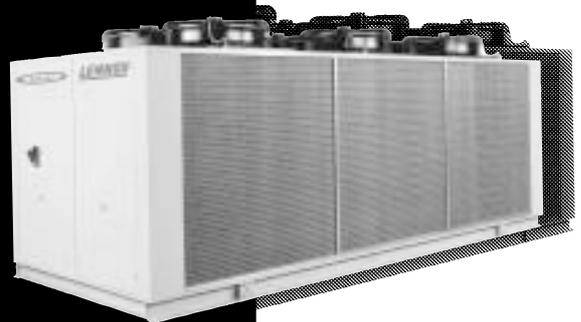


***LENNOX***<sup>®</sup>

INSTALLATION -  
OPERATING &  
MAINTENANCE MANUAL



PROVIDING **GLOBAL SYSTEM SOLUTIONS**

ECOLOGIC  
08-2002





<b>1. PREFACE</b> .....	3
<b>2. WARRANTY</b> .....	4
<b>3. SAFETY</b> .....	4
3.1. Safety Definitions .....	5
3.2. Warning labels .....	5-6
<b>4. LAY-OUT AND INSTALLATION</b> .....	7
4.1. Preparations .....	7
4.2. Delivery and Transport .....	9
4.2.1. Warnings .....	10
4.2.2. Antifreeze protection .....	10
4.3. Installation .....	10
4.4. Commissioning .....	12
4.5. Start-up .....	12
4.6. De-commissioning .....	13
<b>5. COOLING PROCESS</b> .....	14
<b>6. MODELS NUMBERS DESCRIPTION</b> .....	15
<b>6.1 ECOLOGIC™ CHILLER MODELS</b> .....	16
6.1. Models .....	16
6.2. Construction .....	16
6.3. Part Summary .....	17
6.4. Refrigerant flow diagrams .....	18
6.4.1. ECOLOGIC™ chillers with Climatic Control System .....	18
6.4.2. ECOLOGIC™ chillers with Climatic II Control System .....	21
6.5. Checking of the ECOLOGIC™ chiller .....	24
6.6. Part Descriptions .....	24
6.6.1. Main Components .....	24
6.6.2. Accessories .....	25
6.6.3. Control panel and safety features .....	25
6.6.4. Options .....	26
<b>7. SAFETY DURING OPERATION</b> .....	29
7.1. Safety and Protection Features .....	29
7.2. Safety during de-commissioning .....	29
<b>8. CONTROL</b> .....	30
<b>9. MAINTENANCE</b> .....	30
9.1. General .....	30
9.2. Maintenance schedule for operating personnel .....	32
9.3. Maintenance schedule for qualified personnel .....	33
9.4. Replacement of warning labels .....	35
<b>10. FAULT MESSAGES AND FAULTS</b> .....	35
<b>11. REFRIGERANT HANDLING</b> .....	36
11.1. General .....	36
11.2. Technical points to remember .....	36
11.2.1. The glide effect .....	36
11.2.2. Charging the installation with refrigerant .....	36
11.2.3. Charging of an installation with R-407c .....	37
<b>12. POSSIBLE FAULT CAUSES</b> .....	37
<b>13. ABBREVIATIONS</b> .....	38

## **COPYRIGHT**

**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 the operation of this product), reproduced, issued to or made available to third parties without the prior written agreement of Lennox.**

## 1. PREFACE

**Please read this operating manual prior to commissioning the ECOLOGIC™ chiller. Familiarise yourself with the operation and control of the ECOLOGIC™ chiller and 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 be stored in a permanent location in the vicinity of the ECOLOGIC™ chiller. For the sake of clarity, important items in this manual are shown as follows:

<b>Text</b>	<b><i>Important general instructions.</i></b>
<b>Text</b>	<b><i>Important instructions relating to normal operating conditions.</i></b>
<b>! NOTE text</b>	<b><i>Danger of damage to the chiller.</i></b>
<b>! NOTE text</b>	<b><i>Danger of personal injury.</i></b>

This manual contains important instructions regarding the commissioning of the ECOLOGIC™ 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.***

**FOR NETHERLAND :** the STEK logbook, including the required certificates will be handed over by the installation technician or left with the machine following commissioning by Lennox.

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 ECOLOGIC™ 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 licenced 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.***

## 2. WARRANTY

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.

## 3. 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 ECOLOGIC™ chiller, heat is being transported by a pressurised refrigerant, with changes in pressure and temperature. Fans have been provided to discharge heat into the environment. The entire process taking place in the chiller is described in chapter 4. The protection of operating and maintenance personnel was central in the design of the ECOLOGIC™ 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. 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 (< 50 Volt). The service panels can only be opened using tools.

**Notwithstanding the fact that the ECOLOGIC™ chiller is 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 ECOLOGIC™ chiller. Operations on the cooling circuit or electrical equipment should be carried out by authorised personnel.**

### 3.1. Safety Definition

The ECOLOGIC™ chiller meets the following safety definitions:

- **Pr-EN-378-1.**
- **EU Directive 89/392/EG ("Machine Directive").**
- **EN-60204-1.**
- **"EMC Directive".**
- **Pressure Equipment Directive 97/23/CE.**
- **RLK (Netherlands)**

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

### 3.2. 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



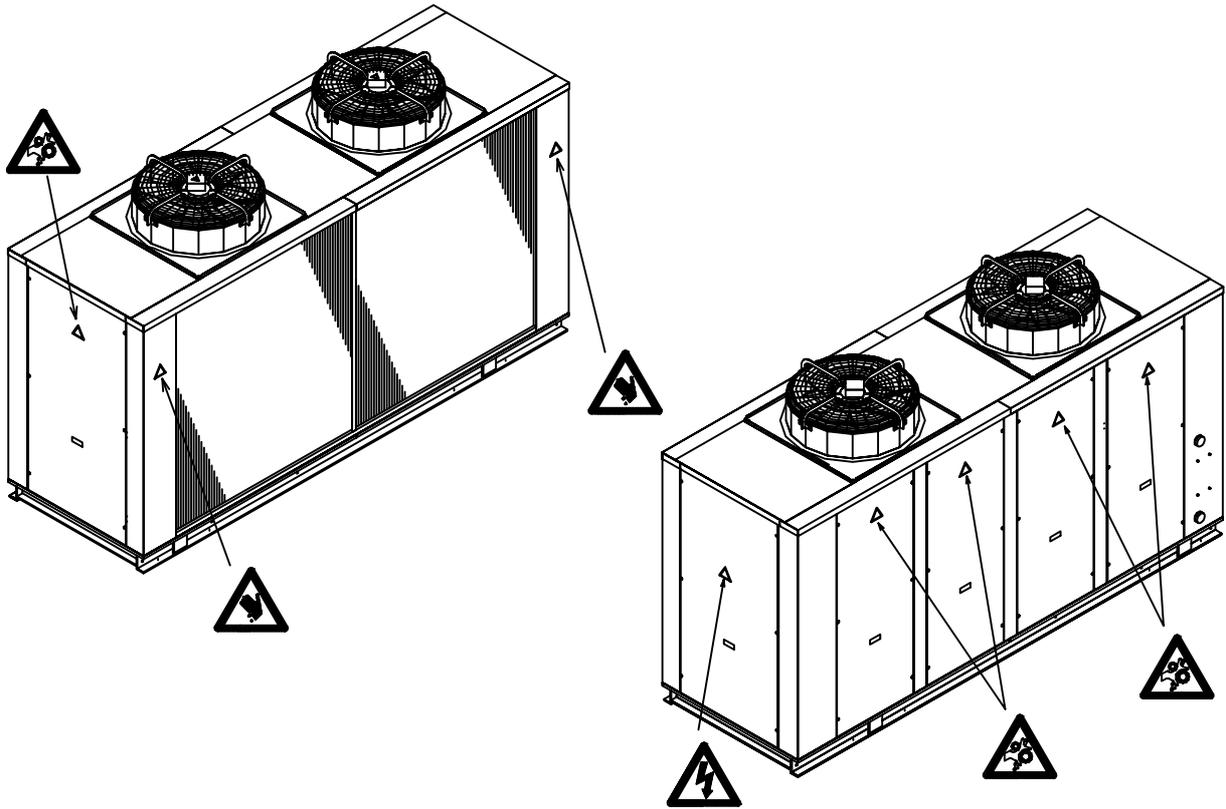
Rotating parts



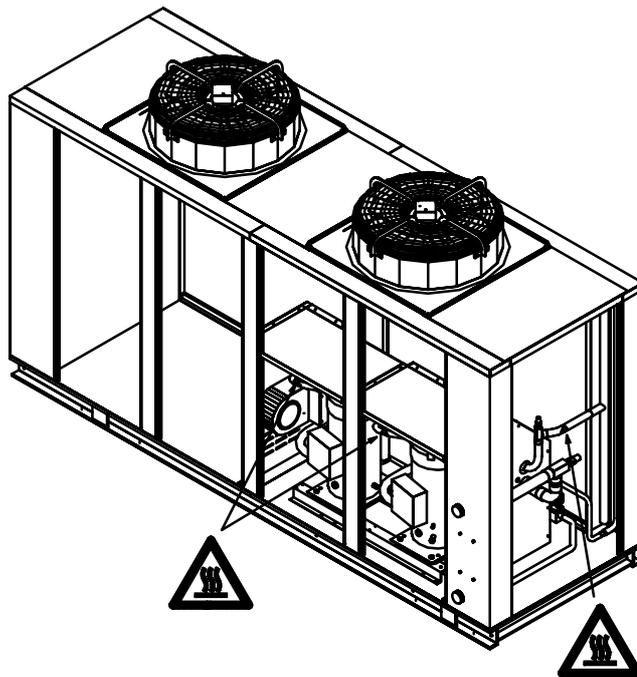
Sharp parts

Check regularly that the warning labels are still in the correct positions on the machine and replace them if necessary. Relevant instructions are provided in chapter 9.4.

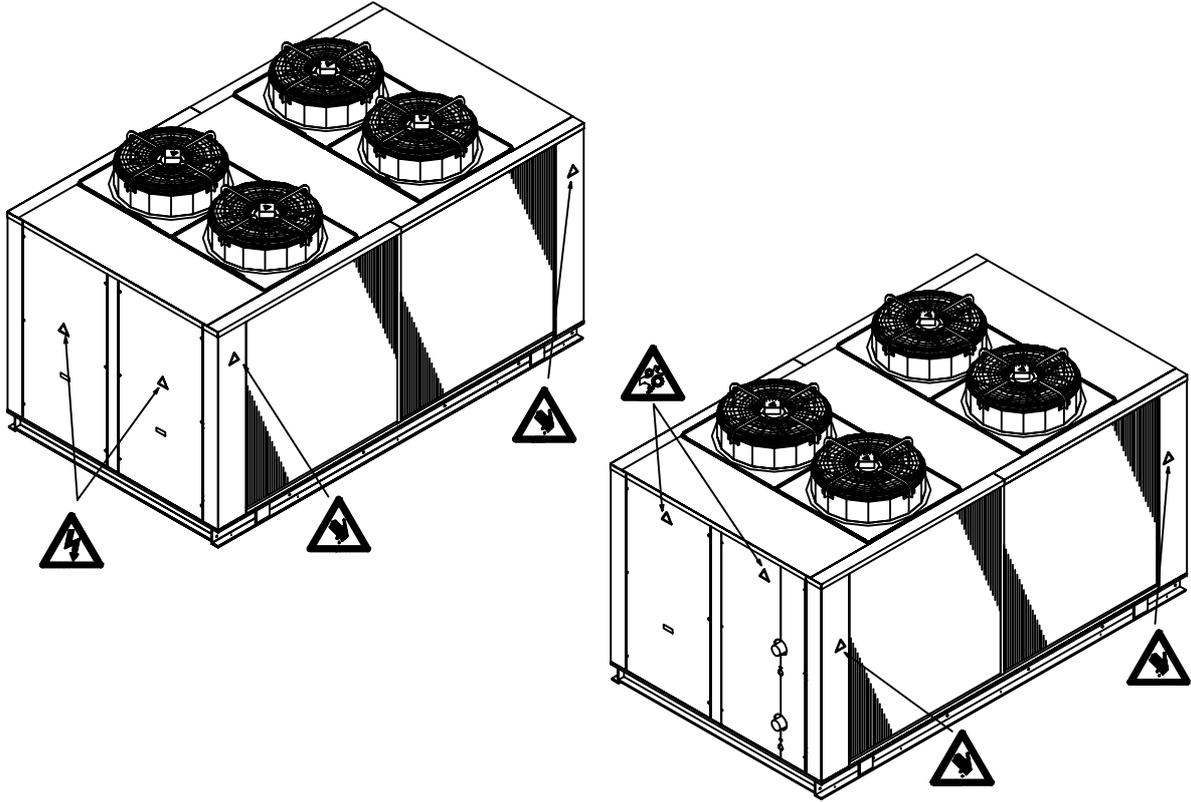
The illustrations below indicate the various warning label locations on the unit.



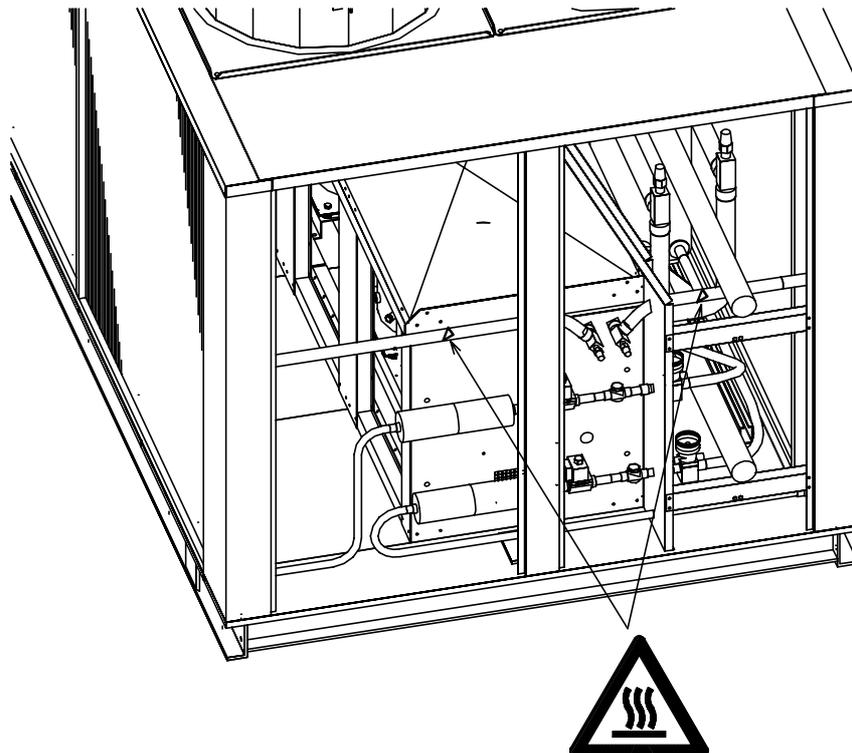
**Fig. 1.** Warning labels on the outside of the 1F, 2F and 3F-models.



**Fig. 2.** Warning labels on the inside of 1F, 2F and 3F-models.



**Fig. 3. Warning labels on the outside of 4F, 6F and 8F-models.**



**Fig. 4. Warning labels on the inside of 4F, 6F and 8F-models.**

## 4. LAY-OUT AND INSTALLATION

### **! NOTE:**

***This chapter contains important instructions relating to the safe installation of the ECOLOGIC™ chiller.***

### 4.1. Preparations

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

- The ECOLOGIC™ air-cooled chiller is designed for outdoor installation. Please consult Lennox prior to implementing other types of installation.
- The foundations and lay-out should provide adequate space around the machine for checking and service operations. The safety aspect of these operations should also be taken into account. This free area is also required for an unrestricted air supply to the condenser. The free area is set with a minimum all round clearance of 1.5 m, providing there are no objects in the vicinity that are higher than the machine itself. Locate the chiller where it is least affected by wind (install windbreaks where wind speeds > 2.2 m/s). The foundations should provide for the machine to be level, afford sufficient support for the load and keep vibration to a minimum.

### **! NOTE:**

***For fault-free operation the chiller should be completely level (insert shims below vibration absorbers if necessary).***

***Please consult Lennox in the event of queries or doubt on the lay-out options.  
Information on dimensions and weights is included in the above mentioned specification sheet and the dimensional drawing of the machine.***

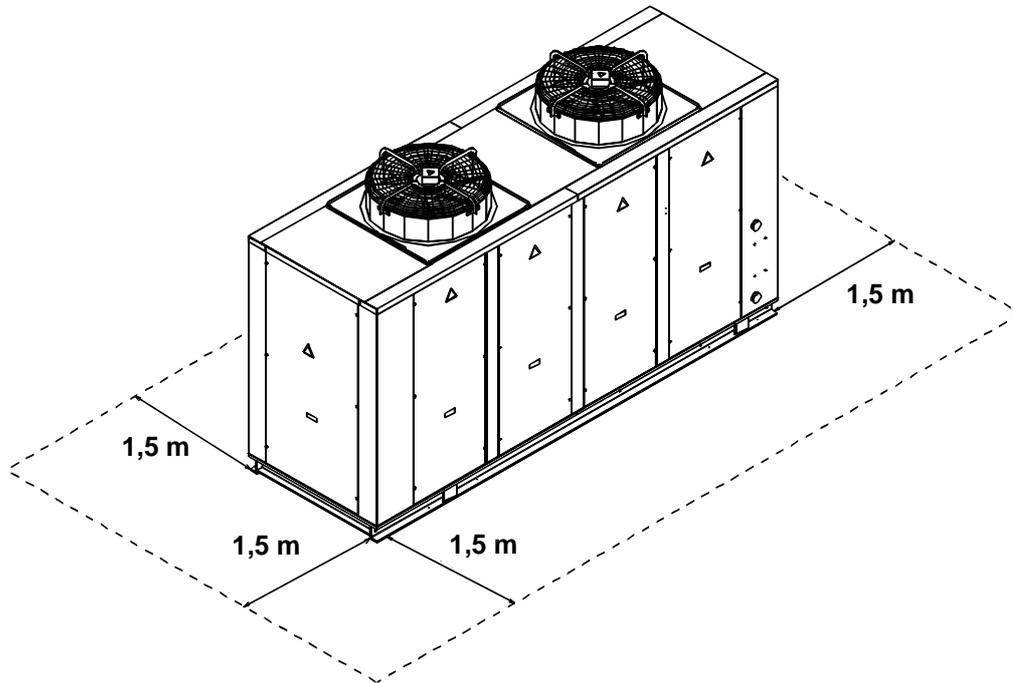


Fig.7. Free area 1F-, 2F- and 3F-models

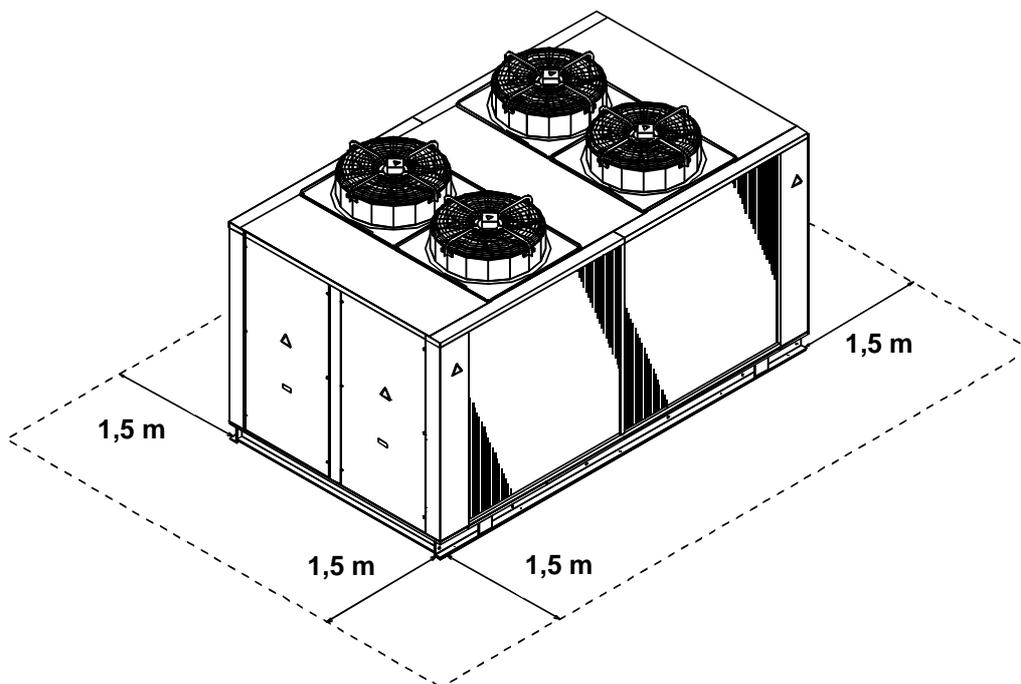


Fig. 8. Free area 4F-, 6F- and 8F-models

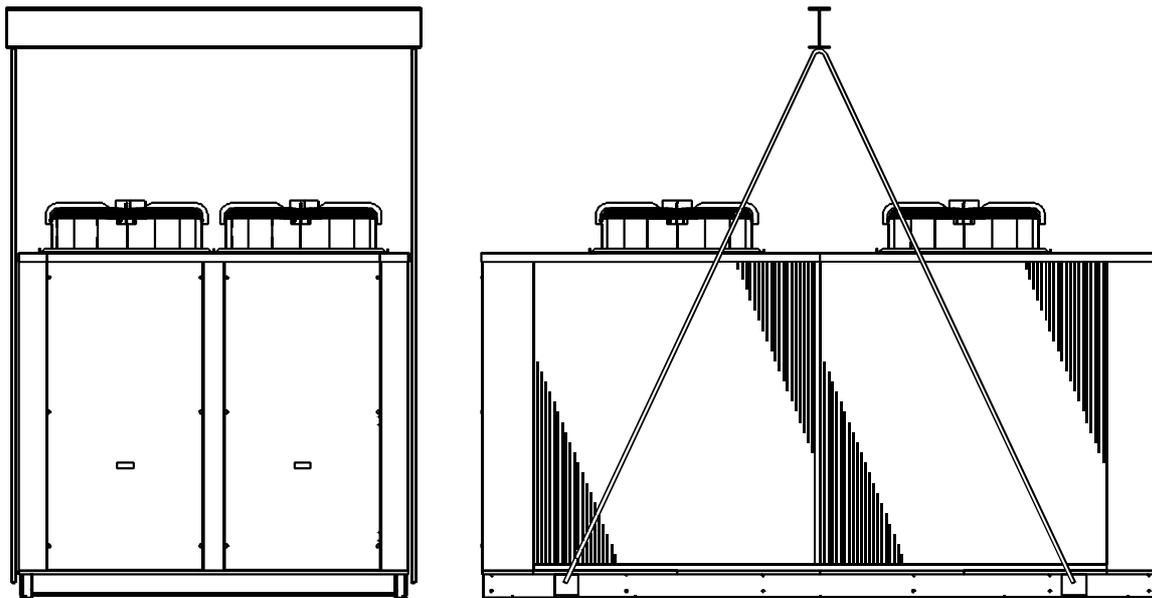
## 4.2. Delivery and Transport

We recommend that the machine is checked for transport damage immediately after delivery. Any transport damage should be reported immediately to the transporter and within 24 hours to Lennox. The transport of the machine to the installation site is provided by Lennox. Unloading, however, is the responsibility of the installer. If transport damage is not reported immediately, any guarantee claims will be void.

Also check that the delivery is complete (see packing list) and that the required documentation is included with the machine (in the switch compartment).

The transport and lifting instructions illustrated in the drawing below should be observed during transport on the assembly site.

These instructions are also displayed on the exterior of the machine. The machine should be moved with suitable lifting gear.



**! NOTE:**

The heat exchangers of the condensers are 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!).

**! NOTE:**

Rubber AVM & factory accessories are to be found in the control panel for shipping. If the unit is mounted on AVM these should be fitted to the unit before final positioning.

### 4.2.1. WARNINGS

#### Water connections - Evaporator

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. They may be supplied as an option by the manufacturer.

#### Water analysis

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

We do not advise operation of the units with open loops which can cause problems with oxygenation, nor 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.

### 4.2.2. ANTIFREEZE PROTECTION

#### Use glycol/water solution

#### **ADDITION OF GLYCOL IS THE ONLY EFFICIENT WAY TO PROTECT AGAINST FREEZE-UP**

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. Corrosion can occur with these antifreeze solutions in the presence of air.

#### 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 : *air bleeders are not designed to admit air.*

**FREEZE UP OF AN EVAPORATOR DUE TO COLD WEATHER CONDITIONS CANNOT GIVE RISE TO A WARRANTY CLAIM.**

### 4.2.3. 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 EVAPORATOR THAT IS PUNCTURED BY ELECTROLYTIC CORROSION IS NOT COVERED BY THE UNIT WARRANTY.**

### 4.3. Installation

The following requirements and safety features should be observed during the installation of the ECOLOGIC™ chiller.

- ECOLOGIC™ chillers are designed for application in a closed chilled water circuit.
- When delivered the water connections of the ECOLOGIC™ chillers are sealed to prevent dirt from entering the system. These seals should be left intact as long as possible. The water connections of the ECOLOGIC™ chiller are fitted with groove-lock couplings. On option, the two corresponding couplings and two 20-cm long pipes with smooth ends could be included for connection. If required, the pipes can be welded, or threaded at the smooth end to be fitted to the piping system. Obviously the groove-lock system can be used for further assembly. Whichever option is selected, it is important that the pipes are fitted to the piping system first, and that the connection with the chiller is made at the last moment.

**NOTE : GREASE SEAL BEFORE INSTALLATION.**

***The rubber packing should be greased before fitting the groove-lock coupling.***

***Ensure that the pipe connections are stress-free. When connecting the water lines to the machine ensure that the connections to the machine are not twisted or connected the wrong way around.***

- If the machine is installed on vibration absorbers, compensators should be incorporated in the chilled water lines. These compensators should be fitted between the connections of the chiller and the first fixed support point of the piping. We recommend that compensators are also used in situations where the machine is not installed on vibration absorbers. This will prevent the transmission of vibration via the hydraulic circuit.
- A flow protection, which will switch off the chiller if the chilled water flow through the machine is interrupted, should be included in the chilled water circuit. This flow protection could be a vane switch, an electronic flow switch or a differential pressure switch. With a differential pressure switch only the pressure difference on the evaporator should be measured. The setting should be checked regularly to prevent possible pollution.
- Provisions should also be made to measure the amount of chilled water. These are necessary to establish whether the ECOLOGIC™ chiller is functioning within its application range.
- To protect the chiller a filter should be included in the chilled water circuit (60 mesh, mesh size 0.25 mm). This filter should be fitted directly in front of the chiller (seen in flow direction). The filter should be checked at least twice a year. This considerably reduces any water side pollution of the evaporator.
- The chilled water system should be flushed and clean prior to connection of the evaporator. A venting device should be installed at the highest point of the chilled water circuit piping.
- If there is a possibility of the machine operating long term at a high input water temperature, a mixing control should be included in the chilled water circuit. This mixing control should limit the water input temperature to the maximum acceptable value to prevent overloading of the compressor and the machine from cutting out due to a high pressure fault.
- The minimum required content of the chilled water circuit is included in the Application Guide. If the total water content of the system is below this value, a buffer tank should be included in the chilled water circuit. The content specified above is based on normal air conditioning applications. Higher capacities may be required if used in other applications. Consult Lennox if this should be the case.
- Connections for the supply voltage, the start command, the external protections and possible fault messages should be linked to the relevant terminals in the control panel in accordance with the wiring diagram.
- If additional feed-throughs are made during installation, the switch compartment should be thoroughly cleaned following assembly so that no metal parts remain amongst the switch material. Any blank plate parts left behind as a result of the holes being drilled should be coated with preservative to prevent corrosion.
- Finally, it is recommended that thermometers and pressure gauges be included in the chilled water inlet and outlet lines in the immediate vicinity of the chiller. This will simplify checking operations and will assist in the search for the possible cause(s) of a fault.

#### 4.4. Commissioning

##### Initial commissioning

The initial commissioning should be carried out by Lennox. Please, contact Lennox Sales Offices in order to make an appointment.

##### **Checking prior to commissioning (to be carried out by installation technician)**

- Check the points mentioned in chapter 7.3.
- Check the chilled water circuit and all connections to the chiller for leakage.
- Check the direction of the pump and the flow direction of the chilled water. (It is recommended to mark the direction of the pump and the flow direction in the piping circuit with arrows.)
- Check that the chilled water flow agrees with the nominal flow (see Application Guide). In practice the flow protection will usually only protect the chiller from switching on whilst there is (practically) no flow in the chilled water circuit. In that case the flow protection should be set at the highest possible value (providing this is below the nominal value).
- Rinse the piping system by operating the pump(s) for some time. Then clean all filters in the installation.
- Check that there are no restrictions to the airflow over the condenser.
- Check that the supply voltage is correct. ECOLOGIC™ chillers are designed to operate in a clockwise direction. The direction of the field should therefore be checked and the 2 phases changed over to ensure correct rotation if necessary.
- Once the lines have been connected and the installation has been filled, the level of machine should be re-checked.
- Check the adjustment of the spring vibration absorbers if applicable.
- The chilled water system should be filled with the correct amount of water or water/glycol.
- The main and control current switches should be switched on at least 6 hours prior to start-up in order to heat the oil in the compressor crankcases and/or oil separators. Depending on the chiller model, this will also require the auxiliary supply to be switched on. This supply is also switched via the main switch.
- The oil level in the compressor sight-glass should be between  $\frac{1}{2}$  and  $\frac{3}{4}$  the way up the sight-glass.
- The pressure in the refrigerant circuits should correspond to the pressure of the relevant refrigerant at ambient temperature.
- The chilled water pump valves should be opened.
- Checks should be made to establish the presence of air in the chilled water system, which should be vented if necessary.
- The chilled water pumps should now be started.
- If a water/glycol mixture is used, checks should be made to ensure that the mixture is in accordance with the design value. Samples can be taken once the pumps have circulated the mixture for approximately 10 minutes. The mixture must be brought to the design value prior to starting the chiller.
- Checks should be made to ensure that the discharge, suction and liquid valves in the refrigerant circuits are open (if present, optional)

##### **Once all the above conditions have been met the ECOLOGIC™ chiller can be started.**

- Consult the wiring diagram and operating manual of the control system to familiarise yourself with the operation/control of the machine.
- Once all external release conditions have been met (start command, flow protection, pump switch) and the load is sufficient, the ECOLOGIC™ chiller will start up.

#### 4.5. Start-up

Prior to starting the chiller, the installation engineer should ensure that the following conditions are met:

On all ECOLOGIC™ chillers the machine briefly remains **blocked** when the mains voltage is switched on. This is required to create the correct start-up conditions (see operating manual of the relevant control system and / or the wiring diagram).

#### **Checking the operating conditions:**

The operating conditions should be checked shortly after start-up, but not before stable operating conditions have been established. The following are important values: discharge and suction pressure in the refrigerant circuit(s), the chilled water inlet and outlet temperatures and the ambient temperature. Compare these conditions with the data provided.

The ECOLOGIC™ chiller will always start at the lowest capacity level. Release of the consecutive capacity levels will take place after a set time, depending on the chilled water inlet and/or outlet temperature. During checking of the operating conditions, reference can also be made to the values included in the wiring diagram.

#### **4.6. De-commissioning**

The following actions should be completed to de-commission the ECOLOGIC™ chiller (see also chapter 6.2):

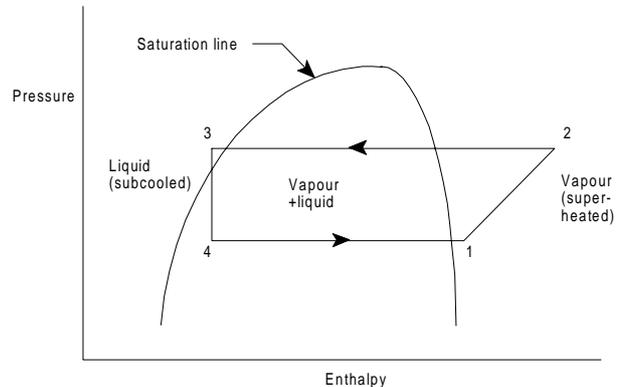
- Remove the start command from the terminal strip on the control panel (see wiring diagram).
- Leave the main and control current switches on to maintain the temperature of the oil in the compressor crankcases or oil separators and to keep any heating tapes operating.
- In the event that there is a risk of freezing, Lennox recommends that the chilled water circuit be drained and blown through with compressed air. All valves in the refrigerant circuit(s) should be closed. The main switch should then be switched off.

***If the chiller is to be taken out of service for an extended period, the refrigerant should be pumped down by authorised personnel. Open discharge, suction and liquid valves (if present) and bring the refrigerant circuits to slight overpressure using nitrogen gas. Make occasional checks to ensure that the pressure in the system remains constant.***

## 5.COOLING PROCESS

The ECOLOGIC™ chiller has been designed to cool water or a water/glycol mixture. In the evaporator, heat is extracted from the liquid to be cooled through evaporation of refrigerant. The refrigerant is circulated by the compressor through a closed circuit. A pressure-enthalpy diagram of the cycle is shown below. During the cycle the refrigerant is subject to the following changes of state.

- 1-2 The refrigerant gas given off by the evaporator is compressed by the compressor, causing temperature and pressure to rise.
- 2-3 The compressed gas originating from the compressor is cooled to saturation temperature in the aircooled condenser, following which condensation occurs at constant pressure. Finally the liquid refrigerant is *subcooled* by a few degrees.
- 3-4 The subcooled liquid is expanded to evaporation pressure in the expansion valve. Part of the liquid will evaporate during expansion.
- 4-1 In the evaporator the liquid refrigerant will evaporate at constant pressure. The required heat is extracted from the liquid to be cooled. Finally, in the last part of the evaporator the gaseous refrigerant is *superheated*.



### ! Notes:

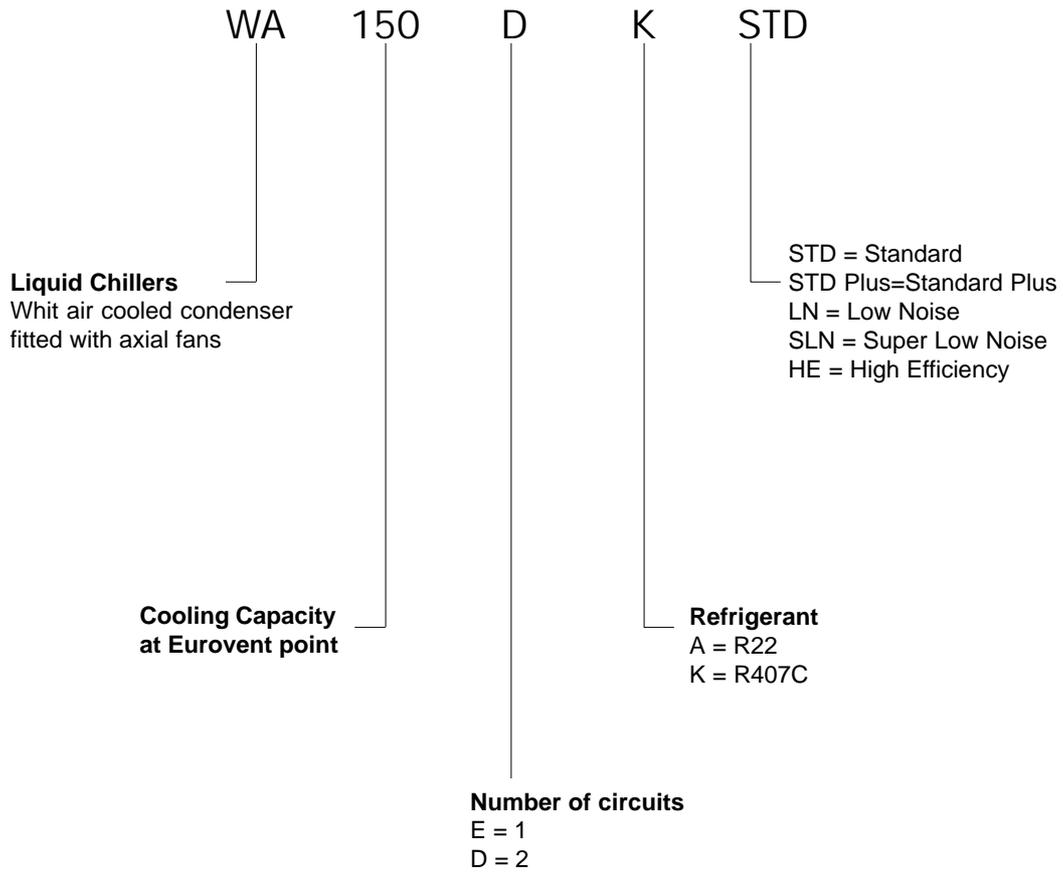
**Subcooling** in the condenser is required to ensure that the refrigerant flows entirely in liquid form to the expansion valve. This valve will only operate satisfactorily if the refrigerant enters entirely in liquid form.

**Superheating** of the refrigerant gas in the evaporator is required to prevent the liquid refrigerant from entering the compressor. Liquid refrigerant in the compressor could result in excessive dilution of the lubricant.

The expansion valve ensures that only the amount of refrigerant necessary to reach the required superheating of the refrigerant gas after the evaporator is allowed through.

Refrigerants R-407c and R-22 are used in the ECOLOGIC™ chillers. Both these refrigerants are included in group L1, based on the prEN-378-1 classification, in which they are classified in safety group A1. According to this classification, A1 is the group with the lowest flammability and toxicity risk. For further information refer to the refrigerant manufacturer's documentation, which is available on request from Lennox.

6. MODEL NUMBER DESCRIPTION



## 6.1 MODELS

The ECOLOGIC™ chiller is available in four basic versions: the Standard (STD), Standard Plus(STD Plus) the low noise (LN), the High Efficiency (HE) and the Super Low Noise (SLN) version.

With the exception of the fans, the four models are constructed of the same components. The low noise version is equipped with low speed fans.

This results in a lower noise level. Furthermore the compressors in the LN version are covered with acoustic jackets and in the SLN and HE versions, the compressors are fitted inside a sound insulated housing.

The model indication of the chillers is illustrated in the following table.

In addition to the already mentioned differences between the versions, two fundamentally different control systems are employed in the ECOLOGIC™ range, as illustrated in the table below.

Unit version	Control system
High Efficiency, HE Super Low Noise,SLN	Climatic II Control System
Standard, STD Standard Plus, STD Plus Low Noise, LN	Climatic II Control System <i>Or</i> Climatic Control System

The technical data of the ECOLOGIC™ chiller is included in the before-mentioned specification sheet and the dimensional drawing.

Model	IDENTIFICATION				
	Chiller	Unit version / type		Circuits	Refrigerant
		STD/STD Plus /LN	SLN / HE		
2F		100E	40E	E=Single circuit	R407C
			45E		
			65E		
3F	WA	90D	75E	D=Double circuit	<i>Or</i> R22
			100E		
			110E		
4F	=	200D	90D		
			230D		
			130D		
6F	Waterchillers,	300D	150D		
			200D		
			230D		
8F	Air-cooled	370D	200D		
			300D		
			370D		

## 6.2 Construction

The ECOLOGIC™ chillers are constructed of a dipped galvanised frame, made up of hot-rolled UNP beams. The housing is constructed from galvanised steel plating, all exterior parts are covered with an epoxy-polyester colour coating standard in RAL-9002. A switch compartment, housing the control panel, has been incorporated in the machine housing. The service panels of the units are mounted with stainless steel bolts.

**6.3. Part Summary**

The ECOLOGIC™ chiller range consists of the following main parts:

- Hermetic scroll compressors.
- Air-cooled condensers, made up of copper pipe, with aluminium fins, whereby the air flow is provided using axial fans.
- A plate evaporator, a single circuit plate evaporator for the E models, a double circuit plate evaporator, whereby both circuits are interwoven, for the D models.
- Expansion valve, depending on the type of control system. thermostatic on the Climatic Control System, thermostatic or electronic on the Climatic II Control System.
- Switch compartment containing the entire protection and control system (see also chapter 5.7.3).

The refrigerant circuits are completed with copper refrigerant flow lines, including the following accessories (for each refrigerant circuit):

- Liquid valve
- Filter / drier
- Solenoid valve (optional)
- Sight-glass with moisture indicator (optional)
- Discharge and suction valve (optional)

The following table shows the number of parts per model.

Part	Model									
	1F	2F		3F		4F		6F		8F
	STD	LN STD Plus	HE STD	LN/STD STD Plus	HE STD	LN/STD STD Plus	HE STD	LN/STD STD Plus	HE STD	HE STD
Circuits	1	1	1	2	1	2	2	2	2	2
Compressors	2	3	2	4	3	6	4	6	6	6
Condensers	1	1	1	2	1	2	2	2	2	4
Fans	1	2	2	3 (90D:2)	3	4	4	6	6	8
Evaporators	1	1	1	1	1	1	1	1	1	1
Expansion valve	1	1	1	2	1	2	2	2	2	2
Liquid valve	1	1	1	2	1	2	2	2	2	2
Filter / drier	1	1	1	2	1	2	2	2	2	2
Solenoid (optional)	1	1	1	2	1	2	2	2	2	2
Sight-glass (optional)	1	1	1	2	1	2	2	2	2	2
Delivery valve <sup>1)</sup> (optional)	1	1	1	2	1	2	2	2	2	2
Suction valve (optional)	1	1	1	2	1	2	2	2	2	2

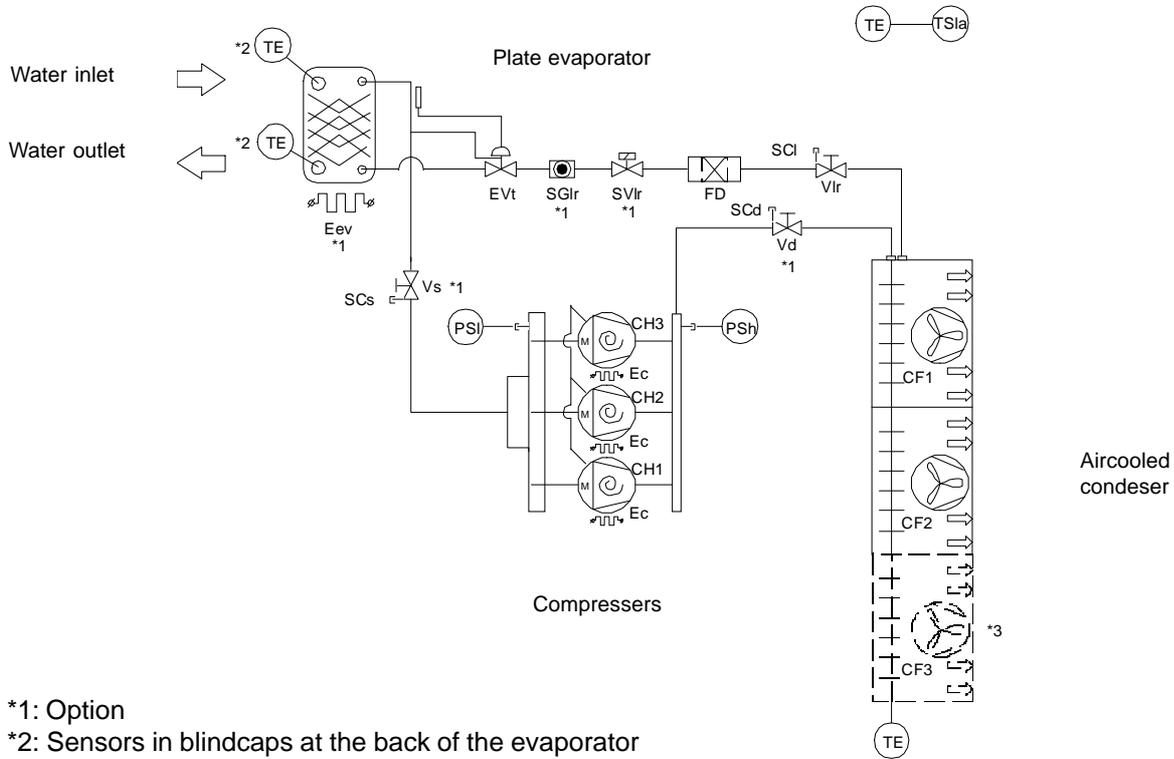
<sup>1)</sup>: On the Climatic II, the function of the solenoid valve is handled by the electronic expansion valve.

The refrigerant flow diagrams of the various models are included in the next chapter for clarification.

### 6.4. Refrigerant flow diagrams

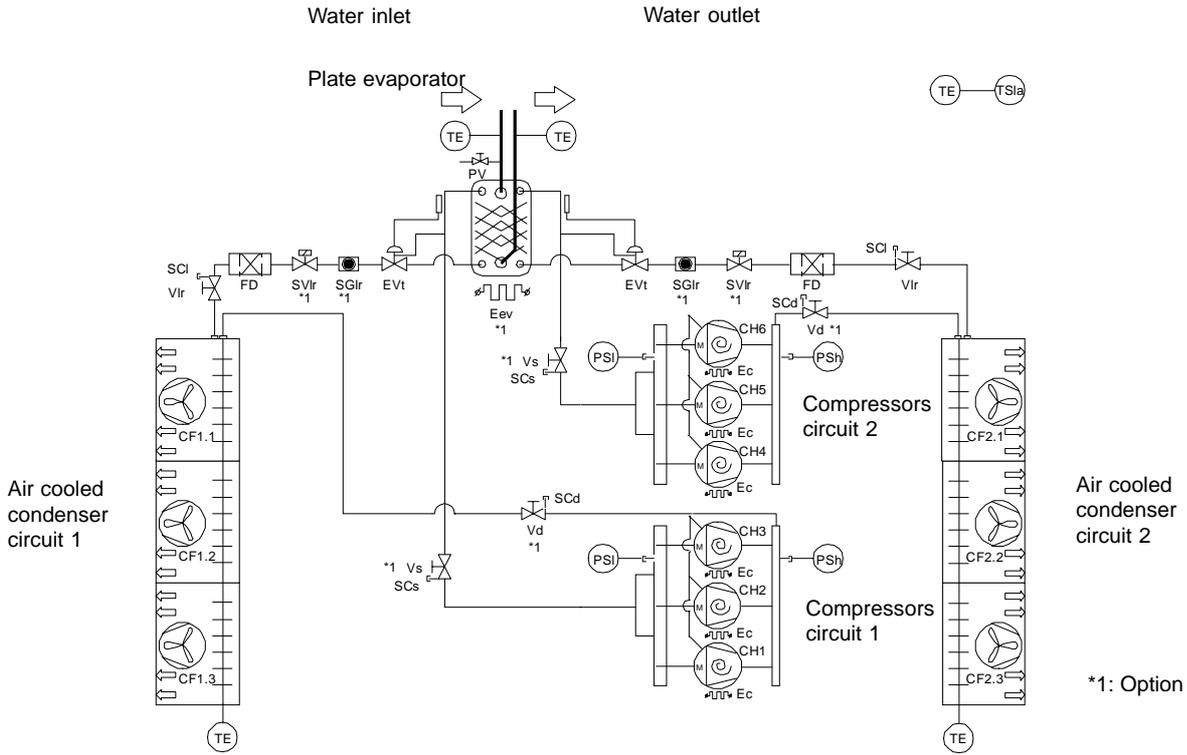
#### 6.4.1. ECOLOGIC™ chillers with Climatic Control System

##### WA-100E – WA110E.

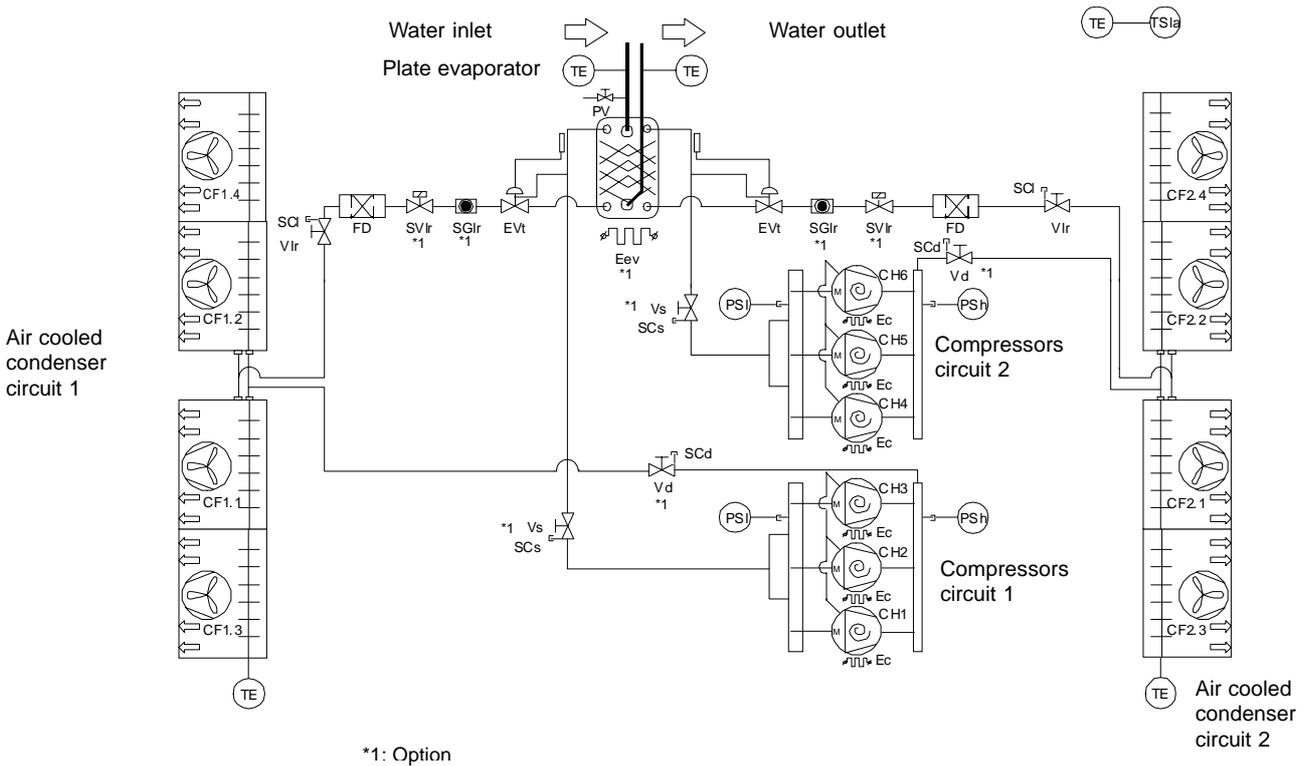




**WA200D-HE/SLN – WA230D-HE/SLN + WA300D-STD/STD Plus LN+ WA370D-STD/STD Plus LN.**

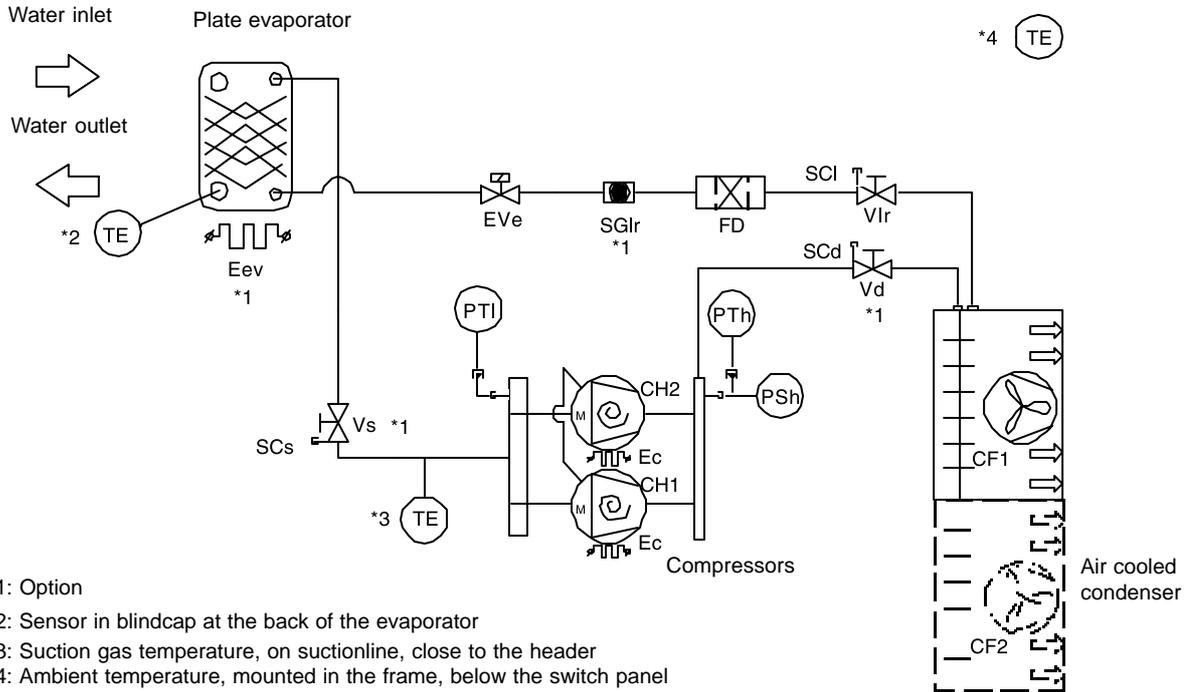


**WA300D-SLN/HE + WA370DSL/HE.**

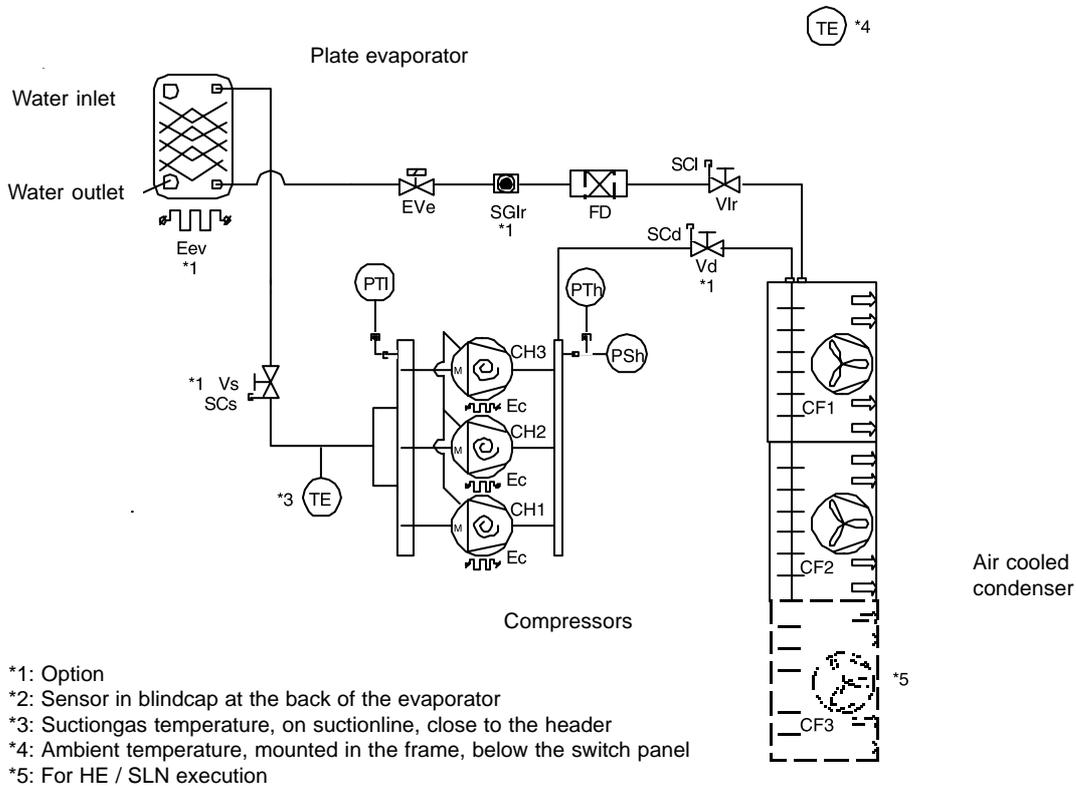


6.4.2. ECOLOGIC™ chillers with Climatic II Control System

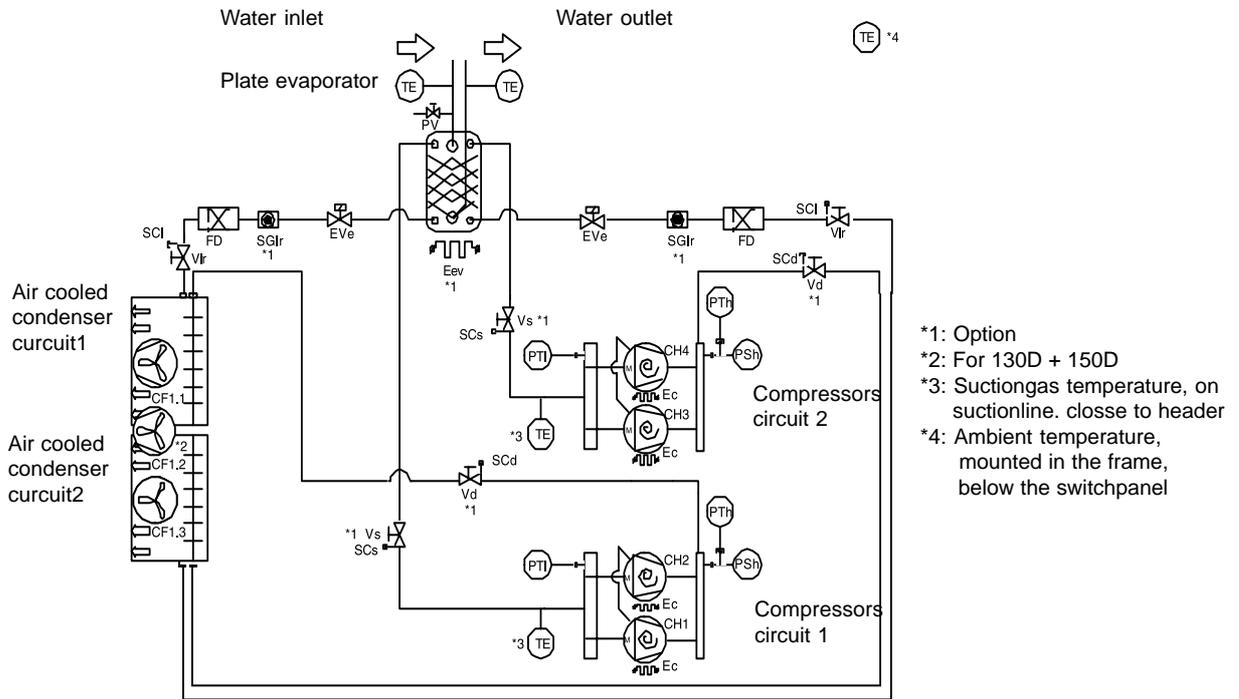
WA40E – WA75E SLN/HE.



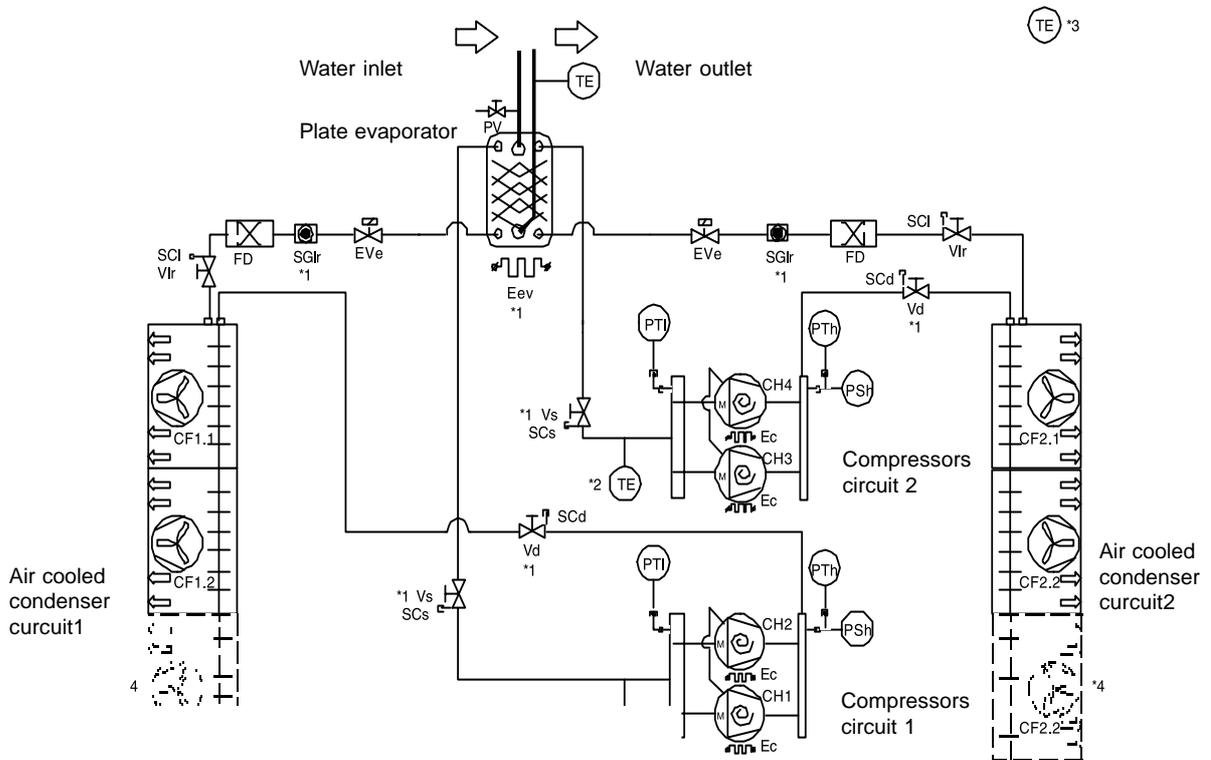
WA100E – WA110E.



**WA90D-STD/STD Plus LN – WA150D-STD/STD PlusLN.**

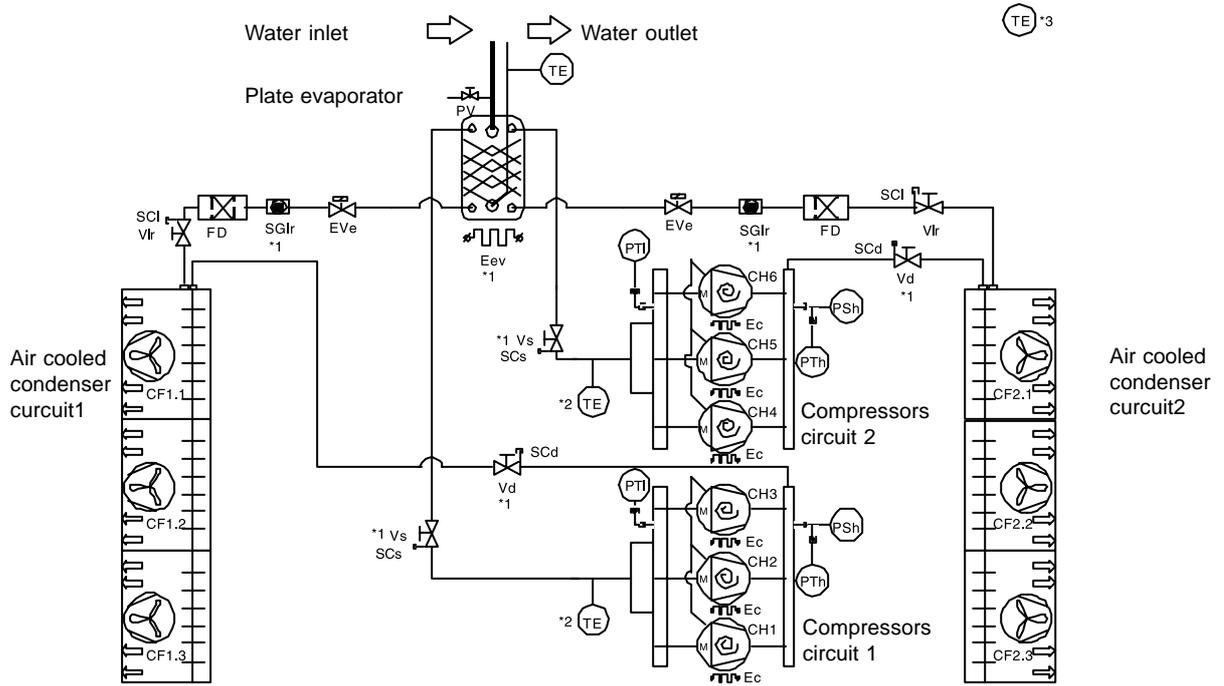


**WA90D-HE/SLN – WA150D-HE/SLN + WA200D-STD/STD Plus LN+ WA230D-STD/STD Plus LN.**



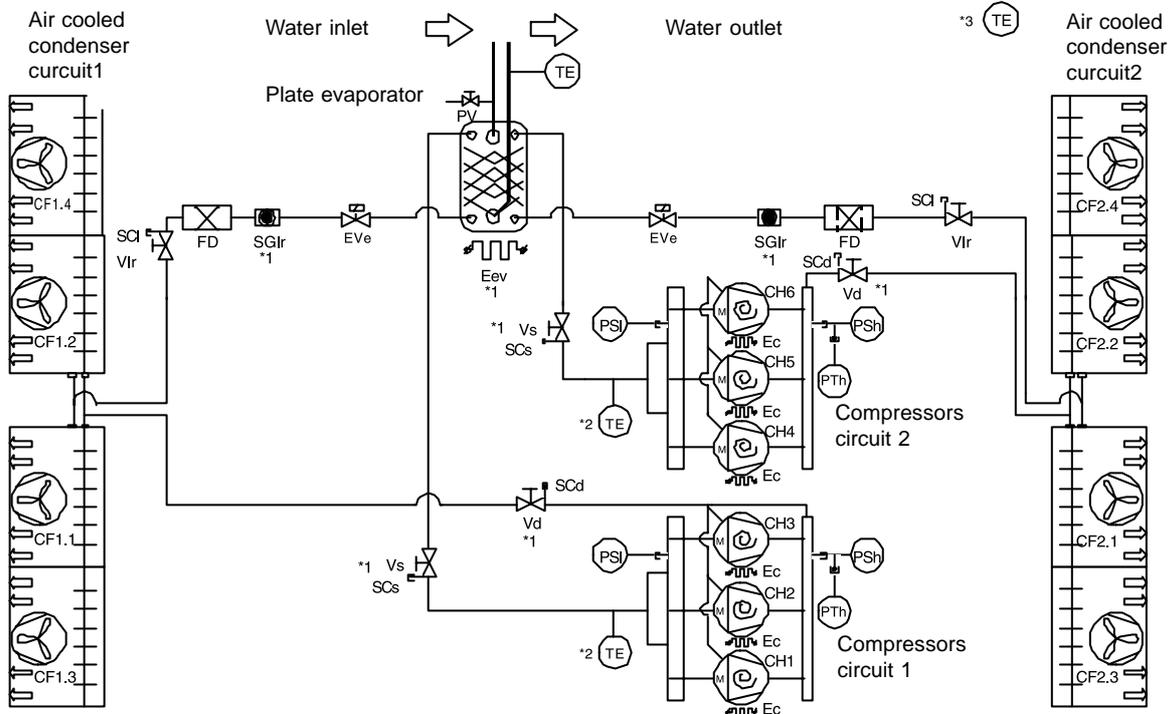
- \*1: Option
- \*2: Suctiongas temperature, on suctionline, close to header
- \*3: Ambient temperature, mounted in the frame, below the switch panel
- \*4: For HE / SLN-execution

**WA200D-HE/SLN + WA230D-HE/SLN + WA300D-STD/STD Plus LN + WA370D-STD/STD Plus LN.**



- \*1: Option
- \*2: Suctiongas temperature, on suctionline, close to header
- \*3: Ambient temperature, in the frame, below the switchpanel

**WA300D-HE/SLN + WA370D-HE/SLN.**



- \*1: Option
- \*2: Suctiongas temperature, on suctionline, close to header
- \*3: Ambient temperature, in the frame, below the switchpanel

Consult the refrigerant flow diagram sent to you under separate cover.

The abbreviations used in the previous refrigerant flow diagrams are explained in chapter 13.

## 6.5. Checking of the ECOLOGIC™ chiller

Following assembly, the ECOLOGIC™ chiller is pressure tested and checked for leakage. The refrigerant circuits are then evacuated and provided with the required operating charge of refrigerant. Finally, the ECOLOGIC™ chiller is test run under nominal conditions at the Lennox test site and checked for satisfactory operation. The chillers are, therefore, ready for operation upon delivery. It is possible to witness test running of the ECOLOGIC™ chiller at the Lennox test site. In that case arrangements should be made via the sales department.

## 6.6. Part Descriptions

### 6.6.1 Main Components

#### Compressors

Your ECOLOGIC™ chiller is fitted with hermetic scroll compressors. The motor and compressor are housed in a hermetically sealed housing, whereby the motor cooling is provided by the refrigerant gas. Compressors are equipped with an oil sight-glass. The electric motor is provided with winding temperature protection (Klixon or thermistor).

***Scroll compressors only operate correctly in the correct rotation direction. They therefore need to be connected to a clockwise rotating field (phase sequence). Incorrect rotation can result in defects, but the compressor will not pump refrigerant, will be unusually noisy and will switch off after approximately 20 minutes.***

The compressors of one refrigerant circuit are linked in parallel. A discharge and a suction valve are options for each set. Capacity is controlled by the switching on or off of the compressors. The electrical system is controlled by the controls in the switch compartment.

#### **! NOTE:**

***Due to their high volumetric output, scroll compressors can reach a vacuum very quickly. The compressors should therefore not be used to suck in refrigerant, as this will surely lead to irreversible damage.***

***Starting a compressor with the suction valve (Vs) closed will also lead to irreversible damage. The suction pressure of a scroll compressor must never be lower than 0.2 bar (manometer pressure).***

***The chillers are wired to ensure that when the supply voltage is connected in a clockwise direction, the compressors rotate in the correct direction. The machines were also tested on the Lennox test site using clockwise phase rotation.***

#### Air-cooled condenser

The air-cooled condensers consist of one, two or four heat exchangers, constructed of copper piping equipped with aluminium fins. The air flow through the heat exchangers is provided by direct drive axial fans. The fans are controlled by the controls.

To protect operating and maintenance personnel from injury, the fans are fitted with protective grids on the exhaust side (exterior of the machine).

#### Evaporator

The evaporator consists of a hermetically soldered package of stainless steel plates. The plates have been stamped with a herringbone profile. As a result of the staggered stacking method, channels are created between the plates, through which the medium flows in a very turbulent manner. The turbulence creates correct heat transfer and keeps the influence of pollution to a minimum. The plate package is arranged in such a way that each channel through which the medium to be cooled flows is located next to a channel containing the evaporating refrigerant flow. This has resulted in the creation of a very compact evaporator with a relatively low refrigerant content.

The double circuit plate evaporator is designed in such a way that the consecutive refrigerant channels are alternately linked to the first or second circuit. Both circuits are interwoven.

The exterior of the evaporator is insulated with moisture and diffusion-proof insulation material. Optional heating tape could be attached below the insulation material. The tape ensures that the liquid (to be cooled) in the evaporator does not freeze during low ambient temperatures, providing there is a continuous flow through the evaporator. (This heating tape is not always necessary if the ECOLOGIC™ chiller is used to cool a water/glycol mixture. Please refer to the chiller wiring diagram.) On the 4F-, 6F- and 8F-models connecting pipes are fitted between the machine and the evaporator connections. These pipes are also fitted with insulation and could possibly be fitted with optional heating tape. The heating tape (if present) is switched on and off by the controls.



**Thermostatic expansion valve (chillers with Climatic)**

The thermostatic expansion valve is a temperature/pressure controlled regulating valve with exterior pressure equalisation. The valve allows the correct amount of refrigerant to pass in order to achieve the required superheating at the end of the evaporator. Temperature and pressure are measured immediately after the evaporator in the suction line. The superheating reduces when the load in the evaporator drops. The valve will then adjust the refrigerant flow until the set (required) value is reached again.

**Electronic expansion valve (Climatic II)**

The function of the electronic expansion valve is the same as that of the thermostatic expansion valve. The process is managed better as a result of this valve being controlled by the controls, whereby more process data is available.

**6.6.2. Accessories**

The refrigerant flow diagrams can also be consulted for the descriptions of the following parts (see also chapter 5.4). Every refrigerant circuit also includes the following accessories.

**Liquid valve**

A valve has been fitted in the liquid line, immediately after the condenser output, to be used for the refilling and pumping out of refrigerant and during operations on the filter/drier.

**Filter / drier**

The filter/drier is mounted in the liquid line after the liquid valve. The filter/drier absorbs any residual moisture remaining in the chiller after the vacuum process.

The filter/drier also collects any residual parts originating from the assembly and any oil sediment. Filter/driers are applied in two versions in the ECOLOGIC™ chillers.

- Hermetically sealed filter/drier
- Replaceable filter/drier.

**6.6.3. Control panel and safety features**

The control panel conforms fully to EN-60204-1. The main and control current groups are clearly separated on the control panel. The ECOLOGIC™ chiller is delivered with the wiring diagram. Part of this diagram is an illustration of the control panel layout.

Consult the operating manual of the control system included in your machine (and the wiring diagram if necessary) for details on the operation and re-setting of the various protections.

**High Pressure**

The chiller is protected from excessively high operating pressure in the high pressure side by a minimum of one high pressure switch, which is connected to the pressure side of the compressor. The high pressure switch will switch off the relevant circuit when the set value is exceeded. The high pressure switch is equipped with a reset.

**Low Pressure**

The chiller is protected from low operating pressure in the low pressure side either by a low pressure switch (chillers with CLIMATIC), or by a low pressure sensor (chillers with CLIMATIC II™), which is connected to the controls.

**Frost Protection**

The evaporator is protected from damage caused by freezing water resulting from abnormal operating conditions by a temperature sensor in the evaporator output, which is connected to the controls. (This protection is not always necessary if the ECOLOGIC™ chiller is used to cool a water/glycol mixture.)

### 6.6.4. Options

For details on the options available on the ECOLOGIC™ chiller see the Application Guide. Consult the wiring diagram for details of electrical options.

#### R22

The units are supplied with HCFC22 as the refrigerant. This is only available as an option outside of the EEC.

When specified with R22 the unit is supplied with operational set points and components that are suitable for operation with the refrigerant.

#### Sight Glass

A sight glass is provided for determining refrigerant condition if on the liquid line, one sight glass per circuit is provided.



Sight Glass

#### Low Ambient kit (all seasons)

Allows start-up and operating of the unit up to outside temperature down to -15°C (recommended for outside temperatures below +6°C).

Units equipped with basic Climatic control (Std, Std Plus & LN)

The unit is generally equipped with a low pressure switch and an antifreeze thermostat. The thermostatic expansion valve is by-passed by a solenoid valve on start-up.

Also included with this option is the compressor oil heaters and antifreeze protection heaters.

Units equipped with advanced Climatic II control (HE & SLN)

For units equipped with electronic expansion valves and CLIMATIC II, the standard programme enables the control of the start-up down to -20°C with no additional cost.

#### Alucoat 507 on condensers (Epoxy coating)

This is an anti corrosion sprayed coating that offers additional protection to the condenser fins for salt laden atmospheres such as seashores and in areas of industrial pollution.

This is not suitable for heavy industrial pollution, strong alkalis, oxidizers, wet bromine and chlorine and fluorine in heavy concentrations.

[www.altena.com](http://www.altena.com) for additional data.

#### BlyGold Plus on condensers

This is an anti-corrosion coating that the coils are fully dipped in that offers additional protection to the condenser coil for salt and mild industrial pollution. Two standards are available BlyGold Plus Tropic the traditional gold finish for mild marine, industrial and Middle East applications. For a higher level of protection for heavy industrial and marine applications BlyGold PoluAl a silver finish.

[www.blygold.com](http://www.blygold.com) for additional data.

#### Replaceable Core filter drier

Installed after the condensers, allows the replacement of the hygroscopic cores without having to remove the body of the core filter.



Replaceable Core filter drier

#### Compressor Isolation valves

The supply and fitting of manual suction and discharge isolation valves on either side of each circuit to allow service on the compressors with out removal of the full refrigerant charge. This is recommended if it is proposed that LENNOX carry out the service and maintenance work.



Compressor Isolation valves

#### HP/LP gauge set

Liquid filled gauges that measures the evaporating Low pressure (LP) and condensing high pressure (HP) on each refrigerant circuit. Gauges are glycerin filled to damp gas pulsation and are mounted externally.

The gauges are compound gauges that display the saturated refrigerant temperature for the various refrigerants available.

The same information is available on the Climatic II controller. Be careful not to duplicate functions. Display of High and low pressure is available from the Climatic II controller and it is not necessary to add gauges.



HP/LP gauge set

#### Dual pressure Relief valves UDT

Refrigerant pressure relief valves are fitted on the HP and a single pressure relief valve on LP side of the refrigeration system. This option has twin valves connected on a common HP or LP header with an isolation valve. This allows one valve to be on line at all times while the remaining valve is serviced, replaced or calibrated.

#### Condenser coil Guards

Removable polyester coated metal guards that protect the entire condenser coil outer surface from light accidental damage during shipping and on site.

Also prevents to direct contact by hand of the condenser coil sharp edges. The condenser coil guard is removable for cleaning of the condenser coil. The condenser coils guard's acts as a deterrent but do not offer total protection.



Condenser coil Guards

**NB : This option add 40 mm on the total unit width.**

### Mains Transformer 400V/230V

Avoids the separated power supply 230V/1/50Hz for the compressor crankcase heaters and the optional antifreeze heater on evaporator. This enables the customer to make just one power connection at the main switch the remaining power to the control circuit and heaters is provided by the transformer. The mains transformer comes fully wired and tested. This option can reduce customer's installation costs and does not require a customer to use a neutral cable.

### Connection for External Trace heating

This option allows for a customer to make a connection in the LENNOX panel for external trace heating for pipe work etc. This would be activated by the antifreeze protection thermostat mounted on the Lennox unit. This is only possible if Antifreeze option is selected for the chiller.

### Power and control panel to IP55

Standard control panel rating is IP43 which is suitable for external operation. In some countries the standard panel rating for external operation is to IP55. The IP55 rating ensures that the panel is waterproof when a water jet is directed directly onto the panel. The panel also has a higher mechanical strength for impact resistance.

The panel is supplied with Hinged doors. Multipoint door latching and door seals, the wire connections are all have gland seals to maintain the IP55 sealing rating.

**NB :This option adds length.**

### Main ON/OFF switch (Door interlocked)

It allows the general cut-off and isolation of the main 3-phase power supply, when the machine is running or stopped. The main isolator also acts as a thermal overload device to protect from excess current draw. If the mains transformer is fitted this switch will also cut power from the control and antifreeze Heaters. CAUTION If the mains switch is in the off position and a separate power supply is NOT provided to the anti freeze heaters Freezing can occur.



Main ON/OFF switch

The mains switch is supplied with covers on the connections. The mains switch is used to isolated power from the unit for safe working on the electrical system.

### Flow switch

According to the unit type, 2 different flow switch types of switch are available: - differential flow switch or a paddle flow switch.

In the case when a differential flow switch has been selected and the option "antifreeze heater" is selected the lines to the flow switch are protected from freezing.

This switch comes piped and fitted on the evaporator and is tested by the factory.



Paddle Flow switch

The paddle switch is supplied loose for fitting in the CHILLED water off line by the customer. It is also required that the customer wire the flow switch directly back to the control panel terminals provided.

When a unit is selected with the pump module a paddle flow switch is supplied fitted as standard.

If a chiller is operated with out a flow switch then Freezing of the evaporator will occur if the chiller is operated with no water flow warranty will be voided if no flow switch is present in the chilled water system.

### Compressor acoustic enclosure

A compressor compartment in Aluzinc steel, the internal sides are lined with acoustic sound-insulating foam: PAE 28 mm, 3 kg/m<sup>2</sup> mass, protection films, fire classification M1.



Compressor acoustic enclosure

The compartment is fitted with lift off doors to allow access to the compressors.

The compartment is fitted with a forced air ventilation fan to control the temperature inside the compressor acoustic cabinet. Standard on SLN, option on High Efficiency only.

### TUV/VDE

Units manufacturing according to the TÜV/VDE norm (electrical components, pressure devices, safety valves...). This norm is no longer required as from May 2002 the Pressure Equipment Directive PED required for CE marking this supercedes all EU local pressure certification standards (TUV, ISPEL, SDM, UDT and BS).

### Reinforced evaporator insulation

One additional layer of thermal insulation of the evaporator increases the insulation from 12.7mm to 26mm closed cell foam that is resistant to water. Classification for fire: M1.

### Double water gauges

Water gauges that measure the pressure on the inlet and outlet of the water circuits. The standard is to have one pressure gauge on the water pressure relief valve.



Double water gauges

**Climatic II (advanced controller)**

On the Std, Std plus and LN units the standard controller is the basic Climatic.

Option is to have Climatic II advanced controller, which offers additional control and functionality over the basic Climatic controller.

Low ambient start down to -18°C and high pressure unloading are standard features together with high and low refrigerant pressure display on each circuit as standard.

Climatic II is supplied with KP02 removable customer interface.



*Climatic II (advanced controller)*

**KP07 Graphic Display**

The KP07 Climatic II graphic display replaces the KP02 and gives a full LCD display and keyboard for customer interface. This offers additional functionality and control features that are not on the KP02 (see separate specification sheet).



*KP07 Graphic Display*

**Water Strainer filter**

Water Strainer/ filter to be installed upstream to the water inlet, to protect the evaporator from any possible impurities (80 microns efficiency). Recommended for shell and tube and must be fitted for Plate heat exchangers.



*Water Strainer filter*

**Anti-vibration mounts**

Elastic supports (Rubber) made of 2 flat and parallel frames, connected together via a rubber ring, fixed under the unit at the points specified by our technical drawings. Reduces the transmission of vibration to the ground and the general sound level. The diameter and strength vary in accordance with the model. Delivered loose not fitted.



*Anti-vibration mounts*

**Service Panels**

This option is to provide a full panel enclosure on the Std, Std plus and LN 100E to 150D versions.

The side of the unit which contains the Compressors is fully enclosed from the base to the top of the unit with painted RAL 9002 removable sheet metal panels.



*Service Panels*

**Chilled water connections**

The chilled water connections on all units are Victaulic connections each unit is supplied with a Victaulic connector and seal for the chilled water connections as standard.

In the event the customer needs to have a grooved Victaulic pipe stub, which he can weld, screw or fit flanges too. This option provides the two additional pipe stubs sections groove at one end for the Victaulic connector and unfinished at the other end for the customer to make the connection of his choice.



*Chilled water connections*

**Electronic Expansion valves**

On the Std, Std plus and LN unit's thermostatic expansion valves are fitted as the standard.

There is the option to fit electronic expansion valve(s) (EEV) with this option the Liquid line solenoid valve is also not required as the EEV acts as a isolation valve.

When selecting the option of electronic expansion valve it is also necessary to select the Climatic II controller.



*Electronic Expansion valves*

**Compressor Soft Starter**

This option available on all models is to provide for the lowest starting current on the compressors. The overall starting current is reduced by 25% to 35% depending on the number of compressors and model selected.

**STEK**

If this option is selected the chiller is built to respect the STEK regulations. The unit is fitted with refrigerant circuit isolation valves one in the main suction and one in discharge line of the main distributor to the compressors and a sight glass is fitted in each refrigerant circuit.

Also included is the required paperwork and certification documentation.

**None standard options available**

Power factor Correction; Plexy glass in the panel; Emergency stop buttons; 3 phase +neural mains isolator; Phase reversal protection; earth leakage breaker; Architectural louvers; Chilled water pressurization unit; IP65 control panel; High pressure condenser fans; remote power hook up for remote hydraulic module.

*For these and other none standard options contact the sales team.*

## 7. SAFETY DURING OPERATION

### 7.1. Safety and Protection Features

The safety of installation technicians and operating personnel is guaranteed by the following features.

- High pressure switches will switch off the compressors before the operating pressure has reached the maximum acceptable value. Depending on the control system used, other measures will be taken beforehand (see the operating manual of the relevant control system).
- Depending on the chosen version piping is protected by sheet metal parts.
- The main switch, if present (optional), can be locked in the zero (off) position.
- On versions incorporating an auxiliary supply, the latter will also be switched off by the main switch, if present (optional).
- The service panel located in front of the main current part of the control panel can only be removed when the main switch, if present (optional), is in the zero (off) position.
- All service panels are fixed with bolts, and can only be removed using specific tools.
- All live parts are touch proof to prevent accidents during maintenance operations (maintenance is often performed with the service panels removed and the supply switched on). It is important that the protections fitted by Lennox remain in place. If the original protections need to be removed for maintenance purposes, they should be re-fitted in their original location/manner. Some safe voltage parts (<50V) are not touch-proof.
- The fans on the exterior of the chiller are fitted with (fine mesh) protective grids. To prevent inadvertent contact with a rotating fan on the inside of the chiller during maintenance operations, the fans on the inside of the chiller may be also fitted with (coarse mesh) protective grids (only applicable for versions where this part of the unit is accessible).
- Warning labels are located on or near parts that could produce the following hazards:

**High temperatures (pressure gas lines)**

**Electrical voltage (switch compartment).**

**Rotating parts (service panels providing access to the condenser compartment).**

**Sharp parts (fins of the heat exchangers of the air-cooled condensers).**

### 7.2. Safety during decommissioning

If the ECOLOGIC™ chiller is to be taken out of service for an extended period, or dismantled, the following points should be observed:

- The machine should be isolated correctly (see chapter 7.6).
- If the chiller is to be taken out of service for an extended period, the refrigerant should be pumped down by authorised personnel. The refrigerant circuits should be brought to slight overpressure using nitrogen gas. During this operation the discharge, suction, liquid and solenoid valves should be open (if present).
- If the chiller is to be dismantled, the oil and refrigerant need to be drained off and discharged by suitably qualified personnel. (All in accordance with the regulations governing substances which affect the ozone layer).

**! NOTE:**

***ECOLOGIC™ chillers contain refrigerant under pressure. Always ensure that pressurised lines or other parts under pressure are prevented from damage or perforation, as this could allow refrigerant to escape. Escaping refrigerant is a hazard for the eyes and the skin (burning - very low temperatures) and is damaging to the environment. Furthermore, machines with insufficient refrigerant will not operate correctly.***

**! NOTE:**

***With a roof mounted chiller, the effect of gusts of wind should be taken into account when removing service panels. Ensure that the panels cannot be blown away by a gust of wind during lifting. Take care that the force of the wind on the panel does not result in a loss of balance and/or a fall. If the panels have to be removed during operations, ensure that they are stacked so that they are not exposed to gusts of wind. Due to their size and weight, panels that are blown away could cause damage and/or injury.***

**8. CONTROL**

How your ECOLOGIC™ chiller is controlled depends on the version you have chosen; see chapter 5. All the relevant information concerning operation is contained in the operating manual for the relevant control system.

**9. MAINTENANCE****9.1. General**

Regular and careful maintenance of your ECOLOGIC™ chiller is essential for long term, efficient and fault-free operation. You will be able to carry out some maintenance operations yourself; refer to chapter 9.2. Other maintenance work should be carried out by suitably qualified and authorised personnel, see chapter 9.3. Operations on the refrigerant circuit should only be executed by suitably trained and certified personnel. Maintenance can be carried out by the Lennox service organisation, with whom a service contract can be arranged.

If faults and / or non-conformities are found, these should be reported to our service organisation immediately. When doing so, it is essential that you tell us the type of machine and its serial number. If the fault occurred during the warranty period, please also quote the Lennox order number assigned to the machine. Consult the electrical diagram if necessary during checking operations.

**For Netherlands :**

The frequency of periodic checks carried out by qualified personnel should at least be in accordance with the applicable RLK.

These checks and operations on the refrigerant or control technology part of the chiller should be registered in the logbook. The logbook with its associated certificates and instruction card should always be stored in/near the chiller. For example in the control panel of the machine.

***The inspection schedules in this manual are intended as a guideline during maintenance operations. Lennox does not vouch for the completeness of this information and can therefore not accept liability for any possible omissions.***

**! NOTE:**

**The main switch of the machine should be disabled and locked during operations on electrical equipment.**

### ■ Compressors

The scroll compressors are hermetically sealed and do not contain parts such as valves, ball bearings or suction springs. They therefore do not require maintenance.

### ■ Electrical equipment and switches

On the whole maintenance is limited to the removal of dust and dirt at least twice a year and cleaning of the contacts if necessary. The operation of measurement and control equipment should also be checked periodically.

### ■ Condenser

The heat exchanger of the condenser should be checked periodically for visible pollution, and thoroughly cleaned if necessary. It should not be cleaned with a wire brush.

In view of the danger of damage to the fins, Lennox recommends that the cleaning be carried out by specialists.

A separate maintenance contract (specifically for the coating) can be agreed for heat exchangers with protective coatings.

### ■ Evaporator

The water filter have to be checked and cleaned regularly.

The evaporator should be checked periodically. The evaporator does not require any maintenance other than the maintenance of its satisfactory condition or repair of the insulation if necessary. In the event of water side pollution, the evaporator should be chemically cleaned by certified personnel. Pollution can be detected by observing a reduction in evaporation temperature compared to a similar operating situation under clean conditions.

### ! NOTE:

**Never use strong inorganic acids to clean the evaporator to prevent corrosion of the materials.**

### ■ Filter/drier

Maintenance of the filter/drier is limited to the replacement of the ceramic cylinders on the 110E-,230D-, 300D- and 370D-models or replacement of the entire filter/drier unit on the other machines, following moisture saturation. However, the capacity of the filter/driers is such that replacement only needs to take place when the refrigerant circuit is opened for extensive repairs. A difference in temperature before and after the filter/drier points to a blockage caused by pollution. The replacement of filter/driers or filter/drier ceramics should only be carried out by suitably qualified and certified personnel.

## 9.2. Maintenance schedule for operating personnel

**! NOTE:**

*Operations on the refrigerant circuit should only be executed by suitably trained and certified personnel.*

Machine in operation	Number of inspections per year
<b>! NOTE: The top section of a scroll compressor in operation is hot!</b>	<b>Compressors</b>
Check the condition of the compressor (noise, temperature, leakage, pollution, corrosion)	4
Check the oil level (should be visible in the compressor sight-glass)	4
	<b>Refrigerant circuits</b>
Check (if present) the refrigerant sight-glass (no gas bubbles should be visible in the sight-glass and look out for discoloration of the moisture indicator)	4
Check the condition of the piping (pollution, leakage, corrosion, vibration)	4
Check the bracing of the piping (fixing, inlay material)	4
Check the condition of the insulation (pollution, moisture, damage)	2
	<b>Evaporator</b>
Check the condition of the evaporator (pollution, leakage)	2
Check the condition of the insulation (pollution, seams, damage, is it tightened)	2
Check the water connections (pollution, leakage, corrosion, sticking of fixings)	2

Machine de-commissioned (main switch off and locked)	Number of inspections per year
<b>Compressors</b>	
Check the oil level of the compressors (between ½ and ¾ of the sight-glass height)	2
<b>Control panel</b>	
Check that the switch compartment is clean and dry.	2
Check the condition of the cables (corroded, burned, damaged)	2
<b>Condenser</b>	
Check the condition of the heat exchanger (pollution, leakage, corrosion, obstructions)	4
Check the condition of the fans (pollution, corrosion, axle play)	4
Clean the fan blades	2
Check the air flow over the assembly (fall wind, blind angle, short circuit, suction waste gas)	2
Check that the fixing bolts are tightened	2
Check the protective grids (fixing, holes, corrosion)	2

***When a chiller is restarted it will again remain blocked for a short time (see operating manual of the relevant control system and / or the wiring diagram).***

### 9.3. Maintenance schedule for qualified personnel

Machine in operation	Number of inspections per year
<b>Compressors</b>	
<b>! NOTE: The top section of a scroll compressor in operation is hot.</b>	
Check the condition of the compressor (noise, temperature, leakage, pollution, corrosion)	2
Check the operation of the crankcase heater (compressor switched off)	2
Check the oil level (should be visible in the compressor sight-glass)	2
Check the suction pressure (3 bar < suction pressure < 6 bar)	2
Check the discharge pressure (10 bar < discharge pressure < 23 bar)	2
Check the current (see specification sheet)	2
Check the exhaust fan (on the HE and SLN versions) of the compressor housing (in operation as soon as one compressor is in operation)	2
<b>Refrigerant circuits</b>	
Check (if present) the refrigerant sight-glass (no gas bubbles should be visible in the sight-glass and look out for discoloration of the moisture indicator)	2
Check the refrigerant circuit for leakage	2
Check the condition of the piping (pollution, leakage, corrosion, vibration)	2
Check the bracing of the piping (fixing, inlay material)	2
Check the condition of the insulation (pollution, moisture, damage)	2
Check superheating of the suction gas (3K < superheating < 8 K)	2
Check subcooling of the liquid (2K < subcooling < 6K)	2
<b>Evaporator</b>	
Check the condition of the evaporator (pollution, leakage)	2
Check the condition of the insulation (pollution, seams, damage, is it tightened)	2
Check the water connections (pollution, leakage, corrosion, sticking of fixings)	2
Check the operation of the evaporator heating (current: see wiring diagram)	2
<b>Condenser</b>	
Check the condition of the fans (noise, pollution, temperature, corrosion)	2
Check the current of the fans (current: see wiring diagram)	2
<b>Protections</b>	
Check the operation and settings of the following protections:	
-The flow protection (flow switch or differential pressure switch)	2
-The high pressure switches	2
-The low pressure switches (on BCS)	2
-The thermal protections by pushing the reset button (this will only check switching off)	2
-The switching off of the compressor by interrupting the Klixon or the thermal protection (remove from terminal strip)	2
-Switching off the first fan on every circuit by interrupting the Klixon (remove from terminal strip)	2
-The safety functions included in the controls (see operating manual of the relevant control)	2

**! NOTE:** See the note overleaf.

**! NOTE:** When the operation of the protections is checked by removing connections from the terminal strip, ensure that these are replaced in their original positions and fitted securely.

<b>Machine de-commissioned (main switch off and locked)</b>	<b>Number of inspections per year</b>
<b>Compressors</b>	
Check the oil level of the compressors (between ½ and ¾ of the sight-glass height)	2
Check that the electrical connections are tightened	2
<b>Control panel</b> (refer to wiring diagram for settings)	
Check that the switch compartment is clean and dry.	2
Check the condition of the switches (pollution, corrosion)	2
Check the condition of the contacts (pollution, corrosion, burning)	2
Check that all connections are tightened	2
Check the condition of the cable insulation (corroded, burned, damaged)	2
Check the settings of the thermal protections	2
Check the condition of the fuses (tightened, value)	2
<b>Condenser</b>	
Check the condition of the heat exchanger (pollution, leakage, corrosion, obstructions)	2
Clean the heat exchanger with a soft brush	2
Check the condition of the fans (pollution, corrosion, axle play, imbalance)	2
Clean the fan blades	2
Check the protective grids (fixing, holes, corrosion)	2
Check the air flow over the assembly (fall wind, dead angle, short circuit, suction waste gas)	2
Check that the fixing bolts are tightened	2
Check that the electrical connections are tightened	2
<b>General</b>	
Check the assembly of the chiller (vibration absorbers, foundation, level?)	2
Check the condition of the housing (tightened, pollution, corrosion)	4
Check the fixing points of the removable parts	2
On the HE and SLN versions check the condition of the noise insulation on the compressor housing	2
Check that all warning labels are still in place	2

***When a chiller is restarted it will again remain blocked for a short time (see operating manual of the relevant control system and / or wiring diagram).***

***All operations on the refrigerant installation, which are subject to the stipulations in the relevant RLK, should be registered in the logbook associated with the installation (Netherlands only).***

It is also advisable to register the relevant operating conditions during checking operations.

- Chilled water inlet and outlet temperature
- Discharge and suction pressure
- Ambient temperature
- The capacity step at which the machine is operating at that point in time.

Some of this data can be gathered using the controls (see operating manual of the relevant control)

## 9.4. Replacement of warning labels

Missing or damaged warning labels should be replaced. A summary of all warning labels required on and in the machine is included in chapter 3.2.

Proceed as follows when fitting the warning labels:

- ***Clean the base using a non-aggressive degreasant.***
- ***Heat the area with a blow drier until it is just warm to the touch.***
- ***Remove the cover strip and stick the warning label into the required position.***
- ***Press down and ensure no air bubbles are left behind.***

Leave the glue to dry for at least 24 hours before bringing the warning label into contact with water and/or cleaning agents.

***Please contact the Lennox service department in the event of a fault on the ECOLOGIC™ chiller. An indication of the possible cause of the fault will allow us to solve the problem much more efficiently.***

### **! NOTE:**

Operations on the refrigerant circuit should only be executed by suitably trained and certified personnel.

ECOLOGIC™ chillers contain refrigerant under pressure. Improper operations on the refrigerant circuit could result in refrigerant escaping. This represents a hazard to the eyes and to the skin (burning - very low temperatures). Escaping refrigerant is also hazardous to the environment, and a chiller containing insufficient refrigerant will not operate correctly.

## 10. FAULT MESSAGES AND FAULTS

The control system in all versions of the ECOLOGIC™ chiller is designed to simplify fault analysis. The operating manuals of the relevant controls indicate how to gain access to the required information. It may also be helpful to consult the wiring diagram.

### **Method of operation in the event of a fault:**

- ***Analyse the fault using the control system (see operating manual of the relevant control system) and the summary included in chapter 12, if necessary.***
- ***Depending on the nature of the fault and the actions to be taken, the fault can be remedied in situ or may require the assistance of qualified personnel.***

### **! NOTE:**

During operations on the machine, the supply should be disconnected and the main switch locked.

## 11. REFRIGERANT HANDLING

### 11.1. General

The two refrigerants employed in ECOLOGIC™ chillers are fundamentally different. The following table highlights a number of these differences.

	<i>R-407c</i>	<i>R-22</i>
<b>Composition</b>	<b>Mixture of 3 HFKs</b>	<b>Pure HCFK</b>
ODP (R-11 = 1)	0	0.05
GWP (CO <sub>2</sub> = 1.0)	1600	1700
AEL [ppm]	1000	1000
Boiling point [°C]	-41	-44
Glide	YES	NO

Clarification: ODP = Ozone Depletion Potential, based on the reducing output of R-11.  
 GWP = Greenhouse Warming Potential, based on greenhouse effect of CO<sub>2</sub>.  
 AEL = Allowable Exposure Limit.

#### **! NOTE:**

**ECOLOGIC™ chillers contain refrigerant under pressure. Improper operations on the refrigerant circuit could result in refrigerant escaping. This represents a hazard to the eyes and to the skin (burning - very low temperatures). Escaping refrigerant is also hazardous to the environment, and a chiller containing insufficient refrigerant will not operate correctly.**

## 11.2. Technical points to remember

### 11.2.1 The glide effect

During measurements on the refrigerant circuit with refrigerants consisting of a pure substance, a fixed ratio exists between the pressure and temperature in the co-existence area (where both moisture and liquid are present).

This does not apply, however, to refrigerant mixtures with the glide feature. In these refrigerants the liquid has a different temperature (bubble point) than that of the gas (dew point) at the same pressure.

This is important when defining subcooling and superheating. Subcooling should always be defined by comparing the liquid temperature with the bubble point temperature at the measured pressure.

Superheating should always be defined by comparing the temperature of the suction gas with the dew point temperature at the measured pressure.

### 11.2.2. Charging the installation with refrigerant

Installations should always be recharged via the connection on the liquid valve (Vlr).

#### **! NOTE:**

**Never attempt to start the compressor in an evacuated circuit as this would cause immediate, irreversible damage to the compressor.**

#### **! NOTE:**

**Due to their high volumetric output, scroll compressors can reach a vacuum very quickly. The compressors should therefore not be used to suck in refrigerant, as this will surely lead to irreversible damage. Even starting a compressor with the suction valve (Vs) closed will lead to irreversible damage. The suction pressure of a scroll compressor must never be lower than 0.2 bar (manometer pressure).**

### 11.2.3. Charging of an installation with R-407c

An installation with R-407c should be charged with refrigerant in **liquid** form, to ensure that the correct composition is entered.

If, for any reason, part of the refrigerant content of an installation has disappeared, the installation should be recharged with refrigerant of the original composition.

#### ! NOTE:

**Operations on the refrigerant circuit should only be executed by suitably trained and certified personnel.**

## 12. POSSIBLE FAULT CAUSES

### Possible Fault Causes

Problem or fault	Possible cause
Machine does not start	No voltage Main switch off Machine blocked Release conditions not met (of start command, pump switch or flow switch) Chiller in fault mode No cooling request Machine outside operational area
High pressure fault	Polluted condenser heat exchanger Discharge valve closed Thermal protections of one or more condenser fans disengaged (first fan of each circuit is protected by Klixon) Chiller overloaded, chiller operating outside design conditions
Low pressure fault	Suction valve closed Not enough refrigerant for expansion valve (gas bubbles in sight-glass) Filter/drier polluted (> 1 K temperature difference) Evaporator polluted on water side
Frost Protection	Not enough water flow (outside operational area) Capacity control operating incorrectly Heating tape faulty Faulty temperature sensor in water inlet or outlet
Thermal compressor protection	Chiller overloaded, chiller operating outside design conditions
Klixon \ thermistor compressors	Motor winding thermally overloaded, unit outside design conditions

**The possible fault causes listed in the above table are guidelines to assist in locating the fault. Lennox does not vouch for the completeness of this information and can therefore not accept liability for any possible omissions.**

### 13. ABBREVIATIONS

The following table includes meanings of the specific abbreviations used in this operating manual. Also refer to the chapter containing information on the relevant subject. Where possible the same abbreviations are used in the wiring and cooling technology diagram.

Abbreviation	Meanings
C	Climatic Control System
CAC	Condenser, Air Cooled
CF	Condenser Fan
CH	Compressor Hermetic
Ec	Electric heater, compressor
C II	Climatic II Control System
Eev	Electric heater, evaporator
EVAP	Evaporator
EVe	Expansion Valve, electronic
EVt	Expansion Valve, thermostatic
FD	Filter Drier
PS <sub>h</sub>	Pressure Switch, high pressure
PS <sub>l</sub>	Pressure Switch, low pressure
PT <sub>h</sub>	Pressure Transmitter, high pressure
PT <sub>l</sub>	Pressure Transmitter, low pressure
PV	Purge Valve
SC <sub>d</sub>	Service Connection, discharge
SC <sub>l</sub>	Service Connection, liquid
SC <sub>s</sub>	Service Connection, suction
SG <sub>l</sub>	Sight Glass, liquid refrigerant
SV	Solenoid Valve
SV <sub>l</sub>	Solenoid Valve, liquid refrigerant
TE	Temperature (sensing) Element
TS <sub>l</sub>	Temperature Switch, low ambient temperature
V <sub>d</sub>	Valve, discharge
V <sub>l</sub>	Valve, liquid refrigerant
V <sub>s</sub>	Valve, suction





**BELGIUM :** LENNOX BENELUX N.V./S.A.  
tél. : + 32 3 633 30 45  
fax : + 32 3 633 00 89  
e-mail : info.be@lennoxbenelux.com

**CZECH REPUBLIC :** LENNOX JANKA  
tél. : + 420 2 510 88 111  
fax : + 420 2 579 10 393  
e-mail : janka@janka.cz

**FRANCE :** LENNOX FRANCE  
tél. : + 33 4 72 23 20 20  
fax : + 33 4 78 20 07 76  
e-mail : accueil@lennoxfrance.com

**GERMANY :** LENNOX DEUTSCHLAND GmbH  
tél. : + 49 69 42 09 79 0  
fax : + 49 69 42 09 79 40  
e-mail : info.de@lennoxdeutschland.com

**MIDDLE EAST :** LENNOX DISTRIBUTION  
tél. : + 971 4 262 9309  
fax : + 971 4 266 7082  
e-fax : + 1 240 368 73 62  
Mobile : 971 50 4510669  
e-mail : mmrifai@emirates.net.ae

**NETHERLANDS :** LENNOX BENELUX B.V.  
tél. : + 31 33 2471 800  
fax : + 31 33 2459 220  
e-mail : info@lennoxbenelux.com

**POLAND :** LENNOX POLSKA Sp. z o. o.  
tél. : + 48 22 832 26 61  
fax : + 48 22 832 26 62  
e-mail : info@lennoxpolska.pl

**PORTUGAL :** LENNOX CLIMATIZAÇÃO LDA.  
tél. : +351 22 999 84 60  
fax : +351 22 999 84 68  
e-mail : info@lennoxportugal.com

**RUSSIA :** LENNOX DISTRIBUTION MOSCOW  
tél. : + 7 095 246 07 46  
fax : + 7 502 933 29 55  
e-mail : lennox.dist.moscow@mtu-net.ru

**SLOVAKIA :** LENNOX SLOVAKIA  
tél. : + 421 2 44 87 19 27  
fax : + 421 2 44 88 64 72

**SPAIN :** LENNOX REFAC S.A.  
tél. : + 34 915 40 18 10  
fax : + 34 915 42 84 04  
e-mail : marketing@lennox-refac.com

**UKRAINE :** LENNOX DISTRIBUTION KIEV  
tél. : + 380 44 213 14 21  
fax : + 380 44 213 14 21  
e-mail : jankauk@uct.kiev.ua

**UNITED KINGDOM :** LENNOX INDUSTRIES LTD  
tél. : + 44 1604 599400  
fax : + 44 1604 594200  
e-mail : ukmarketing@lennoxind.com

**OTHER EUROPEAN COUNTRIES, AFRICA, LENNOX DISTRIBUTION :** tél. : + 33 4 72 23 20 14  
fax : + 33 4 72 23 20 28  
e-mail : marketing@lennoxdist.com



**LENNOX**®

ECOLOGIC  
IOM-EC-0802-E

[www.Lennox europe.com](http://www.Lennox europe.com)