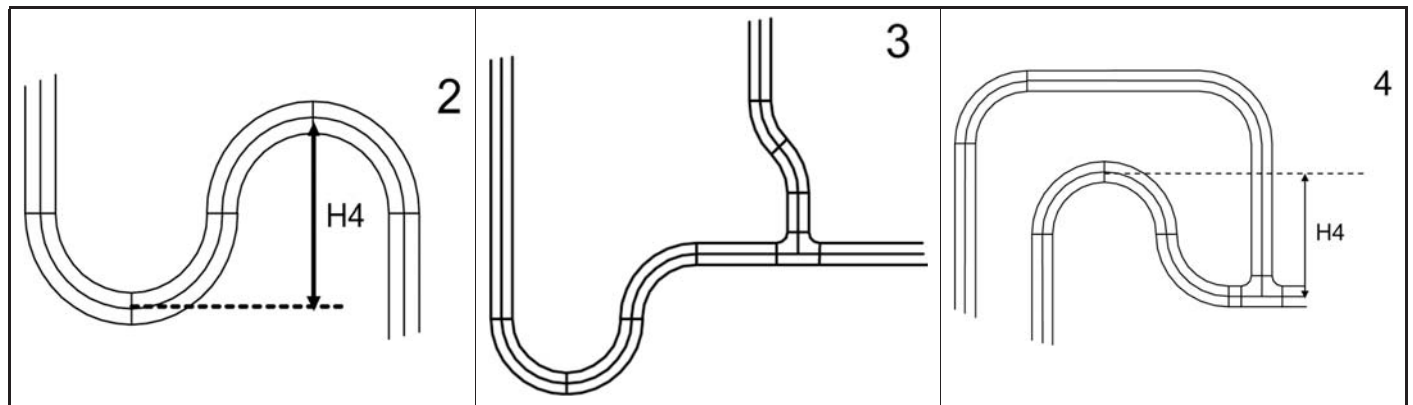
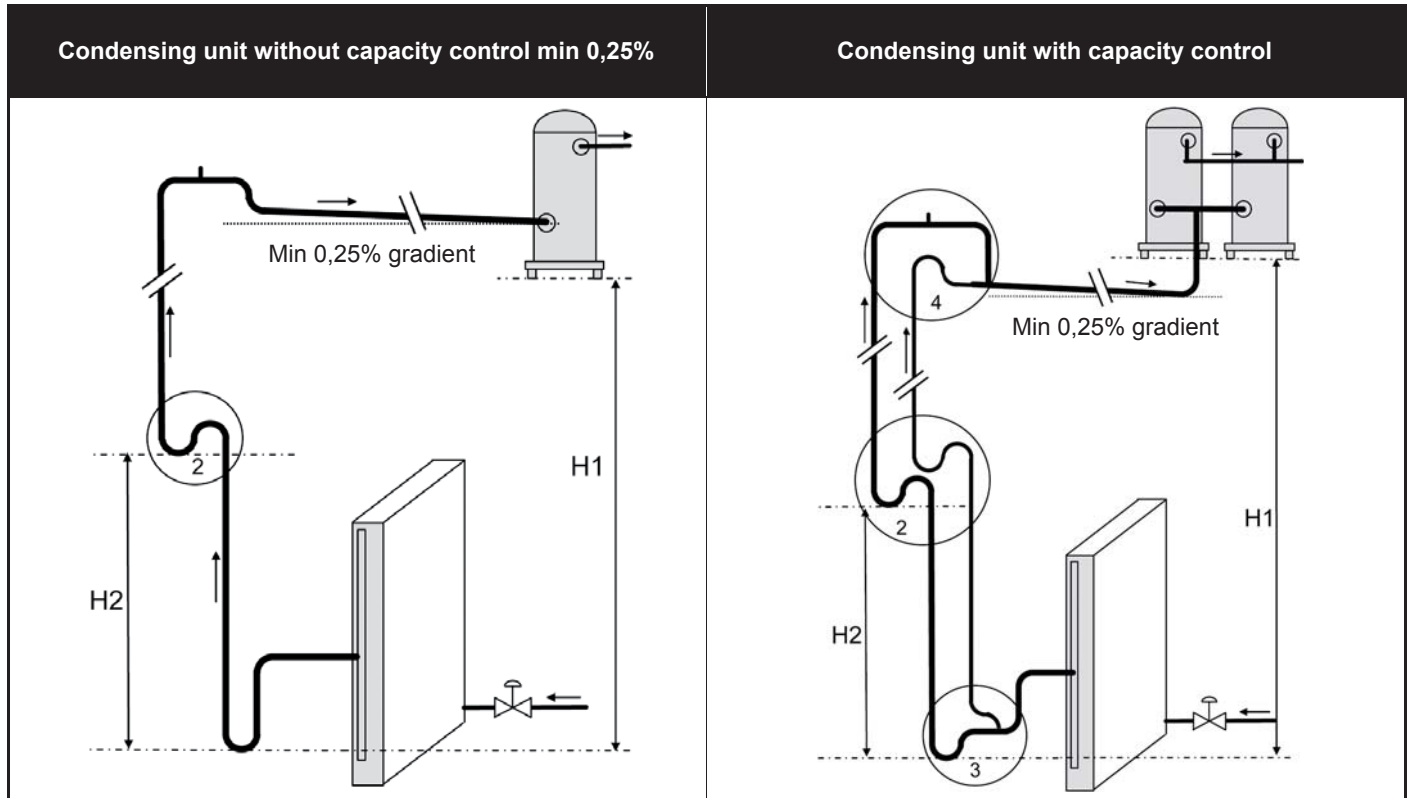
H1: 15 m. maxi
 H2: 5 m. maxi
 H3: 0,3 m. maxi
 H4: 0,15 m. maxi

1 - Lower trap with single tube
 2 - Clode coupled trap
 3 - Lower trap with double tubes
 4 - Higher trap with double tubes

WARNING: The liquid level between the condenser and the check valve A must compensate the check valve pressure drop.

*If receiver option: PED declaration class 3
 If no receiver option: PED declaration class 1*

Condensing units



H1: 15 m. maxi
 H2: 5 m. maxi
 H4: 0,15 m. maxi

- 1 - Lower trap with single tube
- 2 - Clode coupled trap
- 3 - Lower trap with double tubes
- 4 - Higher trap with double tubes

If receiver option: PED declaration class 3
If no receiver option: PED declaration class 1

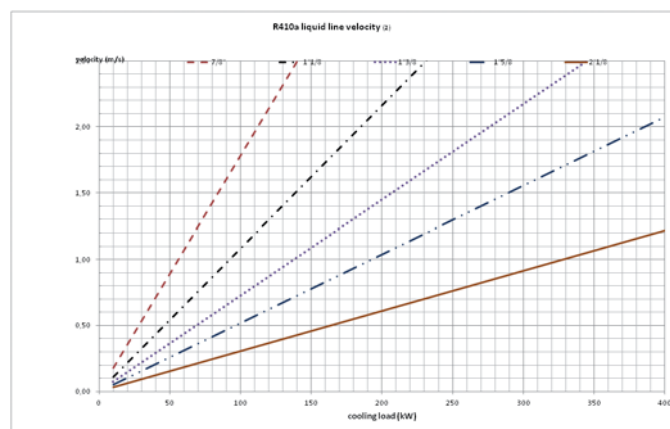
7.1 - Liquid line sizing

Determine the size of liquid lines using:

1. Operating conditions at full load.
2. Maximum pressure drop of 100 kPa
3. Liquid velocity under 2 m/s (to avoid liquid slugging).
4. For liquid risers, make sure that liquid sub cooling is sufficient to counteract the loss of static pressure and prevent gas flashing.

For MRC and HYDROLEAN units:

If the refrigerant in the liquid line flashes to a gas because the pressure drops too low or because of an increase in elevation, then the refrigeration system will not operate correctly. Liquid sub-cooling is the only method that prevents refrigerant flashing to gas due to pressure drops in the line. Pressure drops corresponding to 1.5°C saturated temperature must not be exceeded. Special attention must be paid to the liquid line sizing when the expansion valve is positioned higher than the condenser: The total pressure drop in the liquid line is the sum of the friction loss, plus the weight ($g \cdot p \cdot \Delta h$) of the liquid refrigerant column. An additional subcooler may have to be installed to prevent a phase change in the liquid line if the total pressure drop is too high. At 45°C, the volume mass of refrigerant R-410A in the liquid phase is approximately 940 kg/m³. A pressure of 1 bar corresponds to a liquid head of: $100\,000 / (940 \times 9.81) = 10.8$ m. The maximum recommended speed in the liquid lines is 1.5 m/s to avoid liquid hammering that may occur when the solenoid valve closes.



(2): at 45°C with 5°C subcooling and 8°C suction temperature; for other conditions, use the correction factor table.

7.2 - Discharge lines and suction lines

Calculate these to obtain a gas velocity in vertical sections that enables compressor oil migration and steady return to the compressor (tables C and D).

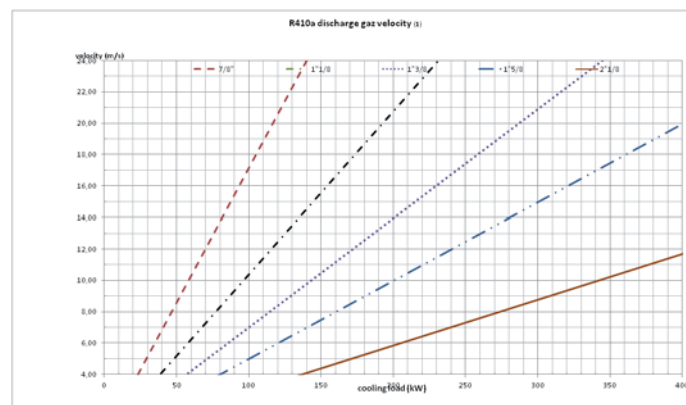
Determine the dimensions of vertical lines using the following tables.

Horizontal lines may be bigger in order to compensate pressure drop in vertical lines.

The total pressure drop in the piping has to be lower or equal to 1°C at saturation pressure on the suction side.

For MRC and HYDROLEAN units:

The pressure drop at the compressor discharge (pipes linking the compressor outlet with the condenser inlet) must be as small as possible to limit system performance losses (At 50°C condensing temperature, with 1.5°C equivalent pressure drop (1.07bar), the compressor power input increases by 3% and the cooling capacity decreases by 2.5%). Maximum refrigerant speed: 15m/s; minimum speed on horizontal lines: 3.5 m/s; minimum speed on rising lines: 8m/s.



(1): at 50°C condensing temperature and 8°C suction temperature; for other conditions, use the correction factor table.

Correction tables for MRC and HYDROLEAN units:

Discharge gas velocity correction factors		Condensing temperature °C							
		25	30	35	40	45	50	55	60
Suction temperature °C	13	1,37	1,25	1,15	1,07	1,01	0,96	0,93	0,92
	8	1,41	1,30	1,20	1,11	1,05	1,00	0,97	0,96
	3	1,47	1,34	1,24	1,16	1,09	1,04	1,01	1,00

Liquid line velocity correction factors		Liquid line temperature °C, 5°C subcooled							
		20	25	30	35	40	45	50	55
Suction temperature °C	13	0,67	0,72	0,77	0,83	0,90	0,99	1,10	1,23
	8	0,67	0,72	0,78	0,84	0,91	1,00	1,11	1,24
	3	0,68	0,73	0,78	0,85	0,92	1,01	1,12	1,26

7.3 - Mechanical isolation of refrigerant lines

Isolate refrigerant lines from the building to prevent the vibrations normally generated by the lines to the building structure. Avoid bypassing the isolation system on the unit by securing refrigerant lines or electrical conduits too tightly. Any vibrations will be transmitted to the building by rigid piping.

Lack of vibration isolation on refrigerant pipework will lead to early failure of copper pipe and loss of gas.

7.4 - Pressure test

To avoid formation of copper oxide during brazing operations, blow a little dry nitrogen through the pipes.

Piping must be made with tubing that is perfectly clean, plugged during storage and between connections operations.

During these operations, observe the following precautions:

1. Do not work in a confined atmosphere, refrigerant fluid can cause asphyxiation. Make sure there is sufficient ventilation.
2. Do not use oxygen or acetylene instead of refrigerant fluid and nitrogen for leak testing : this could cause a violent explosion.
3. Always use a regulator valve, isolating valves and a pressure gauge to control test pressure in the system. Excessive pressure can cause lines to burst damage to the unit and/or cause an explosion with severe personal injury.

Ensure conduct liquid line and gas line pressure tests are in conformity with applicable legislation. Before starting up a unit on a receiver, the piping and the condenser must be dehydrated. Dehydration should be carried out using a double stage vacuum pump, capable of drawing 600Pa absolute pressure vacuum.

Best results are obtained with a vacuum down to 100 Pa.

To get down to this level at normal temperatures, i.e. 15 °C, it is often necessary to leave the pump running for 10 to 20 hours. The duration of pump operation is not a factor of efficiency. The pressure level must be checked before the unit is put into service.

7.5 - Refrigerant charge

Chillers with R410A must be filled in the liquid phase. Never charge a machine operating on R410a in the vapour phase (vapour): the composition of the mixture could be modified. In liquid phase, connect either to a liquid isolating valve, or to the quick-connector on the liquid line at the valve outlet.

Note for all units:

Split units are supplied with a refrigerant or nitrogen holding charge. Before pulling down the vacuum for dehydration, completely purge the unit. Every time refrigerant is added, check the state of the charge with the sight glass if provided and also by the amount of liquid sub cooling at the condenser outlet according to the system design value. In all cases, do not top up the charge until the unit reaches a stable state of operation. Don't overcharge a system, this can adversely affect operation.

Overcharging causes:

- Excessive discharge pressure,
- A risk of damage for the compressor,
- Excessive power consumption.

7.6 - Oil charge

All units are delivered with a complete oil charge, and there is no need to add any oil before start up or afterwards. When a compressor is replaced and in the case of split units, it may be necessary, due to the length of piping installed, to add a certain amount of oil. Please refer to the following oil tables. Overcharging with oil can cause serious problems on an installation, particularly for the compressors.

Oil Recommendation for LENNOX chillers			
Refrigerant	Compressor type	Brand	Oil Type
R410A	Scroll ZP	Copeland	ICI EMKARATE RL32-3MAF or for refill MOBIL EAL Arctic 22CC

7.7 - Air cooled condensers

An air cooled condenser connected to a unit must have the same number of circuits as the unit. Selection of the condenser must be made carefully to enable transfer of the heat capacity of the unit even at the highest temperatures expected on an installation.

It is mandatory to control the head pressure in order to enable the unit to operate properly whatever the season:

A variety of different systems may be used, but the most simple and efficient of these modulates fan operation using a pressure or temperature control.

For condensers fitted with a small number of fans (1 or 2), it may be necessary to vary the fans speed.

Head pressure control systems that operate by flooding the condenser with liquid refrigerant should be avoided.

7.8 - PED category

The PED Category of the entire MRC (and MWC) range is Category II.



IMPORTANT

- Start up and commissioning must be conducted by LENNOX authorised engineer.
- Never shut off power to the crankcase heaters except for long service operations or seasonal shutdown

Check that all drain and purge plugs are in place and well tightened prior to fill the installation with water.

1 - LIMITS

Prior to any operation, please checks the operation limits of the unit given in the «APPENDIX» at the end of the IOM, These tables will give you all necessary information concerning the operating envelop of the unit. Please consult the «Risk analysis and hazardous situations according to 97/123 directive» given in the «APPENDIX» at the end of the IOM, or supplied with the unit.

2 - REFRIGERATION CIRCUIT CHECKS AND RECOMMENDATIONS

In case of split units, check the installation has been made according to the recommendation described § Installation. The unit refrigeration circuit sketch is given in the «APPENDICES» at the end of the IOM or supplied with the unit.

3 - HYDRAULIC SYSTEM INSTALLATION CHECKS (NEOSYS)

The unit hydraulic sketch is given in the «APPENDIX» at the end of the IOM.

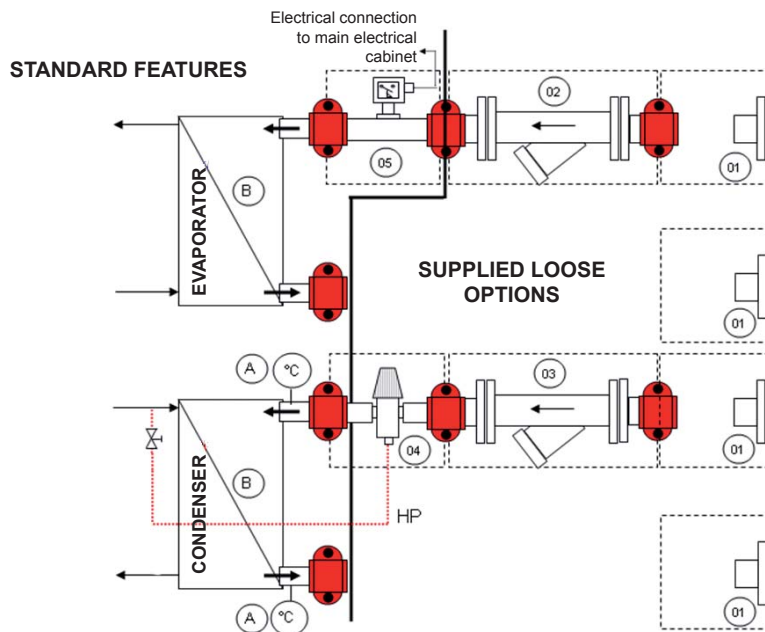
4 - INSTALLATION OF EXTERNAL HYDRAULIC COMPONENTS (FOR HYDROLEAN AND MWC)

Some hydraulic components may be supplied loose by LENNOX:

01	Kit for groove lock Coupling for MWC	05	Paddle Flow Switch
02	Evaporator Water inlet Filter	A	Inlet Outlet water temperature probe
03	Condenser Water inlet Filter	B	Heat exchangers
04	Pressure regulated Water valve		Hot water control option

Refer to the “OPTIONS” section for information on connection and installation

MWC units are delivered with Victaulic connection. Hydrolean units are delivered with Threaded male connection.

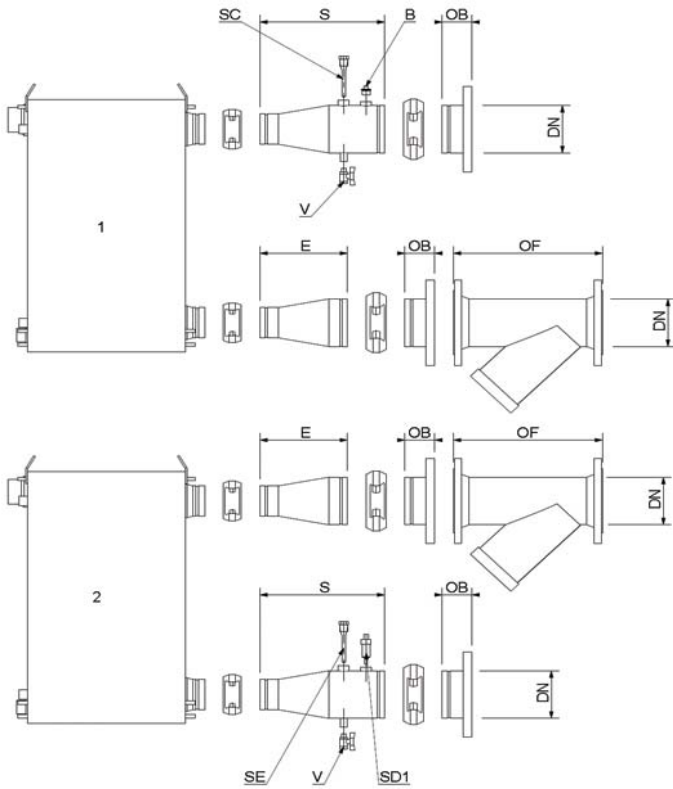


The components are located inside the units or in a separate box and must be installed by a qualified engineer. Note: In case of plate heat exchangers it is mandatory that a filter is installed at exchanger unit entrance.

These filters must remove all particles with a diameter greater than 1 mm.

5 - HYDRAULIC CONNECTIONS AND OPTIONS (FOR HYDROLEAN AND MWC)

Standard connections are Victaulic type for MWC and external threaded for Hydrolean, flange connections (MWC only) and filters are options



	E	S	OB	OF	SC	SE	DN
MWC 180	-	215	80	350	RT.WCOUT	RT.WEOUT	100
MWC 230							
MWC 280							
MWC 330							
MWC 380	235	335	80	400	RT.WCOUT1 RT.WCOUT2	RT.WEOUT	125
MWC 450							
MWC 510							
MWC 570							
MWC 650							
MWC 720							

- 1: Condenser
- 2: Evaporator
- B: Plug
- DN: Diameter
- E: Water inlet
- OB: Flange option
- OF: Filter option
- S: Water outlet
- SE: Evaporator sensor + pocket bulb
- SC: Condenser sensor + pocket bulb
- SD1: Flow switch
- V: Valve

For the commissioning, the flow switch must be mounted on the pipe “S” for the evaporator and connected on the flow switch electrical cable via a special connector. And the outlet sensors must be mounted in the pocket bulbs. The flow switch cable and the outlet sensor cables are already connected to the electrical panel and attached on the frame. The filters are mounted on the heat exchanger inlets.

6 - CHECK LIST BEFORE START-UP

Check that all drain and purge plugs are in place and well tightened prior to fill the installation with water or brine. Before proceeding with start-up, even for a test of short duration, check the following points, after having made sure that all the valves on the refrigeration circuit are fully open (discharge valves and liquid valves).

Starting up a compressor with the discharge valve closed will either trip the HP safety switch, or blow the cylinder head gasket or the internal pressure safety disc.

1. The liquid pump(s) and other apparatus interlocked with the unit (coils, air handling units, dry coolers, cooling towers, terminals such as fan coil units, etc.) are in working order as required by the installation and according to their own specific requirements. Place all water valves and refrigerant valves in their operating positions and start the water circulating pumps. Ensure main power supply is isolated before any work is started. Ensure unit is correctly earthed and that earth continuity is correctly done. Check that anti-vibration mountings are correctly installed and set.
2. Check the cleanliness and the tightness of all electrical connections, both the connections made at the factory and the connections made on site. Also make sure that all thermostat bulbs are correctly inserted and tightened in the various wells, if necessary add

heat conducting paste to improve contact. Make sure all sensors are correctly fitted and that all capillary tubes are fastened. The technical data printed at the top of the wiring diagram should correspond with those indicated on the unit nameplate.

3. Make sure that the power supplied to the unit corresponds to its operating voltage and that phase rotation corresponds to the direction of rotation of the compressors.
4. Ensure that the water circuits mentioned in 1 are completely filled with water or brine as the case may be; with the air bled out of all high points, including the evaporator ensuring they are perfectly clean and leaktight. In the case of machines with water cooled condensers, the condenser water circuit must be ready to operate, filled with water, pressure tested, bled, filter cleaned after 2 hours of operation of the water pump. Cooling tower in operating condition, water supply and overflow checked, fan in operating condition.
5. Reset all manually resetting safety devices (where necessary).
Open power circuits to all components: compressors, fans...
6. Power up the unit with the main disconnect switch (option). Visually check the oil level in the compressor crankcases (bullseyes). This level may vary from one compressor to another, but should never be higher than the first third of the way up the bullseyes.



CAUTION: Power up the compressor crankcase heaters at least 24 hours before starting the unit. This will enable the refrigerant in the crankcases to evaporate off, and prevents damage to compressors through lack of lubrication during start up.

7. Start the pump(s) check the flow of liquid to be cooled through the heat exchangers: note the inlet and outlet water pressures, and, using the pressure drop curves, calculate liquid flow by applying the following formula:

$$\text{Actual flow} \\ Q = Q1 \times \sqrt{(P2/P1)}$$

Where

P2 = pressure drop measured on site

P1 = pressure drop published by LENNOX for a liquid flow of Q1

Q1 = nominal flow

Q = real flow

Adjust the evaporator circuit and condenser circuit water flows (via regulating valves, pump speed position..) to come close to the designed conditions (LENNOX software).

8. On units with air cooled condensers, check for correct operation of the fans and that the protective grilles are in good condition. Make sure that rotation is in the right direction.
9. Before making any electrical connections, check that insulation resistance between power supply connection terminals is in keeping with applicable regulations. Check the insulation of all electrical motors using a DC 500V megohmmeter, following the manufacturer's instructions.

CAUTION: Do not start any motor whose insulation resistance is lower than 2 mégohms.

Never start any motor while the system is under a vacuum.

7 - MASTER-SLAVE CONFIGURATION (2 UNITS OR MORE)

In case of 2 units or more that shall operate together, the controller allows several configurations: please consult the controller manual to enter the right parameters.

1 - CHECKS TO BE MADE DURING START UP

Before starting the unit, fill in the check list sheet of this manual and follow the instructions below to be sure that the unit is correctly installed and ready to operate.

1. Thermometers and pressure switches installed in the chilled water circuit and the condenser water circuit.
Check these safety devices in this order: high pressure switch, low pressure switch, fan control pressure switches and thermostats, anti short cycle relay. Make sure all indicator lights operate correctly.
2. Run evaporator pump prior to start the chiller.
3. Flow switch installed and wired into the control box operates properly.
4. With the compressor running, check the oil pressure. If there is a fault, do not restart the compressor again until the source of the problem has been located.
5. Check that there is sufficient cooling load on the day the start up is conducted (at least 50 % of the nominal load).

PROCEDURE TO FOLLOW WHEN STARTING THE UNIT

5a Press the power "ON-OFF" switch. The compressor will only start if the evaporating pressure is greater than the cut-in set point of the low pressure switch. Check immediately the good rotation of the compressor. Evaporating pressure drops steadily, the evaporator empties itself of the liquid refrigerant accumulated in it during storage. After a few seconds, the solenoid valve opens if any.



REMEMBER THAT THE COMPRESSOR IS A SCROLL TYPE COMPRESSOR:

Before starting the unit, the compressor should be checked that rotates in the correct direction, through a three phase protection. Scroll type compressors only compress in one direction of the rotation. Therefore, it is essential that the phase connection for scroll-type three-phase compressors be carried out correctly (the correct direction of rotation can be checked when the pressure on the suction side decreases and the pressure on the discharge side increases when the compressor is activated). If the connection is wrong, the rotation will be reversed causing a high noise level and a reduction in the amount of current consumed. If this occurs, the compressor's internal protection system will operate in shutting down the unit. The solution is to disconnect, switch the wires between two of the phases and connect the three again).

ASTP protection is included with the unit compressors: This device protects the compressor against high discharge temperatures. When the temperature reaches critical values, ASTP protection causes "Scrolls" are separated. Compressor may stop pumping with motor running.



Evaporating pressure drops steadily, the evaporator empties itself of the liquid refrigerant accumulated in it during storage. After a few seconds, the solenoid valve opens if any.

- 5b Check on the sight glass (upstream of the expansion valve if available) that the bubbles disappear progressively, indicating a correct refrigerant charge and without non condensable gas. If the humidity indicator changes colour, indicating the presence of humidity, replace the filter-drier cartridge if the latter is of the replaceable type. The best practice recommends checking the sub cooling after the condenser.
- 5c Check that, when the cooling load has been balanced by the capacity of the unit, the chilled liquid is at design temperature.
6. With the compressor running, check the oil pressure. If there is a fault, do not restart the compressor again until the source of the problem has been located.

7. Check the current values per phase on each compressor motor.
8. Check the current values per phase on each fan motor (If available)
9. Check compressor discharge temperature.
10. Check suction and discharge pressures and compressor suction and discharge temperatures.
11. Check chilled liquid entering and leaving temperatures.
12. Check condenser entering and leaving air or water temperatures.
13. Check outdoor air temperature in case of split units
14. Check liquid refrigerant temperature at the condenser outlet.

These verifications should be made as quickly as possible with a stable cooling load, i.e. the cooling load of the installation should be the same as the capacity developed by the unit. Measurements taken without heeding this condition will result in unusable and probably wrong values.

These verifications can only be made once the proper operation of all safety devices and unit controls has been established.

2 - WATER FLOW CHECKS

The unit control system displays the inlet and water outlet temperature to be displayed. It is very important that the unit operates at the correct water flow rate. It is dangerous to leave the unit operating at a low flow rate as this could result in serious damage to components as well as the water exchanger (on the evaporator side, the flow switch will stop the unit at too low water flows). If the unit operates at too high a flow rate, this will also hinder optimum performance. The second way of determining the operating flow rates is to measure the temperature difference between the water in and outlet at full or partial loads.

Checking the water flow rate (it is vital to measure the thermal peak) (Standard unit)

The nominal flows at design conditions and the delta T at design conditions must be used. Now, during start-up, the ambient conditions will often be different from the ambient design conditions, and therefore, the cooling capacity (and the heat rejection) of the chiller will be different from those at design conditions. Use the chiller performance charts of the AGU to find the right ΔT on the evaporator (and condenser side). For a unit selected at design conditions, this will give the nominal delta T on the evaporator side (ΔT_{en}), (on the condenser side (ΔT_{cn})) and the nominal flows (den and dcn). At ambient start-up conditions, the charts will give start-up flows on the evaporator side (desu) (and on the condenser side (dcsu)). If the water flows are correct, for this start-up conditions, the delta T on the evaporator (ΔT_{esu}) should be $\Delta T_{esu} = \Delta T_{en} \cdot \text{desu} / \text{den}$ (and the delta T on the condenser (ΔT_{csu}) should be $\Delta T_{csu} = \Delta T_{cn} \cdot \text{dcsu} / \text{dcn}$).

3 - FUNCTIONS AND MAIN REFRIGERANT COMPONENTS

1. Compressor (scroll type): a compressor is a device driven by a motor to bring a refrigerant gas from a low pressure, low temperature phase to a high pressure, high temperature phase.
2. Evaporator (brazed plate type): a heat exchanger in which on one side the refrigerant evaporates, thus extracting heat from the water or brine on the other side.
3. Condenser (brazed plate type for water cooled unit or tube & fin or Microchanneels for air cooled): a heat exchanger in which on one side the refrigerant condensates, thus releasing heat on the other side (water or brine or air if remote condenser or air cooled).
4. Expansion valve (thermostatic or electronic type): a device that regulates the refrigerant flow to the evaporator.

Very important:

The expansion valve fitted on each circuit of the unit has been selected for a given operating range; it must be replaced with a model with the same reference from the same manufacturer.

1. Low pressure switch: this pressure switch initiates unconditional shut down of the unit if evaporating pressure drops below the Low pressure set point value.
On HYDROLEAN the low pressure switch is auto reset. The controller will lock the fault preventing a new start up after three faults.
 - +6°C ambient temperature machines (standard) P = 6 bars relative
 - Optional -20°C ambient temperature machines P = 1.5 bars relative
2. High pressure switch: this pressure switch initiates unconditional stoppage of the unit if compressor discharge pressure exceeds the operating limits. Reset is automatic. HP setting=42 bar.
3. High pressure safety relief valve: the ultimate safety device that releases refrigerant if the pressure exceeds the service pressure.
4. Filter dryer: this is designed to keep the circuit clean and to remove all traces of humidity from within the refrigeration circuit, since this can impair operation of the unit, by acidification of the oil, which causes slow disintegration of the varnish protecting of the compressor motor windings.
5. Oil level controller on MRC version: It prevents the circuit from starting with a too low oil level; it is not activated when the compressors are already running.
6. Crankcase heater: Every compressor is fitted with a single phase crankcase heater that is activated when the compressor stops to ensure separation of the refrigerant and the compressor oil. It is therefore powered up when the compressor is not running.

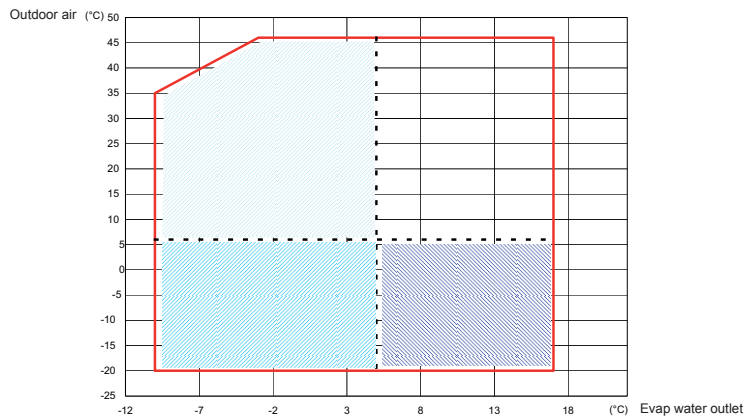
1 - OPERATING LIMITS



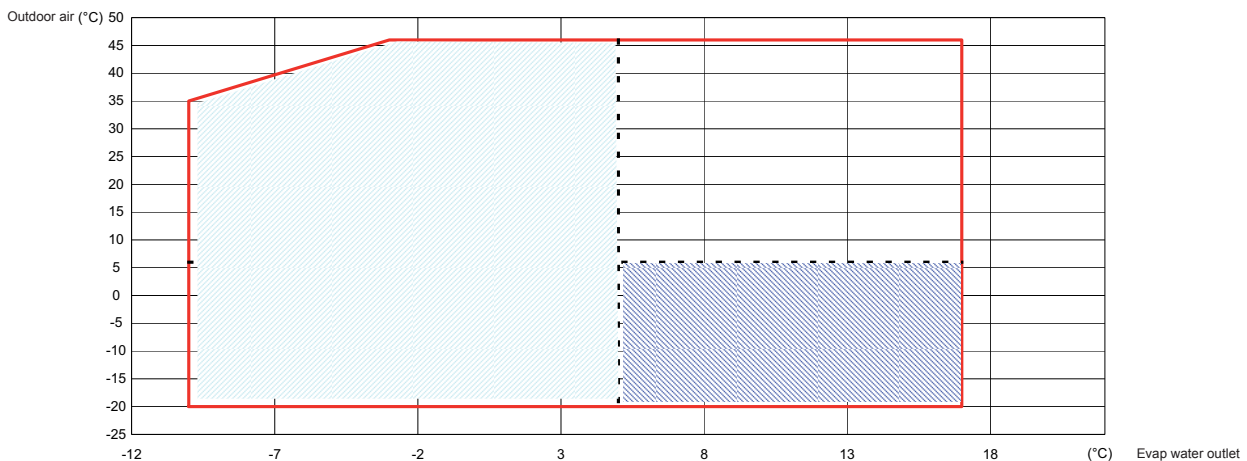
WARNING: It is very important ensure the units operate well inside these envelopes.

1.1 - NEOSYS

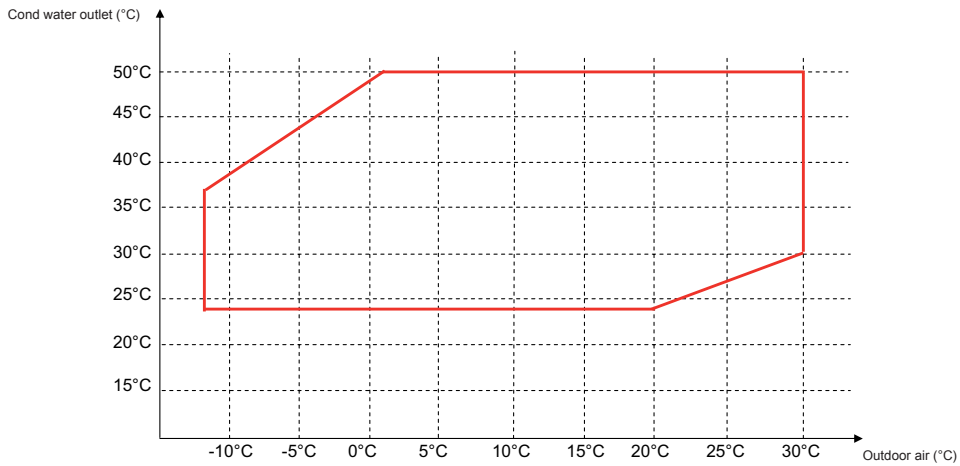
NAC		200 > 340	380	420 - 480	540	600 > 680	760	840 - 960	1080
Min. outlet water temperature	°C	5							
Min. outlet water temperature with brine operation option		-10							
Max. inlet water temperature	°C	20							
Min. difference water inlet/outlet	°C	3							
Max. difference water inlet/outlet	°C	8							
Min. outside air temperature	°C	6							
Min. outdoor air temperature, winter operation option	°C	-20							
Maximum outside air temperature, full capacity operation	°C	46	43	46	43	46	43	46	43



NAH COOLING MODE		200 > 480
Min. outlet water temperature	°C	5
Max. inlet water temperature	°C	20
Min. difference water inlet/outlet	°C	3
Max. difference water inlet/outlet	°C	8
Min. outside air temperature	°C	6
Maximum outside air temperature, full capacity operation	°C	46

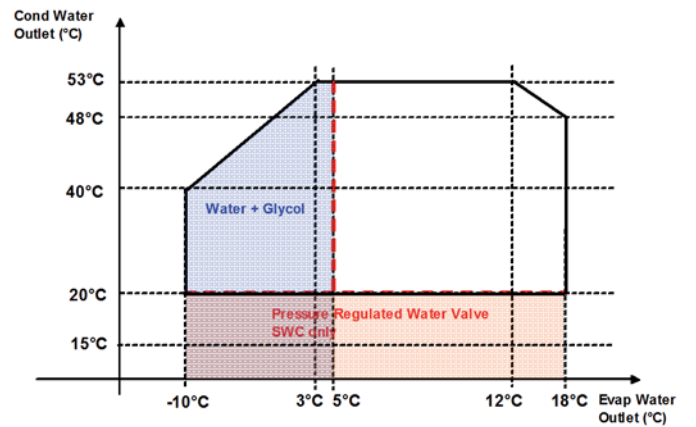
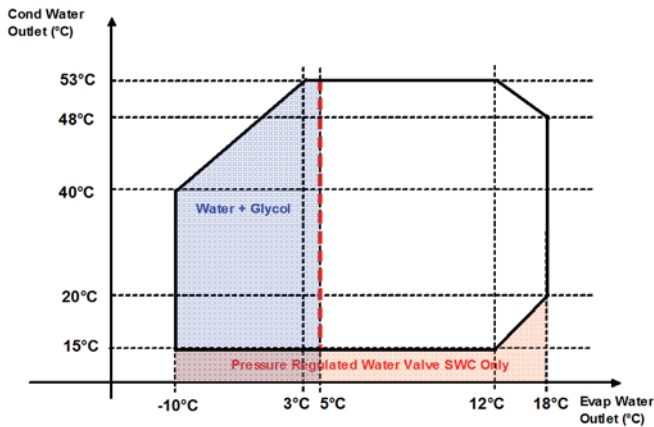


NAH HEATING MODE		200	230	270	300
Min. condenser outlet temperature	°C			24	
Max. condenser outlet water	°C			50	
Min. difference water inlet/outlet	°C			3	
Max. difference water inlet/outlet	°C			8	
Min. outside air temperature with water outlet 37°C	°C			-12	
Max. outside air temperature	°C			30	

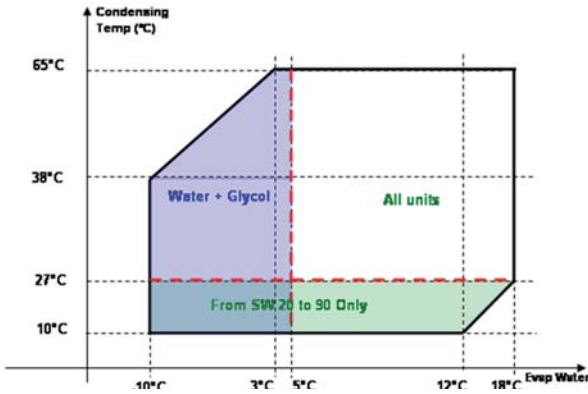


**1.2 - HYDROLEAN COOLING AND HEAT PUMP VERSION
SIZE 025-035-050-070-080-100-120**

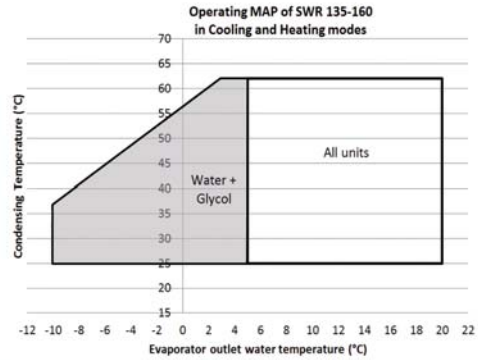
**1.3 - HYDROLEAN COOLING AND HEAT PUMP VERSION
SIZE 135-160**



**1.4 HYDROLEAN WITH REMOTE CONDENSER
(SIZES 025-035-050-070-080-100-120)**



**1.5 - HYDROLEAN WITH REMOTE CONDENSER
(SIZES 135-160)**



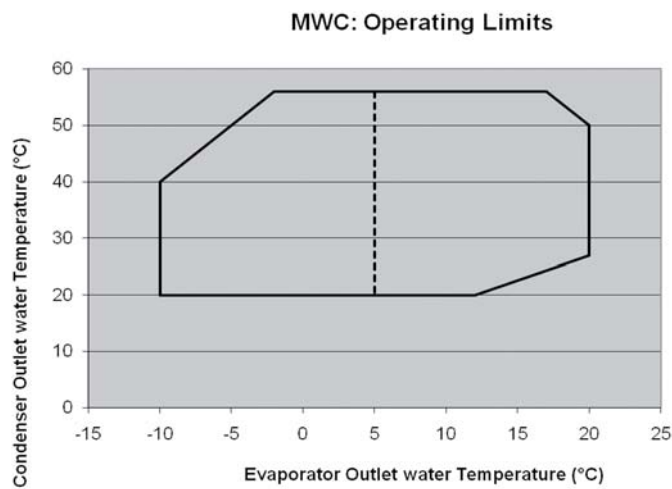
Indication on Pipe sizing for SWR type units

	Discharge Line				Liquid Line			
	Circuit 1		Circuit 2		Circuit 1		Circuit 2	
	Mini Dia.	Min / Max speed	Mini Dia.	Min / Max speed	Mini Dia.	Min / Max speed	Mini Dia.	Min / Max speed
	Inches	m/s	Inches	m/s	Inches	m/s	Inches	m/s
025	7/8"	10 / 15 m/s	-	-	5/8"	0,5 / 1,5 m/s	-	-
035	7/8"	10 / 15 m/s	-	-	5/8"	0,5 / 1,5 m/s	-	-
050	1" 1/8	10 / 15 m/s	-	-	7/8"	0,5 / 1,5 m/s	-	-
070	1" 1/8	10 / 15 m/s	-	-	7/8"	0,5 / 1,5 m/s	-	-
080	1" 3/8	10 / 15 m/s	-	-	7/8"	0,5 / 1,5 m/s	-	-
100	1" 1/8	10 / 15 m/s	7/8"	10 / 15 m/s	7/8"	0,5 / 1,5 m/s	5/8"	0,5 / 1,5 m/s
120	1" 1/8	10 / 15 m/s	7/8"	10 / 15 m/s	7/8"	0,5 / 1,5 m/s	5/8"	0,5 / 1,5 m/s
135	1" 1/8	10 / 15 m/s	1" 1/8	10 / 15 m/s	7/8"	0,5 / 1,5 m/s	7/8"	0,5 / 1,5 m/s
160	1" 3/8	10 / 15 m/s	1" 1/8	10 / 15 m/s	7/8"	0,5 / 1,5 m/s	7/8"	0,5 / 1,5 m/s

1.6 - MWC (ALL SIZES)

MCW version	All sizes	
Operating limits (Water Delta T on evap and cond: 5K)		
Min. evap. outlet water temperature	°C	5
Max evap. outlet water temperature	°C	20
Min. difference water inlet/outlet	°C	3
Max. difference water inlet/outlet	°C	8
Min. cond. outlet water temperature	°C	20
Max. cond outlet water temperature		
Operation at full capacity	°C	56

MRC version	All sizes	
Operating limits (Water Delta T on evap: 5K)		
Min. evap. outlet water temperature	°C	5
Max evap. outlet water temperature	°C	20
Min. difference water inlet/outlet	°C	3
Max. difference water inlet/outlet	°C	8
Min. condensing temperature	°C	25
Max. condensing temperature		
Operation at full capacity	°C	62



2 - CLIMATIC CONTROL

See the specific CLIMATIC 60 manual
 See the specific «Basic CLIMATIC controller» manual

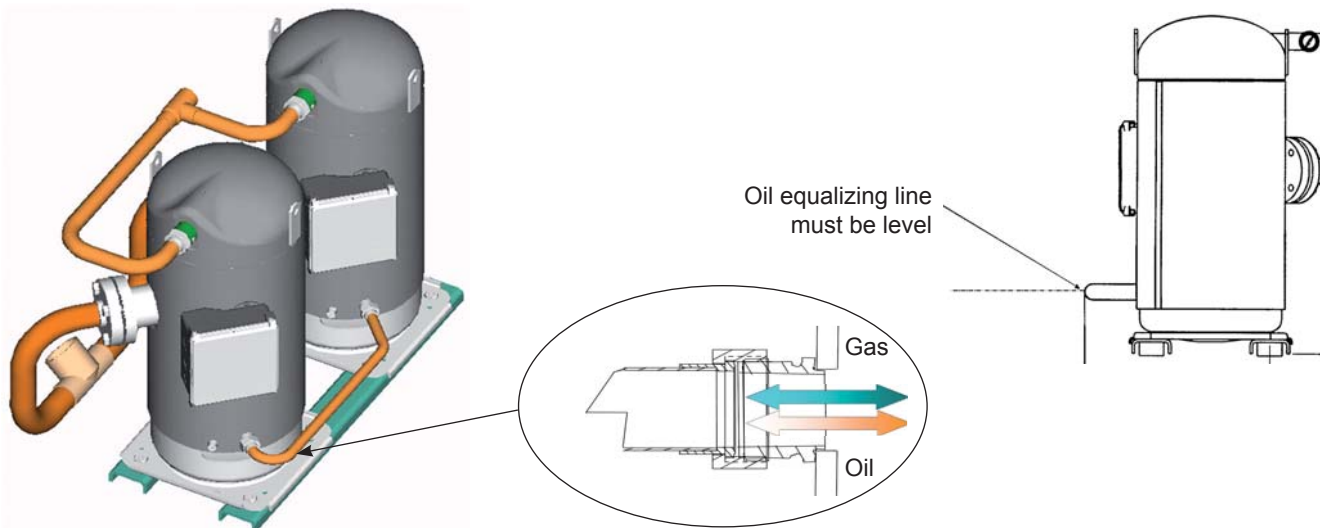
3 - UNIT OPERATION: REFRIGERATION CIRCUIT

3.1 - Tandem and Trios scroll assemblies

With tandem and trios assemblies the oil balancing is achieved through the use of a large two phase line tube



It is **IMPERATIVE** that this tube is perfectly level during operation to ensure proper oil balancing between the two crankcases
 It is also **IMPERATIVE** for the compressor to be mounted on a rigid base frame as there is no flexibility in the oil equalizing line. The whole assembly can then be mounted on silencers.



The oil equalizing Line is fitted with a sight glass which can be used to check the oil level in the compressor assembly. It is mandatory to stop both compressors to get a good reading of the oil level in the crankcase of the compressors.

There can be two types of tandem assemblies:

- EVEN TANDEM when both compressors are the same models
- UNEVEN TANDEM when compressors are different models

In the case of uneven tandem assemblies a restrictor is inserted in the suction of one of the two compressors. The purpose of this restrictor is to equalize the suction pressure in order to ensure a better oil return to both compressors.

Contact LENNOX after sales offices for additional informations.



WARNING: THE UNIT WITH UNEVEN TANDEM CAN NOT OPERATE WITHOUT A RESTRICTOR.

3.2 - Copeland scroll discharge temperature protection

If the oil in the compressor gets too hot it will start to deteriorate and lose its ability to lubricate, and will eventually cause a compressor failure. LENNOX compressors are sometimes fitted with a specially designed sensor in the hottest part of the compression cycle, just above the discharge port of the scroll sets. This sensor is connected to the solid-state protection module in the terminal box. If the temperature rises above a pre-set value, the compressor will be shut down for 30 minutes before restarting the compressor.

3.3 - Kit for low chilled water temperature (option)

This option can only be selected on HYDROLEAN Cooling only units SWC.



It is required for unit which operates constantly with chilled water outlet temperatures below 0°C. The Expansion Valve used in low temp applications can not be used with water temperatures over 0°C as the evaporating temperature will remain negative. It is mandatory to use Glycol on such application.

Special controller setting for antifreeze protection:

	Factory settings		Min	Max
	Standard	If option		
A11 - Anti-freeze alarm activation set point	3	-10	-127	127
A12 - Hysteresis of anti-freeze alarm	2	2	0	25,5

3.4 - High and low pressure gauges (option not available on NEOSYS)

They enable an instantaneous readout of suction and discharge pressures.

Liquid filled gauges that measure the evaporating Low pressure (LP) and condensing high pressure (HP) on each refrigerant circuit. Gauges are "glycerine" filled to damp gas pulsation and are mounted externally. The gauges are compound gauges that display the saturated refrigerant temperature for the refrigerant R410A.



3.5 - Sight glass (option)

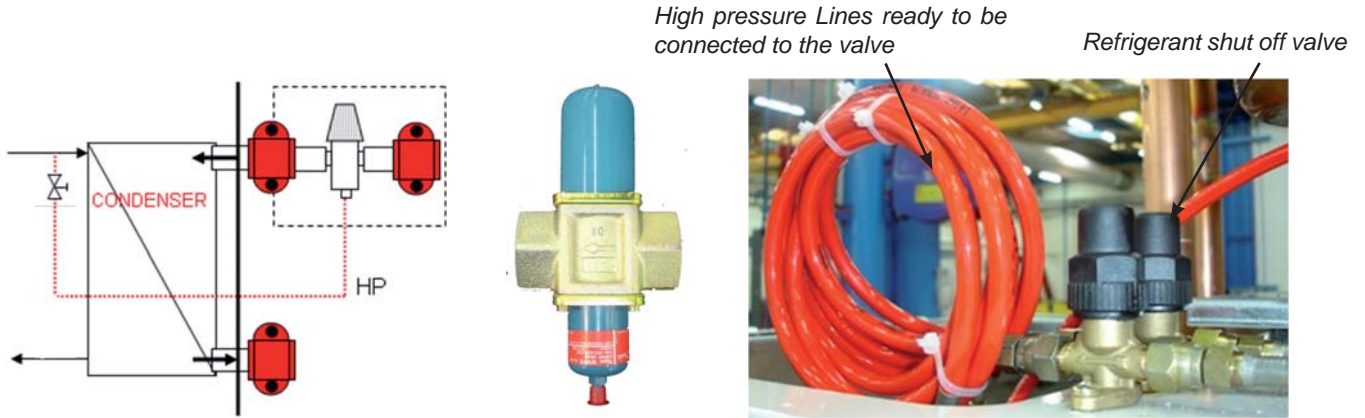
This feature when fitted enables visual check of the state of the liquid refrigerant (phase liquid gas or both) in the liquid line, upstream of the thermostatic expansion valve. It also enables to some extent the detection of humidity in the circuit.

3.6 - Pressure regulated water valve (option for water cooled units only)

This device is available as an option for low capacity water cooled condensing units (HYDROLEAN or MCW). The PRESSURE REGULATED WATER VALVE should be installed on the condensing water system. It enables water flow through the heat exchanger to be adjusted so as to maintain condensing pressure at an appropriate value. On HYDROLEAN this feature is supplied loose as a kit with refrigerant high pressure line ready to be connected to the valve. An isolating valve is also provided on this high pressure line to isolate the valve in case of leak.



WARNING: It is imperative to avoid any air ingress into the refrigeration system during the connection of the refrigerant High Pressure line to the water valve. The connection to the water pressure regulating valve MUST be checked for refrigerant leaks after installation.



3.7 - Fan control pressure switch and thermostat

The function of these devices is to ensure a level of head pressure compatible with proper unit operation. An increase in outdoor air temperature increases head pressure, and this is maintained at its required value by fan operation.

3.8 - Antifreeze function

This function only exists on units designed for brine or glycol/water chilling for which the freezing temperature depends on the concentration of the solution.

Whatever type of device is used (see case 1 and 2), cut-out by the antifreeze function causes immediate unit stoppage.

CASE 1: Antifreeze thermostat:

This device monitor chilled liquid temperature at the evaporator outlet. It triggers when the temperature goes below the minimum value (+ 4°C for water).

CASE 2: Antifreeze pressure switch:

This monitors evaporating pressure of the refrigerant. It triggers when the temperature goes below the preset minimum value.

Note: On units fitted with CLIMATIC control, see the appropriate user manual for more specific details.

4 - UNIT OPERATION: ELECTRICAL AND CONTROL FEATURES

See the specific «Basic CLIMATIC controller» manual

4.1 - Fan over current protection

Circuit breaker designed to stop the fan motors in the event of phase over current in relation to the permitted value.

4.2 - Compressor motor over current protection

Circuit breaker designed to protect each motor winding against accidental over current.

4.3 - Chilled liquid pump interlock

This interlock is made only if the the pump is supplied with the liquid chiller. As soon as the unit is powered up and the remote on/off for the unit is validated, the pump starts running. Prior operation of the pumps is mandatory for compressor operation.

Note: on units with CLIMATIC control, control of 1 or 2 water pumps is catered for by the control program.

4.4 - Flow switch for the chilled liquid (option)

This control device initiates unconditional unit stoppage as soon as the flow of chilled liquid (water, brine, etc...) ensured by the pump becomes insufficient, since this could cause rapid evaporator freeze up. When the contact opens due to a lack of flow the unit must stop immediately.

If the purchaser installs a flow switch himself, electrical connections should be made to the two remote interlock terminals (dry contact).

4.5 - Antifreeze protection (standard)

This feature is provided as standard by the climatic controller: and can be adjusted for brine or glycol/water chilling for which the freezing temperature depends on the concentration of the solution.

The antifreeze protection provided causes an immediate shut down of the unit c

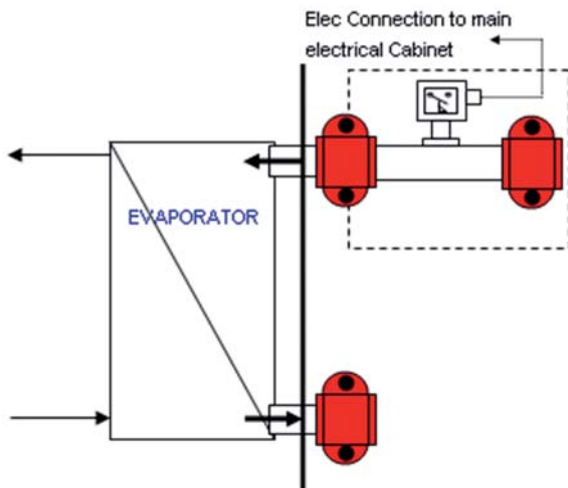
The controller monitors the chilled water outlet temperature. It then triggers the fault if the temperature goes below the set point value (+ 4°C for water).

4.6 - Flow switch for the chilled water (standard)

This control device is supplied loose as standard on all HYDROLEAN and initiates unconditional unit shut down as soon as the flow of chilled liquid (water, brine, etc...) is too low.

On HYDROLEAN units a cable is provided to connect the external flow switch to the control panel.

If the user installs a flow switch himself, electrical connections should be made to the two remote interlock terminals (dry contact).



4.7 - Control of external single pump for evaporator (option)

The optional control and protection of external pump for evaporator can be selected on all HYDROLEAN units.

It consists in the addition of a circuit breaker and contactor controlled by the CLIMATIC.

The protection is located in the main electrical panel close to the compressor protections.

The pump parameters can be accessed using the password "38".

		Factory setting	Min	Max
Pump operation mode: Continuous operation "0"	P01	0	0	1
Pump ON - compressor ON delay (seconds)	P02	240	0	255
Compressor OFF - pump OFF delay (seconds)	P03	240	0	255

Size of the protections provided for both evaporator and condenser single pumps

	25 35	50 70 80	100 120	135	160
PMP1 (Max kW with 400V and $\text{Cos}\phi = 0,6$)	1,0	1,7	1,7	2,6	4,2
Protection Range Provided (A)	1,6-->2,5	2,5-->4	2,5-->4	4-->6,3	6,0-->10
PMP2 (Max kW with 400V and $\text{Cos}\phi = 0,6$)	1,0	1,7	1,7	2,6	4,2
Protection Range Provided (A)	1,6-->2,5	2,5-->4	2,5-->4	4-->6,3	6,0-->10

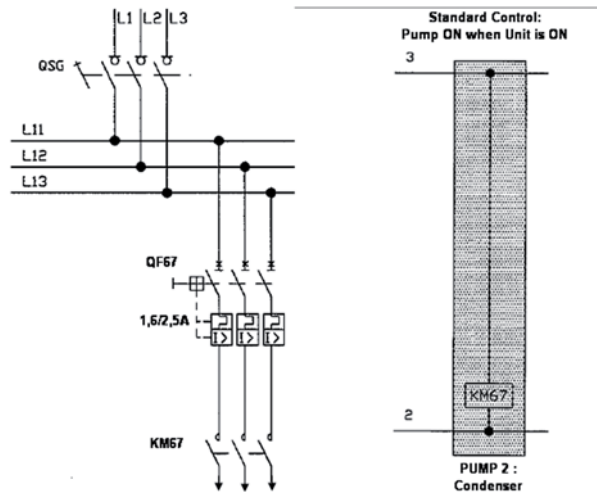
4.8 - Control of external single pump for condenser (option)

The optional protection of external pump for condenser can be selected on all HYDROLEAN units.

It consists in the addition of a circuit breaker and contactor which is switched ON when the unit is ON and OFF when the unit is Off. This contactor can also be controlled by an external signal from the customer's installation: 24V dry contact to be connect-ed directly on the pump 2 contactor.

This protection can be located in the main electrical panel or in an additional electrical cabinet inside the unit depending on the configuration of the unit and options.

Wiring for external pump on condenser



4.9 - Control and protection of external fans (option)

The optional control and protection of external fans can be selected on all HYDROLEAN units.

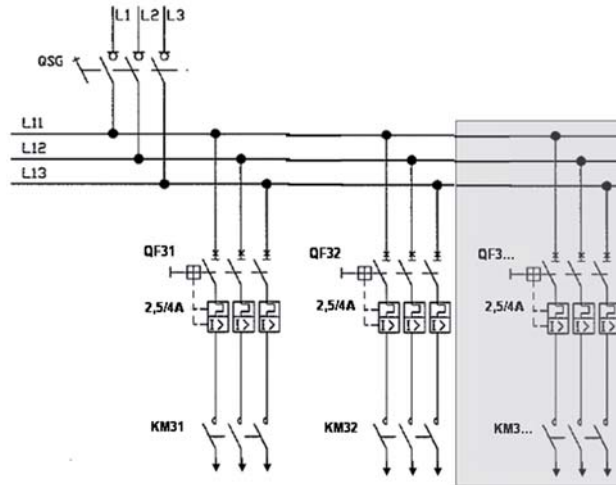
It consists in the addition of a circuit breaker and contactor per fan and controlled as standard by adjustable pressure switches.

This protection can be located in the main electrical panel or in an additional electrical cabinet inside the unit depending on the configuration of the unit and options.

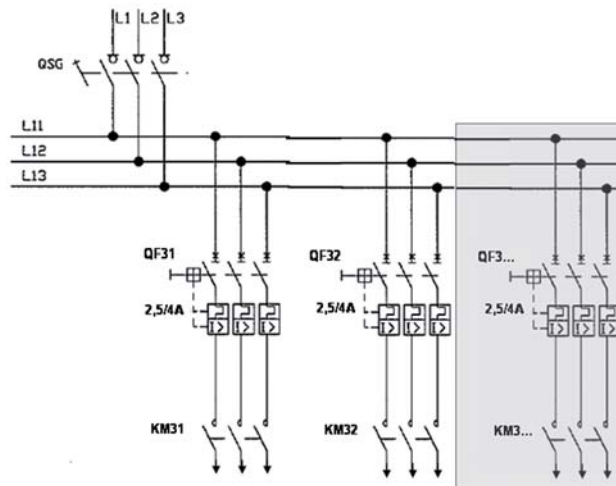
Size of the protection provided

	25 35	50 70 80	100 120 135 160
FAN1 (Max kW with 400V and $\text{Cos}\phi = 0,72$)	2	2	2
Protection Range Provided (A)	2,5-->4	2,5-->4	2,5-->4
FAN2 (Max kW with 400V and $\text{Cos}\phi = 0,72$)	2	2	2
Protection Range Provided (A)	2,5-->4	2,5-->4	2,5-->4
FAN3 (Max kW with 400V and $\text{Cos}\phi = 0,72$)	-	2	2
Protection Range Provided (A)	-	2,5-->4	2,5-->4
FAN4 (Max kW with 400V and $\text{Cos}\phi = 0,72$)	-	-	2
Protection Range Provided (A)	-	-	2,5-->4

Wiring for external fan protection



Wiring for control of external fan



Incompatibilities between options and features on HYDROLEAN

UNIT TYPE AND SIZE	SW 25 35	SW 50 70 80	SW 100 120 135 160
CONTROLLER MODEL	Climatic 40		
AVAILABLE OPTIONS & FEATURES	Dynamic Set Point or Remote Heat/Cool or Control on Hot Water	Remote ON / OFF or Dynamic Set Point or Remote Heat/Cool or Control on Hot Water	Remote ON / OFF
	Remote ON / OFF or Control on Hot Water		Dynamic Set Point
			Control on Hot water
			Remote Heat/Cool

4.10 - Hot water control (option)

This option can only be selected on HYDROLEAN Cooling only units SWC and consist in a special configuration of the program and temperatures probes fitted to the condenser.



It is NOT recommended to use a pressure regulating valve when the control on hot water option is selected.

4.11 - Remote heat cool (standard if no incompatibilities refer to previous page for details)

This option can only be selected on HYDROLEAN Heat Pump version SWH and consist in a special configuration of the program. It allows the remote change over from cooling to heating mode.

Refer to the unit electrical schematic diagram for information on how to connect the remote heat cool signal.

5 - OTHER FEATURES AND OPTIONS

5.1 - Loss of power supply

There are no problems restarting the machine after a loss of power supply of short duration (up to about one hour). If loss of power supply lasts longer than this, when power supply is resumed set the unit to «OFF» with the compressor crankcase heaters activated for as long as it takes to bring sump oil back up to temperature, then restart the unit.

5.2 - Air cooled chiller

5.2.1 - Starting sequence

- Press the unit start switch, the power light will come on ; The control circuit cannot be energised if there is no power supply to the main power circuit.
- Depending on the demand for cooling, the control thermostat authorises start up of the compressor(s), which takes place in sequence. The compressor run indicating lights come on.

5.2.2 - Regulator stoppage sequence

When the cooling load starts decreasing from its maximum value, the multi-stage control thermostat shuts down successive stages depending on the progressive reduction in return chilled liquid temperature.

Depending on machine equipment, staged reduction consists either in shutting down a compressor or activation of a compressor capacity reducer. This continues until the unit shuts down completely through action of the regulator. The compressor regulation stoppage lights come on.

5.2.3 - Safety shutdown sequence

If a default occurs on a circuit, it is detected by the appropriate safety device, (high pressure overshoot, loss of oil pressure, motor protection, etc...) The relay in question initiates unconditional stoppage of the compressor on that circuit and the safety stoppage indicating light comes on.

Some defaults give rise to immediate stoppage of the entire unit:

- Tripped flow switch,
- Tripped antifreeze thermostat
- etc....

In cases other than that of manually reset safety devices, starting up of the circuit or the machine takes place automatically once the default has been cleared.

5.2.4 – Condensing pressure control water valve

This device is available as an option for low capacity water cooled condensing units (HYDROLEAN and MCW)

The high pressure control water valve should be installed on the condenser outlet. It enables water flow through the heat exchanger to be varied so as to maintain condensing pressure at an appropriate value.

Warning:

During the life-time of the system, inspection and tests must be carried out in accordance with national regulations. The information on operating inspections given in annex C of standard EN378-2 can be used if no similar criteria exist in the national regulations.

We recommend regular and thorough servicing of the LENNOX unit. The following maintenance instructions form a part of the operations required for this type of equipment.

However, it is not possible to give fixed and precise rules for permanent maintenance procedures capable of keeping all units in perfect operating condition since too many factors depending on local conditions specific to the installation, the way the machine is operated, the frequency of operation, climatic conditions, atmospheric pollution, etc. Only trained experienced personnel can establish strict maintenance procedures adapted to the conditions listed above.

Nonetheless, we recommend a regular maintenance schedule:

- 4 times a year for chillers operating all year long
- 2 times a year for chiller that only operate during the cooling season

All operations must be performed in conformity with the maintenance plan; this will extend the service life of the unit and reduce the number of serious and costly breakdowns.

It is essential to keep a «service log», for weekly records of operating conditions of the machine. This log will serve as an excellent diagnostic tool for maintenance personnel ; likewise, the machine operator, by noting down changes in machine operating conditions, will often be able to anticipate and avoid problems before they actually occur or worsen.

The manufacturer cannot be held responsible for any malfunctioning of any equipment it provides if it is caused by a lack of maintenance or by operating conditions beyond those recommended in this manual.

Shown below, and as an illustration only, are some of the most common rules applied for maintenance.

It is therefore advisable to ask your dealer about maintenance contracts. Local legislation must be respected.

1 - WEEKLY MAINTENANCE

1. Check the compressor oil level. This should be half way up the sight glass with the machine running at full load. Let the compressor operate for 3 to 4 hours before adding any oil. Check the oil level every 30 minutes. If the level does not reach the level indicated above, contact a qualified refrigeration mechanic.

For uneven tandems and trios where the oil level sight glass is on the equalizing line, the control must be done after a complete stop of both compressors. The oil level should be half way up the sight glass.

2. Overcharging with oil can be as dangerous to a compressor as a lack of oil. Before topping up, contact a qualified technician. Only use oils recommended by the manufacturer.

3. The flow of liquid refrigerant through the sightglass should be steady and without bubbles. Bubbles are a sign of a low charge, a possible leak, or of a restriction in the liquid line. Contact a qualified technician.

Each sight glass is fitted with a humidity indicator. The colour of the element changes according to the level of humidity in the refrigerant, but also according to temperature. It should indicate «dry refrigerant. If it shows «wet» or «CAUTION», contact a qualified refrigeration technician.

CAUTION: when starting up the unit, run the compressor for at least 2 hours before taking a humidity reading. The humidity detector is also sensitive to temperature, and as a consequence, the system must be at normal operating temperature to give a meaningful reading.

4. Check if the operating pressures are higher or lower than those recorded when the machine was put into service.

5. Inspect the entire system so as to detect any eventual abnormality: noisy compressor, loose casing panels, leaky pipes or juddering contacts.

6. Record temperatures, pressures, date and times and any other observations in the service log.

7. Leak detection is recommended.

2 - ANNUAL MAINTENANCE

On units with water cooled condensers, it is important that the unit be serviced regularly by a qualified technician, at least once every year or every 1000 hours of operation. Failure to observe this rule can lead to cancellation of the warranty and will clear LENNOX of whatever responsibility.

A service visit by a qualified technician is also recommended after the first 500 hours of operation after the unit is first put into service.

1. Inspect valves and piping. Clean the filters if necessary, clean the condenser tubes (see « Cleaning the condenser » §4).
2. Clean the chilled water piping filters.

CAUTION: the chilled water circuit may be pressurised. Observe the usual precautions when depressurising the circuit before opening it. Failure to observe these rules could lead to accidents and cause injury to service personnel.

3. Clean any corroded surfaces and repaint them.

4. Inspect the chilled water circuit for any signs of leakage.

Check operation of the water circulating pump and its ancillaries.

Check the percentage of antifreeze in the chilled water circuit, top up as necessary (if antifreeze is used).

5. Carry out all weekly maintenance duties.

The first and last inspection will include the seasonal shutdown procedure or the restarting procedure depending on the case.

These inspections should include the following operations:

- Check the contacts of motor contactors and control devices.
- Check the adjustment and operation of each control device.
- Conduct an oil analysis to determine the acidity. Record the results.
- Change the oil if necessary.

WARNING: oil analyses should be carried out by a qualified technician. Misinterpretation of the results could cause damage to the equipment.

Also, analysis operations should be conducted according to the right procedures, so as to avoid accidents and potential injury of service personnel.

- Follow the recommendations given by LENNOX as concerns compressor oil (see the appropriate table).
- Conduct a refrigerant leak test.
- Check motor winding isolation.

Other operations may be necessary depending on the age and the number of hours of operation of the installation.

3 - PREVENTIVE MAINTENANCE



PREVENTIVE MAINTENANCE SAVES COSTLY REPAIRS.

Record temperatures, pressures, date and times and any other observations in the service log book. Check maintenance of the following points.

- **GENERAL STATE OF THE CASING:**
Casing, paint, deterioration due to bumps, rust spots, leveling and supporting, state of the anti-vibration mounts, if installed, screwed panels, etc.
- **ELECTRICAL CONNECTIONS:**
State of cables, tightness of screws, grounding, current draw of the compressor and fans and checking that the unit is receiving the correct voltage.
- **COOLING CIRCUIT:**
Check that pressure values are correct and that there are no leaks. Check if the operating pressures are higher or lower than those recorded when the unit was put into service and take into account the impact of the ambient temperature on the operating pressures. Check that there is no damage on the pipe insulation

- **COMPRESSOR:**
Inspect the oil level. Oil for refrigeration equipment is clear and transparent. It keeps its colour over a long period of operation. Given that a correctly designed and installed refrigeration system will operate without any problems, there is no need to replace the compressor oil even after a very long period of operation. However, oil that has become dark in colour has been exposed to impurities in the refrigeration piping system or to excessive temperatures on the discharge side of the compressor, and this inevitably impairs the quality of the oil. Darkening of the colour of the oil or degradation of its qualities can also be caused by the presence of humidity in the system. When the oil has changed colour or has been degraded, it must be changed. On request, LENNOX can carry out an oil analysis.
Inspect the state of the compressor mountings.
- **CONTROL:**
Check Set Points and normal operation.
- **WATER:**
If the installation contains anti-freeze, regularly check the state of the anti-freeze on the evaporator and condenser side as well as the cleanliness of the water.
- **WATER FILTER:**
Clean the water inlet filter(s) if necessary.
- **WATER PUMP:**
When the installation is going to work with percentages of glycol up to 20% and water temperatures below -5°C, even do we use a specific closing for the water pump, it is advisable to clean the water pump's closing every year and a half, in order to avoid leaks by crystallization.
- **PLATE HEAT EXCHANGER(S):**
Prove the general isolation state and tightness of the water connections.
- **CHECK FOR REFRIGERANT LEAKAGE AND WATER LEAKAGE.**
- **SIGHT GLASS on MRC version:**
The liquid refrigerant flow through the sight glass should be steady and without bubbles. Bubbles are a sign of a low charge, a possible leak, or of a restriction in the liquid line. Each sight glass is fitted with a humidity indicator. The color of the element changes according to the level of humidity in the refrigerant, but also according to temperature. It should indicate «dry refrigerant. If it shows «wet» or «CAUTION», contact a qualified refrigeration technician.
CAUTION: when starting up the unit, run the compressor for at least 2 hours before taking a humidity reading. The humidity detector is also sensitive to temperature, and as a consequence, the system must be at normal operating temperature to give a meaningful reading.

4 - CLEANING THE CONDENSER

4.1 - Air cooled condensers

Clean the coils either with a vacuum cleaner, cold water, compressed air, or with a soft brush (non metallic). On units installed in a corrosive atmosphere, coil cleaning should be part of the regular maintenance program. On this type of installation, all dust gathered on the coils should be quickly removed by regular cleaning.

Caution: Except for NEOSYS range with MCHx coils, do not use high pressure cleaners that could cause permanent damage to the aluminium coil fins.

4.2 - Plate heat exchanger condensers

Use a non corrosive solvent to remove scale deposits. The equipment to be used for external water circulation, the quantity of solvent and the safety measures to be taken must be approved by the company supplying the cleaning products or by the company conducting these operations.

5 - COMPRESSORS / OIL DRAINAGE

Oil for refrigeration equipment is clear and transparent. It keeps its colour over a long period of operation.

Given that a correctly designed and installed refrigeration system will operate without any problems, there is no need to replace the compressor oil even after a very long period of operation.

Oil that has become dark in colour has been exposed to impurities in the refrigeration piping system or to excessive temperatures on the discharge side of the compressor, and this inevitably impairs the quality of the oil. Darkening of the colour of the oil or degradation of its qualities can also be caused by the presence of humidity in the system. When the oil has changed colour or has been degraded, it must be changed.

In this event, before putting the unit back into service, the compressor and the refrigeration circuit will have to be evacuated.

6 - CORRECTIVE MAINTENANCE



MAKE SURE THAT THE UNIT IS COMPLETELY DISCONNECTED FROM THE POWER SUPPLY BEFORE CARRYING OUT ANY TYPE OF WORK ON THE UNIT.

If some component in the cooling circuit must be replaced, follow these recommendations:

- Always use original replacement parts.
- Environment laws stipulate recovery of refrigerants and prohibit their release into the atmosphere.
- If cuts must be made in the pipe work, use pipe cutters. Do not use saws or any other tools that produce filings.
- All brazing must be carried out in a nitrogen atmosphere to prevent corrosion from forming.
- Use silver alloy brazing rod.
- Take special care that the flame from the torch is aimed in the opposite direction from the component to be welded and is covered with a wet rag in order to avoid overheating.
- If a compressor must be replaced, disconnect it electrically and un-braze the suction and discharge lines. Remove the securing screws and replace the old compressor with the new one. Check that the new compressor has the correct oil charge, screw it to the base and connect the lines and electrical connections.
- Carry out the vacuum above and below through the Schrader valves of the outdoor unit until -750 mm Hg is reached. Once this level of vacuum has been reached, keep the pump in operation for at least one hour. **DO NOT USE THE COMPRESSOR AS A VACUUM PUMP.** If the compressor runs in vacuum it will fail.
- Charge the unit with refrigerant according to the data on the Name Plate for the unit and check that there are no leaks.



PRECAUTIONS TO BE TAKEN IN THE USE OF R-410A REFRIGERANT

The following precautions characteristic of this gas should be taken:

- The vacuum pump must have a check valve or solenoid valve.
- Pressure gauges and hoses for the exclusive use with R-410A refrigerant should be used.
- The charge should be carried out in the liquid phase.
- Always use weighing scales to charge the refrigerant.
- Use the leak detector exclusive for R-410A refrigerant.
- Do not use mineral oil, only synthetic oil to ream, expand or make connections.
- Keep pipes capped before using them and be very thorough about any possible moisture and dirt (dust, filings, burrs, etc.).
- Brazing should always be carried out in a nitrogen atmosphere.
- Reamers should always be well sharpened.
- The refrigerant bottle must contain at least 2 % of the total amount.

7 - IMPORTANT

Before proceeding with any service operations, make sure that the power supply to the unit is switched off.

When the refrigeration circuit has been opened it will have to be evacuated, recharged, and inspected to ensure that it is perfectly clean (filter-drier) and leak tight. Remember that only trained and qualified personnel are authorised to operate on a refrigeration circuit. Regulations stipulate recovery of refrigerants and forbid wilful discharge of refrigerants into the atmosphere.

1 - LIST OF THE MOST COMMON PROBLEMS

PROBLEMS – SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
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A. THE COMPRESSOR DOES NOT START

<ul style="list-style-type: none"> Motor control circuits established, the compressor does not run 	<ul style="list-style-type: none"> No power supply 	<ul style="list-style-type: none"> Check main power supply and switch positions
	<ul style="list-style-type: none"> Compressor motor burnt out 	<ul style="list-style-type: none"> Replace
<ul style="list-style-type: none"> Low voltage reading on voltmeter 	<ul style="list-style-type: none"> Voltage too low 	<ul style="list-style-type: none"> Contact power company
<ul style="list-style-type: none"> The system does not start 	<ul style="list-style-type: none"> Breaker tripped or fuses blown 	<ul style="list-style-type: none"> Determine the cause. If the system is in running order, close the disconnect
		<ul style="list-style-type: none"> Check condition of fuses
	<ul style="list-style-type: none"> No water flow in the evaporator or condenser 	<ul style="list-style-type: none"> Measure flow, check the water pump and water circuitry and filters
	<ul style="list-style-type: none"> Flow switch contacts open 	<ul style="list-style-type: none"> Find the cause of the trip out
		<ul style="list-style-type: none"> Check circulation of liquid in the evaporator, and the condition of the flow switch
	<ul style="list-style-type: none"> Anti short cycle relay action 	<ul style="list-style-type: none"> Wait until the anti short cycle time delay has expired
	<ul style="list-style-type: none"> Faulty control thermostat 	<ul style="list-style-type: none"> Check for proper operation, set points, contacts
	<ul style="list-style-type: none"> Oil pressure switch tripped 	<ul style="list-style-type: none"> Check the oil pressure switch and determine the cause of the trip out
	<ul style="list-style-type: none"> Antifreeze thermostat or low pressure safety switch tripped 	<ul style="list-style-type: none"> Check evaporating pressure, the condition of the antifreeze thermostat and the low pressure safety switch
	<ul style="list-style-type: none"> Compressor thermal protection relay tripped 	<ul style="list-style-type: none"> Check for proper operation of the relay
	<ul style="list-style-type: none"> High pressure safety switch tripped 	<ul style="list-style-type: none"> Check the condensing pressure, and the condition of the high pressure safety switch
<ul style="list-style-type: none"> (if any) Low pressure safety switch trip out 	<ul style="list-style-type: none"> Check low pressure safety switch differential 	
<ul style="list-style-type: none"> Normal operation with too frequent starts and stoppages due to action of the low pressure safety switch. Bubbles in sight glass. Or, normal compressor operation, but the low pressure safety switch trips out and resets frequently 	<ul style="list-style-type: none"> Low refrigerant charge 	<ul style="list-style-type: none"> Check the charge through the Sight glass on the liquid line, carry out a leak test, then top up the refrigerant charge
		<ul style="list-style-type: none"> On MRC version, oil level too low

PROBLEMS – SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
<ul style="list-style-type: none"> Suction pressure too low, Filter drier frozen up 	<ul style="list-style-type: none"> Filter-drier obstructed 	<ul style="list-style-type: none"> Check the state of the drier and replace the filter
	<ul style="list-style-type: none"> Solenoid valve closed 	<ul style="list-style-type: none"> Check that the valve is operating properly
	<ul style="list-style-type: none"> Expansion valve closed 	<ul style="list-style-type: none"> Check bulb and capillaries, operation of the valve
	<ul style="list-style-type: none"> Compressor suction valve 	<ul style="list-style-type: none"> Check the filter

B. THE COMPRESSOR SHORT CYCLES ON HIGH PRESSURE SAFETY SWITCH TRIP OUT

	<ul style="list-style-type: none"> High pressure safety switch trip out 	<ul style="list-style-type: none"> Check high pressure safety switch differential
	<ul style="list-style-type: none"> Low air/water flow in condenser or dirty condenser coil (poor heat exchange) 	<ul style="list-style-type: none"> Check that pumps are operating correctly or the state of cleanliness of the coils / check fan operation
	<ul style="list-style-type: none"> Incondensable substances in the refrigeration circuit 	<ul style="list-style-type: none"> Bleed from circuit and top up the refrigerant charge. Note : it is not permitted to discharge refrigerant to atmosphere

C. THE COMPRESSOR RUNS IN LONG CYCLES OR RUNS CONTINUOUSLY

	<ul style="list-style-type: none"> Faulty control thermostat 	<ul style="list-style-type: none"> Check operation
<ul style="list-style-type: none"> Temperature too low in the conditioned space 	<ul style="list-style-type: none"> Chilled water thermostat set too low 	<ul style="list-style-type: none"> Adjust it
<ul style="list-style-type: none"> Bubbles in sight glass 	<ul style="list-style-type: none"> Low refrigerant charge 	<ul style="list-style-type: none"> Check the refrigerant charge in the sight glass and top up if necessary
	<ul style="list-style-type: none"> Filter-drier partly obstructed 	<ul style="list-style-type: none"> Check the drier and replace as required, change the filter cartridge
	<ul style="list-style-type: none"> Expansion valve partly closed 	<ul style="list-style-type: none"> Check expansion valve bulb and capillary, measure superheat
	<ul style="list-style-type: none"> Liquid line valve not open far enough 	<ul style="list-style-type: none"> Open the valve completely
<ul style="list-style-type: none"> Noisy compressor, or abnormally high suction pressure or low discharge pressure 	<ul style="list-style-type: none"> Leaky internal compressor valves/seals Low oil level 	<ul style="list-style-type: none"> Contact LENNOX, compressor may have to be changed. Add oil

PROBLEMS – SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
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D. THE COMPRESSOR CUTS OUT ON OIL PRESSURE SAFETY SWITCH

	<ul style="list-style-type: none"> Oil pressure switch tripped 	<ul style="list-style-type: none"> Check operation of the oil pressure safety switch
<ul style="list-style-type: none"> Oil level in sight glass is too low - 	<ul style="list-style-type: none"> Oil pressure too low 	<ul style="list-style-type: none"> Check the oil level in the sight glass on the crankcase, check the cleanliness of the oil filter, check the oil pump
<ul style="list-style-type: none"> Visible oil leak / Oil level too low 	<ul style="list-style-type: none"> Low oil charge 	<ul style="list-style-type: none"> Check that there is no leakage and add oil
	<ul style="list-style-type: none"> Leaky oil sump 	<ul style="list-style-type: none"> Repair and add oil
<ul style="list-style-type: none"> Suction line unusually cold, compressor noisy 	<ul style="list-style-type: none"> Liquid refrigerant present in the compressor crankcase 	<ul style="list-style-type: none"> Check appearance of the oil in the sight glass. Measure temperature of the oil pump, measure superheat at the expansion valve, check that the valve bulb is tightly attached
	<ul style="list-style-type: none"> Poor heat exchange in the evaporator 	<ul style="list-style-type: none"> Check water flow. Check fouling by measuring the water pressure drop. Excessive oil migration in the circuit: measure evaporating pressure, superheat and the temperature of the oil pump

E. THE COMPRESSOR CUTS OUT ON ANTIFREEZE PRESSURE SWITCH

	<ul style="list-style-type: none"> Antifreeze pressure switch tripped 	<ul style="list-style-type: none"> Check that the pressure switch is operating properly
	<ul style="list-style-type: none"> Low water flow in the evaporator 	<ul style="list-style-type: none"> Check the water pump
	<ul style="list-style-type: none"> Evaporator obstructed 	<ul style="list-style-type: none"> Determine the degree of fouling by measuring water pressure drop
	<ul style="list-style-type: none"> Evaporator frozen up 	<ul style="list-style-type: none"> Measure pressure drop in water circuit, keep water circulating until evaporator has thawed completely
	<ul style="list-style-type: none"> Low refrigerant charge 	<ul style="list-style-type: none"> Check the refrigerant charge and add refrigerant if necessary
	<ul style="list-style-type: none"> Liquid refrigerant in the compressor crankcase 	<ul style="list-style-type: none"> Check appearance of the oil in the sight glass. Measure superheat at the expansion valve, check that the valve bulb is tightly attached
	<ul style="list-style-type: none"> Poor heat exchange in the evaporator 	<ul style="list-style-type: none"> Check water flow. Check fouling by measuring the evaporator pressure drop. Excessive oil migration in the circuit : measure evaporating pressure, superheat

PROBLEMS – SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
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F. THE COMPRESSOR CUTS OUT ON ITS MOTOR PROTECTION THERMAL RELAY

	<ul style="list-style-type: none"> • Thermal protection tripped 	<ul style="list-style-type: none"> • Check operation of thermal protection, change it if necessary
	<ul style="list-style-type: none"> • Motor windings are not being sufficiently cooled 	<ul style="list-style-type: none"> • Measure superheat in the evaporator, adjust it if necessary
	<ul style="list-style-type: none"> • Compressor operating out of its application range 	<ul style="list-style-type: none"> • Check operating conditions

G. COMPRESSOR CUTS OUT THROUGH ACTION OF THE MAIN POWER FUSE

	<ul style="list-style-type: none"> • Power supply on two phases only 	<ul style="list-style-type: none"> • Check power supply voltage
	<ul style="list-style-type: none"> • Faulty motor windings 	<ul style="list-style-type: none"> • Replace the compressor
	<ul style="list-style-type: none"> • Compressor seized 	<ul style="list-style-type: none"> • Replace the compressor

H. THE COMPRESSOR STARTS WITH DIFFICULTY

	<ul style="list-style-type: none"> • Faulty windings 	<ul style="list-style-type: none"> • Replace the compressor
	<ul style="list-style-type: none"> • Mechanical problem 	<ul style="list-style-type: none"> • Replace the compressor

I. THE COMPRESSOR IS NOISY

	<ul style="list-style-type: none"> • If starting on a single winding on compressors fitted with part winding start or star-delta 	<ul style="list-style-type: none"> • Check operation of the starter contacts, the start up time delay and the condition of the windings
<ul style="list-style-type: none"> • Compressor knocking 	<ul style="list-style-type: none"> • Broken mechanical parts inside compressor 	<ul style="list-style-type: none"> • Replace the compressor
<ul style="list-style-type: none"> • Suction line is unusually cold 	<ul style="list-style-type: none"> • Liquid slugging 	<ul style="list-style-type: none"> • Check superheat and that the expansion valve bulb is correctly installed
	<ul style="list-style-type: none"> • Expansion valve blocked in open position 	<ul style="list-style-type: none"> • Repair or replace
	<ul style="list-style-type: none"> • Broken suction valves 	<ul style="list-style-type: none"> • Replace broken valves
<ul style="list-style-type: none"> • High discharge pressure. The water regulating valve or the pressure operated water valve taps or knocks 	<ul style="list-style-type: none"> • Pressure operated water valve fouled, water pressure is too high or irregular 	<ul style="list-style-type: none"> • Clean the valve. Install and expansion tank upstream of the valve
<ul style="list-style-type: none"> • Compressor shuts down through action of the oil pressure safety switch 	<ul style="list-style-type: none"> • Low oil charge 	<ul style="list-style-type: none"> • Add oil

PROBLEMS – SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
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J. DISCHARGE PRESSURE TOO HIGH

• Water is far too hot at condenser outlet	• Water flow too low or water temperature too high in the condenser	• Adjust the pressure operated water valve or the thermostat on the cooling tower
• Water is far too cold at the condenser outlet	• Condenser tubes fouled	• Clean the tubes
• Condenser abnormally hot	• Presence of air or incondensibles in the circuit, or excessive refrigerant charge	• Purge incondensibles and/or air, and recover excess refrigerant
• Chilled water leaving temperature too high	• Excessive cooling load	• Reduce load, reduce water flow if necessary

K. DISCHARGE PRESSURE IS TOO LOW

• Water is very cold at condenser outlet	• Condenser water flow too high or water temperature is too low	• Adjust the pressure operated water valve or the thermostat on the cooling tower/dry cooler
• Bubbles in sight glass	• Low refrigerant charge	• Repair the leak and add refrigerant

L. SUCTION PRESSURE IS TOO HIGH

• The compressor runs continuously	• Too much cooling demand on the evaporator	• Check the system
• Suction line unusually cold. Liquid refrigerant returns to compressor	• Expansion valve opened too far	• Adjust superheat and check that the expansion valve bulb is correctly fitted in place. Check parameters for electronic expansion valve.
	• Expansion valve blocked in open position	• Repair or replace

M. SUCTION PRESSURE IS TOO LOW

• Bubbles in sight glass	• Low refrigerant charge	• Repair the leak and add refrigerant
• Excessive pressure drop across the filter-drier or the solenoid valve	• Filter-drier obstructed	• Replace the cartridge
• No refrigerant passing through the expansion valve	• Expansion valve bulb has lost its charge.	• Replace the bulb
• Loss of capacity	• Expansion valve obstructed	• Clean or replace

PROBLEMS – SYMPTOMS	PROBABLE CAUSE	RECOMMENDED ACTION
<ul style="list-style-type: none"> • Conditioned space too cold 	<ul style="list-style-type: none"> • Control thermostat contacts stuck in closed position 	<ul style="list-style-type: none"> • Repair or replace
<ul style="list-style-type: none"> • Compressor short-cycling 	<ul style="list-style-type: none"> • Capacity modulation setting too low 	<ul style="list-style-type: none"> • Adjust
<ul style="list-style-type: none"> • Superheat value too high 	<ul style="list-style-type: none"> • Excessive pressure drop in the evaporator 	<ul style="list-style-type: none"> • Check the external equalizing line on the expansion valve
<ul style="list-style-type: none"> • Low pressure drop in the evaporator 	<ul style="list-style-type: none"> • Low water flow 	<ul style="list-style-type: none"> • Check water flow. Check the condition of the filters, look for obstructions in the chilled water circuit piping

2 - CONTROL DEVICES

Operation

By reacting to compressor discharge pressure, the high pressure switch monitors efficiency of the condenser. Poor efficiency, the result of an excessive condensing pressure, is usually caused by:

- A dirty condenser
- Low water flow
- Low air flow

The low pressure switch monitors the pressure at which the refrigerant evaporates in the evaporator tubes.

Low evaporating pressure is usually caused by:

- Low refrigerant charge
- A faulty expansion valve
- An obstructed liquid line filter-drier
- A damaged compressor cylinder bank unloaded.

The control thermostat monitors chilled water temperature at the evaporator inlet. The most common causes of abnormal temperatures in this zone are:

- Low water flow
- Thermostat setting too low

The oil pressure switch monitors oil injection pressure on the compressor.

Low oil pressure is usually caused by:

- Low oil charge
- A worn or faulty oil pump
- A defective crankcase heater, causing condensation of refrigerant in the oil sump.

The above information does not represent a complete analysis of the refrigeration system. It is intended to familiarise the operator with unit operation and to provide him with the technical data required to enable him to recognise, correct or report a fault.

Only trained and qualified personnel is authorised to service and maintain this equipment.

3 - REGULAR CHECKS TO BE MADE - CHILLER UNIT ENVIRONMENT

CHILLED WATER CIRCUIT VALUE

- Inlet / Outlet pressure gauges for pressure drop kPa
- Evaporator inlet temperature °C
- Evaporator outlet temperature °C
- Glycol concentration ⁽¹⁾ %
- Flow switch operational at flow %
- Chilled water pump interlock []
- Filter on water circuit []

CONDENSER WATER CIRCUIT

- Inlet / Outlet pressure gauges for pressure drop kPa
- Condenser inlet temperature °C
- Condenser outlet temperature °C
- Regulation on condenser water inlet []
- Condenser pump interlock []
- Filter on water circuit []
- Unrestricted air flow on condenser coils ⁽²⁾ []

ELECTRICAL POWER SUPPLY

- Control circuit voltage V
- Power circuit power supply voltage L1/L2 V
- Power circuit power supply voltage L2/L3 V
- Power circuit power supply voltage L3/L1 V

(1) Depending on the application

(2) According to the type of unit

4 - MANUFACTURER’S RECOMMENDED INSPECTIONS

4.1 - LIQUID CHILLERS WITH SCROLL COMPRESSOR(S)

4.1.1 - Number of recommended preventive maintenance visits:

NUMBER OF RECOMMENDED PREVENTIVE MAINTENANCE VISITS

Year	Start up	500/1000h visit	Major technical inspection	Inspection visit	Tube analysis
1	1	1		2	
2			1	3	
3			1	3	
4				3	
5			1	3	1 ⁽¹⁾
6			1	3	
7				3	
8			1	3	
9			1	3	
10				3	1
+10					Every year

This table is published for units operating under normal conditions with an average annual runtime of 4000 hours. In hostile industrial environments, a specific maintenance visit schedule must be planned.

(1) Depending on the quality of the water

4.1.2 - Description of inspection duties - Liquid chiller with scroll compressor(s)

START UP

- Check unit installation
- Check water flow and water circuit ancillaries
- Check safety devices
- Check leak tightness
- Configuration of the microprocessor based management system (if used)
- Verification of operating parameters and unit performance
- Transmission of the machine service log

500 h / 1000 h VISITS

- Post wear in inspection
- Oil acidity test, leak test
- Replacement of the filter-drier cartridges depending on the results of the test above.
- Monitor unit performance and any eventual variations linked to use of the installation.

INSPECTION VISIT

- Leak test
- Operating test with record of measurements taken and functional analysis.

MAJOR TECHNICAL INSPECTION

- Inspection visit
- Acid test
- Oil change if necessary
- Replacement of filter-drier cartridges
- Check up on the microprocessor based management system (if used)
- Adjustment of safety devices
- Verification of unit interlocks
- Lubrication of bearings / dampers if necessary

TUBE ANALYSIS

- Inspection of water cooled evaporator and condenser tube bundles with an eddy current test to enable potentially serious problems to be anticipated.
- Frequency: every 5 years up to 10 years (depending on the quality of water), then every 3 years.

Machine identifications:	Affair number:		
Year of manufacture:			
NORMAL CONDITIONS OF USE			
Leaving chilled water temperature:			°C
Outdoor air temperature:	Max:	°C	Min: °C
Power supply voltage:	V/Ph/Hz		
Refrigerant type:			
Date and time measurements were taken:			
Outdoor air temperature:			°C
Company responsible for measurements:			
Name of technician:			
Remarks:			

	Circuit 1			Circuit 2			Circuit 3	Circuit 4
	Compr. 1	Compr. 2	Compr. 3	Compr. 1	Compr. 2	Compr. 3	Compr. 1	Compr. 1
Number of hours of operation								
Compressors in service per circuit								
Evaporating pressure	Bar							
Suction piping temperature	°C							
Condensing pressure	Bar							
Discharge piping temperature	°C							
Oil pump temperature	°C							
Oil pressure	Bar							
Oil level	A							
Current on phase 1 per compressor	A							
Current on phase 2 per compressor	A							
Current on phase 3 per compressor	°C							
Liquid line temperature	Bar							
Evaporator pressure drop	°C							
Chilled water temperature	°C							
Leaving chilled water temperature	Bar							
Condenser pressure drop	°C							
Condenser entering water temperature	°C							
Condenser leaving water temperature	Bar							
H.P. pressure switch cut-out	Bar							
H.P. pressure switch cut-in	Bar							
Low pressure switch cut-in	Bar							
Oil pressure switch cut-out	Bar							
Antifreeze pressure switch cut-out	Bar							

Fan pressure switch 1: (cut-out / bar)	Fan 2 :	Fan 3 :	Fan 4 :
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This check list should be filled in by the contractor to make sure that unit installation takes place according to appropriate industry practices.

WARNING: Disconnect the power supply before carrying out any inspections on the unit. If the unit must be left powered up, proceed with precaution to avoid risk of electrocution.

Note: some units have a separate control circuit supply that is not isolated when the main power supply is OFF. This must be isolated separately.

RECEPTION

- Check absence of transport damage
- Check for missing items
- Availability of suitable lifting gear, slings and spacers

UNIT INSTALLATION

- Shipping crate removed
- Clearances checked
- Vibration isolators mounted
- Unit set in place
- Unit levelled

CHILLED WATER CIRCUIT

- All piping checked for leakage
- Thermometers installed
- Water pressure regulator installed
- Balancing valves installed
- Flow switch installed
- System rinsed, cleaned and filled before being connected to the unit. Check presence of filter on unit inlet and state of cleanliness of the filter.
- Checked operation of the pump and evaporator pressure drop

CONDENSER WATER CIRCUIT

- Checked order of power supply phases for scroll and screw compressor units
- All piping checked for leakage
- Thermometers installed
- Water pressure regulator installed
- System balancing valves installed
- System rinsed, cleaned and filled before being connected to the unit. Check presence of filter on unit inlet and state of cleanliness of the filter.
- Checked operation of the pump and condenser pressure drop

ELECTRICAL EQUIPMENT

- Check the main power supply matches the unit data plate.
- Check that the unit is correctly earthed
- Checked order of power supply phases for scroll and screw compressor units
- Checked correct direction of rotation of fan motors and proper operation of the latter.
- Direction of rotation of pump correct
- Control cabinet wired up.
- Power supply conforms with unit nameplate indications
- Pump starter and flow switch circuits complete and in working order
- Pipe heaters installed on all piping exposed to freezing temperatures
- All unions tightened with a torque wrench

GENERAL

- Cooling load available, minimum 50 %
- Coordination between different professions for final commissioning

CUSTOMER ORDER NUMBER LENNOX REFERENCE:

DESIGNATION

COMMENTS:

NAME: SIGNATURE:

APPENDICIES

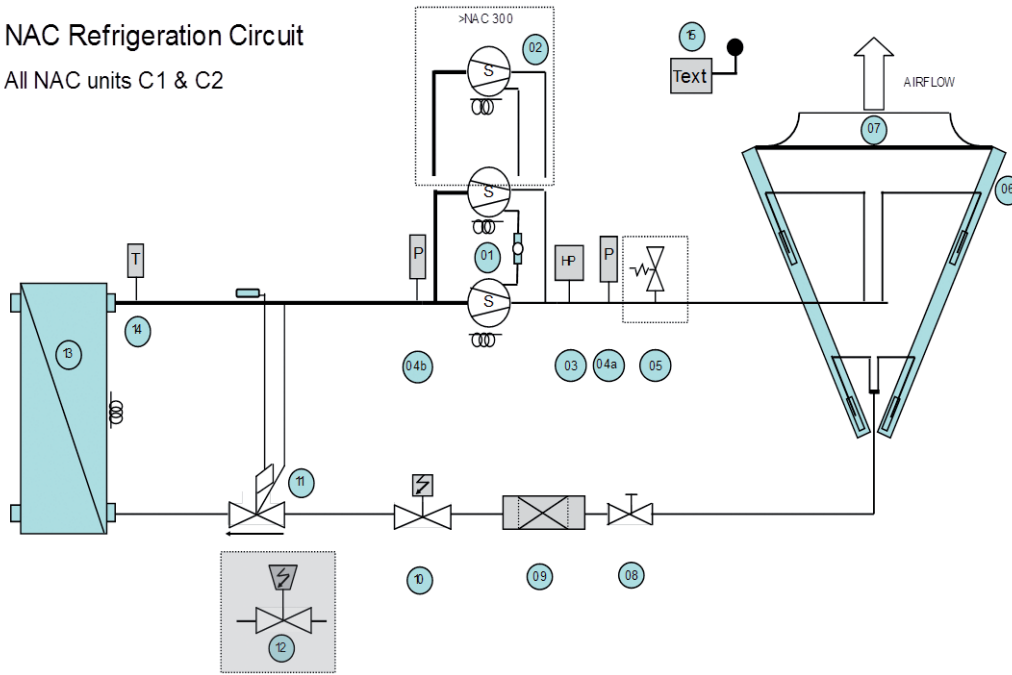
RISK ANALYSIS AND HAZARDOUS SITUATIONS ACCORDING TO 97/23/CE DIRECTIVE


N°	Event	Effect	Risk	Actions to Eliminate the Risk	Information to minimise the occurrence of a risk
1A	Violent Chocks, Static or Dynamic Loads applied	Appearance of cracks, distortions, possibility of rupture	Leaks, liquid or gas projections, Metal parts projections.	Only handling the units using the chassis and lifting rings if available.	Handling procedure shown in the IOM supplied with the unit.
2A	Unit not installed properly or leveled to the ground	Unusual stress in the frame leading to possible and strains vibrations and cracks	Leaks	Level the machine during commissioning. In the case where the unit is installed on anti-vibration mountings, all supporting points must be used and the block hardness must be selected according to the type of units being installed.	Indications on general mechanical drawings in the technical guide and the IOM supplied with the unit.
3A	Unsuited hydraulic or refrigeration pipe-work	Unusual stress on the pipe-work leading to possible and strains vibrations and cracks	Leaks	Proper support and fitting of the pipe-work on site.	Indications in the technical IOM supplied with the unit.
4A	Outdoor temperature below freezing	Strains, vibrations and cracks, pipe bursting.	Partial or complete destruction of the circuit, liquid/gas could be thrown out of the unit	Provide anti-frost protection (ei: Water treated with Glycol, or trace heaters along the pipe-work)	Indications in the technical IOM supplied with the unit.
5A	Circuits exposed to an unusual heat source.	Modification of the mechanical properties of certain materials with a risk or rupture or pipe bursting, leaks or cracks appearing.	Partial or complete destruction of the circuit, liquid/gas could be thrown out of the unit	Recommended minimum and maximum outdoor temperature –20°C to 50°C during operation. –30°C to 65°C during storage Do not expose any part of the machine to a naked flame	Indications of the Min and Max outdoor temperature on the unit nameplate
6A	Unusual increase in the temperature of the Chilled water return to the evaporator or the hot return water to the condenser	Increase of the refrigerant pressure in the heat exchanger with a risk of exceeding the working pressure leading to possible strains, vibrations, cracks and pipe or vessel bursting.	Partial or complete destruction of the circuit, liquid/gas/ metal parts could be thrown out of the unit	Maximum chilled water return temperature: 45°C Maximum hot return water temperature: 50°C Install a temperature limitation device	Indications in the technical IOM supplied with the unit.
7A	Possibility of a unit being hit by lightning	Extreme heat, explosion, cracks.	Partial or complete destruction of the circuit, liquid/gas/ metal parts could be thrown out of the unit	Provide an appropriate protection against lightning.	Indications in the technical IOM supplied

N°	Event	Effect	Risk	Actions to Eliminate the Risk	Information to minimise the Occurrence of a risk
8A	Unit exposed to extremely corrosive materials.	Modification of the mechanical and chemical properties of certain materials with a risk of corrosion rupture, pipe bursting, leaks and cracks.	Partial or complete destruction of the circuit, liquid/gas/metal parts could be thrown out of the unit	Protect the units against these types of products	Indications in the technical IOM supplied
9A	Unit exposed to explosive materials.	Risk of explosion or pipe bursting.	Partial or complete destruction of the circuit, liquid/gas/metal parts could be thrown out of the unit	Protect the units against these types of products	Indications in the technical IOM supplied
10A	Inappropriate Heat Transfer Fluid	Corrosion, excessive heat	Partial or complete destruction of the circuit. Leaks	Usual fluids are Water or Water with Glycol.	Indications in the technical IOM supplied
11A	Inappropriate refrigerant fluid in the circuit	Corrosion, excessive heat, combustion or explosion	Partial or complete destruction of the circuit, liquid/gas/metal parts could be thrown out of the unit	Only use the fluid specified on the unit's nameplate.	Indications of the refrigerant fluid on the unit nameplate
12A	Inappropriate oil in the compressor	Corrosion, excessive heat,	Partial or complete destruction of the circuit. Leaks	Authorized oils: Refer to the compressor nameplate or the documentation.	Indication on the compressor nameplate or the manufacturer documentation.
13A	Working on a part under pressure	Risk of explosion or part bursting away from the machine.	Liquid/gas/metal parts could be thrown out of the unit	Isolate the section of the circuit to be worked on and recover the refrigerant before any work. Always wear protection goggles and gloves.	Indications in the technical IOM supplied
14A	Brazing or un-brazing parts from the circuit	Strains, cracks, pipe bursting	Partial or complete destruction of the circuit, liquid/gas/metal parts could be thrown out of the unit	Parts to be brazed using best engineering practices. Use brazing materials approved by LENNOX. Ensure the circuit is leak free before refilling with refrigerant.	Indications in the technical IOM supplied
15A	Unit exposed to inductive interferences	Corrosions, cracks	leaks	Ensure the unit is earthed properly	Indications in the technical IOM supplied
16A	Unit exposed to internal or external vibrations	Strains, cracks, explosions	Partial or complete destruction of the circuit, liquid/gas/metal parts could be thrown out of the unit	Inspect the unit regularly	Indications in the technical IOM supplied

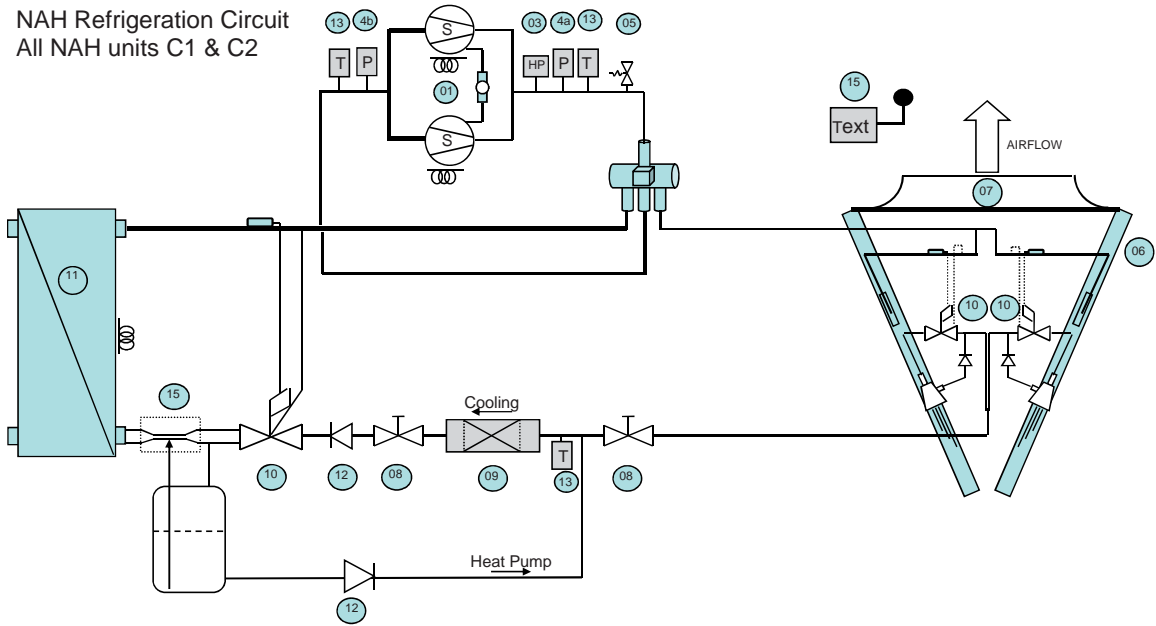
**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
NEOSYS COOLING ONLY**

NAC Refrigeration Circuit
All NAC units C1 & C2



01	1st & 2nd scroll compressors	05	Pressure relief valve	11	Thermostatic expansion valve
02	Third scroll compressor on size above 300 kW	06	Air cooled condenser	12	Electronic expansion valve
03	High pressure switch	07	Fan motor	13	Evaporator heat exchanger
04a / 04b	Pressure transducers HP & BP	08	Manual isolating valve	14	Suction temperatura sensor
		09	Cartridge filter drier	15	External temperature sensor
		10	Solenoid valve		Heating resistance (OPTION)

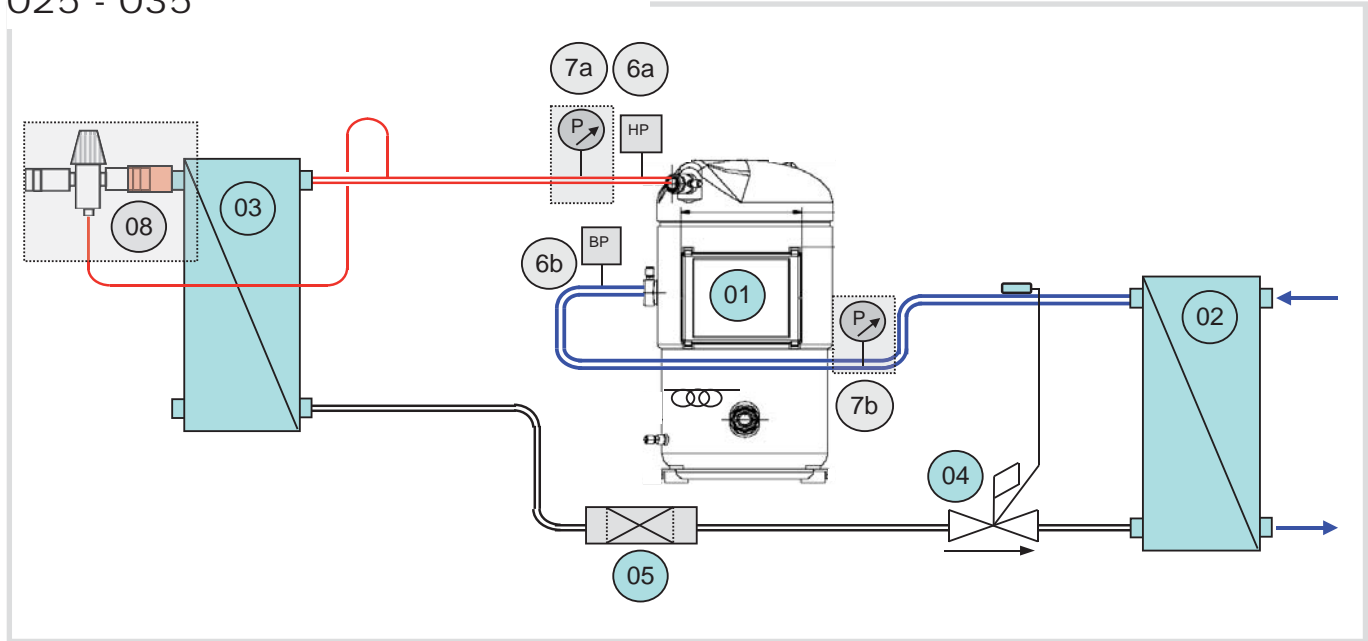
**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
NEOSYS HEAT PUMP**



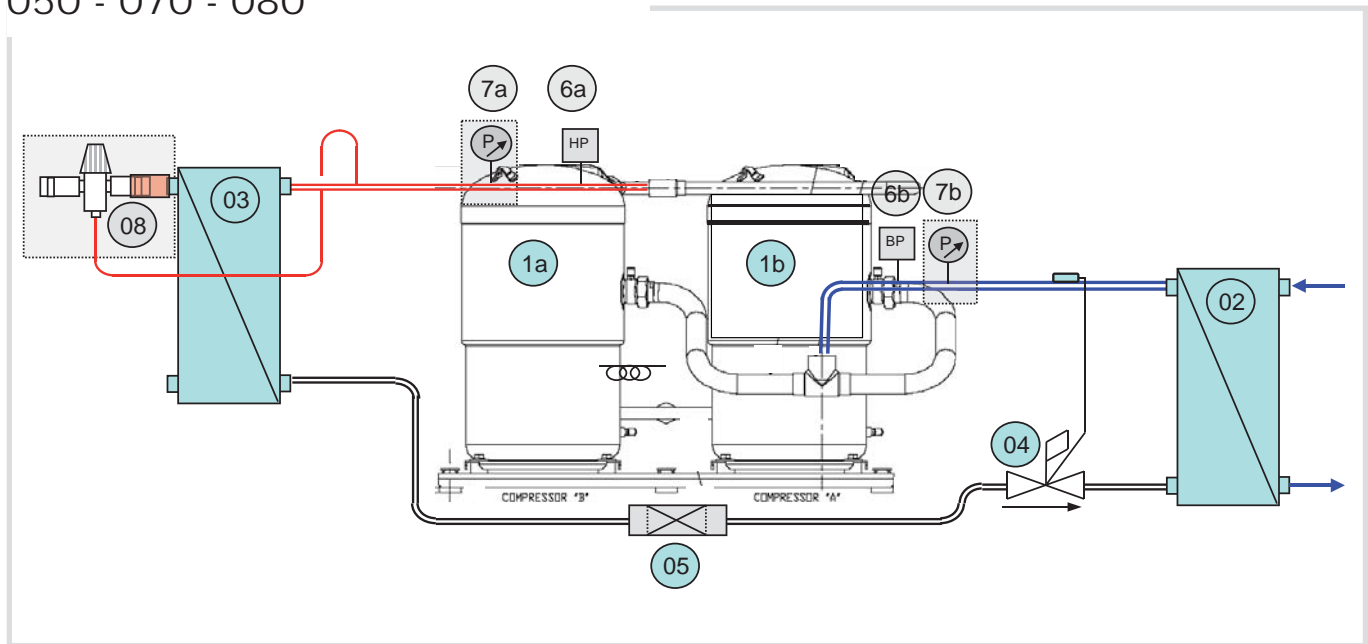
01	1st & 2nd scroll compressors	06	Air cooled heat exchanger	11	Plate heat exchanger
03	High pressure switch	07	Fan motor	12	Non return valve
04a / 04b	Pressure transducers HP & BP	08	Manual isolating valve	13	Discharge temperature sensor
05	Pressure relief valve	09	Cartridge filter drier	14	External temperature sensor
	Heating resistance (OPTION)	10	Thermostatic expansion valve	15	Liquid suction venturi
				16	Liquid receiver

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
HYDROLEAN COOLING ONLY**

025 - 035



050 - 070 - 080

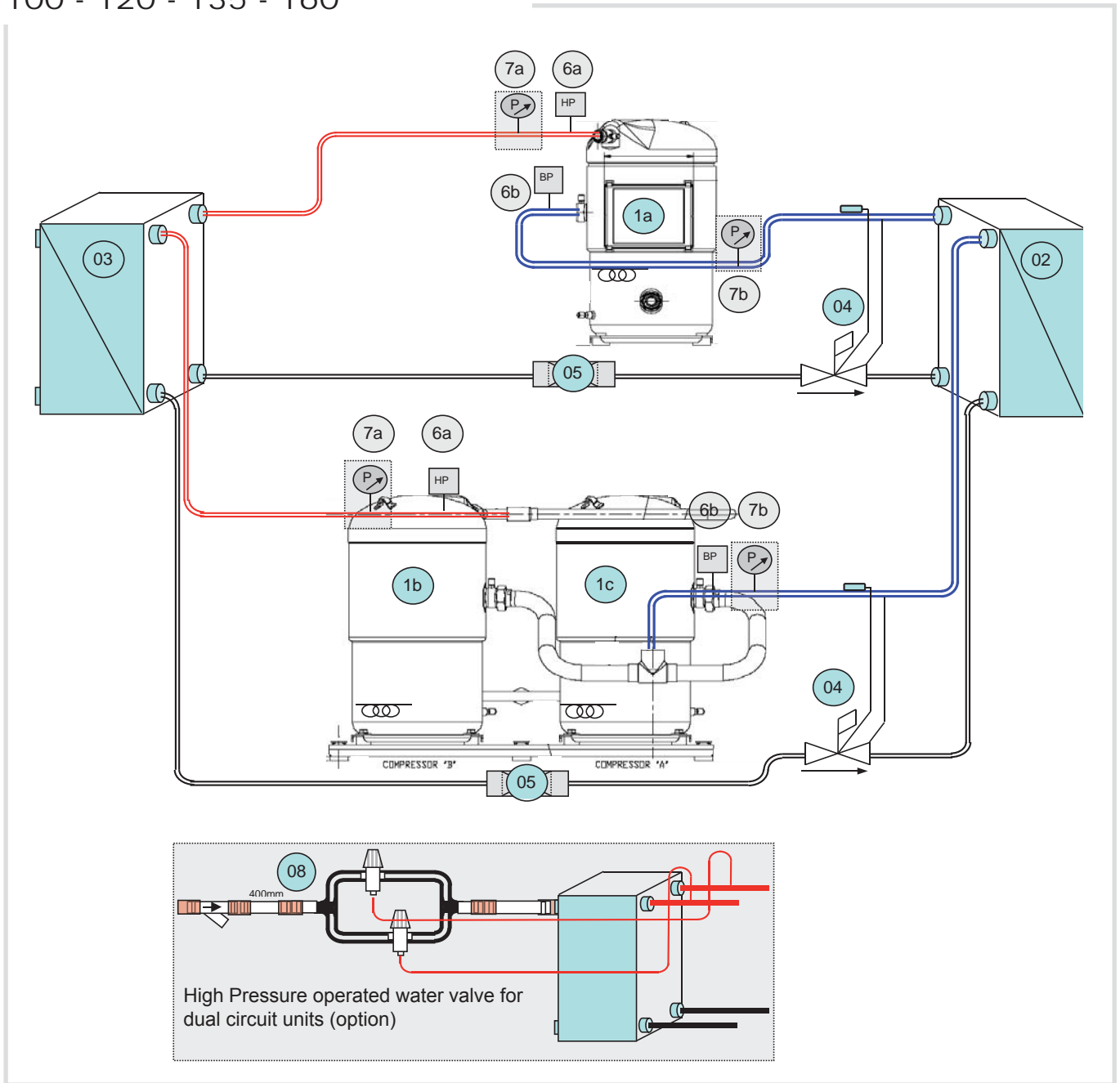


Standard Components	
01.a/ 01.b/ 01.c	Compressors
02	Evaporator
03	Condenser
04	Thermostatic expansion valve
05	Filter drier
06a/ 06b/	Low & high pressure switch

Options	
07a/ 07b/	Low & high pressure gauges
08	Pressure regulated water valve

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
HYDROLEAN COOLING ONLY**

100 - 120 - 135 - 160

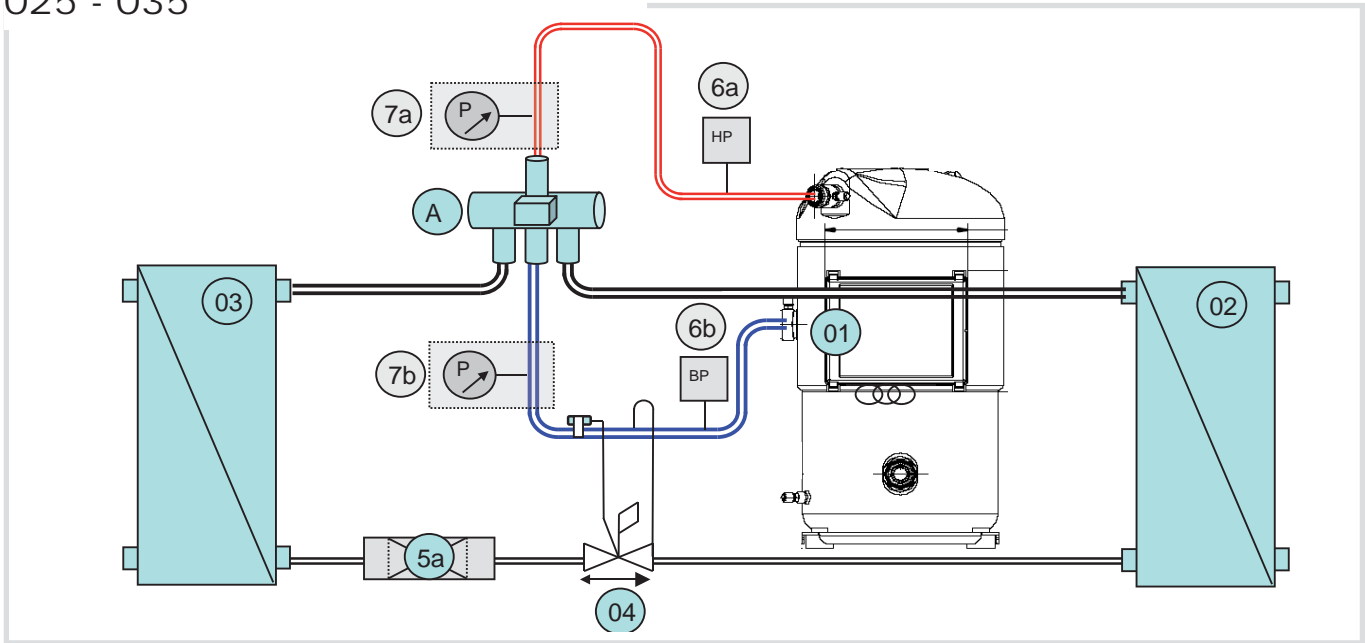


Standard Components	
01.a/ 01.b/ 01.c	Compressors
02	Evaporator
03	Condenser
04	Thermostatic expansion valve
05	Filter drier
06a/ 06b/	Low & high pressure switch

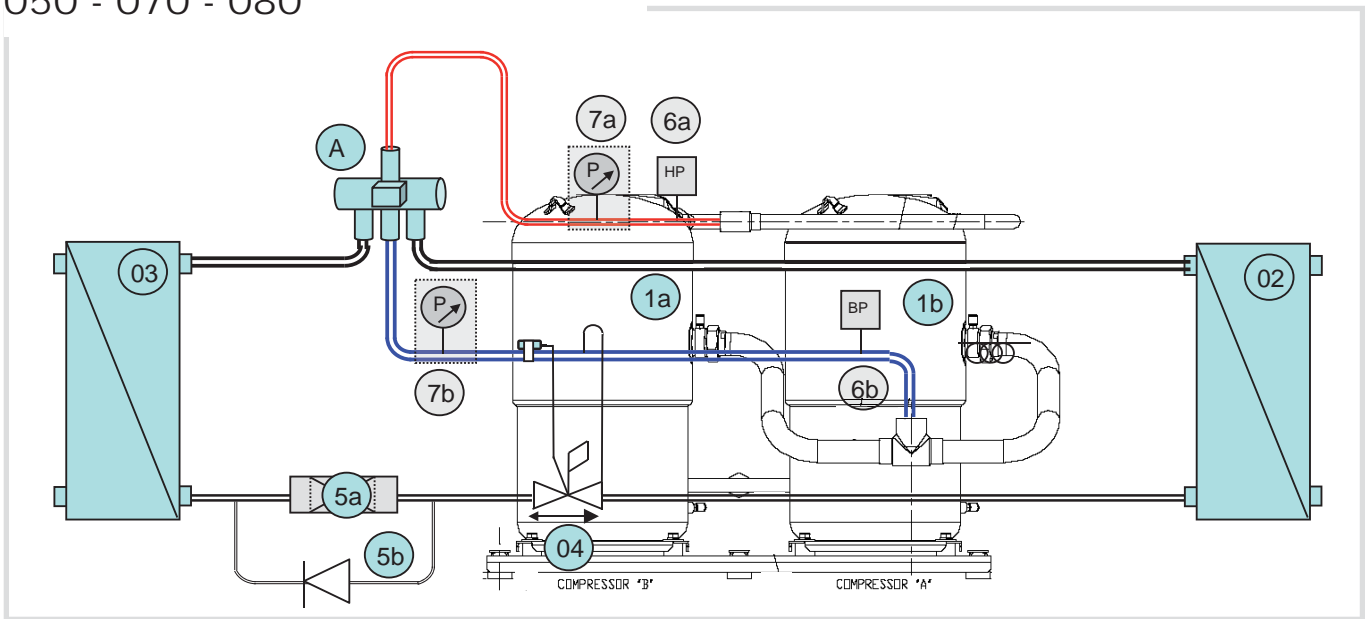
Options	
07a/ 07b/	Low & high pressure gauges
08	Pressure regulated water valve

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
HYDROLEAN HEAT PUMP**

025 - 035



050 - 070 - 080

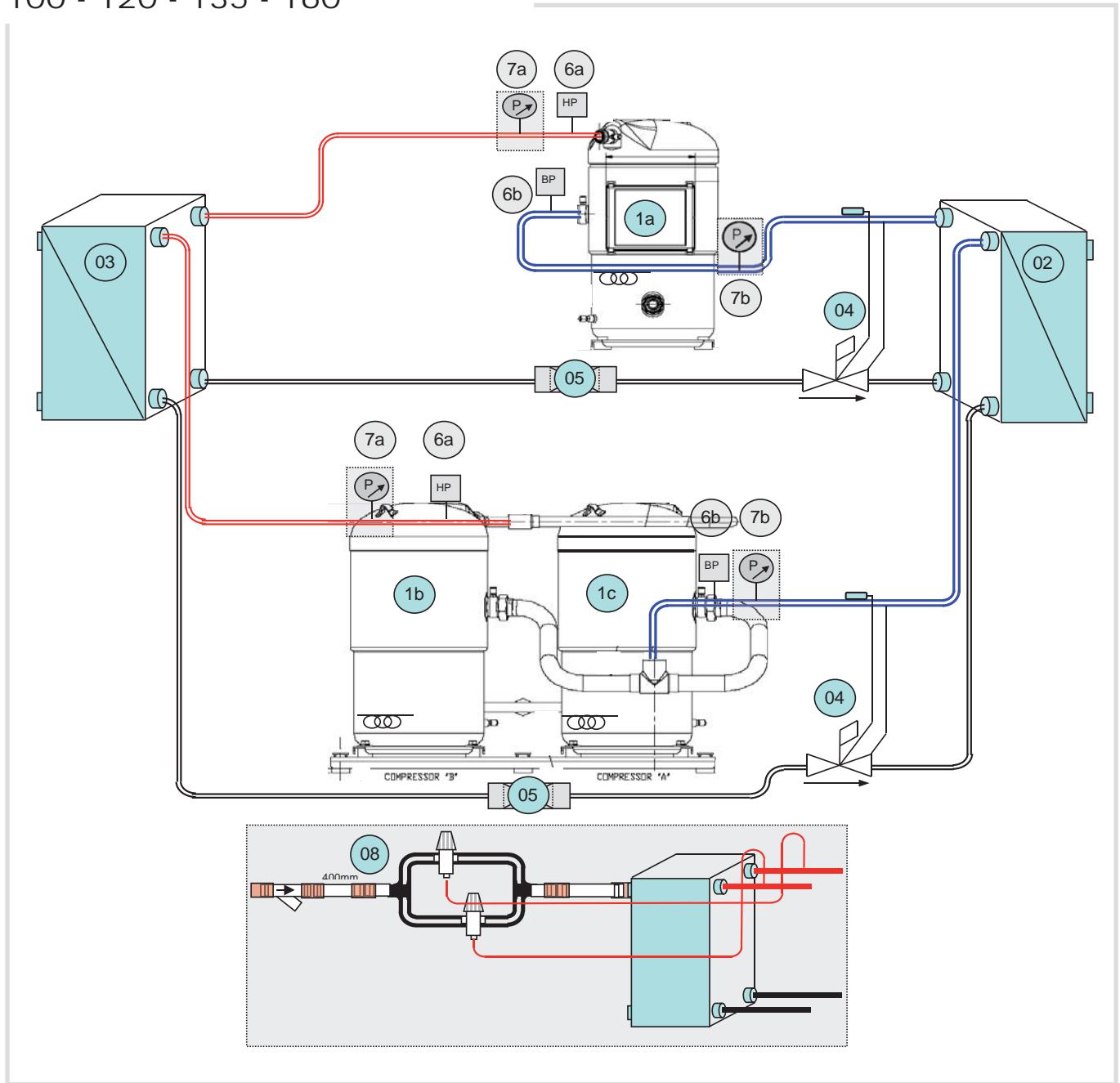


Standard Components	
01.a/ 01.b/	Compressors
02	Evaporator
03	Condenser
04	Thermostatic expansion valve
05	Filter drier & filter by-pass
06.a 06.b	Low & high pressure switch
A	4 way reversing valve

Options	
07.a/ 07.b/	Low & high pressure gauges

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
HYDROLEAN HEAT PUMP**

100 - 120 - 135 - 160

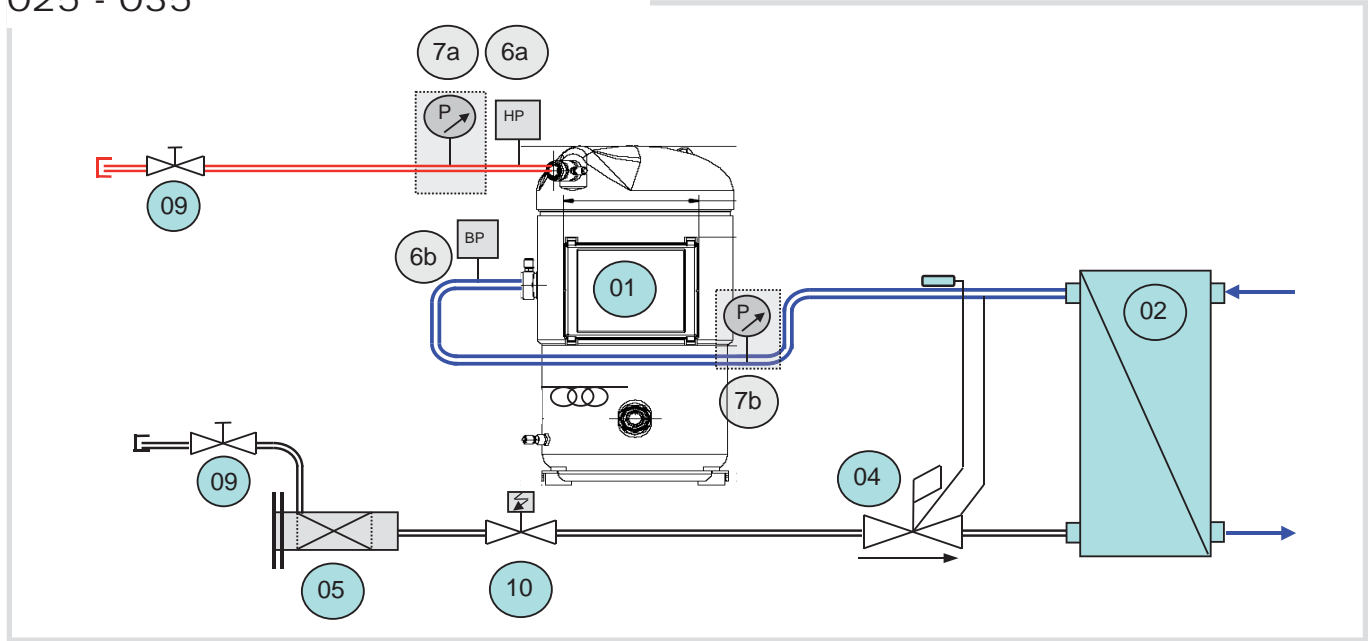


Standard Components	
01.a/ 01.b/	Compressors
02	Evaporator
03	Condenser
04	Thermostatic expansion valve
05	Filter drier & filter by-pass
06.a 06.b	Low & high pressure switch
A	4 way reversing valve

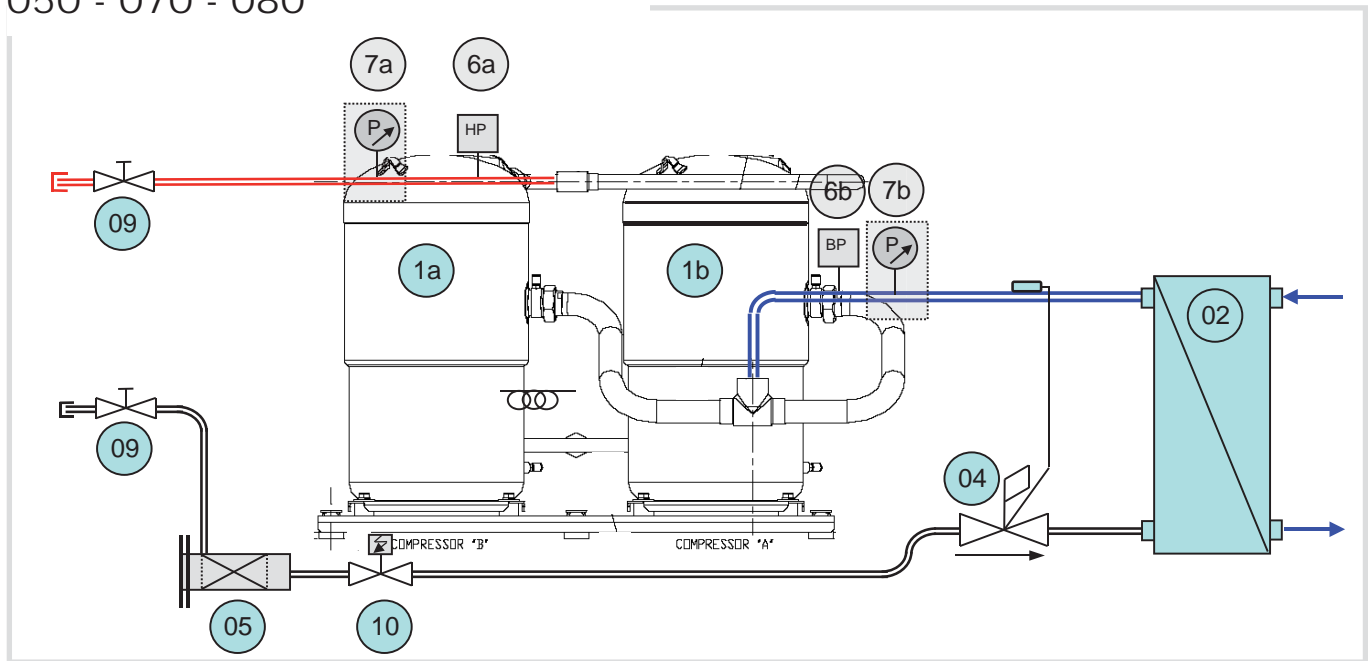
Options	
07.a/ 07.b/	Low & high pressure gauges

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
HYDROLEAN REMOTE CONDENSER**

025 - 035



050 - 070 - 080



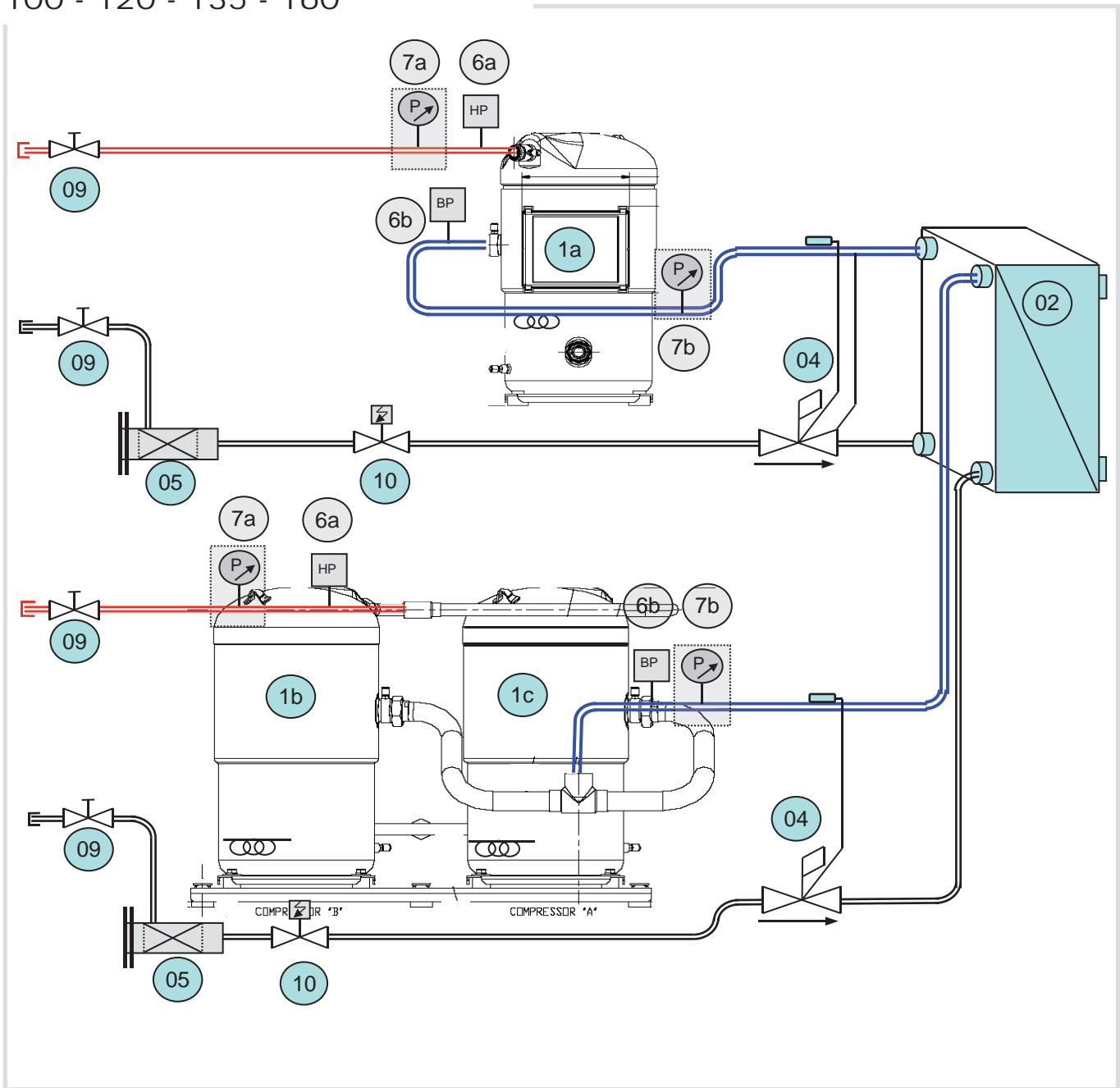
Standard Components	
01.a/ 01.b/ 01.c	Compressors
02	Evaporator
03	Condenser
04	Thermostatic expansion valve
05	Removable cartridge drier filter
06.a 06.b	Low & high pressure switch
09	Manual shut off valve

10	Liquid solenoid valve
----	-----------------------

Options	
07a/ 07b/	Low & high pressure gauges

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
HYDROLEAN REMOTE CONDENSER**

100 - 120 - 135 - 160



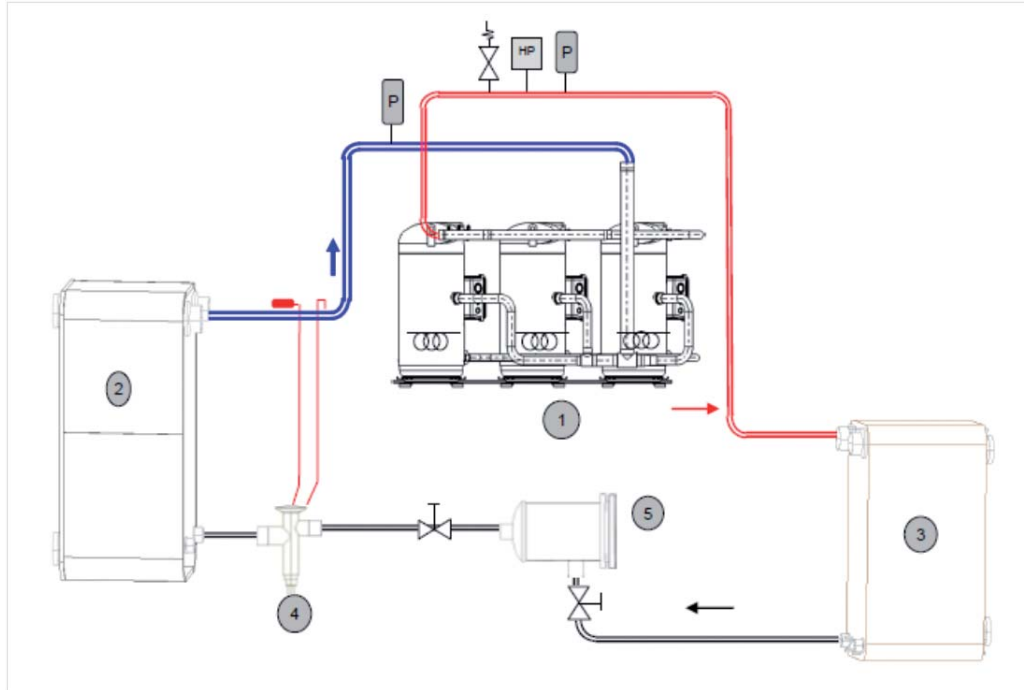
Standard Components	
01.a/ 01.b/ 01.c	Compressors
02	Evaporator
03	Condenser
04	Thermostatic expansion valve
05	Removable cartridge drier filter
06.a 06.b	Low & high pressure switch
09	Manual shut off valve





10	Liquid solenoid valve
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Options	
07a/ 07b/	Low & high pressure gauges

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
MWC**

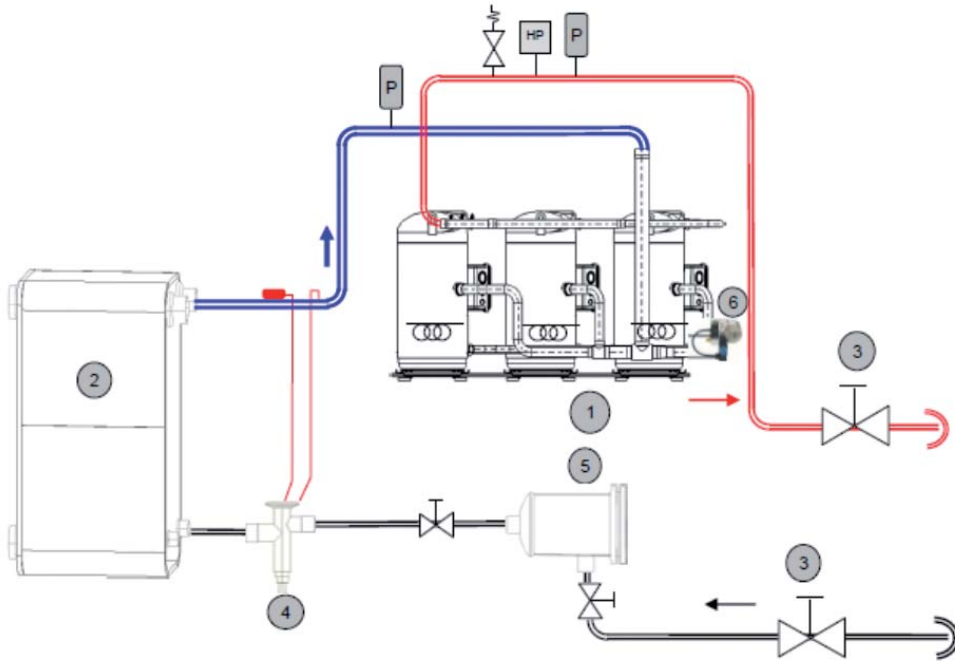
Circuit 1 & 2: 2 or 3 compressors per circuit



Main components			
1	Compressors		High pressure relief valve
2	Water cooled evaporator		High pressure safety switch
3	Water cooled condenser		High and low pressure transducers
4	Expansion valves		High pressure safety switch
5	Cartridge drier filter		

**GENERAL REFRIGERATION CIRCUIT DIAGRAM:
MRC**

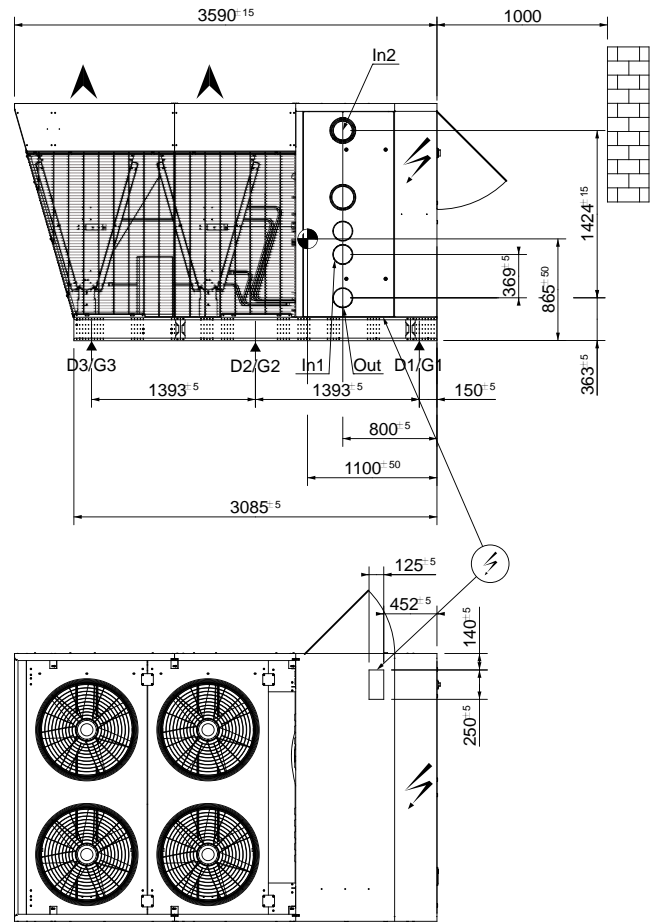
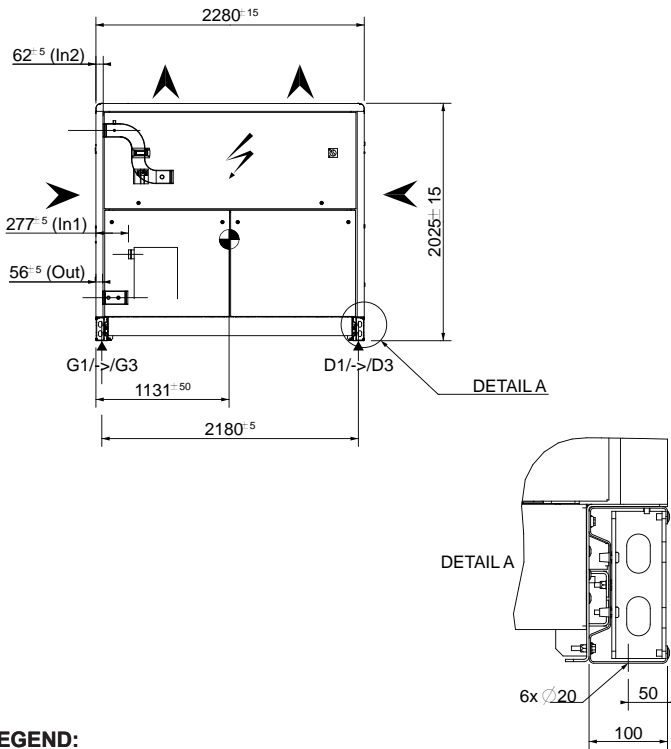
Circuit 1 & 2: 2 or 3 compressors per circuit



Main components			
1	Compressors		High pressure relief valve
2	Water cooled evaporator		High pressure safety switch
3	Manual shut off valves		High and low pressure transducers
4	Expansion valves		High pressure safety switch
5	Cartridge drier filter		
6	Oil level controller		

GENERAL MECHANICAL DRAWING

NAC 200 / 230 / 270
NAH 200 / 230



LEGEND:

- In 1 Water inlet - Unit without hydraulic module - 4" Victaulic
- In 2 : Water inlet - Unit with hydraulic module - 4" Victaulic
- Out : Water outlet - 4" Victaulic

LOAD DISTRIBUTION

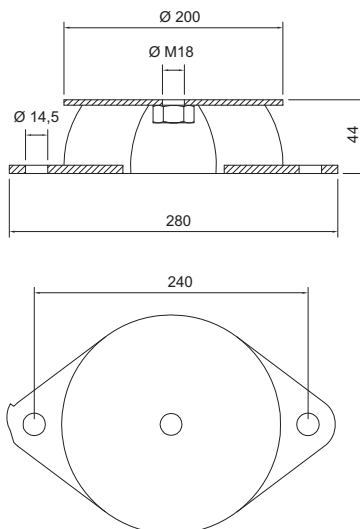
(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3
NAC 200	396	484	242
NAC 230	414	506	253
NAC 270	463	565	283

	G1/D1	G2/D	G3/D3
NAH 200	430	526	263
NAH 230	442	541	270

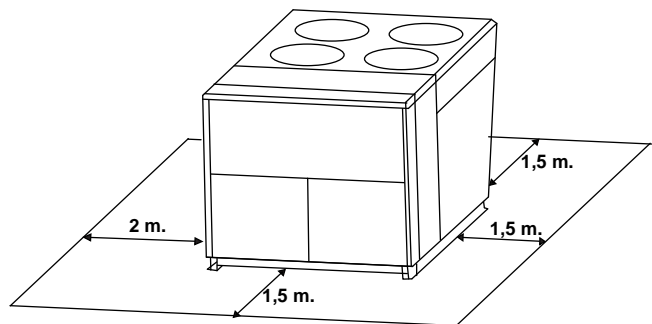
Lennox recommend load distribution as detailed above.

ANTI-VIBRATION MOUNTS (OPTION)



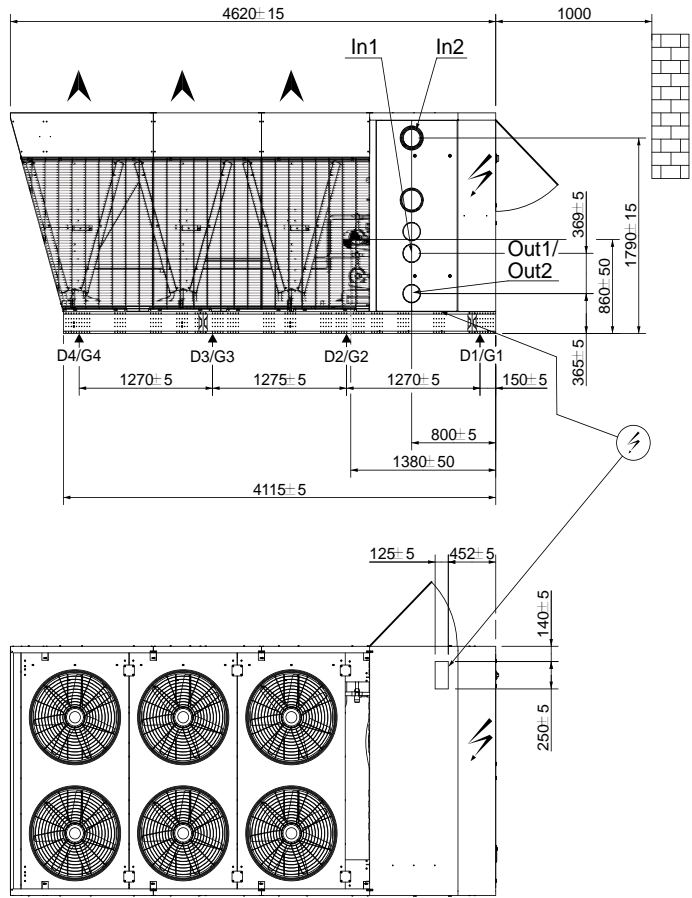
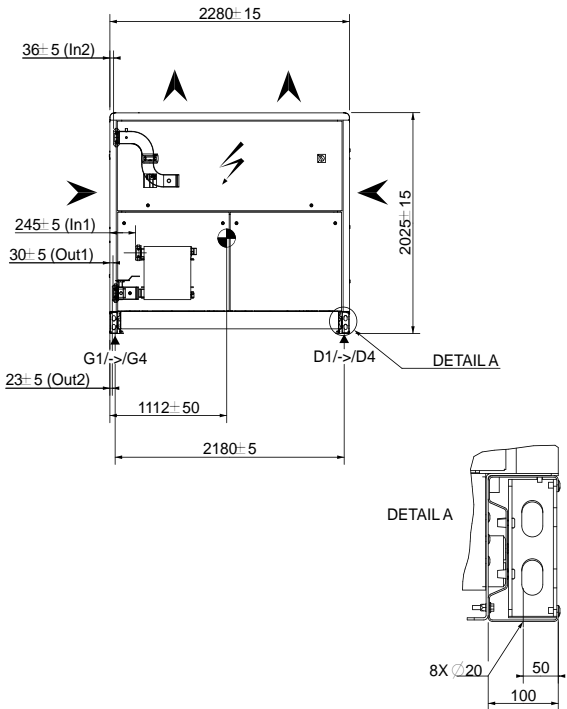
CLEARANCES

Overhead obstructions are not permitted



GENERAL MECHANICAL DRAWING

NAH 270



LEGEND:

- In 1 Water inlet - Unit without hydraulic module - 4" Victaulic
- In 2 : Water inlet - Unit with hydraulic module - 4" Victaulic
- Out : Water outlet - 4" Victaulic

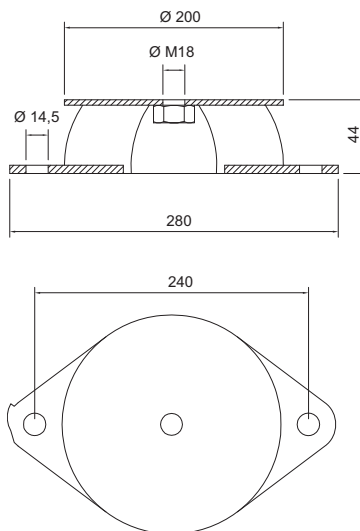
LOAD DITRIBUTION

(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3	G4/D4
NAH 270	413	537	404	271

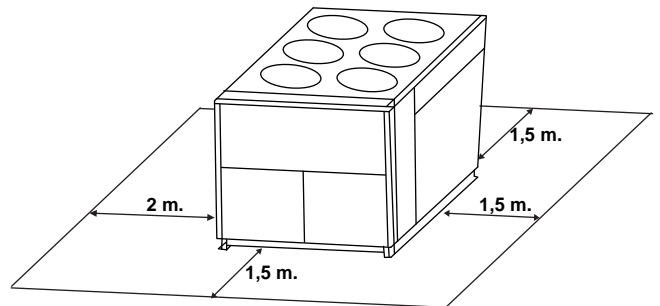
Lennox recommend load distribution as detailed above,

ANTI-VIBRATION MOUNTS (OPTION)



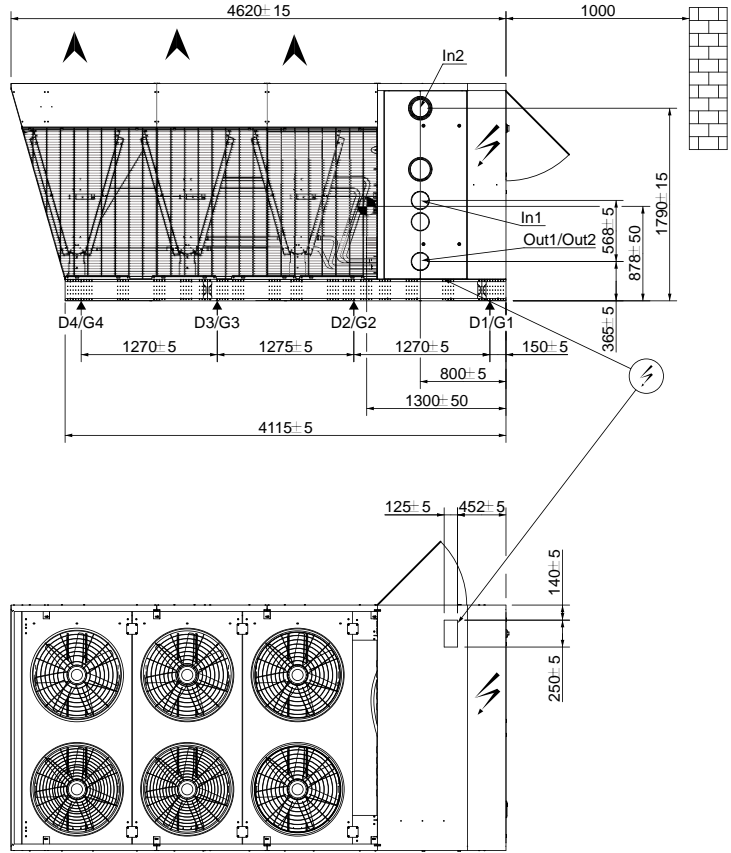
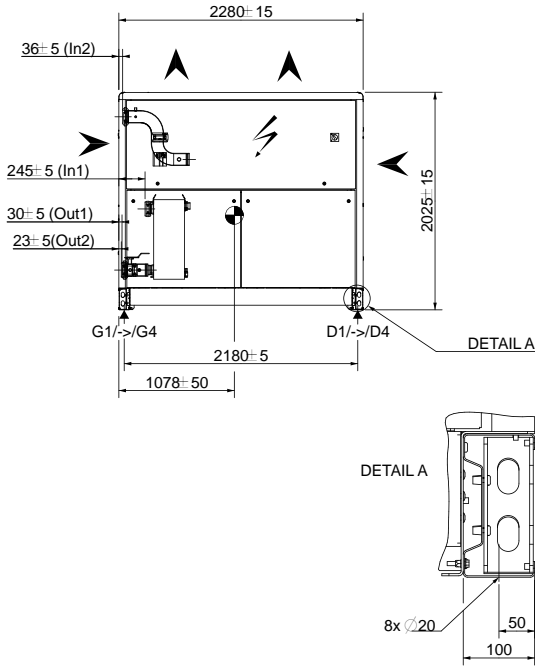
CLEARANCES

Overhead obstruction are not permitted



GENERAL MECHANICAL DRAWING

NAC 300
NAH 300



LEGEND:

- In 1 Water inlet - Unit without hydraulic module - 4"Victaulic
- In 2 : Water inlet - Unit with hydraulic module - 4"Victaulic
- Out 1 : Water outlet - 4"Victaulic
- Out 2 : Water outlet - Unit with hydraulic module - 4"Victaulic

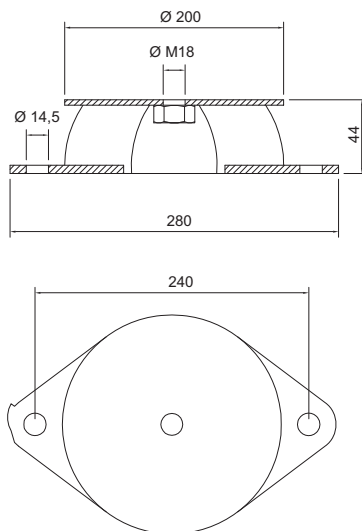
LOAD DITRIBUTION

(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3	G4/D4
NAC 300	397	495	374	253
NAH 300	489	609	460	312

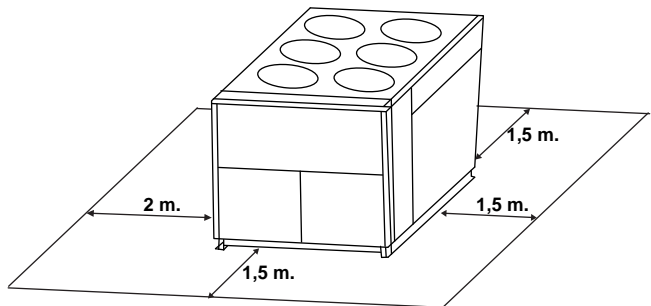
Lennox recommend load distribution as detailed above,

ANTI-VIBRATION MOUNTS (OPTION)



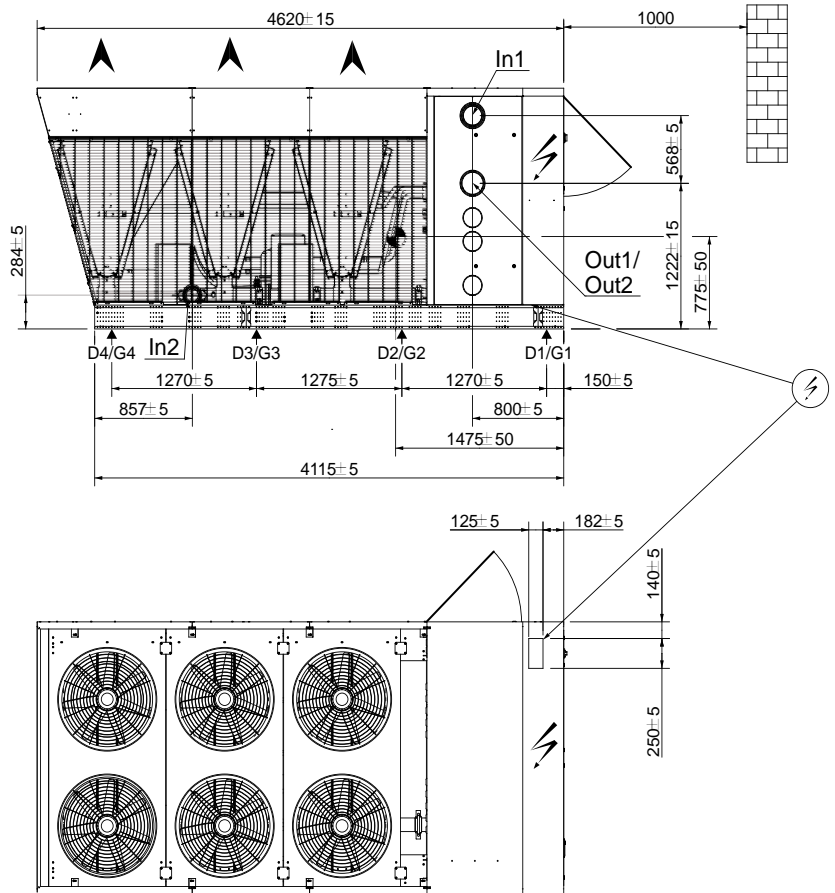
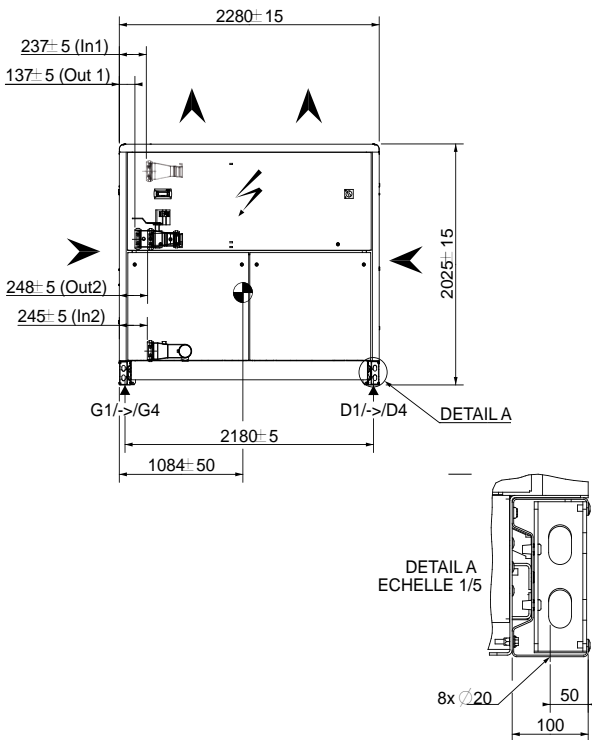
CLEARANCES

Overhead obstruction are not permitted



GENERAL MECHANICAL DRAWING

**NAC 340 / 380
NAH 340**



LEGEND:

- In 1** Water inlet - Unit without hydraulic module - 5"Victaulic

- In 2 :** Water inlet - Unit with hydraulic module - 5"Victaulic

- Out 1 :** Water outlet - Unit without hydraulic module or with variable speed drive - 5"Victaulic

- Out 2 :** Water outlet - Unit with hydraulic module - 5"Victaulic

LOAD DISTRIBUTION

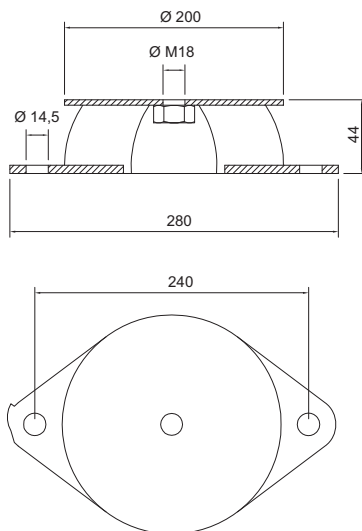
(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3	G4/D4
NAC 340	417	557	428	288
NAC 380	422	564	433	291

	G1/D1	G2/D2	G3/D3	G4/D4
NAH 340	459	614	472	317

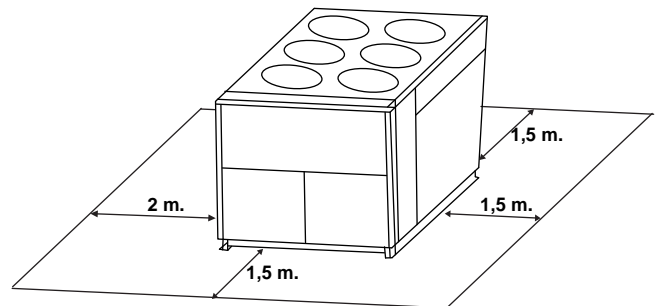
Lennox recommend load distribution as detailed above,

ANTI-VIBRATION MOUNTS (OPTION)



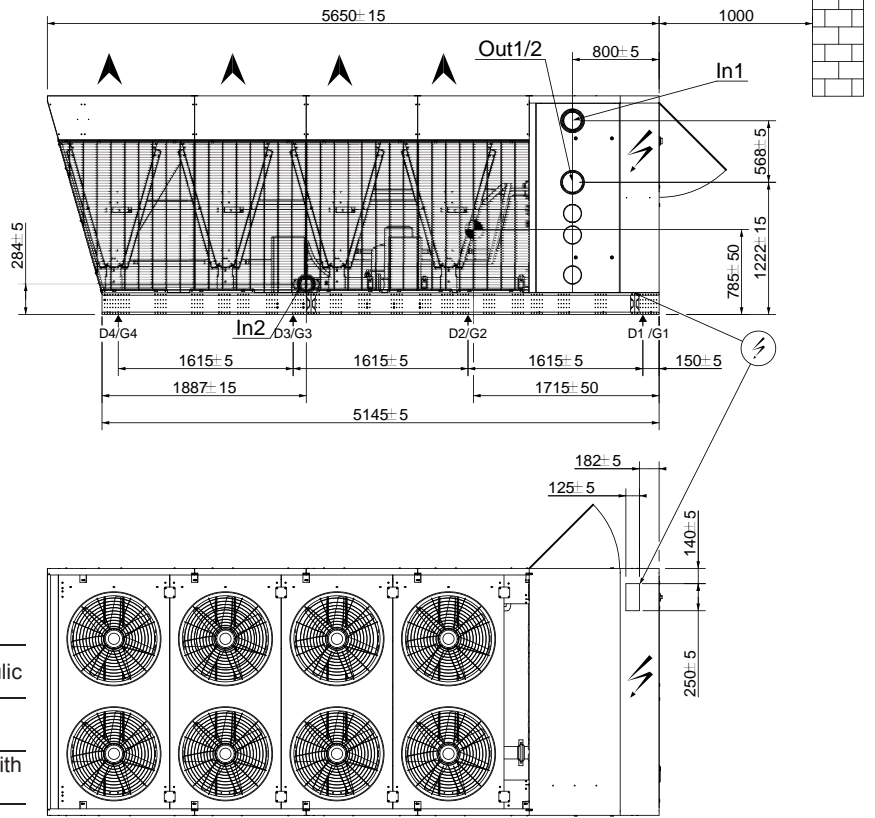
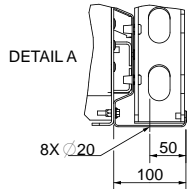
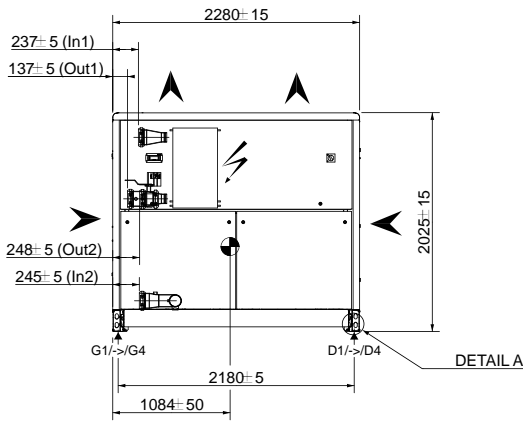
CLEARANCES

Overhead obstruction are not permitted



GENERAL MECHANICAL DRAWING

NAC 420 / 480
NAH 380 / 420 / 480



LEGEND:

- In 1 Water inlet - Unit without hydraulic module - 6"Victaulic
- In 2 : Water inlet - Unit with hydraulic module - 6"Victaulic
- Out 1 : Water outlet - Unit without hydraulic module or with variable speed drive - 6"Victaulic
- Out 2 : Water outlet - Unit with hydraulic module - 6"Victaulic

LOAD DITRIBUTION

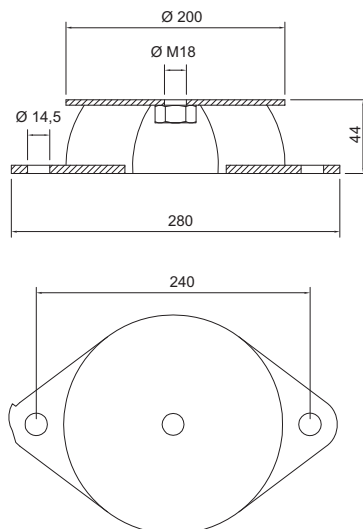
(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3	G4/D4
NAC 420	504	657	494	331
NAC 480	514	670	504	338

Lennox recommend load distribution as detailed above,

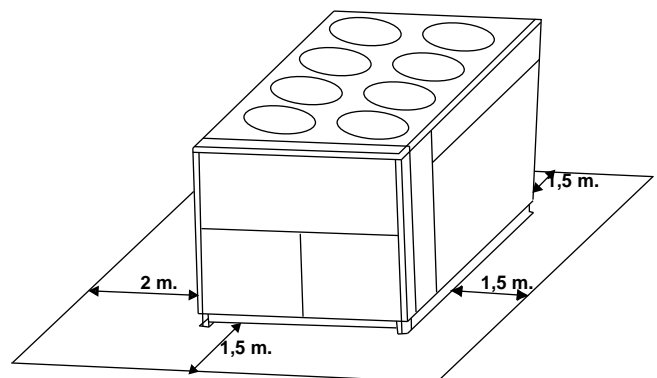
	G1/D1	G2/D2	G3/D3	G4/D4
NAH 380	558	727	547	366
NAH 420	566	737	554	371
NAH 480	576	751	565	378

ANTI-VIBRATION MOUNTS (OPTION)



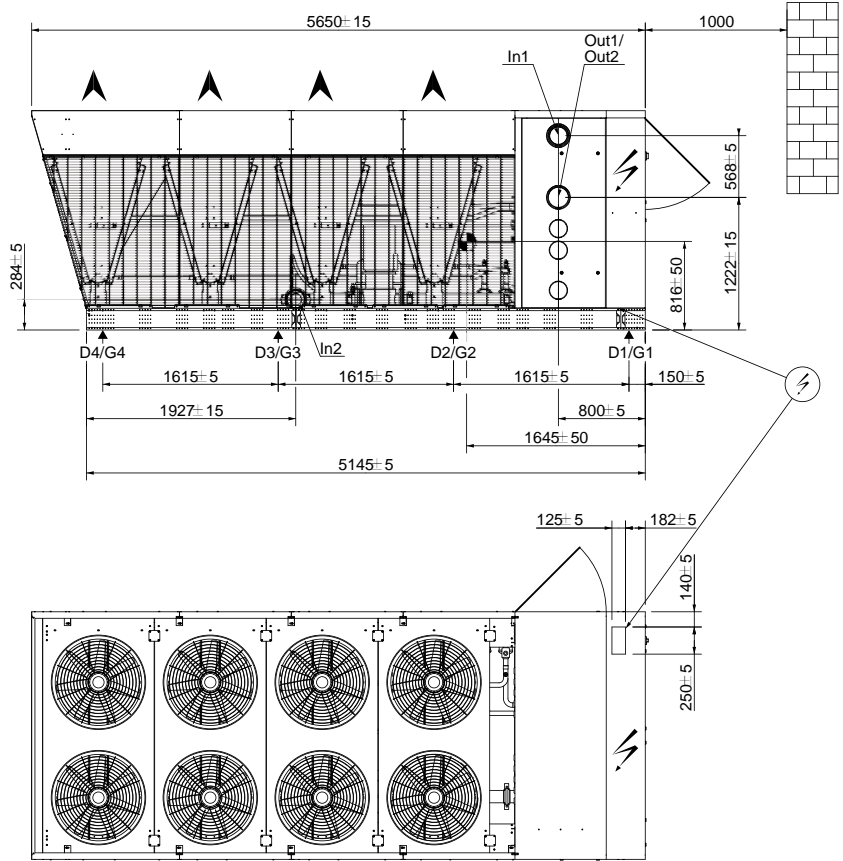
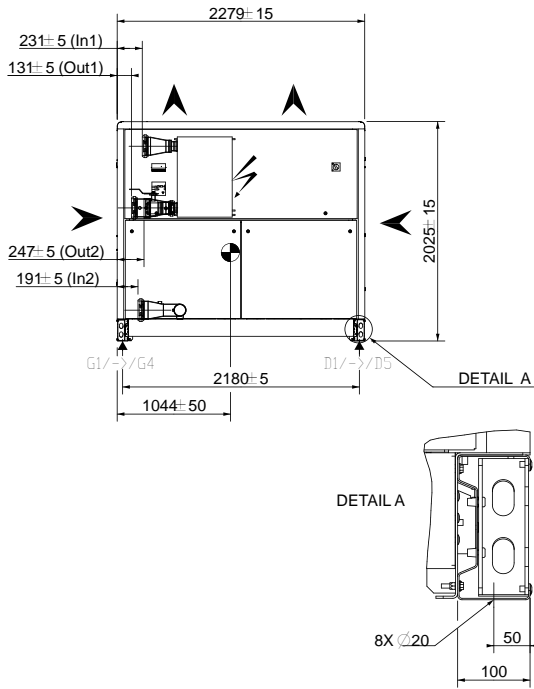
CLEARANCES

Overhead obstruction are not permitted



GENERAL MECHANICAL DRAWING

NAC 540



LEGEND:

- In 1** Water inlet - Unit without hydraulic module - 6"Victaulic
- In 2** : Water inlet - Unit with hydraulic module - 6"Victaulic
- Out 1** : Water outlet - Unit without hydraulic module or with variable speed drive - 6"Victaulic
- Out 2** : Water outlet - Unit with hydraulic module - 6"Victaulic

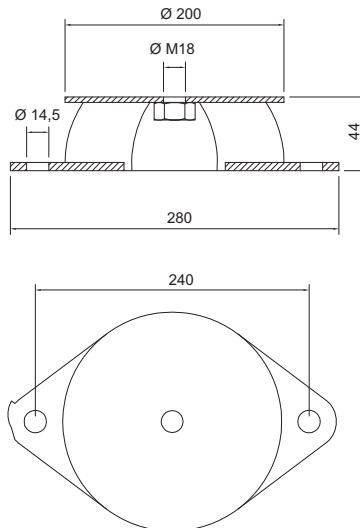
LOAD DISTRIBUTION

(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3	G4/D4
NAC 540	548	693	523	353

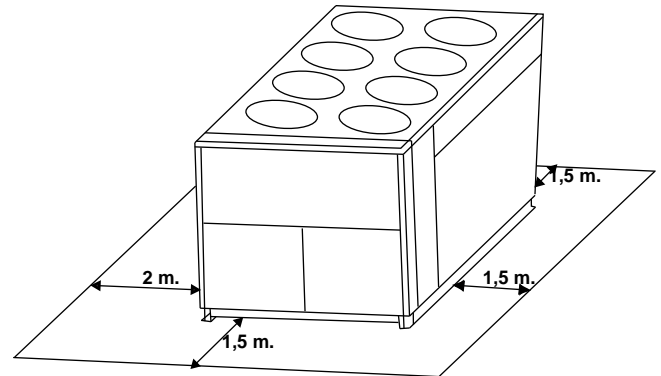
Lennox recommend load distribution as detailed above,

ANTI-VIBRATION MOUNTS (OPTION)



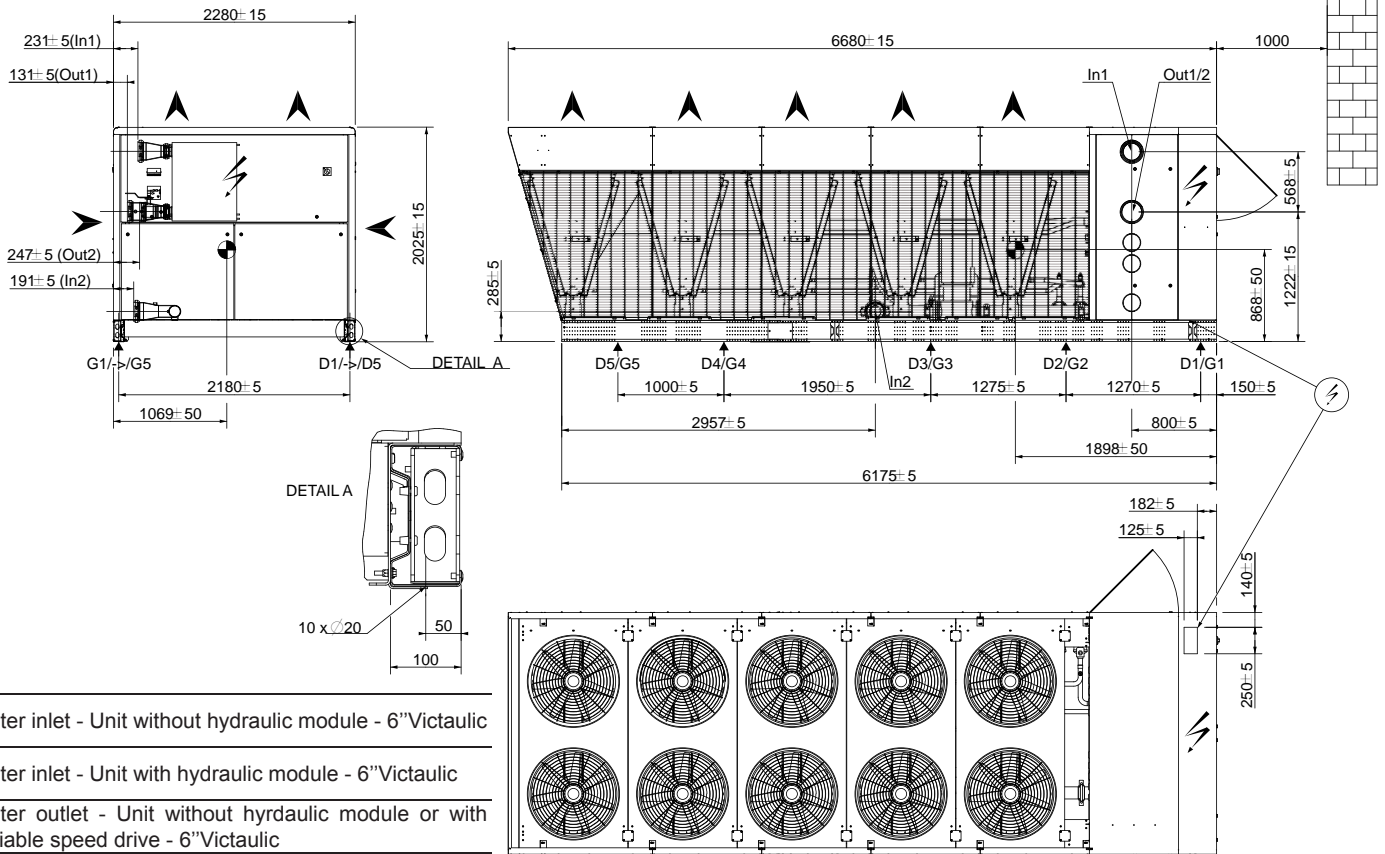
CLEARANCES

Overhead obstruction are not permitted



GENERAL MECHANICAL DRAWING

NAC 600 / 640



LEGEND:

- In 1** Water inlet - Unit without hydraulic module - 6"Victaulic
- In 2 :** Water inlet - Unit with hydraulic module - 6"Victaulic
- Out 1 :** Water outlet - Unit without hydraulic module or with variable speed drive - 6"Victaulic
- Out 2 :** Water outlet - Unit with hydraulic module - 6"Victaulic

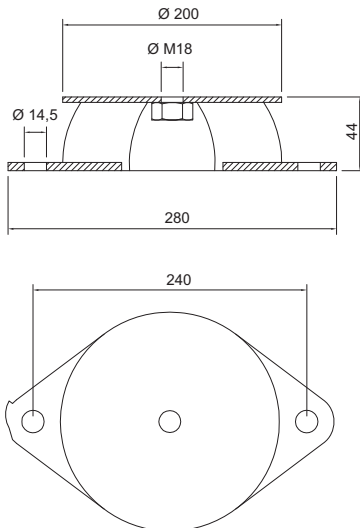
LOAD DISTRIBUTION

(Kg - Operating weights with dual pump hydraulic module)

	G1/D1	G2/D2	G3/D3	G4/D4	G5/D5
NAC 600	477	555	535	416	354
NAC 640	479	558	538	418	356

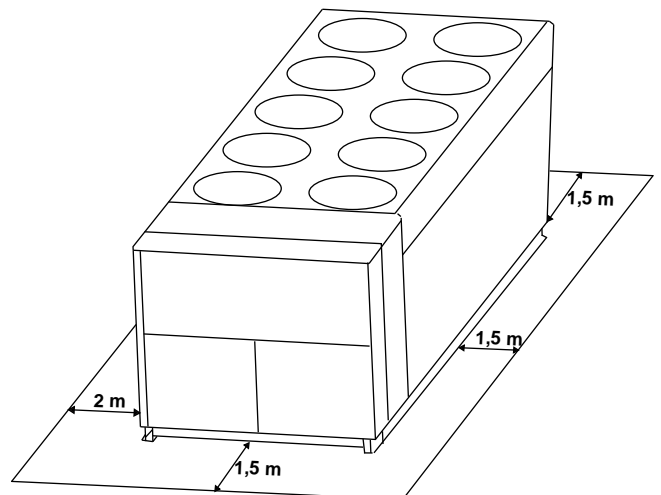
Lennox recommend load distribution as detailed above,

ANTI-VIBRATION MOUNTS (OPTION)



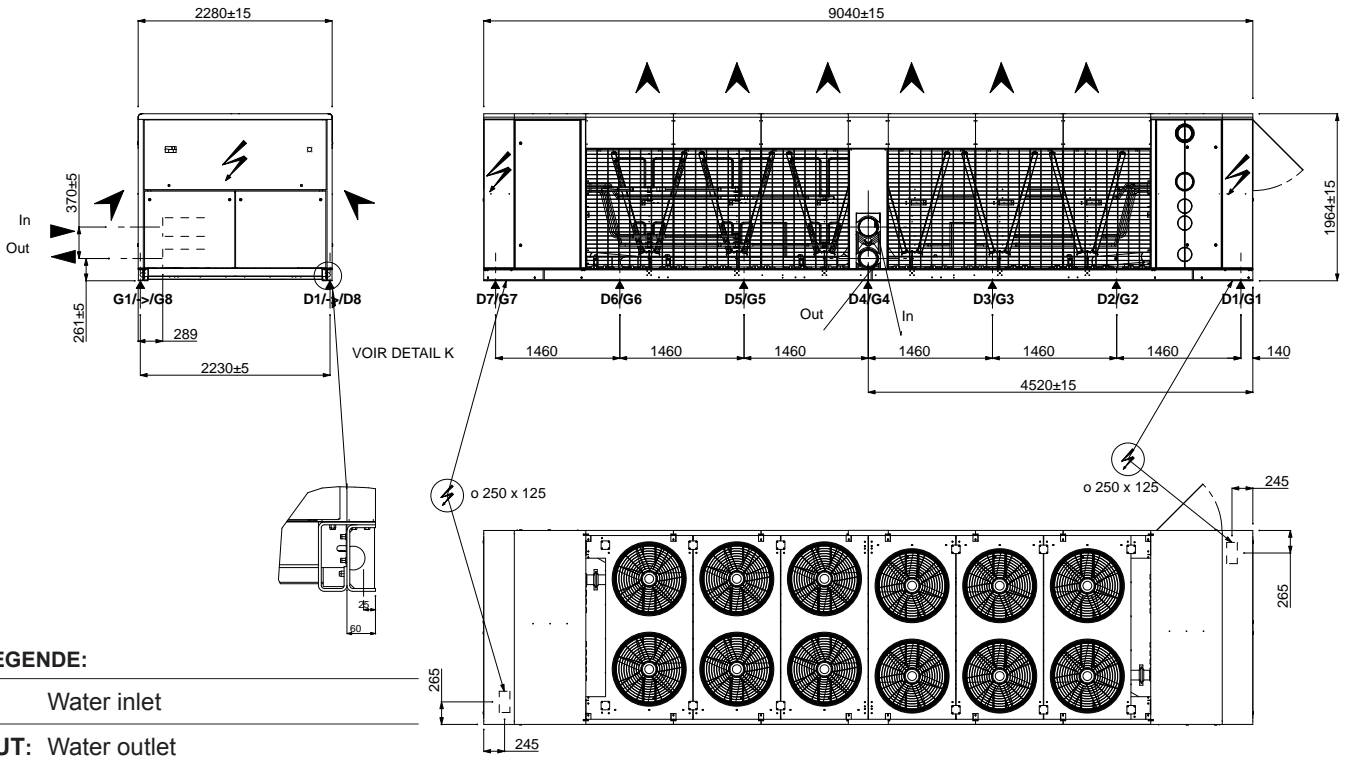
CLEARANCES

Overhead obstruction are not permitted



GENERAL MECHANICAL DRAWING

NAC 680 / 760



LEGENDE:

- IN Water inlet
- OUT: Water outlet

Note: In case of single main power connection (option), main power supply and disconnect switch are located at the right side of the unit.

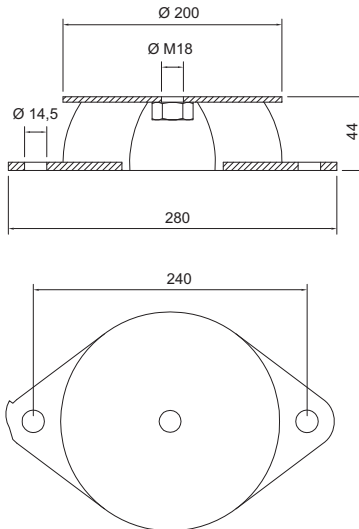
LOAD DISTRIBUTION

(Kg - Operating weights with dual pump hydraulic module)

	G1	G2	G3	G4	G5	G6	G7	D1	D2	D3	D4	D5	D6	D7
NAC 680	480	480	480	480	480	480	480	480	480	480	480	480	480	480
NAC 760	490	490	490	490	490	490	490	490	490	490	490	490	490	490

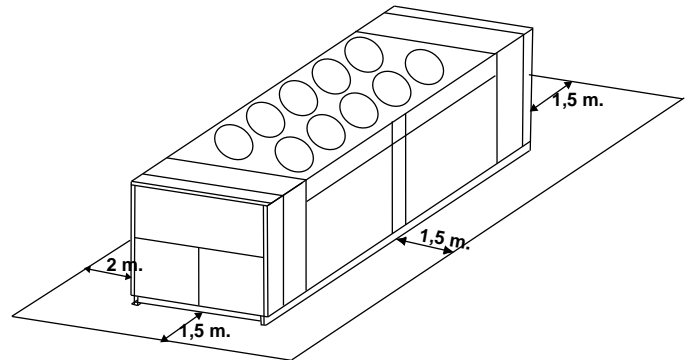
Lennox recommend load distribution as detailed above.

ANTI-VIBRATION MOUNTS (OPTION)



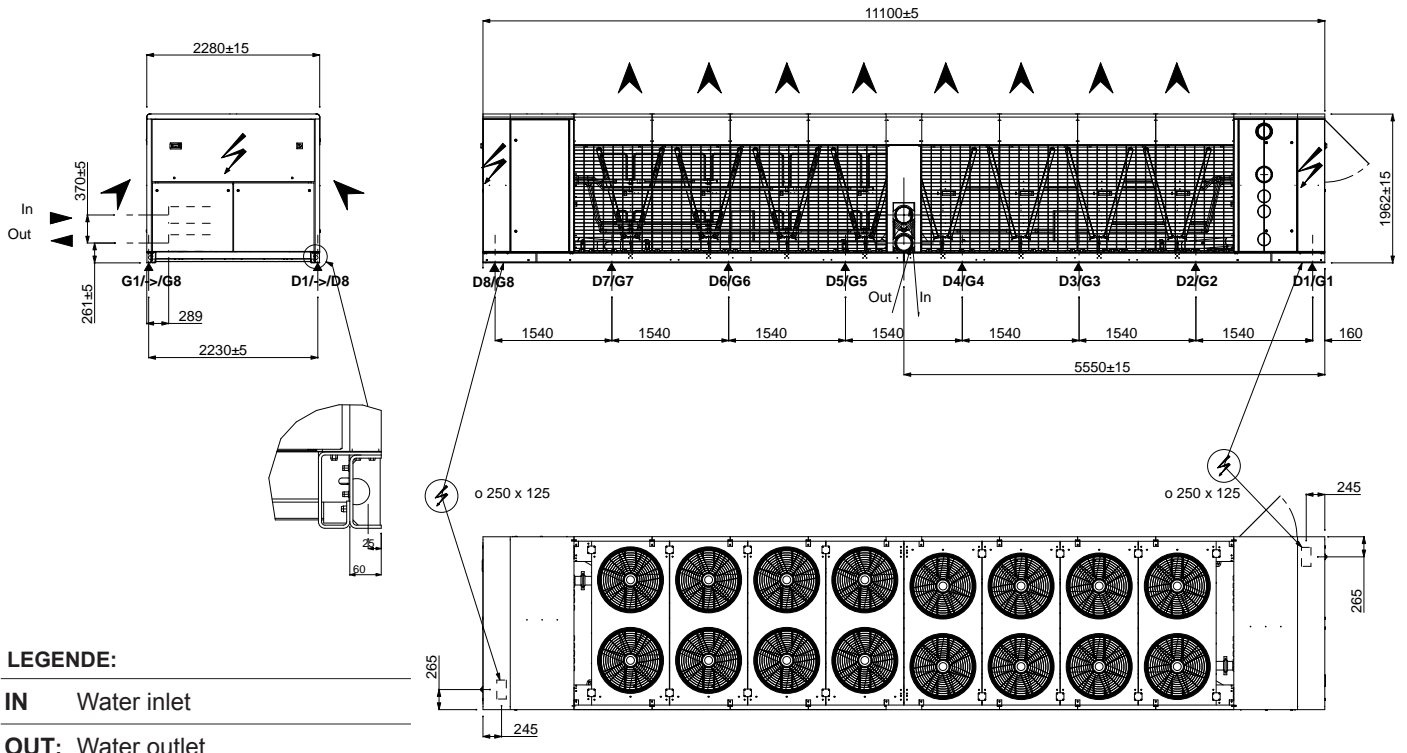
CLEARANCES

Overhead obstructions are not permitted



GENERAL MECHANICAL DRAWING

NAC 840 / 960 / 1080



LEGENDE:

- IN Water inlet
- OUT: Water outlet

Note: In case of single main power connection (option), main power supply and disconnect switch are located at the right side of the unit.

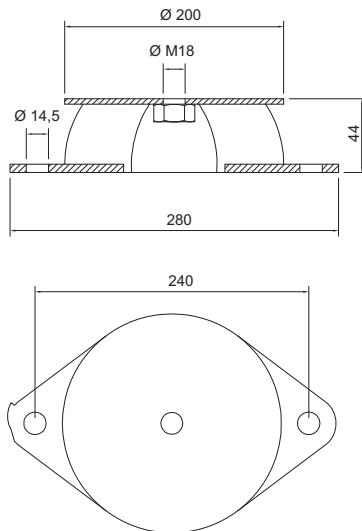
LOAD DITRIBUTION

(Kg - Operating weights with dual pump hydraulic module)

	G1	G2	G3	G4	G5	G6	G7	G8	D1	D2	D3	D4	D5	D6	D7	D8
NAC 840	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
NAC 960	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510
NAC 1080	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510	510

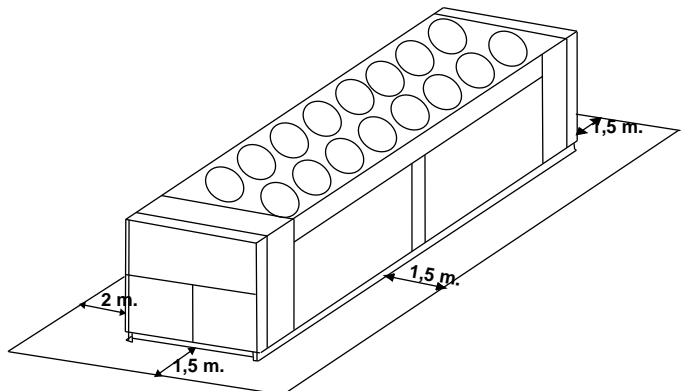
Lennox recommend load distribution as detailed above,

ANTI-VIBRATION MOUNTS (OPTION)



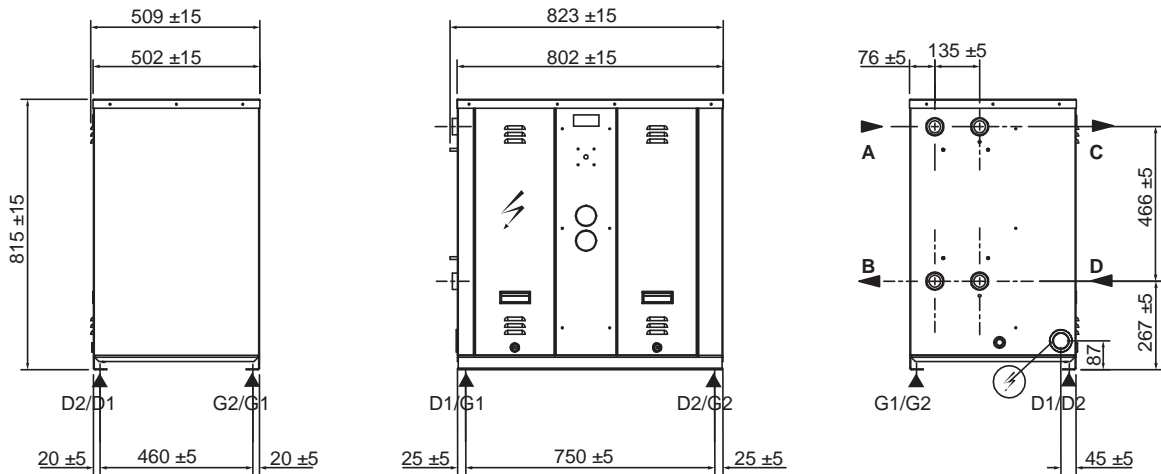
CLEARANCES

Overhead obstructions are not permitted



GENERAL MECHANICAL DRAWING

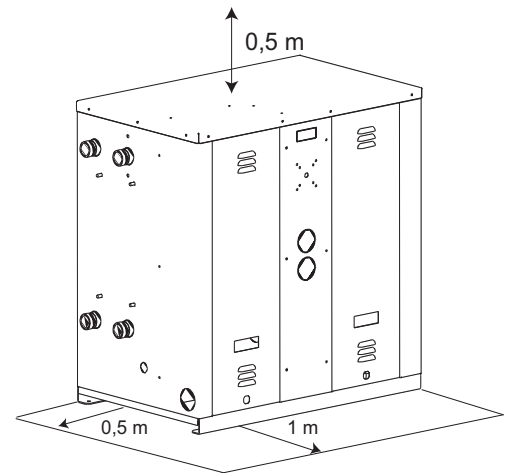
HYDROLEAN 025 / 035



LOAD DISTRIBUTION
(kg - Operating weights)

	SWC		SWH		SWR	
	G1	G2	G1	G2	G1	G2
025	44	44	45	45	39	39
035	62	62	63	63	49	49
	D1	D2	D1	D2	D1	D2
	020	44	44	45	45	39
035	62	62	63	63	49	49

CLEARANCES



PIPING

A Box 025/035		SWC	SWH	SWR
EVAPORATOR		<i>All units</i>		
Water inlet	A	1" 1/2 DN40		
Water outlet	B	1" 1/2 DN40		
CONDENSER		SWC		
Water inlet	D	1" 1/2 DN40		-
Water outlet	C	1" 1/2 DN40		-
CONDENSER		SWH		SWR
Water inlet	C	1" 1/2 DN40		-
Liquid line	D	-		5/8"
Water outlet	D	1" 1/2 DN40		-
Discharge Line	C	-		7/8"

ANTI-VIBRATION MOUNTS (OPTION)

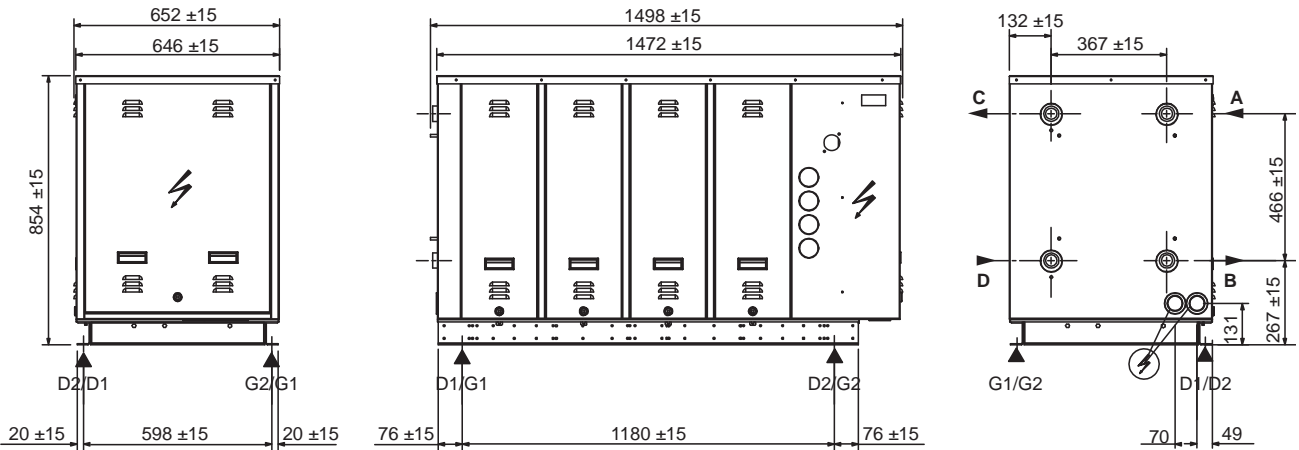


HYDROLEAN		025	035
Type of rubber mounts		APK80/45Sh A	APK80/60Sh A
Number per unit	#	4	4
Height	(C) mm	27	27
Thread diameter	E mm	M8	M8
Max. thread length	mm	10	11,8

GENERAL MECHANICAL DRAWING

HYDROLEAN 050/070/080

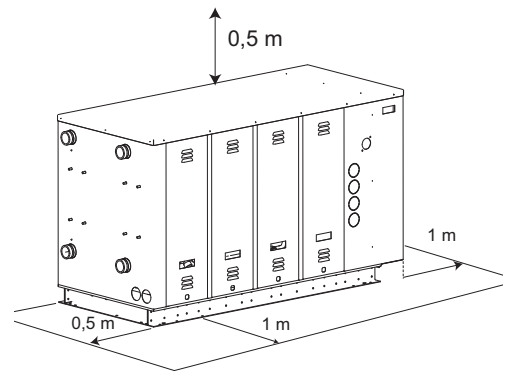
DIMENSIONAL DATA



LOAD DISTRIBUTION
(kg - Operating weights)

	SWC		SWH		SWR	
	G1	G2	G1	G2	G1	G2
050	83	83	85	85	73	73
070	95	95	96	96	79	79
080	99	99	101	101	80	80
	D1	D2	D1	D2	D1	D2
	050	83	83	85	85	73
070	95	95	96	96	79	79
080	99	99	101	101	80	80

CLEARANCES



PIPING

B Box 050/070/080		SWC	SWH	SWR
EVAPORATOR				
Water inlet	A	1" 1/2 DN40		
Water outlet	B	1" 1/2 DN40		
CONDENSER				
		SWC	-	
Water inlet	D	1" 1/2 DN40		
Water outlet	C	1" 1/2 DN40		
		SWH	SWR	
Water inlet	C	1" 1/2 DN40		
Liquid line	D	-		
Water outlet	D	7/8"		
Discharge Line	C	-		
			1" 1/8	

ANTI-VIBRATION MOUNTS (OPTION)

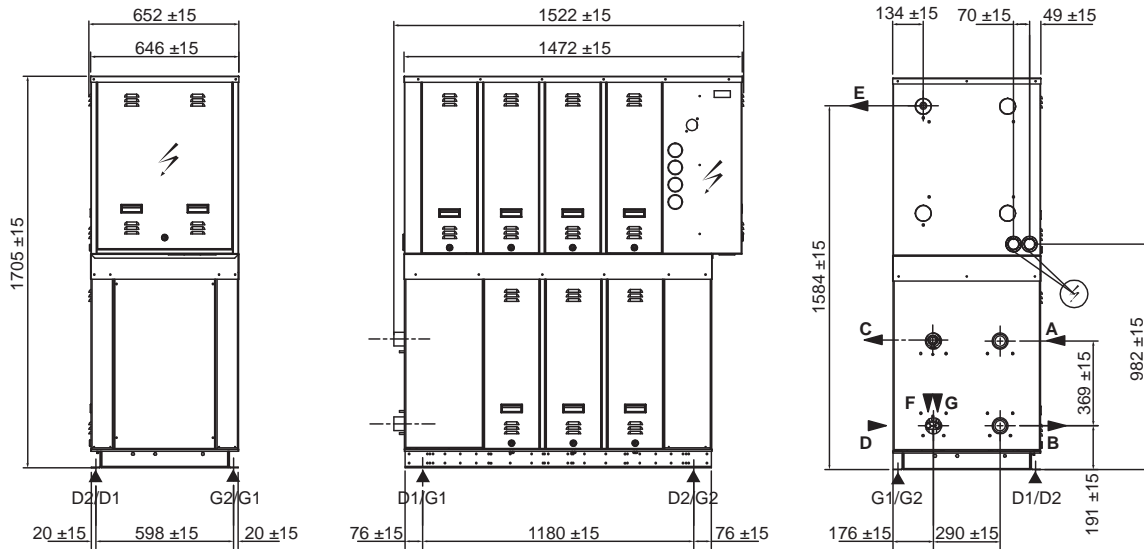


HYDROLEAN	050	070	080
Type of rubber mounts	APK80/75Sh A		APK100/60Sh A
Number per unit	#	4	4
Height	(C) mm	27	28
Thread diameter	E mm	M8	M10
Max. thread length	mm	12,8	10

GENERAL MECHANICAL DRAWING

HYDROLEAN 100/120/135/160

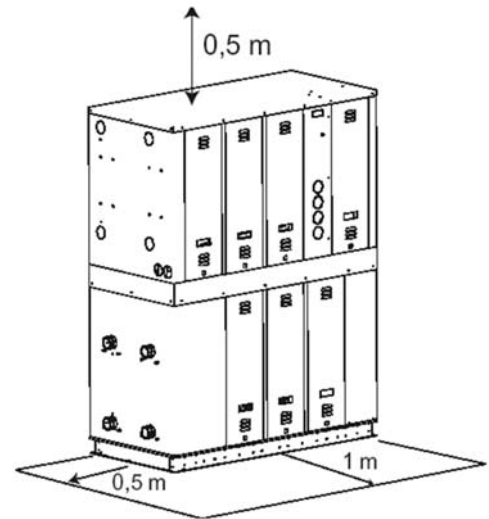
DIMENSIONAL DATA



LOAD DISTRIBUTION
(kg - Operating weights)

	SWC		SWH		SWR	
	G1	G2	G1	G2	G1	G2
100	152	152	154	154	125	125
120	154	154	156	156	128	128
135	185	185	187	187	150	150
160	190	190	193	193	155	155
	D1	D2	D1	D2	D1	D2
	100	152	152	154	125	125
120	154	154	156	156	128	128
135	185	185	187	187	150	150
160	190	190	193	193	155	155

CLEARANCES



PIPING

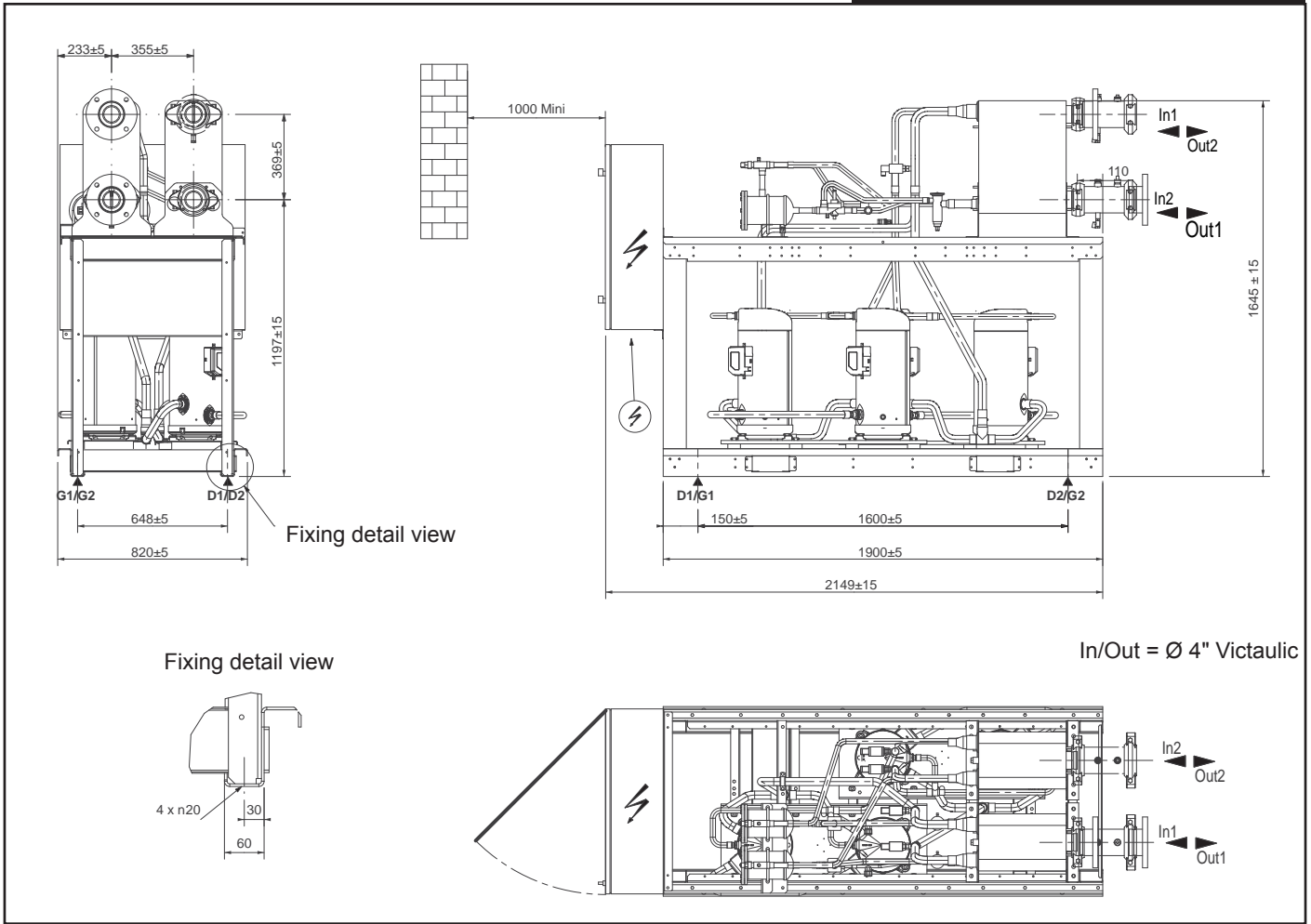
C Box 100/120/135/160		SWC	SWH	SWR
EVAPORATOR				
Water inlet	A	2" DN50		
Water outlet	B	2" DN50		
CONDENSER				
		SWC	-	
Water inlet	D	2" DN50	-	
Water outlet	C	2" DN50	-	
CONDENSER				
		SWH	SWR	
Water inlet	C	2" DN50	-	
Liquid line		-	7/8"	
Water outlet	D	2" DN50	-	
Discharge Line (C1)	E	-		1" 1/8
Discharge Line (C2)	C	-		1" 3/8"

ANTI-VIBRATION MOUNTS (OPTION)



HYDROLEAN	100/120/135/160
Type of rubber mounts	APK100/75Sh A
Number per unit	# 4
Height	(C) mm 28
Thread diameter	E mm M10
Max. thread length	mm 10

MWC 180



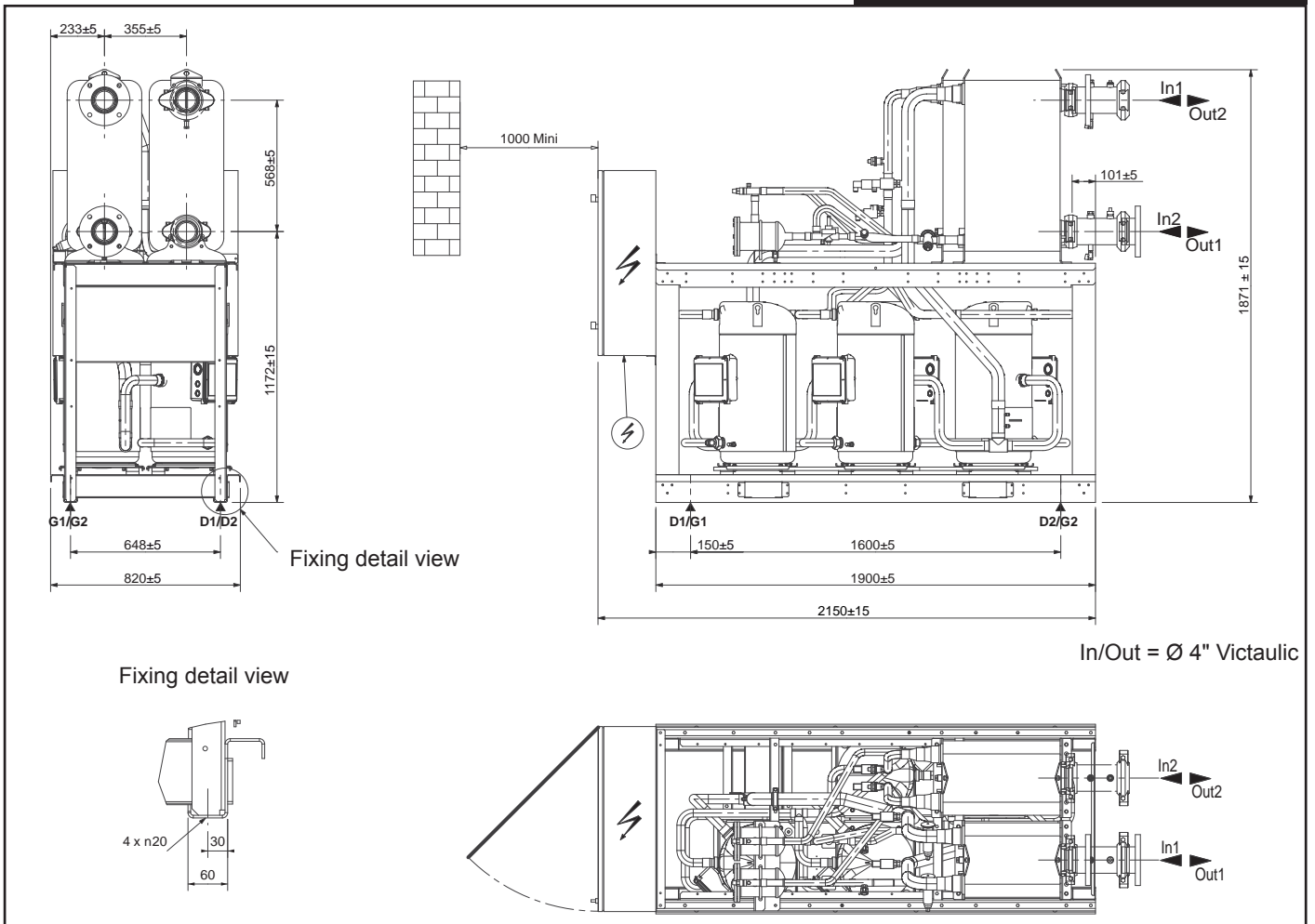
		MWC 180	MRC 180
Evaporator			
In1	Water inlet	4"	4"
Out1	Water outlet	4"	4"
Condenser			
In2	Water inlet	4"	-
Out2	Water outlet	4"	-
Liquid line		-	7/8"
Discharge line		-	1" 1/8

LOAD DISTRIBUTION
(Kg - Operating weights)

	MWC 180	MRC 180
D1	162	160
D2	162	150
G1	162	140
G2	262	200

Lennox recommend load distribution as detailed above

MWC 230 → 380



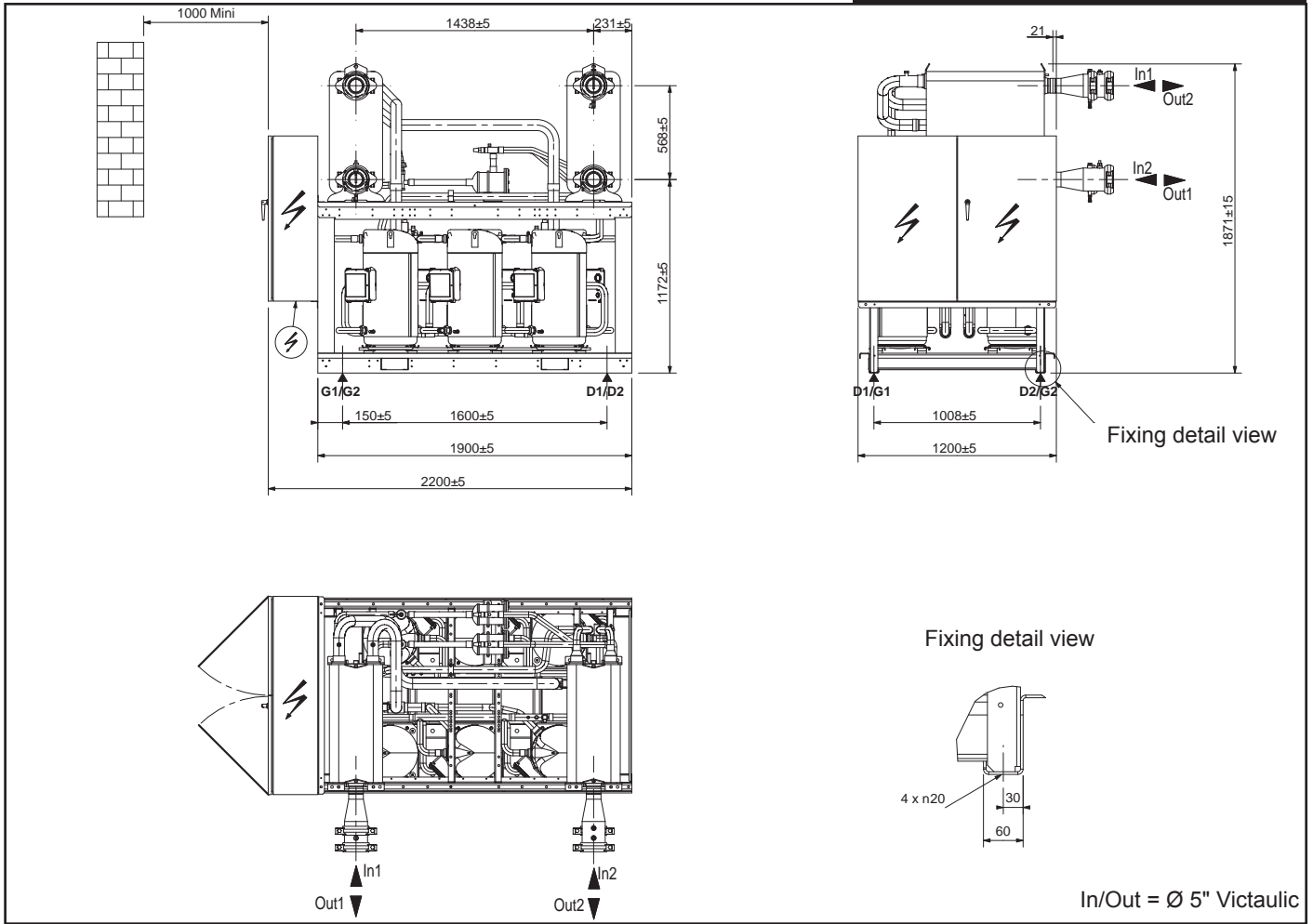
		MWC 230 → 380	MRC			
			230	280	330	380
Evaporator						
In1	Water inlet	4"	4"			
Out1	Water outlet	4"	4"			
Condenser						
In2	Water inlet	4"	-			
Out2	Water outlet	4"	-			
Liquid line		-	1" 1/8 7/8"	2 x 1"1/8	2 x 1"1/8	2 x 1" 1/8
Discharge line		-	1" 3/8 1" 1/8	2 x 1"3/8	2 x 1"3/8	2 x 1" 3/8

LOAD DITRIBUTION
(Kg - Operating weights)

	MWC 230	MWC 280	MWC 330	MWC 380	MRC 230	MRC 280	MRC 330	MRC 380
D1	204	237	277	311	200	230	270	270
D2	214	257	387	441	190	220	350	300
G1	204	247	277	321	170	210	240	310
G2	344	417	387	461	250	290	260	410

Lennox recommend load distribution as detailed above

MWC 450 → 570

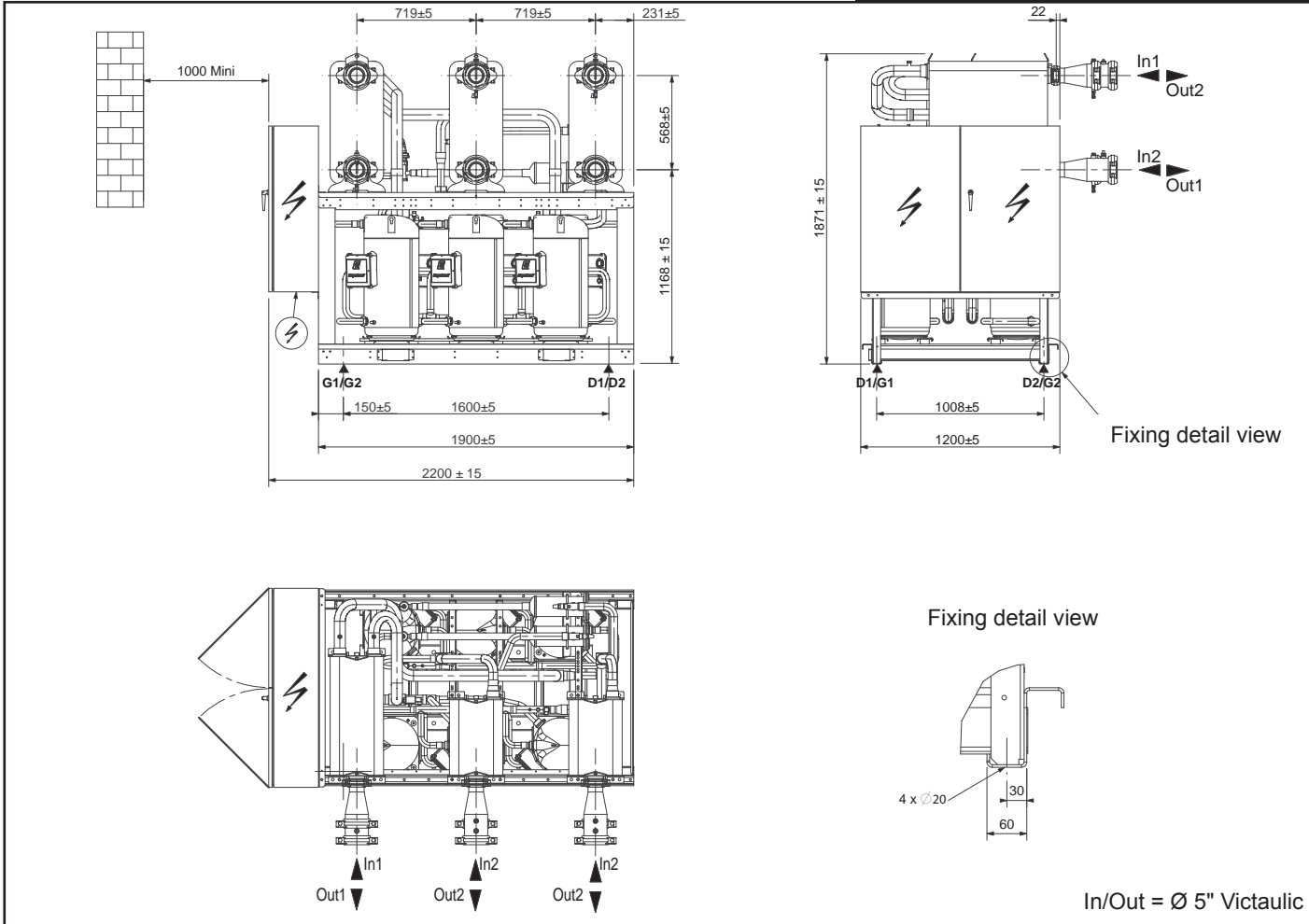


		MWC 450 → 570	MRC 450 → 570
Evaporator			
In1	Water inlet	5"	5"
Out1	Water outlet	5"	5"
Condenser			
In2	Water inlet	5"	-
Out2	Water outlet	5"	-
Liquid line		-	2 x 1" 3/8
Discharge line		-	2 x 1" 5/8

LOAD DITRIBUTION
(Kg - Operating weights)

	MWC 450	MWC 510	MWC 570	MRC 450	MRC 510	MRC 570
D1	553	575	645	540	560	630
D2	543	585	605	350	370	380
G1	453	475	515	440	460	500
G2	433	465	475	330	350	360

MWC 650 → 720

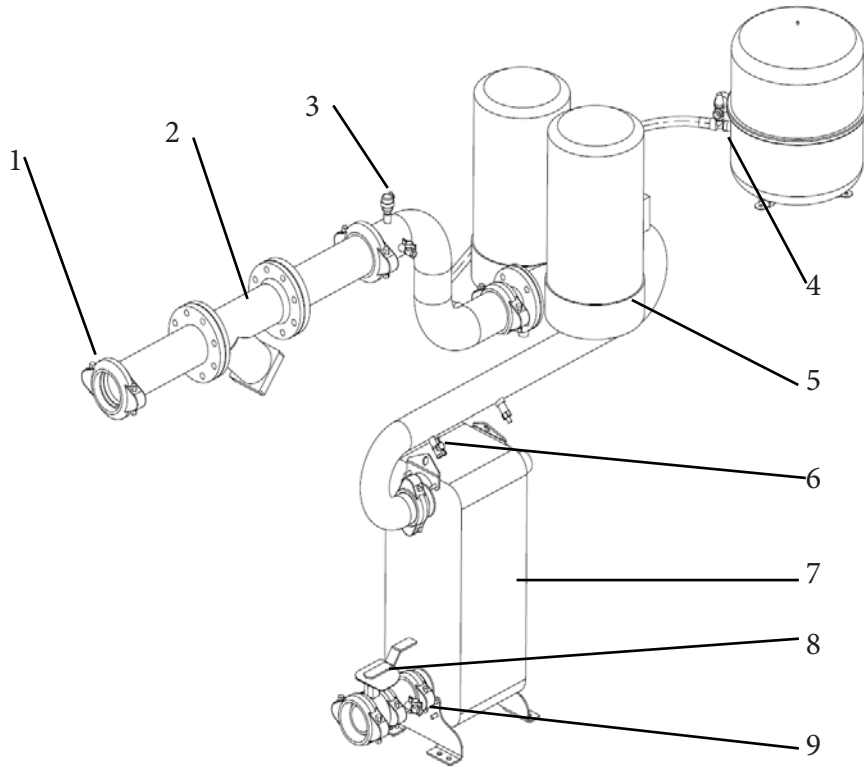


		MWC 650 → 720	MRC 650	MRC 720
Evaporator				
In1	Water inlet	5"	5"	5"
Out1	Water outlet	5"	5"	5"
Condenser				
In2	Water inlet	5"	-	-
Out2	Water outlet	5"	-	-
Liquid line C1 & C2		-	1" 5/8 1" 3/8	2 x 1" 5/8
Discharge line C1 & C2		-	2" 1/8 1" 5/8	2 x 2" 1/8

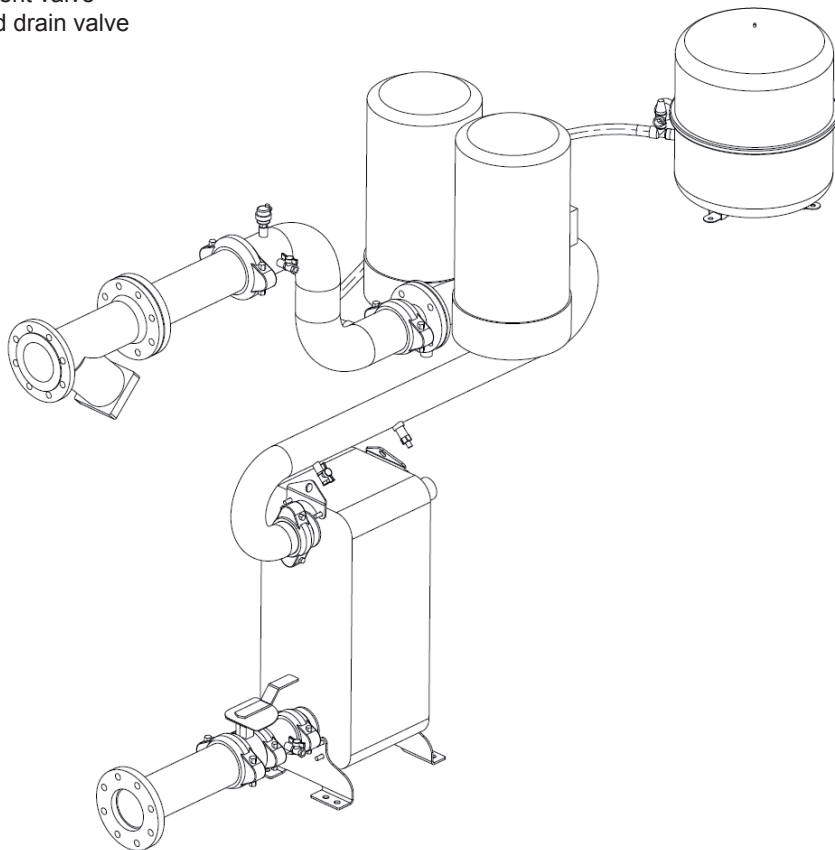
LOAD DITRIBUTION
(Kg - Operating weights)

	MWC 650	MWC 720	MRC 650	MRC 720
D1	775	785	660	670
D2	655	665	410	420
G1	545	555	530	540
G2	465	475	380	390

HYDRAULIC DATA



- 1. All victaulic connections
- 2. Inlet filter (supplied loose)
- 3. Automatic air vent
- 4. Expansion vessel, relief valve & manometer
- 5. Single or dual pump, high or low pressure
- 6. New electronic stainless steel flow switch
- 7. High performance stainless steel evaporator
- 8. Pressure adjustment valve
- 9. Pressure taps and drain valve



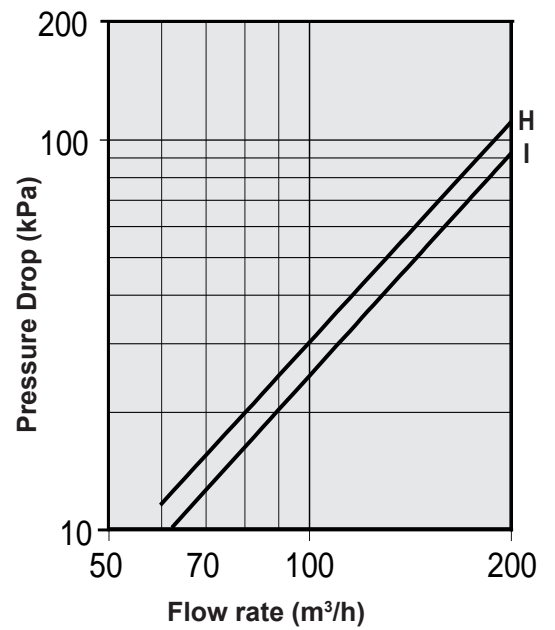
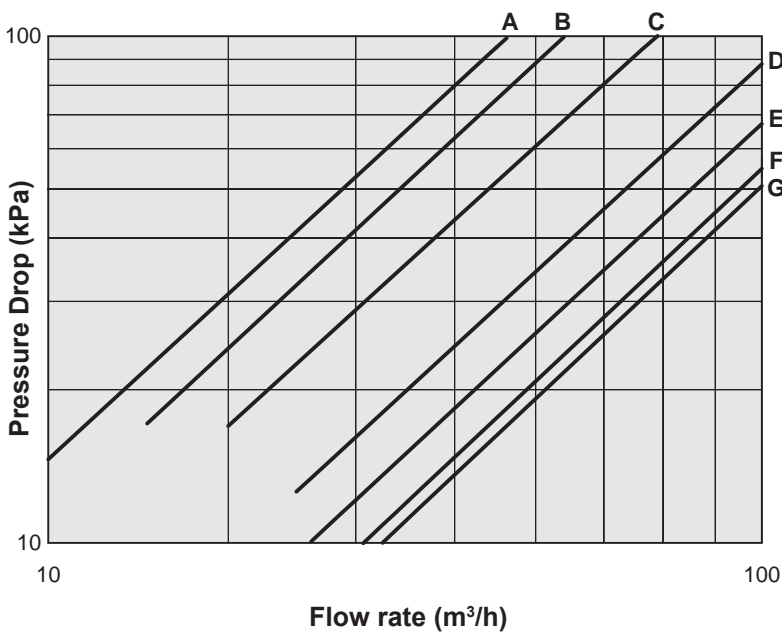
Configuration for flanged connections

PRESSURE DROPS

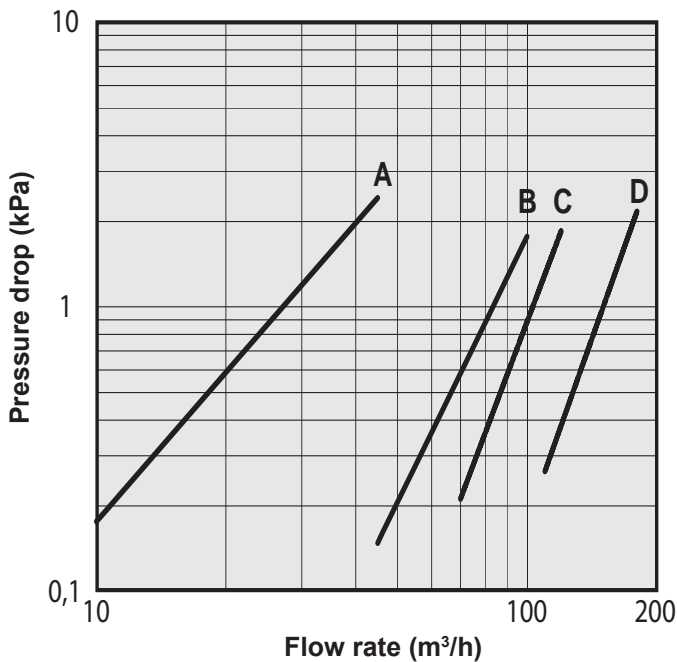
NEOSYS

EVAPORATORS CURVE

NAC	NAH	Curve	NAC	Curve
200		A	540	E
230			600	F
270			640	G
300		C	680	H
340		D	760	
380			840	
420		E	960	I
480			1080	



FILTER CURVE



NAC	NAH	Curve
200		A
230		
270		
300		
340		B
380		
420		
480		
540	-	C
600	-	
640	-	
680	-	D
760	-	
840	-	
960	-	
1080	-	

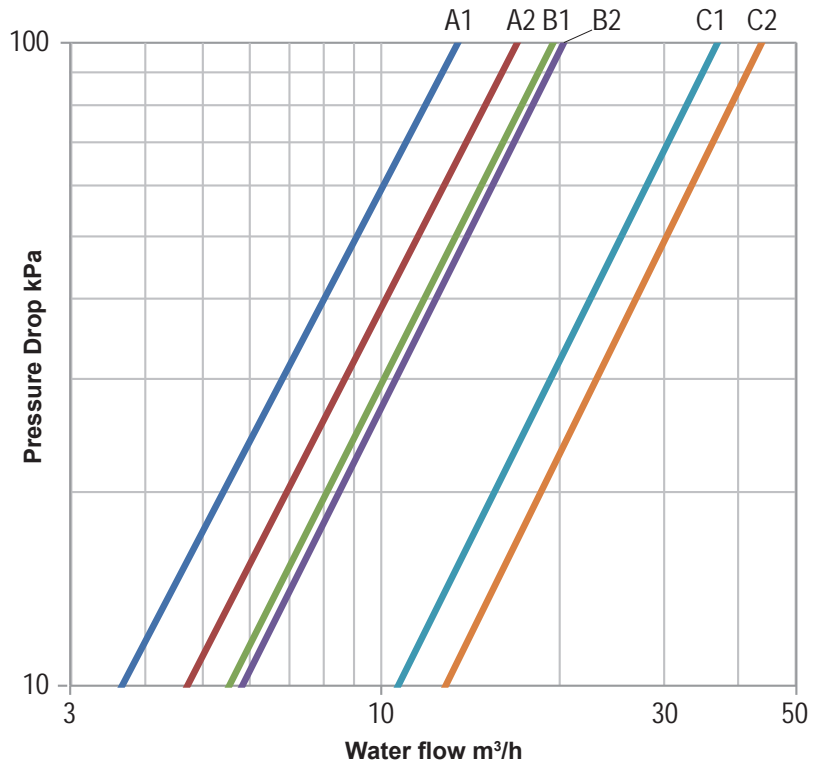
Pressure drops are given for information only. A tolerance of +/- 20 kPa must be considered when selecting water pumps.

PRESSURE DROPS

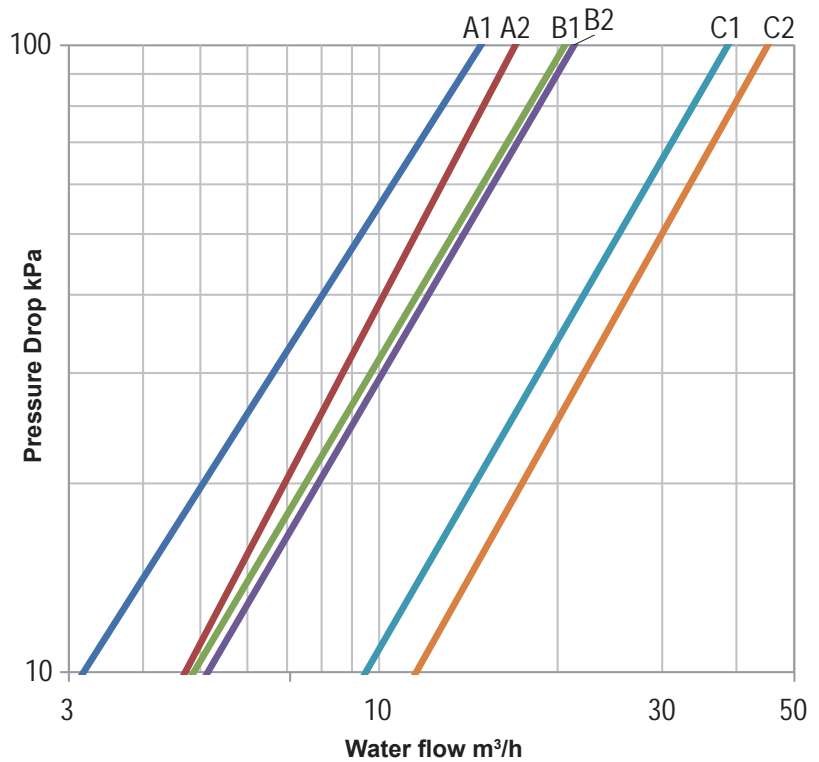
HYDROLEAN

HYDROLEAN	025	035	050	070	080	100	120	135	160
Evaporator/Condenser curve	A1	A2	B1	B2	B2	C1	C1	C2	C2

PRESSURE DROP OF HYDROLEAN PLATE HEAT EXCHANGERS WITH CLEAR WATER



PRESSURE DROP OF HYDROLEAN PLATE HEAT EXCHANGERS WITH WATER AND ETHYLENE GLYCOL 30%

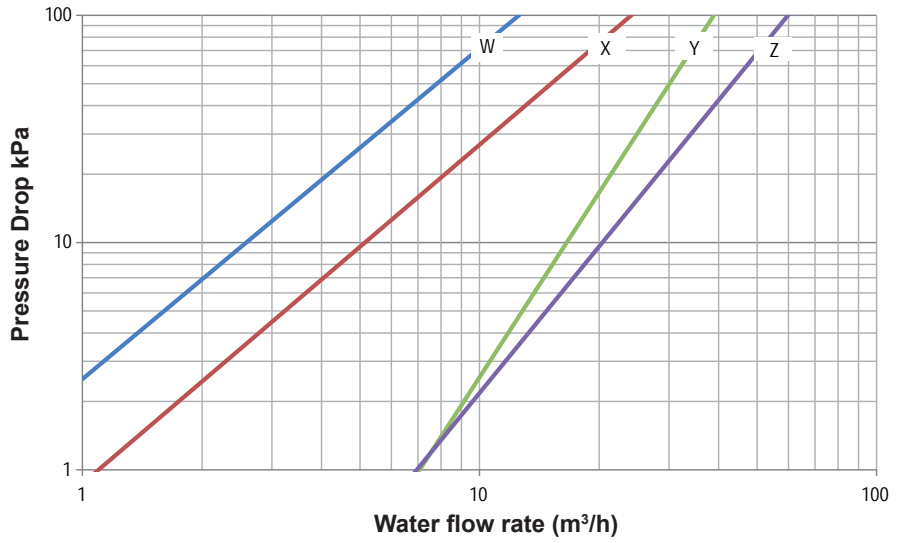


PRESSURE DROPS

HYDROLEAN

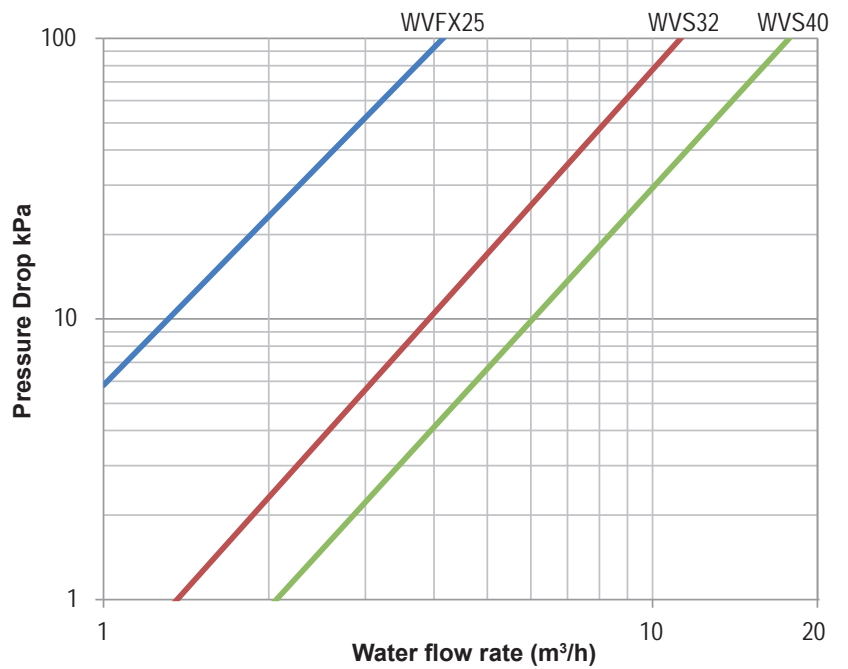
FILTERS

Water filter diameter
 W = 1" 1/2
 X = 2"
 Y = 2" 1/2
 Z = 3"



HYDROLEAN	025	035	050	070	080	100	120	135	160
Filter curve	W	X	X	Y	Y	Y	Y	Z	Z

"FULLY OPEN" PRESSOSTATIC CONTROL WATER VALVE

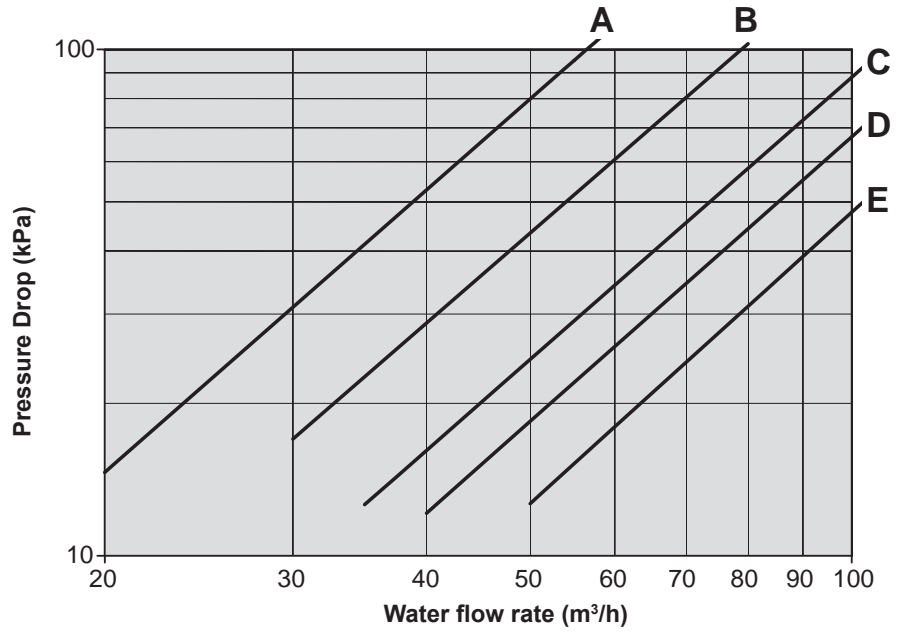


HYDROLEAN	025	035	050	070	080	100	120	135	160
Pressure regulated valve	WVFX25	WVFX25	WVS32	WVS32	WVS32	WVS32	WVS40	WVS40	WVS40

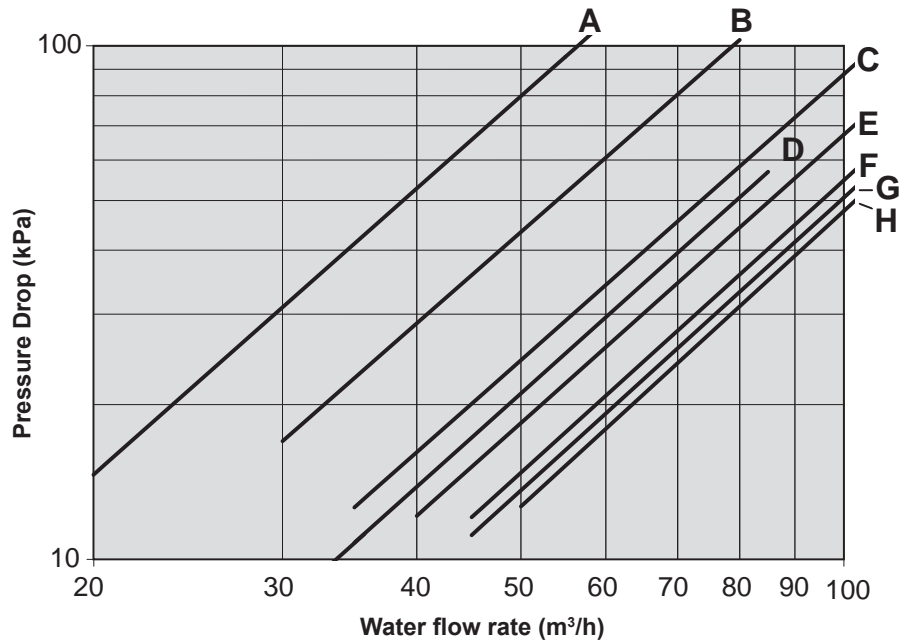
PRESSURE DROPS

MWC

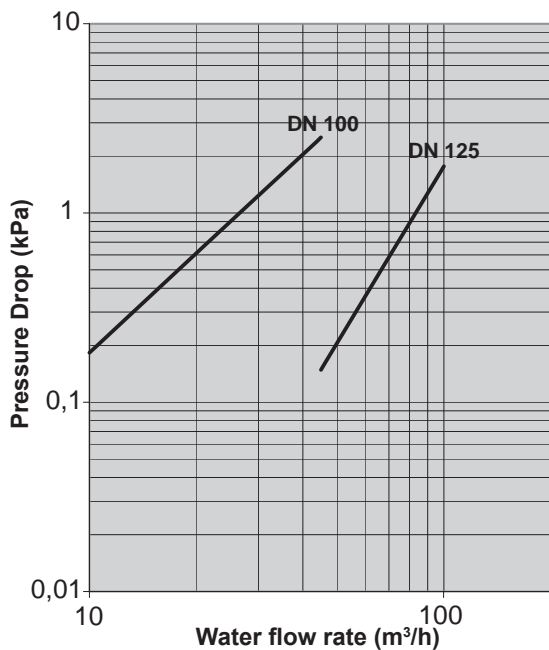
EVAPORATORS CURVE



CONDENSER CURVE



FILTER CURVE



MWC	Curves		
	Evaporator	Condenser	Filter
180	A	A	DN100
230	B	B	DN100
280	B	C	DN100
330	C	C	DN100
380	C	D	DN100
450	D	E	DN125
510	D	F	DN125
570	E	G	DN125
650	E	H	DN125
720	E	H	DN125

Pressure drops are given for information only, A tolerance of +/- 20kPa must be considered when selecting water pumps,

START-UP AND MAINTENANCE LOGBOOK

INSTALLATION CHECK-UP

This check list should be filled in before the start-up with the contractor to make sure that unit installation takes place according to appropriate industry practices.



Refer to safety recommendation prior to any work on the unit.

DATE:

TECHNICIAN:

FIELD NAME:
CUSTOMER :
Unit exact designation:
Affair n° :
Serial n°:
Customer designation:
Contractors contact name and telephone:
Local contact name and telephone:

	YES	NO
SAFETY ACCES TO THE INSTALLATION		
Safety scale :		
Footbridge around unit:		
Clearance conform to regulation:		
Dangerous working conditions :		

CONFIRMATION OF INSTALLER DATA GIVEN PRIOR TO COMMISSIONING

	YES	NO
Compressors crankcase heater ON 24 hours before start-up		
Connection and balancing of the aeraulic network (centrifugal fans)		
Connection, cleaning, rinsing and purging of the hydraulic network		
Water circuit protection against freezing		
Cooling load available, minimum 50 %		
Presence of mesh filters at the entry of the exchangers		
Connection of the remote elements with recommended cable		
Presence of the general power supply (correctly dimensioned)		
Presence of the 220V power supply if any		
Presence of correct water flow		
Connection of controls and alarms		
Vacuum and first refrigerant charge done for split unit		
Safe access to components		

The information of pre startup is in conformity:	YES	NO
--	-----	----

UNIT INSTALLATION

	YES	NO
Clearance around unit in conformity		
Correct condensers ventilation		
Unit levelled		
Vibration isolation mounted and properly dimensioned		
Vibration isolators on piping connection		
Correct earthing of the unit		
Earth continuity on piping		

HYDRAULIC NETWORK

	YES	NO
Glycol protection in conformity		
Primary loop		
Secondary loop		
Water tank		
Water pump at the evaporator entry		
Water flow switch at the evaporator outlet		
Pressostatic flow switch		
Water pump at the condenser entry		
Control of the remote faulty water pumps		
Flow switch cut off control		
Minimum chilled water network volume given by the customer		m ³
Minimum hot water network volume given by the customer		m ³

CLIMATIC SET POINTS

Chilled water set point	°C
Hot water set point	°C
Antifreeze set point (water)	°C
Antifreeze set point (refrigerant)	°C
Compressors reactivity	
Fans reactivity	
Glycol percentage	%
Bios version	
Program version	

START-UP CHECK SHEET

Unit type:	Technician name:
Construction year:	Start-up date:

THERMAL DATA														
Evaporator I / O temp.		/ °C		/ °C		/ °C		/ °C		/ °C		/ °C		
Condenser I / O temp		/ °C		/ °C		/ °C		/ °C		/ °C		/ °C		
Ambient air temp		/ °C		/ °C		/ °C		/ °C		/ °C		/ °C		
FRIGORIFIC DATA														
Cooling capacity:		kW	CIRCUIT 1			CIRCUIT 2			CIRCUIT 3			CIRCUIT 4		
Operating mode			%			%			%			%		
Low pressure			b			b			b			b		
Evaporating temp.			°C			°C			°C			°C		
Suction temp.			°C			°C			°C			°C		
High pressure			b			b			b			b		
Condensing temp.			°C			°C			°C			°C		
Liquid temp.			°C			°C			°C			°C		
Discharge temp.			°C			°C			°C			°C		
Oil level														
Refrigerant type:		Charge												
LP safety cut			b			b			b			b		
HP safety cut			b			b			b			b		
ELECTRICAL DATA														
Power supply		V	CIRCUIT 1			CIRCUIT 2			CIRCUIT 3			CIRCUIT 4		
			C1	C2	C3	C1	C2	C3						
Compressors	KM1	L1 (A)												
		L2 (A)												
		L3 (A)												
	KM2	L4 (A)												
		L5 (A)												
		L6 (A)												
Evaporator pumps		L1 (A)												
		L2 (A)												
		L3 (A)												
Condenser pumps		L1 (A)												
		L2 (A)												
		L3 (A)												
Nominal current (A)		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	
Condensers fans	V1 to V12	L1 (A)												
		L2 (A)												
		L3 (A)												
	V13 to V24	L1 (A)												
		L2 (A)												
		L3 (A)												
		V13	V14	V15	V16	V17	V18	V19	V20	V21	V22	V23	V24	
Water Electric heaters		L1 (A)							Glycol type					
		L2 (A)							Glycol level					
		L3 (A)							%					
Theoric Δp evaporator:		Kpa			Evaporator Measured Δp:						Kpa			
Theoric Δp condenser:		Kpa			Condenser measured Δp:						Kpa			
Evaporator pumps references								Q:			H:			
Condenser pumps references								Q:			H:			

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 1 (500H / 1000H)			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 2			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 3			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 4			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 5			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 6			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 7			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 8			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 9			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 10			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 11			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 12			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 13			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 14			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 15			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 16			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 17			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 18			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE LOGBOOK

MAINTENANCE visit n° 19			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

MAINTENANCE visit n° 20			Date			
	Y / N	Value	Comments			
Unit general control (corrosion, damages...)						
Exchanger cleaning						
Leak test done						
Oil acidity test carried						
Replacement of filter drier cartridge						
Water filters cleans						
Evaporator pressure drop		Kpa				
Water condenser pressure drop		Kpa				
Glycol concentration level		%				
Unit operating parameters checked and in conformity						
Fans currents level checked and in conformity						
Compressors data	CP1	CP2	CP3	CP4	CP5	CP6
Operating hours						
Current at 100% load						
Comments et remarks:						
			TECHNICIAN		CUSTOMER	
			Name		Name	
			Signature:		Signature:	

REFRIGERANT TRANSACTIONS LOGBOOK: EC REGULATION N° 842/2006

GENERAL INFORMATION			
Site name		Serial number	
Site address			
Site operator			
Cooling load			
Refrigerant type		Refrigerant quantity (kg)	
Unit manufacturer		Year of installation	

REFRIGERANT ADDITIONS			
Date	Engineer	Quantity (kg)	Reason for addition

REFRIGERANT REMOVAL			
Date	Engineer	Quantity (kg)	Reason for removal

LEAK TESTS			
Date	Engineer	Test result	Follow up action required



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