LENNOX®

# APPLICATION GUIDE

PROVIDING GLOBAL SYSTEM SOLUTIONS

EcoMax

# CONTENTS



*Our company is a member of the Eurovent Certification Programme. The ECOMAX™ Lennox chillers are tested and rated in accordance with Eurovent certification program.*

Our products comply with the European standards.

*The manufacturing ECOMAX™ family of chillers answers to ISO 9001 control quality system. A copy of the certificat can be get on request.*

**LENNOX have been providing environnemental solutions since 1895, our range of air cooled Chillers continues to meet the standards that have made LENNOX a household name.**

**Flexible design solutions to meet YOUR needs and uncompromising attention to detail. Engineered to last, simple to maintain and Quality that comes as standard.**

The Lennox EcoMax P range of Air-cooled reciprocating compressor chillers utilise the very latest technology in Heat transfer and compressor design technology blended with the LENNOX Climatic control system. This unique blend of technology and controls give a state of the art solution combining reliability and performance that owners and operators demand today.

The EcoMax range of LCH chillers utilise ozone benign refrigerants and are specifically designed to take advantage of the characteristics of these refrigerants and lubricating oils.

Completely self contained and designed for outdoor applications each chiller utilises multiple reciprocating compressors that have a fully self contained lubrication systems managed within the compressor. Positive forced lubrication by a shaft driven oil pump insures that all components receive lubrication This provides a simple and extremely reliable compressor system, compressor motors are cooled with suction gas which passes through a suction strainer before entering the motor. Single or tandem compressors have their own independent refrigerant circuit and are matched to the evaporator and condenser for optimal performance. The condenser coils are arranged to provide full air circulation across the whole surface and avoids bypass by the integration of internal baffles. The condenser fans are multi blades aerofoil section with sickle end sections mounted in a bell mouth orifice to provide maximum airflow and low noise characteristics. The condenser coils, Fans, evaporator, compressors, and the weather proof power and control centre is mounted on a welded fully galvanised rigid base. All sheet metal panels are galvanized and external panels are powder painted RAL 9002 and baked for corrosion resistance.

The LENNOX EcoMax range provides to owners, specifiers and operators Reliability, Efficiency and unsurpassed flexibility to specifically provide cooling solutions matched your needs.

The new Ecomax range has individual versions for customer specific applications.
Each version has a range of units from 300 to 650kW
The versions are the Standard (Std) when cost per Kw is the key driver. High ambient (HA) for operation in extremely high ambient conditions that exist in the Middle East and North Africa. High efficiency (HE) where operating costs and maximum operating efficiency is required at part load operating conditions is required. Low Noise (LN) this version of the Ecomax range is suggested when noise emissions from the installation are an issue for the customers. LENNOX is able with their flexible approach to manufacture to provide additional acoustical solutions specifically to match customer's needs.

## CONSTRUCTION

The chiller is constructed on a solid rugged base frame constructed of **"I" section steel** beams welded together to form a ridged base. The base is structurally able to carry the unit weight and is torsion ally ridged with no vibrating sections The base is **hot dipped galvanised for corrosion protection**. The chiller is lifted, moved and mounted via the base frame that contains AVM mounting and lifting points as standard. Sheet metal panels are galvanised and painted RAL 9002 to achieve a corrosion resistant attractive finish.

## EVAPORATOR

The Evaporator is DX Shell and Tube type with independent refrigeration circuits. DX evaporators operating with HFC407C are well suited for air-cooled operation and are preferable to Flooded type evaporators. This combination offers lower refrigerant charges and independent refrigerant circuits significantly reducing risks of refrigerant loss. The shell is carbon steel trace heated with thermostatic protection to -20°C (option) and insulated with close cell foam (k=0.25). The tubes are copper with enhanced surface area mounted in a U bundle with brass internal baffle plates for maximum heat transfer performance. The evaporator is protected from freezing via the Climatic II control via both temperature and pressure monitoring. The evaporator connections are **flanged as standard.**

### CONDENSER

The condenser is constructed with enhanced surface seamless copper tubes arranged in a staggered pattern mechanically expanded onto high efficiency corrosion resistant aluminium fins. The fins have full fin collars to enhance heat transfer. The fins are rippled but not lanced to provide a **surface that can be cleaned to maintain efficiency**.

## ELECTRICAL CONTROL CENTER

The components of both power and control are split into two sections of one panel. Individual key locked doors access each section, which prevents unauthorised entry. The panel is manufactured IP55 to insure protection in all weather conditions. Wiring is in compliance with EN60204-1.

The electrical system is designed to be **plug and play** as a customer needs only to connect a power supply to enable the unit to operate all the necessary controls and safety devices are already installed. The panel has options of a internal thermostatically controlled ventilation system or anti condensation heaters to maintain ideal operating conditions.
Power section contains contactors, **thermal overloads for compressors and fans**, mains isolation and customer connection points. All 3-phase connections are fully shrouded to prevent any accidental contact. Cable entry is via a removable gland plate
Control is via the Climatic II controller that provides full control of the chiller and refrigeration system. All the safety and scheduling of the refrigeration system, compressors and condenser fans. Control of the chilled water system to provide the design off water temperature at the maximum efficiency by matching the system load, ambient and operating conditions at the minimum power consumption.
The **Climatic II** has a full digital display with trend logging, reading 2050 points of data. Display of all system conditions on a single screen(option). Alarm signalling and display diagnostics by individual refrigerant circuit. Hours run and automatic compressor scheduling. Adaptive control on the high pressure and low pressure operation to prevent nuisance trips. Additional options can be added to enhance the level of control and external communications capabilities.

### "HUSHTONE" CONDENSER FAN

The new Hush tone condenser fan features six aerofoil pitched blades statically and dynamically balanced. The blades have sickle end section in a bell mouth orifice for reduced noise and improved performance. This fan design is unique to ***LENNOX*** . The fans are direct driven via a three phase motor with permanently lubricated ball bearings. The motors are designed for external operation and are available in 3 different speeds with the option of two-speed motor.

## COMPRESSORS

*Motor* - The compressor motors are refrigerant gas cooled, with integral temperature-sensing solid-state overload protection in each phase. The terminal boxes are to IP54 weather protection.
*Housing* - The compressor housing is cast iron, and contains: Removable cylinder heads with internal muffling, suction and discharge service valves, crankcase sight glass and heater, oil and suction strainers, and internal relief valves.
*Crankshaft* - The crankshaft is ductile (nodular) iron, drilled for positive oil distribution, with integral counterweights for balancing. The main bearings are insert type, steel-backed
Babbitt. The thrust bearing is bronze with a Babbitt surface.
*Cylinder Assemblies* - Suction and discharge valves are high-quality, non-flexing, stainless steel. The pistons are aluminum alloy with two piston rings. The connecting rods are aluminum alloy with replaceable shell bearings at the big end. Cylinder liners are removable.
*Lubrication* - The lubrication is force-fed by a reversible oil pump to all crankshaft and bearing surfaces through a fine mesh stainless steel oil strainer.
*Capacity Control* - Capacity control is provided by solenoid-actuated, capacity control valves, which are controlled by the microprocessor center. This method efficiently and effectively matches low load conditions as required. Gas flow is sufficient at all times to cool the motor.
*Isolation* - Each compressor is mounted on isolator pads to reduce vibration transmission to the structure. Compressors are fitted as standard with discharge isolation valve and gas muffler in the discharge line to reduce noise

## FACTORY TESTING

Factory testing of all the EcoMax range means trouble free start ups.
Each individual refrigerant circuit is pressure tested, evacuated and vacuum tested before being charged with refrigerant and oil. The system is then subject to a complete functional test via the Climatic controller that is self diagnostic on all its external sensors. The unit is then placed on the test stand and given a full operational run test to ensure that the unit is fully functional and operating correctly before leaving the factory. This detailed testing insures that the Climatic II has the correct standard operating parameters, communication and control sequence are installed. All the electrical wiring and connections are checked, condenser fans and compressors are operated and checked. The refrigeration system operation is checked for the correct refrigerant charge, setting of the expansion valves and the operation of the safety and protection devices are fully functional. Each and every EcoMax unit spends am minimum of four hours in the test stand. All options that are factory fitted are tested to insure that they operate correctly and any customer external connections such as flow switch or remote on/off are simulated After testing and recording the operation the unit is then given a final refrigerant leak test before passing for cleaning and finishing. All the external components are given a final coat of a clear epoxy coating to help maintain the appearance and corrosion resistance of the complete chiller.

## Standard

The ECOMAX™ Standard range of Air cooled helical rotary screw chillers from LENNOX bring a to specifiers, owners and operators performance and reliability in a compact package.
The standard range is fitted with 2,3 or 4 high performance robust Copeland reciprocating compressors in dual refrigeration circuits. Each refrigerant circuit has a dedicated condenser section and fans. The Lennox "*Hushtone*" fan is fitted as the standard and operates at 700rpm. Each refrigerant circuit contains an oversized filter drier, a mechanical liquid line stop valve with a charging port, , Electronic expansion valve, liquid sight glass and mechanical discharge isolation valve. The single DX evaporator has 2 refrigerant circuits and is fully insulated 13mm with close cell foam insulation sealed to form a vapour tight seal on the evaporator shell. The evaporator is fitted with vent and drain points and is supplied with flanged water connections, the flow and return water sensor pockets are mounted in the pipe stub sections. These units meet the new European pressure equipment directive PED97/23/EC.
The control and power sections are mounted in a single wardrobe weatherproof panel, all the compressor and condenser fan power supplies are individually fitted with thermal overloads. The three phase power and earth connections is via a low level gland plate and connects to a fused thermal overload ensuring complete discrimination. Separate electrical control and antifreeze heater single phase power supplies complete the hook up. The advanced Climatic II microprocessor controller fitted with the KP02 digital display customer interface is supplied as standard on these units. The KP02 customer interface is removable so that access to the control system can be totally controlled allowing only authorised access to the system configuration.
All the chiller components are mounted to a UPN section welded steel channel base frame that has been hot dipped galvanized for corrosion protection. The base has the lifting lugs and mounting points for anti vibration fittings all pre installed. The EcoMax range is built in accordance with current EEC norms and legislative requirements.
The EcoMax standard range has a large number of customer configurable options to meet the local legislative requirements and specific customer needs.

## Low Noise

The ECOMAX™ Low Noise of units uses the same range of Quality components that are utilised in the Standard range previously detailed. In addition the Low Noise range uses larger condenser surface with low speed fans to achieve similar capacity range as the Standard units. The reciprocating compressors are enclosed in an acoustical sheet metal enclosure, which is lined with sound attenuating material. Compartment in covered with sound-insulated foam: PAE 28 mm, 3 kg/m2 mass, protection films, fire classification M1.
This combination significantly reduces the sound power from the chiller. The utilisation of low speed condenser fans combined with the acoustic compressor treatment results in an extremely low emitted sound level radiated from the chiller.
The EcoMax Low Noise range is supplied with both low speed fans and the compressor acoustic enclosure as the standard.
The low speed fans are specifically selected to maintain a high airflow despite the lower rotational speed and when combined with the addition of added condenser surface area means there is no compromise in performance when selecting an EcoMax Low Noise chiller. These units are built and factory tested to the same demanding quality standards that the Lennox brand is renown for.

## High Efficiency

The ECOMAX™ high efficiency range of units is designed to ensure that cooling both at full and part load is provided at the minimum electrical power absorbed. This provides the owner with the lowest operating costs and by reducing power consumption the indirect global warming impact is minimised. The indirect global warming is the generation of CO2 in producing the electrical power to operate the chiller by selecting from EcoMax high efficiency range CO2 production is minimised.
When selecting a Ecomax high efficiency unit the additional costs associated with the additional components required can be recovered in the first few years of operation. A Lennox EcoMax unit has a life expectancy in access of 15 years so after the initial capital difference is recovered in the first few years the continued cost savings can be utilised for other purposes.
The Ecomax high efficiency range uses oversized heat exchanger surfaces in condenser to get the highest efficiencies. The Climatic II controller is supplied with KP02 LED graphic display screen. The unit is fitted with the very latest in Electronic expansion valve technology that is controlled by the Climatic II and uses Lennox unique control algorithms to operate the compressors, condenser fans and expansion valve to provide the best operating efficiency at all operating conditions. The Climatic II controller is looking at 2050 different operating parameters every minute and making adjustments to ensure the efficient and safe operation of the chiller
The Ecomax uses the same range of components as the EcoMax Standard range of chillers and is also fully factory tested to insure trouble free start up.

## High Ambient

The ECOMAX™ high ambient range of chillers is engineered to operate at the high ambient conditions of the Middle East and North Africa. The high ambient units can also be utilized when the application or positioning of the chillers results in the chiller being exposed to high condenser supply air temperatures. The EcoMax high ambient range utilises the same components as the EcoMax standard range. Additional condenser coil surface is used together with 950rpm condenser fans are used to enhance performance for high ambient operation. The use of reciprocating compressors with suction gas cooled motors guarantees long motor life in high ambient conditions. The Climatic II controller is supplied as standard with the KP02 controller. The power and control panel is ventilated via a thermostatically controlled IP55 ventilation fan. This helps prevent electrical components from over heating. The Condenser coil is easily cleanable so that sand and debris can be washed away.
The combination of Climatic II and the Expansion valve technology allows the chillers to start under high ambient conditions and high chilled water temperatures an important feature for high ambient operation. The full range is able to operate at full load conditions with standard chilled water temperatures in ambient as high as 50°C. The high ambient range is subject to the same demanding quality and factory testing requirements as the rest of the EcoMax range.

## ECOMAX™ Standard options details

### *R22*

The units are supplied with HFC407C, as standard the option is to have 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.

### *Blygold Plus on condensers*

This is an anti corrosion 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

### *Blygold Polual on condenser coils*

This anti corrosion coating is suitable for areas of high industrial pollution. This is not suitable for heavy industrial pollution, strong alkalis, oxidizers, wet bromine and chlorine and fluorine in heavy concentrations.

### *Epoxy Coated Condenser fins*

Condenser coils constructed with epoxy coated aluminium condenser fin stock for corrosion protection resistance comparable to Cu/Cu coils in salt laden conditions. The pre coated fins are assembled onto copper tubes with full form collars for enhance heat transfer and reduce corrosion.

### *Cu / Cu Condenser coils*

The condenser is constructed with copper fins and copper tubes for resistance to most industrial and heavy salt laden conditions. This is not advised for use areas exposed to acid rain.

This option adds weight to the unit and care should be taken when selecting the correct unit weights and point loads to insure this is allowed for.

### *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.

### *Refrigerant isolation valves*

The supply and fitting of suction and discharge valves on either side of each compressor to allow service with out removal of the full refrigerant charge. This is recommended if it is proposed that LENNOX carry out the service and maintance work or when working directly with the customer.

### *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 mounted locally at each compressor the gauges are compound gauges that display the saturated refrigerant temperature for various refrigerants Available. Gauges are color coded for easy reference Blue is LP and red is HP. The same information is available on the Climatic II controller. Be careful not to duplicate functions and add unnecessary costs to a unit. If a specification asks for display of High and low pressure then this is available from the Climatic II controller and it is not necessary to add gauges. Competitors will add gauges that are not glycerin filled and these quickly fail due to gas pulsation.

When driving the specification make sure liquid the customer specifies liquid filled gauges.

### *Pressure Relief valves*

Refrigerant pressure relief valves are fitted on both the HP and LP sides 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.

### *Adjustable HP Pressure manual Cut out*

Adjustable HP Pressure manual cut out that is fitted as standard as part of the standard control system this option adds an additional mechanical high pressure switch that has an adjustable operating point.

This option is factory fitting of the mechanical high pressure switch, interconnecting wiring and factory testing of the operation.

The set point will be set above the Electronic cut out point but below the HP pressure relief set point.

Care should be taken if making adjustments in the field that the limits of the unit are not exceeded or that the HP trip point is higher than the relief valve set point.

### *Condenser coil Guards*

Removable polyester coated metal guards that protect the entire condenser coil outer surface from accidental damage. Also prevents to direct access to the unit components the coil guards are removable for service and cleaning.

### *Service Panels to close compressor enclosure*

Galvanized sheet steel panel painted with Epoxy paint RAL9002 are supplied to close off the Compressor enclosure. This presents a clean aspect to the chiller, prevents unauthorized access to the compressors and helps reduce the overall sound level. Panels are designed to be easily removable and are sized to be removed and installed by one person.

### *Anti-intrusion grills*

When a unit is installed in an area that is not secure then it is recommended that anti intrusion grills be fitted. These enclose the lower section of the unit to inhibit access to the components. These are only deterrents and will not provide total security.

### *Mains Transformer*

Avoids the separated power supply 230V/1/50Hz for the compressor crankcase heaters and the option 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.

### *Separate crankcase heater electrical supply*

This option is used if there is the requirement to isolate the main electrical supply. The customer brings a two core supply to the unit that allow the unit to be isolated at the mains while keeping the crankcase heaters energized. This allows the unit to be started as soon as the main power is available.

### *Separate Connection for Trace heating*

This option allows for a customer to make a separate connection in the LENNOX panel for trace heating for chiller. 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.

### *Control panel Anti-condensation heaters*

This option provides for heaters mounted inside the control panel to drive off moisture from condensing on the electrical components inside the panel. The package includes a thermostat to operate the heaters if the ambient falls below the set condition. This option is recommended when low ambient operation is anticipated (Standard on High Ambient).

### *Control panel Ventilation fan*

This option provides for a electric ventilation fan and supply and extract grills to allow positive ventilation with in the power and control cabinet. The fan is controlled via a thermostat. The grills are louvered and fitted with filters to maintain the panel IP rating.

This option is recommended for high ambient applications or where the panel is exposed to direct sunlight.

### *Plexy Glass inside the control panel*

Allows observation of the electrical operation of the controls under live conditions without risk of any accidental contact.

### *Main ON/OFF switch*

It allows the general cut-off and isolation of the main 3 phase power supply, when the machine is running or stopped. If the mains transformer is fitted this switch will also cut power from the control and anti freeze Heaters. CAUTON 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.
The mains switch is supplied with covers on the connections.

The mains switch is used to isolate power from the unit for safe working on the electrical system.

### *Door interlocked Mains switch*

It allows the general cut-off and isolation of the main 3 phase power supply, when the machine is running or stopped. The main switch is interlocked so that the panel can not be opened until the power has been turned off this ensures that the unit cannot be accessed until power has been isolated. If the mains transformer is fitted this switch will also cut power from the control and anti freeze Heaters. CAUTON 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.
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 components.

### *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 case a differential flow switch has been selected, it is necessary to propose the option "antifreeze heater on flow switch" for operating at temperatures lower than 0°C. This switch comes piped and fitted on the evaporator and is tested by the factory.
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.
If a chiller is operated without 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.

### *TUV/VDE*

Units manufacturing according to the TÜV/VDE norm (electrical components, pressure devices, safety valves...).

### *STEK*

Units delivered to meet the requirements of STEK regulations. This includes documentation and certification in addition to the mechanical and testing modifications required.

### *All seasons operating (-20°C) (Low Ambient)*

Allows start-up and operating of the unit up to outside temperature down to -20°C (recommended for outside temperatures below +6°C). The unit is generally equipped with a low pressure switch and an antifreeze thermostat. The first fan is fitted with fan speed control. For units equipped with electronic expansion valves and CLIMATIC, the standard program enables the control of the start-up down to -20°C.

### *Reinforced evaporator insulation*

Oversized thermal insulation of the evaporator increases the insulation from12.7mm to 26mm closed cell foam that is resistant to water. Classification for fire : M1.

### *Inlet/outlet alcohol thermometers*

Measures the water inlet and outlet temperature (supplied loose for fitting by others)

### *Simple water gauge*

Water gauge, which measures the pressure on the inlet and outlet of the water circuits.

### *Alarm signaling relay*

Dry contact relay allowing the remote alarm of compressor or circuit default (on units equipped with 2 compressors: one remote alarm per compressor, on units equipped with 4 compressors: one remote alarm per circuit). CLIMATIC standard : general default.

### *Antifreeze protection for the evaporator*

Resistance heating tape is wrapped around the evaporator

barrel to help protect the evaporator from freezing down to -20°C. Controlled by a thermostat mounted in the main panel.

Note this requires an electrical supply during winter operation. If mains switch is off then there is no supply to the anti freeze heater. A separate supply is recommended under these circumstances. This device will not protect external water pipework connected to the unit and additional frost protection measures are required.

### *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).

### *Compressor Suction Valve*

Refrigerant isolation / stop valve. Fitted on each refrigerant circuit. This will allow the compressor to pump down the refrigerant charge into the condenser and if the compressor is fitted with a discharge check valve allow the compressor to be isolated from the system for maintenance work.

### *Embellished posts*

This is a kit that greatly improves the appearance of the chiller. It consists of sheet metal fill and corner pieces so that the chiller has a smooth appearance with rounded corners. The chiller appearance is with more painted sections and looks very well finished.

### *Water Strainer filter*

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.

### *Anti-vibration mounts*

Elastic supports 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 not fitted. This type of mounts is not adapted to concrete slabs.

### *Spring Anti-vibration mountings*

Spring and cage type isolators with a 30mm deflection for mounting under the unit. Recommended for rooftop installations and any vibration sensitive applications. Deflection and level is site adjustable and deflection may vary according to unit size. AVMs are coded and the correct AVM should be positioned in accordance with the IOM data.

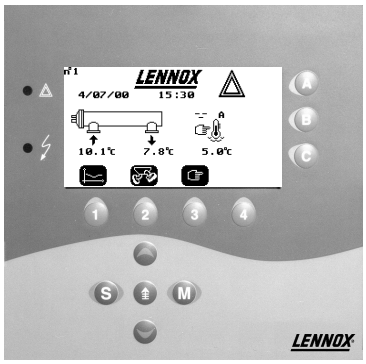
### *Power Factor Correction*

Power factor correction is available to 0.95 contact customer service for details.

### *Two Speed Condenser fans*

This option allow to have a lower fan speed for night operation, not available on Low Noise units.

***For additional none standard options contact the customer service team.***




***KP07 Visual Display Unit***

Use of these guidelines will insure that Lennox products are given the opportunity to operate for their intended purpose and within their design operating envelope. Installing and operating the equipment differently than described herein may affect the warranty as administered by Lennox or their approved agents.

It is naturally expected that good engineering practice will prevail on any project. The failure to address any particular aspect of system design in this manual does not imply that the subject is not important.

### *Chilled Water Systems*

*LENNOX* recommends that chilled water piping for its chillers be designed and installed in conformance to the system recommendations described in (American Society of Heating Refrigeration and Air-Conditioning Engineers, mc.) ASHRAE Handbooks. Specifically the 1996 Edition, HVAC Systems & Equipment, Chapter 12.

### *Multiple Units*

Chillers are frequently installed in multiple. Doing so provides standby reliability and improved performance, and is recommended. Multiplicity of machines however can result in unexpected problems where chiller controls or capacity reduction are overlooked in the design. Single chiller installations are equally susceptible to application oversight. The following offers supplemental information to that discussed in ASHRAE for the purpose of minimizing installation problems.

#### *Water Flow*

Chilled water systems are normally designed with leaving chilled water temperatures of 5.5°C to 8°C (42°F to 46°F),a 5°C (10 degree F) water temperature difference and 0.044m2K/kW fouling factor. Catalog performance tables display data for the chillers at these conditions. Actual design may be different, and Product Manuals include adjustment factors or special rating tables to account for other conditions.

**1**.Addition of secondary coolants such as ethylene glycol.

**2**.Variances from 6°C (10°F) water temperature differences.

**3**.More than standard water fouling.

**4**.Elevation and ambient air temperatures (on Air Cooled Condenser Units).

Specifications and start-up procedures should:

**1**.Confirm that the chilled water piping system had been properly flushed out before being connected to the chiller vessel.

**2**.Confirm that the piping contains.

**a**) A cleanable strainer to remove impurities before they reach the chiller vessel.

**b**) An expansion tank in the piping.

**c**) An air vent located at the system high point to purge trapped air in the piping system. An air vent is also located at the top of the direct expansion chiller vessel and in the waterhead of a flooded vessel evaporator or condenser.

Note: The evaporator may not be the high point in the system as far as venting is concerned.

All water systems include air in solution with the water. The percentage of air that can be retained in solution is a function of the water temperature and water pressure. Since these two values change in both chilled and hot water systems, the presence of both b and c components listed above are vital to the successful operation of the system.

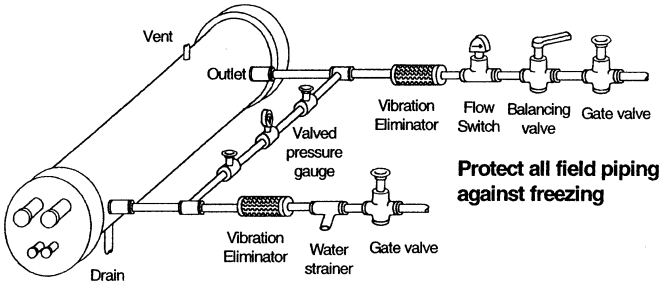
The presence of a cleanable filter or strainer (2a above) in a chilled water piping system is frequently taken for granted. The fact is that the filter or strainer may be inadequate for the installation or may be installed in the wrong location. DX evaporators where the water passes through the shell over the refrigerant tubes act a filter and will retain debris and dirt causing severe reduction in chiller performance or damage to the evaporator tubes.

**1**.If the chilled water pump is located in the chilled water piping exiting the chiller vessel (down stream of the chiller), and the strainer is in its normal position ahead of the chilled water pump, then system impurities will be drawn, unfiltered through the chiller vessel. Severe reduction in chiller performance or damage to the evaporator tubes is the probable result.

**2**. Many chiller installations today are replacements for older less efficient machines or chillers with CFC refrigerants. Existing piping is drained down, opened to atmosphere, and reconnected to the new chiller vessel. Rust formed over the years and during the replacement process can break loose, pass through a conventional strainer, and settle in the chiller vessel that is frequently the lowest point in the piping system. Not only is a higher capacity filter required for these installations, but also chemical treatment of the water is recommended immediately and should be maintained throughout the equipment life.

**3**.Chilled water flow may vary through the evaporator providing the rate of change does not exceed one percent per minute and is not reduced below 40 percent of design. Consult the factory for absolute minimums. Chilled water temperature rate of change should be limited to maintain load and discharge pressure control.

***Figure 1, Typical Chilled Water Piping***




***Inlet***. Vent outlet valved, pressure gauge, Water strainer, Vibration Eliminator, Flow Switch, Balancing valve, Gate valve

***Outlet***. Drain, Vibration Eliminator, pressure gauge, and Gate valve

Protect all field piping against freezing

***Note***: The cross piping for the pressure gauge can be as small as 1/4 inch. The purpose of this arrangement is to provide an easy method to use one gauge to accurately measure both pressures.

### *Freeze Protection*

Lennox air-cooled chillers can be equipped with (optional) thermostatically controlled heat tape under the insulation of the evaporator barrels. The heater comes from the factory connected to the control power circuit but can be rewired (option) to a separate 230V/1/50 Hz supply. If this is done, the disconnect switch should be clearly marked to avoid accidental deactivation of the heater during freezing temperatures. The heater will provide freeze protection to -29°C (-20°F). However, this does not provide protection to the exposed chilled water piping. Unless the evaporator is flushed and drained, two or more of the following recommendations should be part of the system design and be implemented.

**1**.Continuous circulation of water through the piping and heat exchanger.

**2**.Addition of the required concentration of a glycol anti-freeze to the circuit. This will result in decreased capacity and increased pressure drop. Note: do not use automotive grade antifreezes that contain inhibitors harmful to chilled water systems. Only use glycols specifically designated for use in building cooling systems.

**3**.Addition of insulation and heat to any exposed piping and equipment.

**4**.Draining and flushing the chiller with glycol.

### *Variable Speed Pumping*

LENNOX believes that the correct application of a Variable Frequency Drive (VFD) pumping system should be carefully evaluated. It is important that VFD operation be harmonized with the operation of the other components that make up an HVAC system.

The proper operation of a VFD chilled water pump requires that the pump upper and lower flow rate limits match the maximum and minimum flow rate permissible for the evaporator. A flow rate above the maximum permissible level can result in erosion of the tube plate or oscillation of the tube bundle, both resulting in failure of the evaporator. Higher than permissible flow cause noise and a high water pressure drop across the evaporator.

A flow rate below the minimum permissible level results in poor heat exchanger performance due to laminar flow in the evaporator waterside. Turbulent flow is needed for good heat exchanger performance in modern evaporators. Flow rates below the minimum level also result in poor chilled water control, hunting of the thermal expansion valve and liquid refrigerant being carried back to the compressor, causing failure. Low flow rates also lead to accelerate tube fouling as sediment in suspension in the water falls out.

### *Chilled Water Systems*

The refrigeration system is an independent thermodynamic cycle that is primarily controlled by the volume of refrigerant being pumped by the compressor, which in turn is a function of the rate of heat exchange in the evaporator. The leaving chilled water temperature controls the amount of refrigerant pumped by the compressor.

The difference between chilled water entering and leaving is a function of the flow rate of water and the chiller capacity. The use of Variable Frequency Drive (VFD) pumps to vary the chilled water flow rate has a significant impact on both the chiller control system and the thermodynamic performance of the chiller. A chiller is selected to provide a specified capacity with a given set of conditions including flow rate. The chiller is factory tested and started in the field with those design criteria.

The refrigeration system will have been set; refrigerant charge, expansion valve, and control algorithms, all based on a fixed water flow rate. Varying this flow rate with a VFD pump can have disastrous effects if the system is not set up correctly.

The VFD pump should be set to operate between the maximum and minimum flow rates required by the system and these should be within the maximum and minimum vessel design limits established by Lennox. The flow rate change determined by the VFD must allow the control and refrigeration systems on the chiller to adjust. This mandates a slow change-as a guide-no more than 10 percent change in flow every 5 minutes. Since most chilled water systems will have a minimum flow of about 40 percent of design flow, minimum to maximum change will take at least 30 minutes. This will allow the chilled water temperature to balance out as the water volume changes. The change can then be sensed by the chiller controller, which will cause the compressor to increase or decrease capacity. The expansion valve then has time to adjust to accommodate the change in refrigerant demand measured by suction gas superheat. Large change steps in VFD systems do not allow adequate time for these changes to take place. This results in nuisance trips, inefficient operation and premature compressor failure.

The expansion valve should be tested at the minimum flow condition to insure that the correct suction superheat can be maintained. This will require additional set up time for start up which will need to be included in the project costing. Under the low load, low water flow rate there is a high probability of slugging liquid refrigerant back to the compressor, which in extreme cases can result in compressor failure.

### *Multiple Chillers*

A potential problem to be avoided is bypassing chilled water when chillers are connected in parallel. If a single VFD chilled water pump is being used, when one chiller is off the chilled water will still pass through both chillers resulting in a mixed condition of the supply chilled water. This means the chilled water going to the process or HVAC load is not at design set point.

Another consideration on chilled water VFD systems with a primary/ secondary system and bypass is not sizing the bypass large enough to allow sufficient water volume to prevent the chiller from cycling on and off rapidly. This will lead to premature compressor failure. It is important that the primary loop and the by-pass are correctly sized to accommodate the minimum water volume required to avoid frequent compressor cycling.

Lennox does not recommend the use of variable water flow systems on chillers that are controlled by entering water temperature. This is due to the instability of the chilled water outlet temperature and the risk of freezing in the evaporator.

### *Roof top Installations*

Units should be installed on a steel channel or I-beam support above the roof. Accessibility and serviceability of equipment should be a major consideration. Typically, level should be within 1,5 mm per 30 cm along the unit length and width. Spring anti-vibration mountings are recommended with a minimum of 25mm deflection when loaded.

### *Ground Level Installations*

It is recommended that units be installed on a one piece concrete slab with footings extending below the frost line. Level to the same recommended specifications as roof top mounting. Lennox recommend that the chiller be mounted on spring or rubber ant vibration mountings and not be directly rested on the concrete slab.

### *Prevailing Winds*

Prevailing winds should be considered if the unit will be operating in lower than 5°C (42°F) ambient air temperatures. Options to consider where winds are of concern are head pressure controls, wind deflectors, and hail guards. A rule of thumb guide is that whenever the wind can blow directly against vertical coils without deflection, preventive action is required. When possible, position the unit so prevailing winds blow against the ends of the unit. Units having vertical coil surfaces are affected to a greater degree by winds than horizontal coils.

Cold air temperatures below 15°C together with steady or gusting winds in excess of 8 Km/h will result in low refrigerant condensing temperatures. This further results in low refrigerant suction temperatures and pressures and nuisance tripping on unit protective controls. Low ambient all seasons option should be included in the chiller specification. Wind baffles or deflectors such as walls or screens should be considered in the design of the chiller enclosure.

### *Snow Considerations*

Air-cooled units should be elevated to assure unrestricted airflow to condenser coils following severe snowfall conditions. If the chiller units are elevated to provide this clearance, a steel or otherwise reinforced grate must be provided to permit complete component maintenance and service. This should include guardrails and adequate lighting to permit safe access.

### *Low Ambient Operation*

The standard Climatic controller will cycle condenser fans to maintain adequate discharge pressure down to 5°C (42°F). Ambient operating conditions less than 5°C (42°F) will require specifying the optional Low ambient head pressure control. All seasons option will modulate fan speed and control discharge pressure down to -20°C (0°F) with no direct wind on the coils.

### *Clearances*

Air-cooled units require free airflow to and from the condenser coils. Units should be installed per the listed installation clearances. There should be **no obstructions above the fan discharge** that may cause air recirculation. Air restriction and recirculation may cause high pressure trips and will reduce capacity, efficiency, and compressor life. Do not install ductwork on condenser fans. Structures, other equipment, fencing, plants, and trees must be considered for airflow interference. Ventilators, and any sources of contaminated or heated discharges, gases and air will affect system
performance. Pit type installation should meet Lennox requirements. Minimum individual chiller clearances are detailed on the unit dimensional drawings. However multiple chillers, chiller enclosures, walls and pits all can impact on the overall performance of the chiller and need careful consideration.

### *Service Access*

Each end of the unit must be accessible after installation for periodic service work. Compressors, filter-driers, and manual liquid line shutoff valves must be accessible on each side of the unit adjacent to the control box. High pressure and low pressure transducers are mounted close to the compressor. Compressor power connections, overloads, Climatic microprocessor control, and most other operational, safety and starting controls are located in power and control panel mounted at one end of the unit. There should be a minimum of 600mm between the control panel doors in the fully open position and any obstruction.

The electric disconnect switch should be mounted adjacent to the unit but not directly on unit sheet metal components. For most EEC countries a door interlocked mains isolator is required and is a standard Lennox option.

The EcoMax range of chillers allows for mains cable connection via a gland plate mounted at the base of the control panel.

On all Lennox air cooled chillers the condenser fans and motors can be removed from the top of the unit. The complete fan/motor assembly can be removed for service. The fan blade and fan motor rain shield must be removed for access to wiring terminals at the top of the motor.

Minimum clearance requirement drawings on the following pages should be consulted for equipment space layout.

## FOUNDATION

The unit must be set on a flat and level foundation. On ground level installations, the unit should be mounted on a single piece concrete slab and not tied to the building structure. Footings should extend below the frost line.

Rooftop installations require adequate structural beams to support the weight of the unit and service personnel. The design of the beams/supports must minimize deflection and attendant vibration transmission. Also, for sound sensitive applications, unit vibration isolators should be used.

## SPACE AND LOCATION REQUIREMENTS

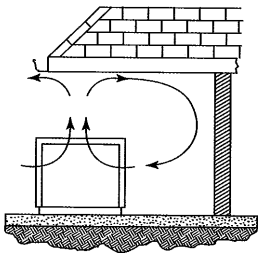
The location of the air cooled chiller must provide for a sufficient supply of ambient air to the condenser and adequate removal of heated air from the condensing unit or remote condenser area. Inadequate air circulation will result in higher head pressures which will cause poor operation and potential failure of equipment. Units must not be located in the vicinity of steam, hot air or fume exhausts. Corrosive atmospheres require custom designed condensers.

Units should be mounted away from noise sensitive spaces whenever possible and must have adequate support to avoid vibration and noise transmission into the building. Units should be mounted over corridors, utility areas, restrooms and other auxiliary areas where elevated levels of sound are not an important factor. Sound and structural consultants should be retained for recommendations.

## CLEARANCE

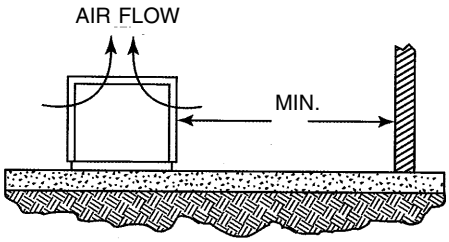
Always provide sufficient clearance room for unit maintenance and service. Minimum clearances are listed in the dimensional data section.
Additional clearance considerations are detailed below :

**Vertical Clearance :**



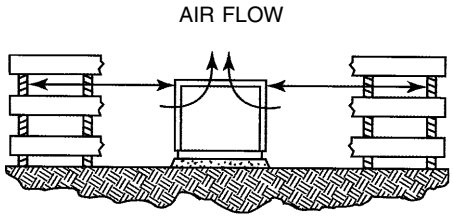
Overhead obstructions are not permitted. Vertical air discharge from the condenser must have no obstructions which can cause the discharge air to be recirculated back to the inlet side of the unit. Recirculation will adversely affect the performance of the unit.

**Lateral Clearance (Walls or Obstructions) :**



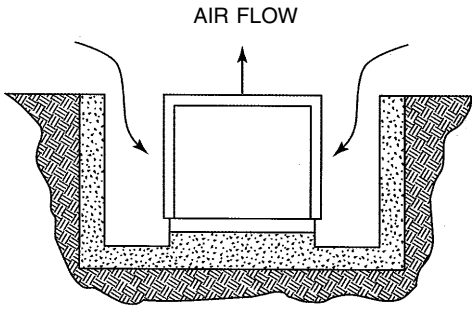

The unit should be located so that air may circulate freely and not be recirculated. For proper air flow and access all sides of the unit should be a minimum of 1.5 meters away from any wall or obstruction. It is preferred that this distance be increased whenever possible. Care should be taken to see that ample room is left for maintenance work through access doors and panels. When the unit is in an area where it is enclosed by three walls the unit must be installed under the guidelines for unit installation in pits.

**Decorative Fences :**



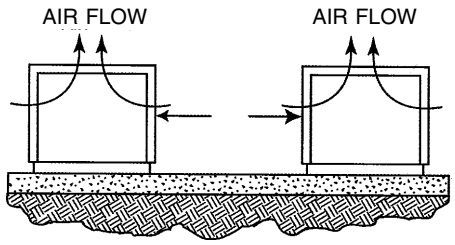

Fences may be installed closer than the 1.5 meter lateral minimum requirement whenever fences permit sufficient free area to allow adequate air flow to the unit. Once again, care should be taken to leave ample room for unit service. Recommended service clearances are listed in the dimensional data section of this Application Guide.

**Units in Pits :**




The top of the unit should be level with the top of the pit. If the top of the unit is not level wiht the top of the pit, a wider pit or discharge stacks must be used to raise discharge air to the top of the pit. This is a miniumum requirement. These applicaitons should be reviews by and Application engineer.For proper air flow and access all sides of the unit should be a minimum of 1.5 meters away from any wall or obstruction.

**Multiple Units (Unit-to-Unit Clearance) :**




For units placed side by side, the minimum distance between units is 3 meters to prevent air recirculation.

## ALTITUDE CORRECTION FACTORS

All Lennox Ecologic™ Chiller performance data is calculated at sea level. Higher altitudes result in decreased air density. This will have a negative effect on the heat transfer capabilities of the condenser which will reduce the overall system performance. Performance correction factors are found on Page 20 with the Unit Selection Procedure. These factors can be applied to the rated performance to determine system capacity.

## AMBIENT RESTRICTIONS

Lennox Ecologic™ Chillers offer year-round operations under a wide variety of ambient conditions. Standard equipment allows for operation in an ambient range from 0 °C through 43 °C. Optional low ambient controls allow for operation down to -29 °C. Low temperature application performance can be determined by referring to Page 20 (Glycol Applications). Options for operation at high ambient temperatures are also available. Consult an Application Engineer for higher or lower ambient conditions.

## COOLER FREEZE PROTECTION

The cooler heater cable is designed to protect the cooler to -29°C ambient. However, there is no freeze protection in the event of a power failure or a heater cable failure. Therefore, one of the following additional measures will provide added protection : add the appropriate percentage of ethylene glycol and/or drain the cooler and piping if the chiller is not operated during the winter months.

### *CLIMATIC Controls*

All the ECOMAX™ range of air cooled reciprocating chillers are fitted with the Lennox Climatic II microprocessor control system. This is supplied LCD customer interface. KP07 LCD graphic display customer interface is an option on the units fitted with the KP02 customer interface.

There is no difference in the capability and control functions between the Climatic fitted with the KP02 or KP07 customer interface the difference is in the way information is displayed.

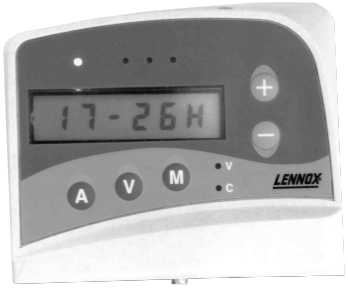
The Climatic control system has many unique and useful features.

The chilled water control The Climatic turns the compressors On and Off based on return water temperature but it controls the loading capacity of the compressors that have been turned on based on outlet chilled water condition. This insures that enough compressors are activated to handle the cooling load and that the leaving chilled water temperature is maintained at its design set point. Additional features allow programming of different values for loading and unloading points and predictive analysis to avoid overshooting of the chilled water set point.

### *Climatic II +KP02 Digital display*

When bidding in the competitive contractor market the option of the KP02 digital console offers a cost reduction but still retains most of the Climatic control features. The KP02 has the unique advantage that it can be disconnected from the controller. This offers the user an interference free unit as authorized users can retain the controller. The standard is for the KP02 to be fitted loose inside the control panel.

The KP02 console unit is used to read or modify values or instructions. It is a digital 6 digit display with 6 indicator lights and 5 operating keys. Data transmission is at 1200 baud rate.
The unit is self diagnostic for communication and sensors.
The unit normally displays the Time.
Access to operating pressures, temperatures and faults is via input of an address against the menu.
The controller is password protected for access into the set point changes.



**KP02 DISPLAY**
**ACCESSIBLE SETTING POINTS AND VARIABLES ON AN AIR-COOLED CHILLER**

### *SETTING POINTS*

All the following parameters can be read on the KP02 in the "setting points mode".

| *Address* | *Designation* |
|---|---|
| 0 | Password |
| 1 | Faults reset |
| 2 | 1st cooled water set-point |
| 3 | 2nd cooled water set-point |
| 4 | Temperature deviation set-point between water inlet and outlet |
| * | Start / stop circuit n |
| * | Minimum cooled water inlet temperature |
| * | Minimum evaporating temperature |
| * | Hour of unoccupied period start |
| * | Hour of unoccupied period end |
| * | Day of unoccupied period start |
| * | Day of unoccupied period end |
| * | High limit pressure for fans regulation |
| * | Low limit pressure for fans regulation |
| * | Time delay for the increase or decrease of one ventilation stage |

### *KP02 II. VARIABLES*

All the following parameters can be read on the KP02 in the "variables mode".

| *Address* | *Designation* |
|---|---|
| 1 | Cooled water inlet temperature |
| 2 | Cooled water outlet temperature |
| 3 | Ambient air temperature |
| * | Low pressure circuit n |
| * | High pressure on circuit n |
| * | Suction temperature on circuit n |
| * | Discharge temperature on compressor m circuit n |
| * | Expansion valve opening on circuit n |

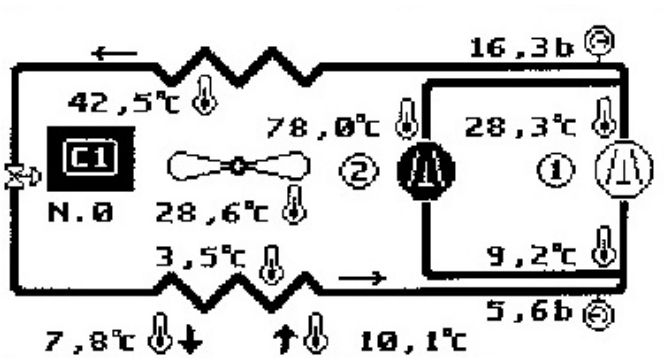
*** Consult the variables list of the considered chiller.**

| *Address* | *Designation* |
|---|---|
| 4 | Number of stages requested by the compressors regulation |
| * | Regulation order for compressor m circuit n |
| * | Number of stages requested by the fans regulation on circuit n |
| * | Evaporating temperature on circuit n |
| * | Condensing temperature on circuit n |

| *Address* | *Designation* |
|---|---|
| 0 | Last fault code memory |
| 5 | Unit availability |
| * | Circuit N°* availability |
| * | Compressor N°* circuit availability |
| 6 | Evaporator inlet or outlet water sensor fault |
| 7 | Cooled water flow fault |
| 8 | Phase rotation control fault |
| 9 | Supply power fault on 230 V backed-up supply |
| 10 | Fans circuit-breaker fault |
| 11/12 | Pump circuit-breaker fault |
| 13/14 | Flow fault on pump & evaporator |
| * | Low pressure fault on circuit N°* |
| * | Probe or sensor fault on circuit N°* |
| * | Frost fault on circuit N°* |
| * | Insufficient superheat fault on circuit N°* |
| * | Expansion valve opening fault on circuit N°* |
| * | Circuit-breaker fault on compressor N°* circuit N°* |
| * | Oil pressure fault on compressor N°* on circuit N°* |
| * | High pressure fault on compressor N°* circuit N°* |
| * | Discharge temperature too high on compressor N°* circuit N°* |
| * | Internal protection fault on compressor N°* circuit N°* |

The Climatic II controller with the KP07 LCD Graphic display customer interface offers a superior level of information display to users and operators. The Graphic display screen shows all the operating conditions of the machine at a glance, this allows quick analysis of the system. This can be compared to other types of control interface where it is necessary to scroll through a number of individual points to establish the system operation. The LENNOX Climatic LCD display allows at a glance complete information for analysis, which can take place either locally at the chiller or remotely using various communication options available.

The Lennox Climatic II graphic display unit uses simple icons to

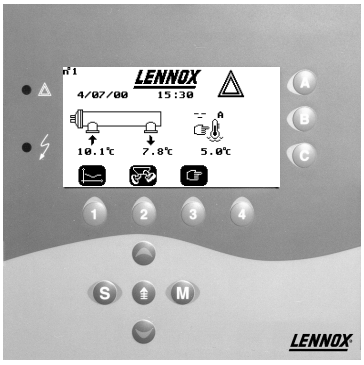



KP07 display

show system operation, warnings and faults these need no translation and are universally understood this ensures that the Climatic controller is simple to use where ever its installed.

### *KP07 Visual Display Unit*

Black and white LCD crystal display backlit with 240x128 Pixels.




Functions

1. Status of each refrigerant circuit with circuit graphic displayed
2. Status of Pumps graphic display (chilled water, conden ser water and secondary system)
3. Fault history for each refrigeration circuit (last 24 occur rences) plus rest of the unit
4. Fault history for pumps
5. Hours run
6. Automatic balance of compressor run hours
7. Time clock, day, date
8. Chilled water set point
9. Programmable auto reset of chilled water set point based on ambient temperature
10. Programmable condenser fan staging
11. Start and stop of pumps (run and standby)
12. Auto switching if lead pump fails
13. Display of timer status (Start and anti recycle)
14. Display of chilled water temperature curve over 24Hrs
15. General machine faults
16. Refrigeration circuit faults
17. Compressor faults
18. Capacity staging
19. Common alarm
20. Fan circuit breaker trip
21. Pump circuit breaker trip
22. Water pressure low
23. Programmable temperature difference set point between flow and return water
24. Freeze protection
25. Programmable Minimum and maximum water set point
26. Self diagnostic on sensors and communications
27. Self diagnostic on electronic expansion valves
28. Phase protection
29. Password protection

The KP07, unit uses JBUS communication protocol at 4800 baud

## FAULT DISPLAY

### *General machine faults*

Chilled water temperature outside authorized range.
Hot water temperature outside authorized range.
Chilled water flow insufficient.
Absence of power on 230 V electrical supply to the machine.
Incorrect connection of 3 phases of general electrical supply to the machine.
Pump in operation.
Pump stopped.
Dialogue interrupted between 2 CPU cards on network.
Insufficient water flow although operational command has been issued to pump.
Tripping of thermo magnetic circuit breaker for at least one fan.
Tripping of thermo magnetic circuit breaker for pump.
Water tank level or pressure insufficient.
Bad reception of 4/20 mA signal transmitted remotely for water instruction.
Chilled water temperature at the input of free cooling outside authorized range.
Dialogue interrupted between KP07 console and a CPU card on the network.
Temperature sensors or pressure detectors faulty.

### *Faults on each refrigeration circuit*

Low pressure
Excess high pressure
Evaporator freezing.
Superheat insufficient.
Vacuum draught on circuit not achieved.
Compressor stopped by refrigeration circuit on/off.
Compressor stopped by remote on / off command to machine.
Incorrect opening of the expansion valve.

***Compressor faults***

Tripping of thermo magnetic circuit breaker for compressor.

Insufficient oil pressure.

Discharge temperature too high.

Tripping of internal protection for compressor.

***Climatic Options***

The Climatic II controller can be interfaced with a number of options to expand the functionality of the system.

***KP07 Remote***

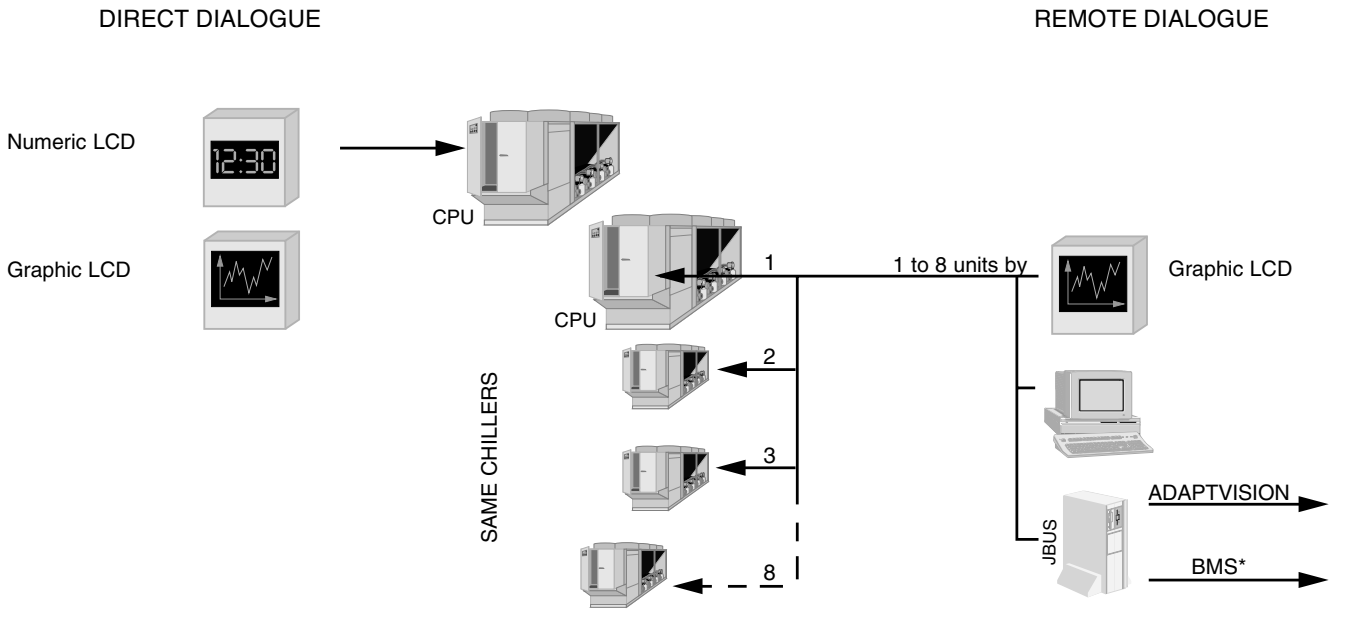
This provides a KP07 display linked to the chiller but remote mounted up to 1km of cable away from the chiller installation.

***Multiple Chiller control***

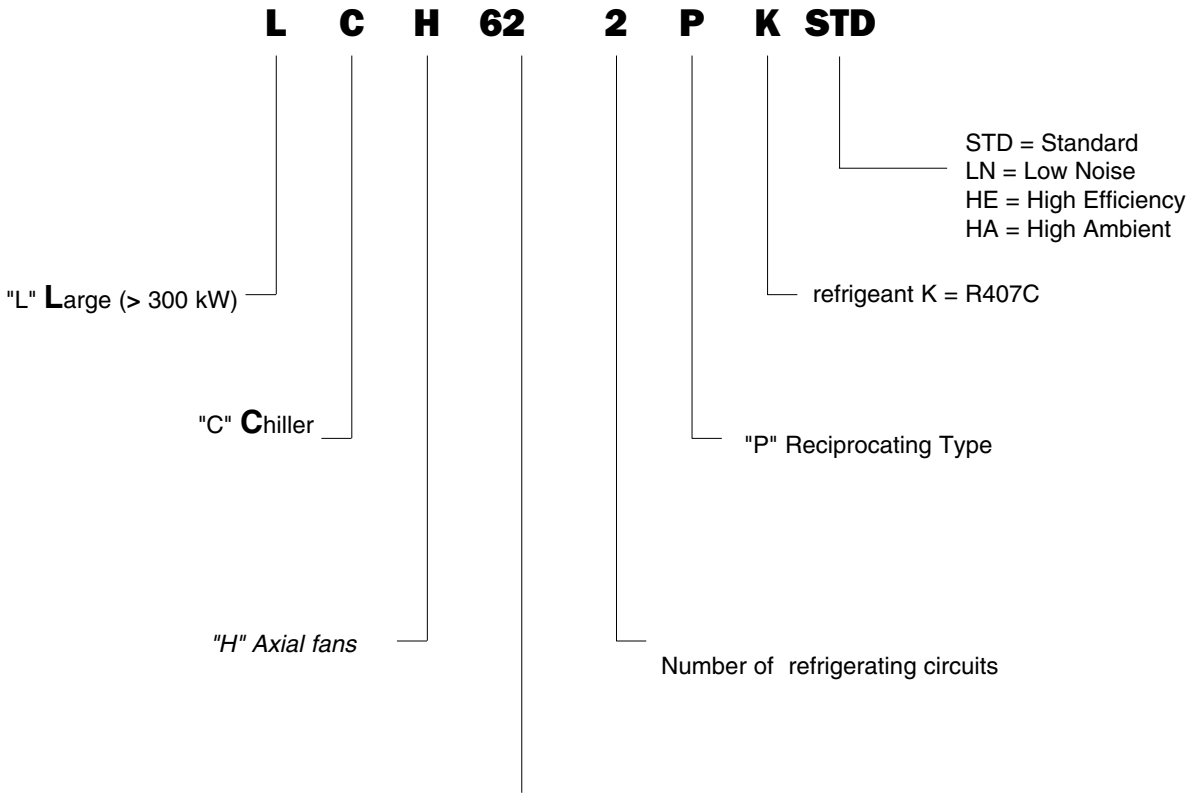
A remote mounted Climatic controller that can control and sequence upto eight identical chillers containing Climatic II controllers. This controller can also control the chillers to maintain a common chilled water set point in a primary chilled water supply.

***JBUS Communication Interface***

This is an additional microprocessor card that is able to provide information in the JBUS protocol to allow information to be exchanged between the Climatic control system and an external BMS system. Lennox have existing protocols in place with most BMS companies but this option can require additional support above the basic costs of the interface module.




* BMS = Business Management Service


L C H 62 2 P K STD
STD = Standard
LN = Low Noise
HE = High Efficiency
HA = High Ambient
"L" Large (> 300 kW)
refrigeant K = R407C
"C" Chiller
"P" Reciprocating Type
"H" Axial fans
Number of refrigerating circuits
Nominal capacity expressed in tens of kW

## ALTITUTE CORRECTION FACTOR

| ELEVATION -M. | Qo CORRECTION |
|---|---|
| Sea Level | 1.000 |
| 305 | 0.996 |
| 610 | 0.992 |
| 915 | 0.988 |
| 1220 | 0.984 |
| 1525 | 0.980 |

## FOULING FACTORS ($M^2$-°C/W)

| FOULING | Qo CORRECTION |
|---|---|
| 0.000044 | 1.00 |
| 0.0000132 | 0.98 |

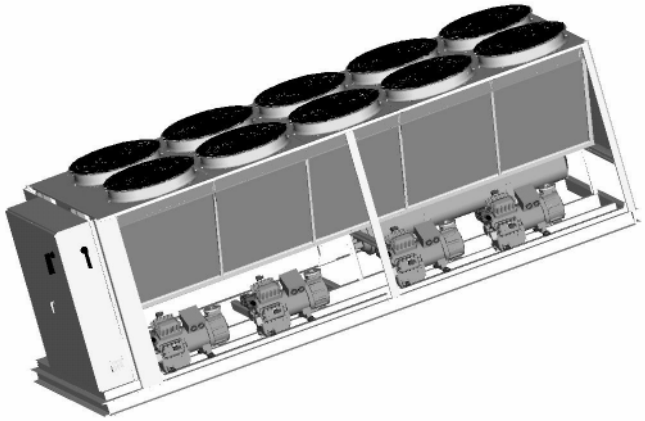
## GLYCOL CORRECTION FACTOR

| % BY WEIGHT | FREEZE POINT °C | PRESSURE DROP MULTIPLIER | CAPACITY FACTOR | FLOW CORRECTION FACTOR |
|---|---|---|---|---|
| 10 | -4 | 1.06 | 1.01 | 1.01 |
| 20 | -10 | 1.13 | 1.018 | 1.05 |
| 30 | -18 | 1.19 | 1.025 | 1.08 |
| 40 | -27 | 1.28 | 1.033 | 1.15 |
| 50 | -38 | 1.37 | 1.04 | 1.20 |

# CONTENTS

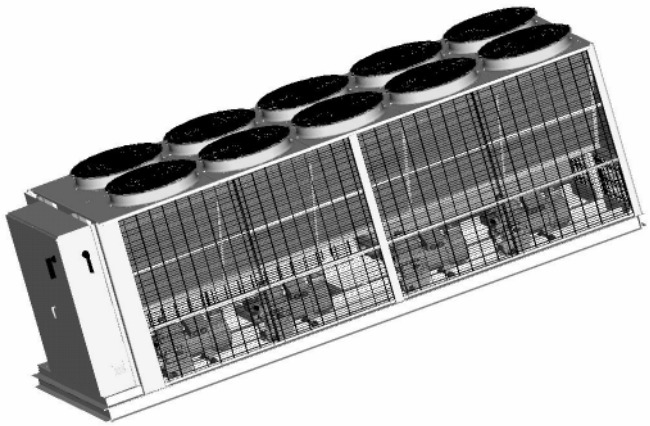


***EcoMax Standard***



**ECOMAX STD unit**

The ECOMAX™ Standard range of Air cooled helical rotary screw chillers from LENNOX bring a to specifiers, owners and operators performance and reliability in a compact package.
The standard range is fitted with 2,3 or 4 high performance robust Copeland reciprocating compressors in dual refrigeration circuits. Each refrigerant circuit has a dedicated condenser section and fans. The Lennox "Hushtone" fan is fitted as the standard and operates at 700rpm. Each refrigerant circuit contains an oversized filter drier, a mechanical liquid line stop valve with a charging port, Electronic expansion valve, liquid sight glass and mechanical discharge isolation valve. The single DX evaporator has 2 refrigerant circuits and is fully insulated 13mm with close cell foam insulation sealed to form a vapour tight seal on the evaporator shell. The evaporator is fitted with vent and drain points and is supplied with flanged water connections, the flow and return water sensor pockets are mounted in the pipe stub sections. These units meet the new European pressure equipment directive PED97/23/EC.
The control and power sections are mounted in a single wardrobe weatherproof panel, all the compressor and condenser fan power supplies are individually fitted with thermal overloads. The three phase power and earth connections is via a low level gland plate and connects to a fused thermal overload ensuring complete discrimination. Separate electrical control and antifreeze heater single phase power supplies complete the hook up. The advanced Climatic II microprocessor controller fitted with the KP02 digital display customer interface is supplied as standard on these units. The KP02 customer interface is removable so that access to the control system can be totally controlled allowing only authorised access to the system configuration.
All the chiller components are mounted to a UPM welded steel channel base frame that has been hot dipped galvanized for corrosion protection. The base has the lifting lugs and mounting points for anti vibration fittings all pre installed. The EcoMax range is built in accordance with current EEC norms and legislative requirements.
The EcoMax standard range has a large number of customer configurable options to meet the local legislative requirements and specific customer needs.



**ECOMAX STD with anti intrusion grill**

## PERFORMANCE TABLES

| ECOMAX STD | Water outlet temp. °C | Air inlet temperature | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 28 °C | | 32 °C | | 35 °C | | 39°C | | 43 °C | | 47 °C | |
| | | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa |
| 322PK | 5 | 329 | 110 | 313 | 115 | 300 | 118 | 284 | 123 | 267 | 126 | ***200*** | ***103*** |
| | 7 | 351 | 113 | 334 | 119 | 322 | 122 | 304 | 127 | 286 | 131 | ***216*** | ***107*** |
| | 9 | 375 | 117 | 357 | 122 | 344 | 126 | 325 | 131 | ***247*** | ***107*** | ***232*** | ***110*** |
| | 11 | 399 | 120 | 381 | 126 | 366 | 130 | 347 | 136 | ***265*** | ***110*** | - | - |
| 412PK | 5 | 392 | 139 | 373 | 144 | 359 | 148 | 340 | 153 | ***210*** | ***95.2*** | - | - |
| | 7 | 420 | 144 | 399 | 149 | 384 | 154 | 365 | 159 | ***227*** | ***98.2*** | - | - |
| | 9 | 448 | 149 | 427 | 155 | 411 | 159 | ***390*** | ***165*** | ***244*** | ***101*** | - | - |
| | 11 | 477 | 154 | 454 | 160 | 438 | 164 | ***277*** | ***100*** | ***262*** | ***104*** | - | - |
| 462PK | 5 | 456 | 152 | 433 | 159 | 416 | 165 | 394 | 171 | 373 | 178 | ***201*** | ***96.0*** |
| | 7 | 488 | 157 | 464 | 165 | 447 | 170 | 423 | 177 | ***231*** | ***95*** | ***217*** | ***98.5*** |
| | 9 | 521 | 162 | 496 | 170 | 478 | 176 | 454 | 183 | ***249*** | ***97*** | ***234*** | ***101*** |
| | 11 | 556 | 167 | 530 | 175 | 510 | 181 | 485 | 188 | ***267*** | ***99*** | ***252*** | ***103*** |
| 532PK | 5 | 516 | 184 | 491 | 191 | 473 | 196 | 449 | 203 | ***249*** | ***108*** | ***234*** | ***112*** |
| | 7 | 551 | 190 | 526 | 198 | 506 | 204 | 481 | 211 | ***268*** | ***111*** | ***252*** | ***115*** |
| | 9 | 588 | 197 | 561 | 205 | 541 | 211 | 515 | 218 | ***288*** | ***114*** | ***272*** | ***119*** |
| | 11 | 626 | 204 | 598 | 212 | 577 | 218 | ***328*** | ***113*** | ***310*** | ***118*** | ***292*** | ***122*** |
| 622PK | 5 | 629 | 221 | 598 | 230 | 574 | 236 | 542 | 244 | ***297*** | ***131*** | ***278*** | ***135*** |
| | 7 | 672 | 229 | 639 | 238 | 614 | 245 | 580 | 253 | ***320*** | ***135*** | ***300*** | ***139*** |
| | 9 | 715 | 236 | 681 | 247 | 655 | 254 | 620 | 263 | ***344*** | ***139*** | ***323*** | ***144*** |
| | 11 | 761 | 244 | 725 | 255 | 698 | 263 | 661 | 272 | ***369*** | ***142*** | ***346*** | ***148*** |

XXX *Water T = 5°C*

***XXX*** *High pressure offloading operating*

**Qo :** *Cooling capacity in kW*

**P :** *Total power*

***Fouling factor*** **:** 0,044 m²C/kW

## COMPRESSORS AND REFRIGERANT CIRCUITS

| *TYPE* ECOMAX STD | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Compressor type* | | Semi-hermetic reciprocating | | | | |
| *Number of compressors / Number of circuits* | | 2/2 | 3/2 | 4/2 | 4/2 | 4/2 |
| *Capacity steps for the unit* | % | 0-37-50-87-100 | 0-33-66-100 | 0-25-50-75-100 | 0-25-50-75-100 | 0-25-50-75-100 |
| *Refrigerant charge per circuit* | ***circuit*** kg | **a :** 49 **b :** 49 | **a :** 64 **b :** 34 | **a :** 64 **b :** 64 | **a :** 64 **b :** 64 | **a :** 83 **b :** 83 |
| *Oil charge per compressor* | l | 7,7 | 7,7 | 7,7 | 7,7 | 7,7 |

## EVAPORATORS

| TYPE ECOMAX STD | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Number* | | 1 | | | | |
| *Water volume* | $dm^3$ | 94 | 113 | 137 | 137 | 176 |
| *Water piping* | (1) | DN 150 | DN 200 | DN 200 | DN 200 | DN 200 |
| *Test pressure - Bar* | *Water* | 15 | 15 | 15 | 15 | 15 |
| | Refrigerant | 34 | 34 | 34 | 34 | 34 |
| *Operating pressure - Bar* | *Water* | 10 | 10 | 10 | 10 | 10 |
| | Refrigerant | 17 | 17 | 17 | 17 | 17 |

(1) : PN 16 flanges

## CONDENSERS

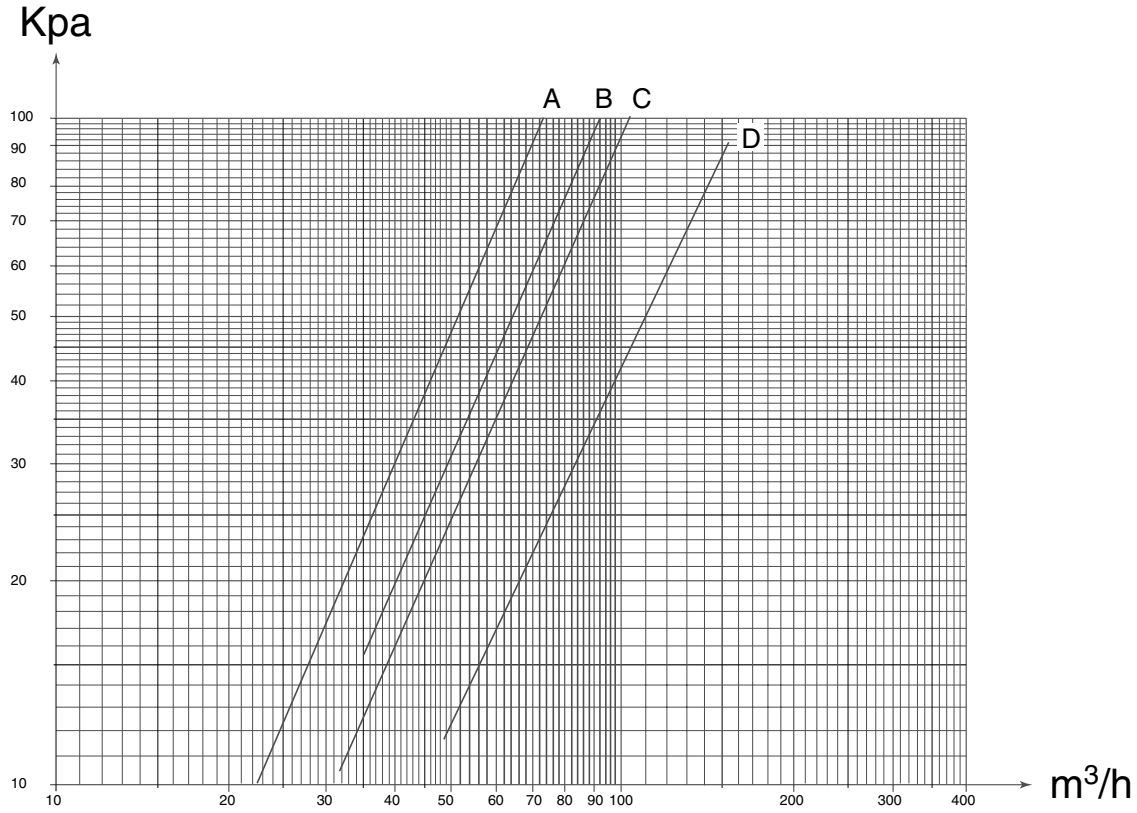
| TYPE | ECOMAX STD | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Ventilation type* | | Axial - Direct coupling 700 tr/mn | | | | |
| *Fan number* | | 6 | **a** : 4<br>**b** : 2 | 8 | 8 | 10 |
| *Air flow rate* | $m^3/h$ | 142 800 | 142 800 | 189 600 | 189 600 | 239 200 |
| *Total input* | kW | 10,2 | 10,2 | 13,6 | 13,6 | 17 |
| *Each fan nominal load current* | A | 5,5 | 5,5 | 5,5 | 5,5 | 5,5 |

## ELECTRICAL DATA

| TYPE | ECOMAX STD | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Maxi power* | *kW* | 152 | 184 | 204 | 245 | 300 |
| *Maxi current* | *A* | 288 | 351 | 395 | 467 | 562 |
| *Start-up intensity* | *A* | 625 | 665 | 655 | 785 | 900 |

*Maximum current and power calculated at 400V/3/50Hz for compressor operation at +12/60°C*
*Max starting current is when last compressor starts up plus all the remaining system is at full load with all condenser fans running.*

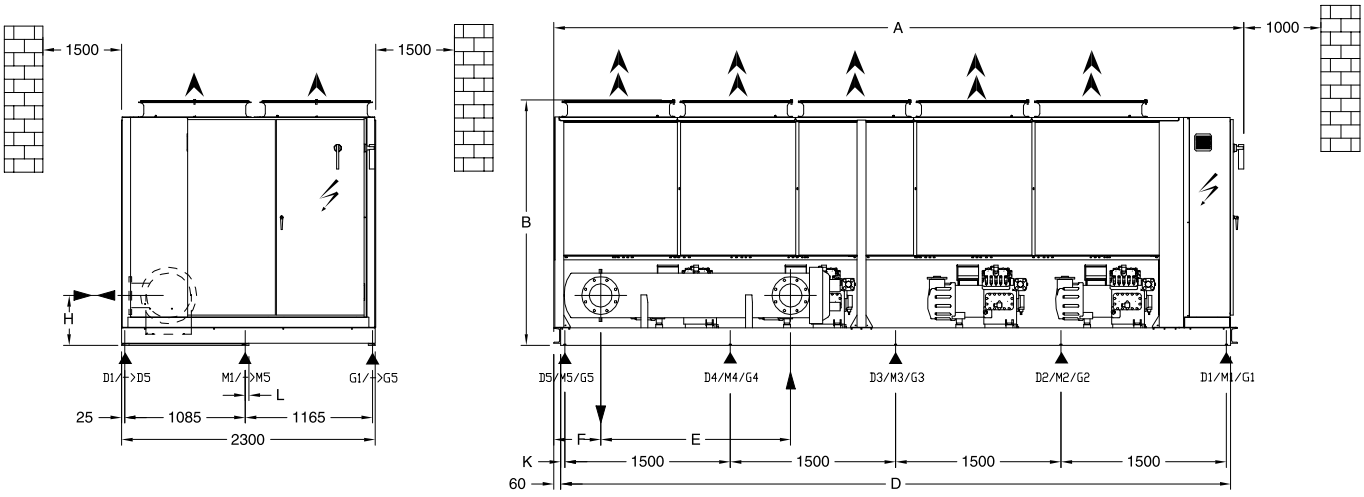
## EVAPORATORS PRESSURE DROPS




| MODEL | ECOMAX STD | 322PK | 412PK | 462PK | 532PK | 622Pk |
|---|---|---|---|---|---|---|
| *Curve* | | A | B | C | C | D |

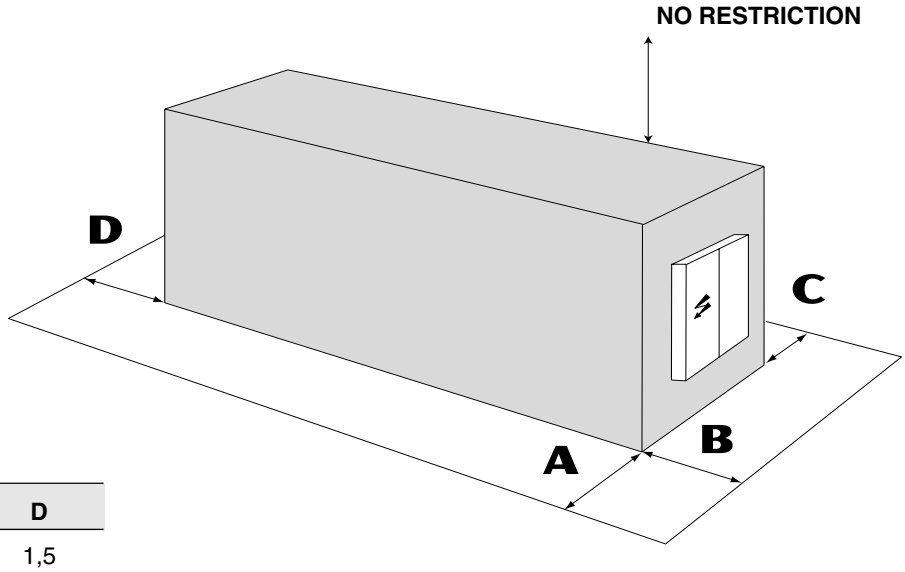
*Pressure drops are given for informations only. A tolerance of +/- 20kPa must be considered when selecting water pumps.*

## DIMENSIONAL DATA



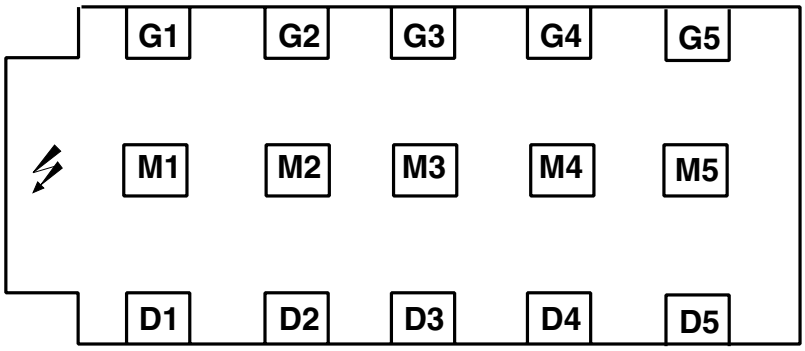

| ECOMAX STD | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| **A** | mm | 4050 | 5050 | 5050 | 5050 | 6260 |
| **B** | mm | 2213 | 2213 | 2213 | 2213 | 2213 |
| **D** | mm | 3390 | 3390 | 4390 | 4390 | 6080 |
| **E** | mm | 2253 | 1723 | 2223 | 2223 | 1724 |
| **F** | mm | 293 | 813 | 303 | 303 | 424 |
| **H** | mm | 390 | 405 | 405 | 405 | 450 |
| **K** | mm | 192 | 695 | 695 | 695 | 40 |
| **n Ø 20** | | 3x3 | 3x3 | 3x4 | 3x4 | 3x5 |

## CLEARANCES




| A | B | C | D |
|---|---|---|---|
| (m) 1,5 | 1,5 | 1,5 | 1,5 |

## LOAD DISTRIBUTION (KG - OPERATING WEIGHTS)




Lennox recommend load distribution as detailed above.
To avoid the M point load, it is possible to support the unit Gi and Di point only. In that case, the new value G'i and D'i will be :

$$G'i = Gi + \frac{Mi}{2}$$

$$D'i = Di + \frac{Mi}{2}$$

| Ecomax STD | *Weight without water* | *Operating weight* | D1 | D2 | D3 | D4 | D5 | M1 | M2 | M3 | M4 | M5 | G1 | G2 | G3 | G4 | G5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 2776 | 2870 | 420 | 340 | 250 | - | - | 370 | 370 | 310 | - | - | 240 | 280 | 290 | - | - |
| **412PK** | 3211 | 3320 | 610 | 330 | 200 | - | - | 520 | 380 | 340 | - | - | 310 | 260 | 370 | - | - |
| **462PK** | 3907 | 4040 | 630 | 440 | 470 | - | - | 520 | 430 | 520 | - | - | 290 | 280 | 460 | - | - |
| **532PK** | 3907 | 4040 | 630 | 440 | 470 | - | - | 520 | 430 | 520 | - | - | 290 | 280 | 460 | - | - |
| **622PK** | 4843 | 5010 | 290 | 380 | 390 | 340 | 250 | 330 | 410 | 430 | 420 | 360 | 220 | 190 | 250 | 360 | 390 |

## NOISE LEVELS

| ECOMAX STD | *Spectrum per octave band (dBA)* 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz | *Global sound power* dBA |
|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 73 | 83 | 89 | 90 | 93 | 90 | 83 | 78 | **97** |
| **412PK** | 73 | 73 | 83 | 89 | 90 | 92 | 90 | 91 | **98** |
| **462PK** | 74 | 74 | 84 | 90 | 92 | 93 | 91 | 92 | **99** |
| **532PK** | 74 | 74 | 84 | 90 | 92 | 93 | 91 | 93 | **100** |
| **622PK** | 75 | 75 | 85 | 91 | 93 | 96 | 92 | 86 | **100** |

Global sound power level measured in compliance with ISO standard 3744.
Only the sound power spectrum and the global sound power value are used in determining pressure characteristics at owner land limit.

# OPERATING LIMITS

| MODEL ECOMAX STD | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|
| *Leaving chilled water temperature (1)* | Minimum : + 5°C / Minimum with 30% glycol : -10°C<br>Maximum : +12°C | | | | |
| *Chilled water entering temperature* | Minimum : (2)<br>Maximum : +20°C | | | | |
| *Difference chilled water inlet/outlet* | Minimum : (3)<br>Maximum : +8 °C | | | | |
| *Maximum water flow rate* $m^3/h$ | **89,3** | **153,5** | **153,5** | **153,5** | **153,5** |

(1) *Below +5°C, add glycol to the heating fluid.*

(2) *Value corresponding to the minimum of 5°C chilled water leaving temperature at considered flow rate*

(3) *Corresponding to the evaporator acceptable maximum flow rate*
*APART FROM THESE VALUES, PLEASE CONSULT US*

**MAXIMUM AMBIENT AIR TEMPERATURE**

*Temperatures are calculated according to start-up units conditions, with two differents configurations*

❶ Full load starting : maxi.conditions (1)

❷ HP offloading operation

***Maxi ambient air temperature (°C)***

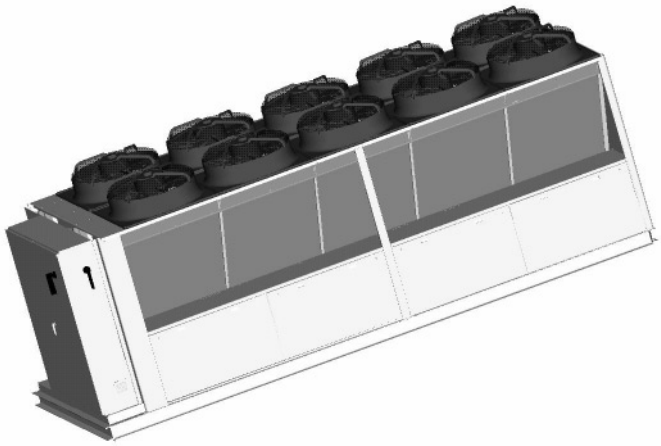
| ECOMAX STD | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|
| Configuration ❶ | 40 | 36 | 39 | 35,5 | 37 |
| Configuration ❷ | 46 | 43 | 49 | 47,5 | 48 |

(1) : Operating limits R407C : 12°C/60°C

# CONTENTS



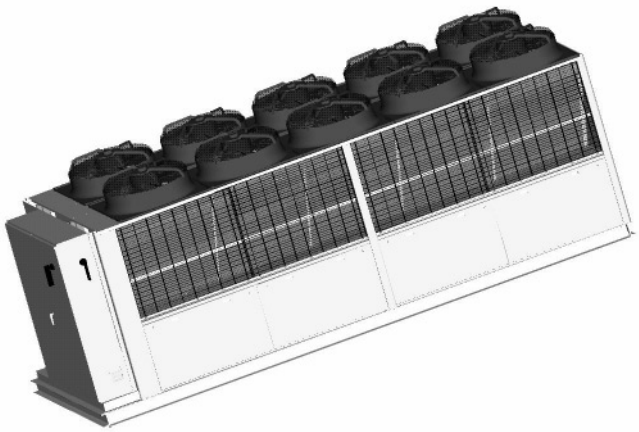
***EcoMax Low Noise***



**ECOMAX LN unit**

The use of reciprocating compressors with suction gas cooled motors guarantees long motor life in high ambient conditions. The Climatic II controller is supplied as standard with the KP02 controller. The power and control panel is ventilated via a thermostatically controlled IP55 ventilation fan. This helps prevent electrical components from over heating. The Condenser coil is easily cleanable so that sand and debris can be washed away. The combination of Climatic II and the Expansion valve technology allows the chillers to start under high ambient conditions and high chilled water temperatures an important feature for high ambient operation. The full range is able to operate at full load conditions with standard chilled water temperatures in ambient as high as 50°C. The high ambient range is subject to the same demanding quality and factory testing requirements as the rest of the EcoMax range.

The ECOMAX™ high ambient range of chillers is engineered to operate at the high ambient conditions of the Middle East and North Africa. The high ambient units can also be utilized when the application or positioning of the chillers results in the chiller being exposed to high condenser supply air temperatures. The EcoMax high ambient range utilises the same components as the EcoMax standard range. Additional condenser coil surface is used together with 950rpm condenser fans are used to enhance performance for high ambient operation.



**ECOMAX LN unit with anti intrusion grill**

## PERFORMANCE TABLES

| ECOMAX LN | Water outlet temp. °C | Air inlet temperature | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 28 °C | | 32 °C | | 35 °C | | 39°C | | 43 °C | | 47 °C | |
| | | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa |
| 322PK | 5 | 337 | 104 | 321 | 109 | 308 | 113 | 291 | 118 | 274 | 122 | ***206*** | ***98.8*** |
| | 7 | 360 | 107 | 343 | 113 | 330 | 117 | 313 | 122 | 295 | 126 | ***222*** | ***102*** |
| | 9 | 384 | 111 | 366 | 117 | 353 | 121 | 334 | 126 | 316 | 131 | ***238*** | ***106*** |
| | 11 | 409 | 114 | 390 | 120 | 376 | 124 | 357 | 130 | 338 | 135 | ***255*** | ***109*** |
| 412PK | 5 | 405 | 132 | 385 | 138 | 370 | 142 | 350 | 147 | 331 | 153 | ***203*** | ***94.1*** |
| | 7 | 433 | 137 | 412 | 143 | 396 | 147 | 376 | 153 | ***233*** | ***93.8*** | ***219*** | ***97.2*** |
| | 9 | 462 | 141 | 440 | 148 | 424 | 152 | 402 | 158 | ***250*** | ***96.6*** | ***236*** | ***100*** |
| | 11 | 492 | 146 | 469 | 153 | 452 | 158 | 429 | 164 | ***268*** | ***99.3*** | - | - |
| 462PK | 5 | 469 | 144 | 445 | 151 | 428 | 157 | 405 | 164 | 383 | 171 | ***205*** | ***90.7*** |
| | 7 | 502 | 148 | 477 | 156 | 459 | 162 | 435 | 170 | 412 | 177 | ***222*** | ***93.2*** |
| | 9 | 536 | 153 | 511 | 161 | 492 | 167 | 466 | 175 | 442 | 182 | ***239*** | ***95.6*** |
| | 11 | 572 | 157 | 545 | 166 | 525 | 172 | 499 | 180 | 473 | 188 | ***258*** | ***97.8*** |
| 532PK | 5 | 531 | 175 | 505 | 183 | 486 | 188 | 461 | 196 | 437 | 203 | ***239*** | ***107*** |
| | 7 | 568 | 181 | 541 | 189 | 521 | 195 | 495 | 203 | ***274*** | ***106*** | ***258*** | ***110*** |
| | 9 | 606 | 188 | 578 | 196 | 557 | 202 | 530 | 210 | ***295*** | ***109*** | ***278*** | ***113*** |
| | 11 | 646 | 194 | 617 | 203 | 595 | 209 | 566 | 217 | ***317*** | ***112*** | ***299*** | ***116*** |
| 622PK | 5 | 648 | 211 | 616 | 220 | 591 | 227 | 559 | 235 | 525 | 243 | ***285*** | ***128*** |
| | 7 | 692 | 218 | 658 | 228 | 633 | 235 | 599 | 244 | 564 | 252 | ***308*** | ***133*** |
| | 9 | 737 | 225 | 702 | 236 | 676 | 243 | 640 | 253 | ***353*** | ***131*** | ***331*** | ***137*** |
| | 11 | 784 | 232 | 747 | 243 | 720 | 251 | 682 | 262 | ***378*** | ***135*** | ***355*** | ***141*** |

XXX *Water T = 5°C*

***XXX*** *High pressure offloading operating*

**Qo :** *Cooling capacity in kW*

**P :** *Total power*

***Fouling factor*** **:** 0,044 m²C/kW

## COMPRESSORS AND REFRIGERANT CIRCUITS

| *TYPE* ECOMAX LN | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Compressor type* | | Semi-hermetic reciprocating | | | | |
| *Number of compressors / Number of circuits* | | 2/2 | 3/2 | 4/2 | 4/2 | 4/2 |
| *Capacity steps for the unit* | % | 0-37-50-87-100 | 0-33-66-100 | 0-25-50-75-100 | 0-25-50-75-100 | 0-25-50-75-100 |
| *Refrigerant charge per circuit* | ***circuit*** kg | **a :** 65<br>**b :** 65 | **a :** 86<br>**b :** 45 | **a :** 86<br>**b :** 86 | **a :** 86<br>**b :** 86 | **a :** 111<br>**b :** 111 |
| *Oil charge per compressor* | l | 7,7 | 7,7 | 7,7 | 7,7 | 7,7 |

## EVAPORATORS

| TYPE ECOMAX LN | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Number* | | 1 | | | | |
| *Water volume* | $dm^3$ | 94 | 113 | 137 | 137 | 137 |
| *Water piping* | (1) | DN 150 | DN 200 | DN 200 | DN 200 | DN 200 |
| *Test pressure - Bar* | *Water*<br>Refrigerant | 15<br>34 | 15<br>34 | 15<br>34 | 15<br>34 | 15<br>34 |
| *Operating pressure - Bar* | *Water*<br>Refrigerant | 10<br>17 | 10<br>17 | 10<br>17 | 10<br>17 | 10<br>17 |

(1) : PN 16 flanges

## CONDENSERS

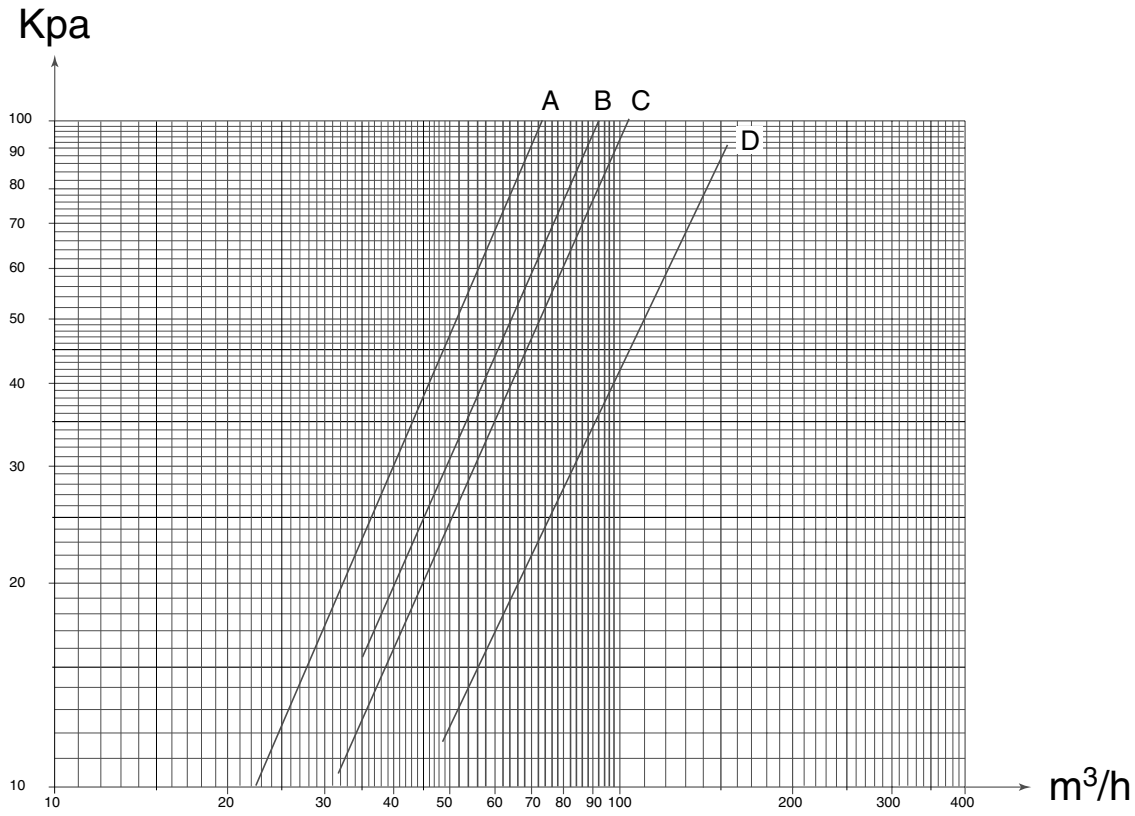
| TYPE | ECOMAX LN | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Ventilation type* | | Axial - Direct coupling 550 tr/mn | | | | |
| *Fan number* | | 6 | **a** : 4<br>**b** : 2 | 8 | 8 | 10 |
| *Air flow rate* | $m^3/h$ | 118 000 | 118 000 | 156 600 | 156 400 | 198 400 |
| *Total input* | kW | 7,2 | 7,2 | 9,6 | 9,6 | 12 |
| *Each fan nominal load current* | A | 2,3 | 2,3 | 2,3 | 2,3 | 2,3 |

## ELECTRICAL DATA

| TYPE | ECOMAX LN | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Maxi power* | *kW* | 149 | 181 | 200 | 241 | 295 |
| *Maxi current* | *A* | 269 | 332 | 370 | 442 | 530 |
| *Start-up intensity* | *A* | 600 | 640 | 620 | 750 | 860 |

*Maximum current and power calculated at 400V/3/50Hz for compressor operation at +12/60°C*
*Max starting current is when last compressor starts up plus all the remaining system is at full load with all condenser fans running.*

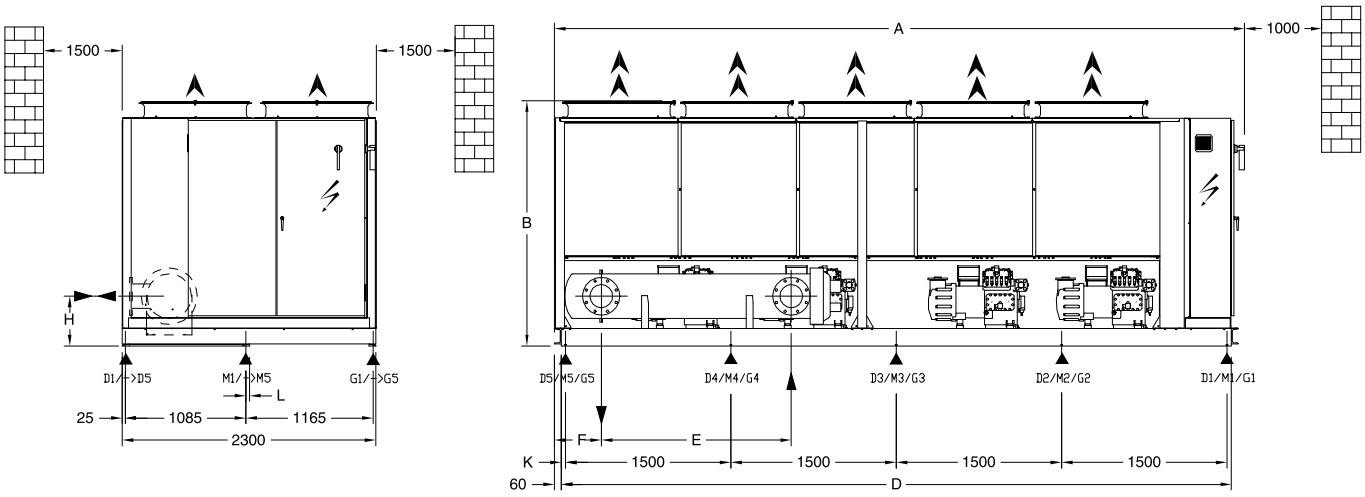
## EVAPORATORS PRESSURE DROPS




| MODEL | ECOMAX LN | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Curve* | | A | B | C | C | D |

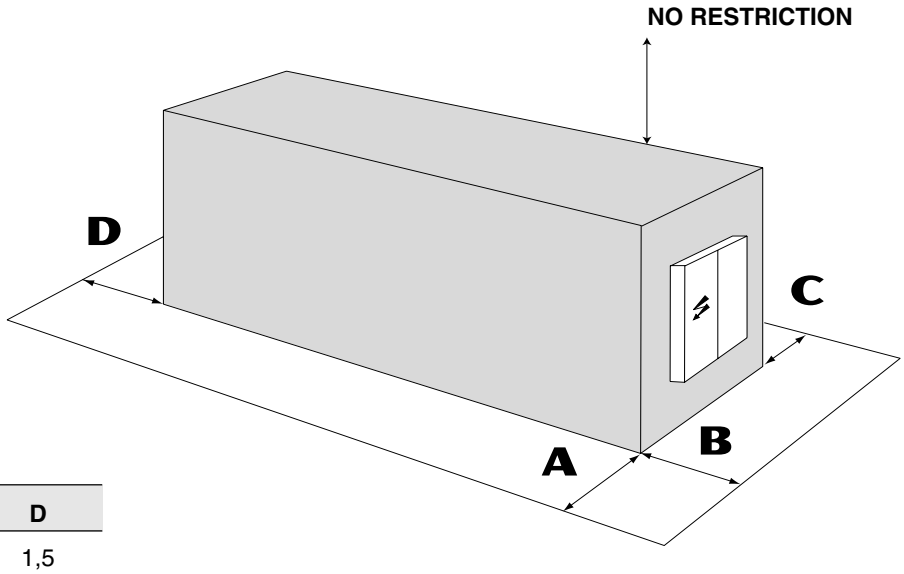
*Pressure drops are given for informations only. A tolerance of +/- 20kPa must be considered when selecting water pumps.*

## DIMENSIONAL DATA



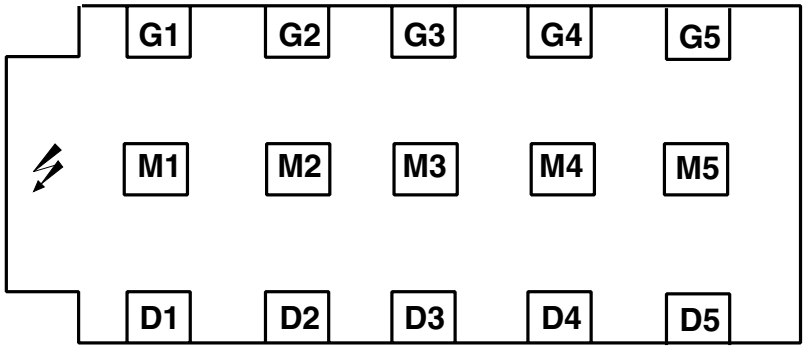

| ECOMAX LN | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| **A** | mm | 4050 | 5050 | 5050 | 5050 | 6260 |
| **B** | mm | 2410 | 2410 | 2410 | 2410 | 2410 |
| **D** | mm | 3390 | 3390 | 4390 | 4390 | 6080 |
| **E** | mm | 2253 | 1723 | 2223 | 2223 | 1724 |
| **F** | mm | 293 | 813 | 303 | 303 | 424 |
| **H** | mm | 390 | 405 | 405 | 405 | 450 |
| **K** | mm | 192 | 695 | 695 | 695 | 40 |
| **n Ø 20** | | 3x3 | 3x3 | 3x4 | 3x4 | 3x5 |

## CLEARANCES




| A | B | C | D |
|---|---|---|---|
| (m) 1,5 | 1,5 | 1,5 | 1,5 |

## LOAD DISTRIBUTION (KG - OPERATING WEIGHTS)




Lennox recommend load distribution as detailed above.
To avoid the M point load, it is possible to support the unit Gi and Di point only. In that case, the new value G'i and D'i will be :

$$G'i = Gi + \frac{Mi}{2}$$

$$D'i = Di + \frac{Mi}{2}$$

| Ecomax LN | *Weight without water* | *Operating weight* | D1 | D2 | D3 | D4 | D5 | M1 | M2 | M3 | M4 | M5 | G1 | G2 | G3 | G4 | G5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 3266 | 3360 | 480 | 400 | 330 | - | - | 430 | 430 | 380 | - | - | 270 | 310 | 330 | - | - |
| **412PK** | 3531 | 3640 | 660 | 360 | 250 | - | - | 550 | 400 | 380 | - | - | 340 | 290 | 410 | - | - |
| **462PK** | 4577 | 4710 | 730 | 500 | 580 | - | - | 610 | 500 | 620 | - | - | 340 | 310 | 520 | - | - |
| **532PK** | 4577 | 4710 | 730 | 500 | 580 | - | - | 610 | 500 | 620 | - | - | 340 | 310 | 520 | - | - |
| **622PK** | 5353 | 5520 | 300 | 420 | 440 | 390 | 340 | 290 | 430 | 490 | 470 | 450 | 200 | 200 | 270 | 390 | 440 |

## NOISE LEVELS

| ECOMAX LN | *Spectrum per octave band (dBA)* 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz | *Global sound power* dBA |
|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 63 | 73 | 83 | 84 | 86 | 84 | 78 | 69 | **91** |
| **412PK** | 63 | 73 | 83 | 84 | 85 | 84 | 86 | 81 | **92** |
| **462PK** | 64 | 74 | 84 | 85 | 87 | 86 | 86 | 81 | **93** |
| **532PK** | 64 | 74 | 84 | 85 | 86 | 86 | 87 | 82 | **93** |
| **622PK** | 65 | 75 | 85 | 86 | 89 | 87 | 80 | 72 | **93** |

Global sound power level measured in compliance with ISO standard 3744.
Only the sound power spectrum and the global sound power value are used in determining pressure characteristics at owner land limit.

## OPERATING LIMITS

| MODEL ECOMAX LN | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Leaving chilled water temperature (1)* | | Minimum : + 5°C / Minimum with 30% glycol : -10°C<br>Maximum : +12°C | | | | |
| *Chilled water entering temperature* | | Minimum : (2)<br>Maximum : +20°C | | | | |
| *Difference chilled water inlet/outlet* | | Minimum : (3)<br>Maximum : +8 °C | | | | |
| *Maximum water flow rate* | $m^3/h$ | **89,3** | **153,5** | **153,5** | **153,5** | **153,5** |

(1) *Below +5°C, add glycol to the heating fluid.*

(2) *Value corresponding to the minimum of 5°C chilled water leaving temperature at considered flow rate*

(3) *Corresponding to the evaporator acceptable maximum flow rate*

*APART FROM THESE VALUES, PLEASE CONSULT US*

### MAXIMUM AMBIENT AIR TEMPERATURE

*Temperatures are calculated according to start-up units conditions, with two differents configurations*

❶ Full load starting : maxi.conditions (1)

❷ HP offloading operation

***Maxi ambient air temperature (°C)***

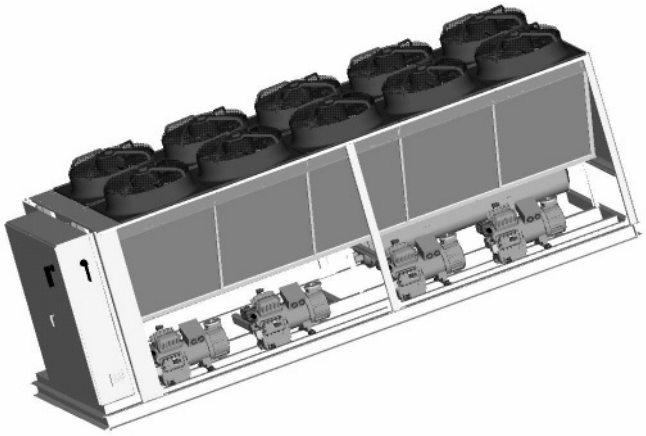
| ECOMAX LN | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|
| Configuration ❶ | 42 | 38,5 | 41 | 38 | 39,5 |
| Configuration ❷ | 47,5 | 45 | 50,5 | 49 | 49,5 |

(1) : Operating limits R407C : 12°C/60°C

# CONTENTS

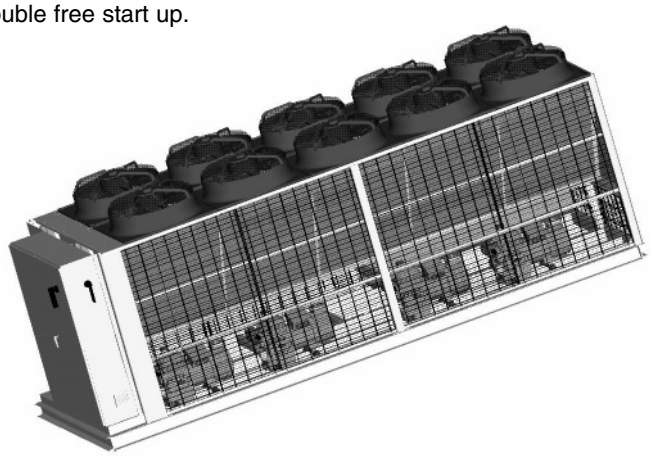


***EcoMax High Efficiency***



**ECOMAX HE unit**

The ECOMAX™ high efficiency range of units is designed to ensure that cooling both at full and part load is provided at the minimum electrical power absorbed. This provides the owner with the lowest operating costs and by reducing power consumption the indirect global warming impact is minimised. The indirect global warming is the generation of CO2 in producing the electrical power to operate the chiller by selecting from EcoMax high efficiency range CO2 production is minimised.
When selecting a Ecomax high efficiency unit the additional costs associated with the additional components required can be recovered in the first few years of operation. A Lennox EcoMax unit has a life expectancy in access of 15 years so after the initial capital difference is recovered in the first few years the continued cost savings can be utilised for other purposes.
The Ecomax high efficiency range uses oversized heat exchanger surfaces in condenser to get the highest efficiencies. The Climatic II controller is supplied with KP02 LCD graphic display screen. The unit is fitted with the very latest in Electronic expansion valve technology that is controlled by the Climatic II and uses Lennox unique control algorithms to operate the compressors, condenser fans and expansion valve to provide the best operating efficiency at all operating conditions. The Climatic II controller is looking at 2050 different operating parameters every minute and making adjustments to ensure the efficient and safe operation of the chiller
The Ecomax uses the same range of components as the EcoMax Standard range of chillers and is also fully factory tested to insure trouble free start up.



**ECOMAX HE unit with anti intrusion grill**

## PERFORMANCE TABLES

| ECOMAX HE | Water outlet temp. °C | Air inlet temperature | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 28 °C | | 32 °C | | 35 °C | | 39°C | | 43 °C | | 47 °C | |
| | | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa |
| 322PK | 5 | 344 | 105 | 328 | 111 | 315 | 114 | 298 | 119 | 281 | 124 | 264 | 127 |
| | 7 | 368 | 108 | 351 | 114 | 338 | 118 | 320 | 123 | 302 | 128 | ***226*** | ***105*** |
| | 9 | 393 | 111 | 375 | 117 | 361 | 121 | 343 | 127 | 324 | 132 | ***243*** | ***108*** |
| | 11 | 419 | 114 | 400 | 120 | 385 | 125 | 366 | 131 | 346 | 136 | ***261*** | ***111*** |
| 412PK | 5 | 416 | 132 | 395 | 138 | 379 | 143 | 359 | 148 | 340 | 154 | ***206*** | ***96.5*** |
| | 7 | 445 | 137 | 423 | 143 | 407 | 148 | 386 | 153 | 365 | 159 | ***223*** | ***99.5*** |
| | 9 | 475 | 141 | 453 | 148 | 436 | 152 | 413 | 159 | 392 | 164 | ***240*** | ***102*** |
| | 11 | 507 | 145 | 483 | 152 | 465 | 157 | 442 | 164 | ***274*** | ***101*** | ***258*** | ***105*** |
| 462PK | 5 | 479 | 145 | 455 | 153 | 437 | 158 | 414 | 166 | 392 | 173 | ***208*** | ***94.3*** |
| | 7 | 514 | 149 | 488 | 157 | 470 | 163 | 445 | 171 | 421 | 178 | ***225*** | ***96.7*** |
| | 9 | 549 | 153 | 523 | 162 | 504 | 168 | 478 | 176 | 453 | 184 | ***243*** | ***99.0*** |
| | 11 | 587 | 157 | 559 | 166 | 538 | 172 | 512 | 181 | 485 | 189 | ***262*** | ***101*** |
| 532PK | 5 | 544 | 175 | 518 | 183 | 499 | 189 | 473 | 197 | 448 | 204 | ***243*** | ***110*** |
| | 7 | 583 | 181 | 555 | 190 | 535 | 196 | 508 | 204 | 481 | 211 | ***263*** | ***113*** |
| | 9 | 623 | 187 | 594 | 196 | 573 | 202 | 544 | 210 | 516 | 218 | ***283*** | ***116*** |
| | 11 | 664 | 193 | 634 | 202 | 611 | 208 | 582 | 217 | ***323*** | ***115*** | ***305*** | ***119*** |
| 622PK | 5 | 663 | 211 | 631 | 221 | 606 | 228 | 573 | 237 | 540 | 245 | ***290*** | ***133*** |
| | 7 | 709 | 217 | 675 | 228 | 650 | 236 | 615 | 245 | 580 | 254 | ***313*** | ***137*** |
| | 9 | 756 | 224 | 721 | 235 | 694 | 243 | 658 | 254 | 621 | 263 | ***337*** | ***141*** |
| | 11 | 805 | 230 | 768 | 242 | 740 | 251 | 702 | 262 | 663 | 272 | ***362*** | ***145*** |

XXX *Water T = 5°C*

***XXX*** *High pressure offloading operating*

**Qo :** *Cooling capacity in kW*

**P :** *Total power*

***Fouling factor*** **:** 0,044 m²C/kW

## COMPRESSORS AND REFRIGERANT CIRCUITS

| *TYPE* ECOMAX HE | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Compressor type* | | Semi-hermetic reciprocating | | | | |
| *Number of compressors / Number of circuits* | | 2/2 | 3/2 | 4/2 | 4/2 | 4/2 |
| *Capacity steps for the unit* | % | 0-37-50-87-100 | 0-33-66-100 | 0-25-50-75-100 | 0-25-50-75-100 | 0-25-50-75-100 |
| *Refrigerant charge per circuit* | ***circuit*** kg | **a :** 65 **b :** 65 | **a :** 86 **b :** 45 | **a :** 86 **b :** 86 | **a :** 86 **b :** 86 | **a :** 111 **b :** 111 |
| *Oil charge per compressor* | l | 7,7 | 7,7 | 7,7 | 7,7 | 7,7 |

## EVAPORATORS

| TYPE ECOMAX HE | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Number* | | 1 | | | | |
| *Water volume* | $dm^3$ | 94 | 113 | 137 | 137 | 137 |
| *Water piping* | (1) | DN 150 | DN 200 | DN 200 | DN 200 | DN 200 |
| *Test pressure - Bar* | *Water* | 15 | 15 | 15 | 15 | 15 |
| | Refrigerant | 34 | 34 | 34 | 34 | 34 |
| *Operating pressure - Bar* | *Water* | 10 | 10 | 10 | 10 | 10 |
| | Refrigerant | 17 | 17 | 17 | 17 | 17 |

(1) : PN 16 flanges

## CONDENSERS

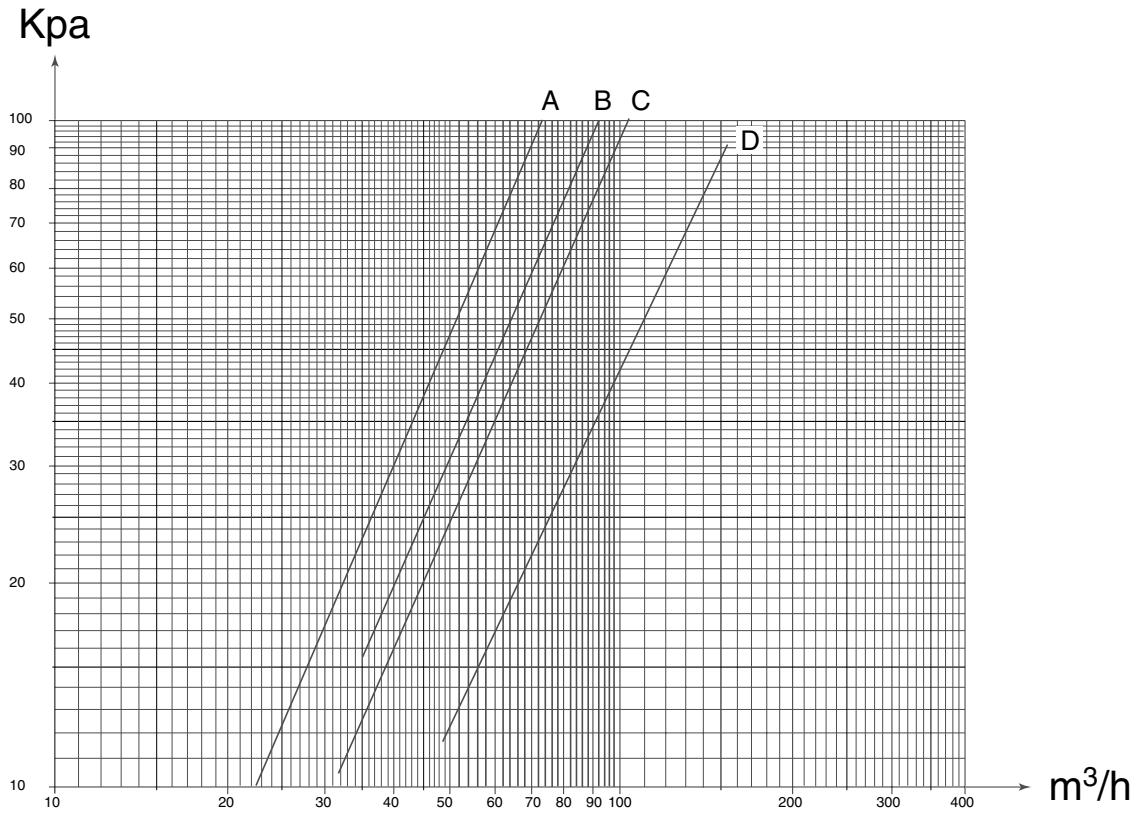
| TYPE | ECOMAX HE | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Ventilation type* | | Axial - Direct coupling 680 tr/mn | | | | |
| *Fan number* | | 6 | **a** : 4<br>**b** : 2 | 8 | 8 | 10 |
| *Air flow rate* | $m^3/h$ | 146 000 | 146 000 | 193 600 | 193 600 | 245 200 |
| *Total input* | kW | 10,5 | 10,5 | 14 | 14 | 17,5 |
| *Each fan nominal load current* | A | 3,6 | 3,6 | 3,6 | 3,6 | 3,6 |

## ELECTRICAL DATA

| TYPE | ECOMAX HE | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Maxi power* | *kW* | 152 | 184 | 205 | 245 | 300 |
| *Maxi current* | *A* | 277 | 340 | 380 | 452 | 543 |
| *Start-up intensity* | *A* | 615 | 655 | 640 | 765 | 880 |

*Maximum current and power calculated at 400V/3/50Hz for compressor operation at +12/60°C*
*Max starting current is when last compressor starts up plus all the remaining system is at full load with all condenser fans running.*

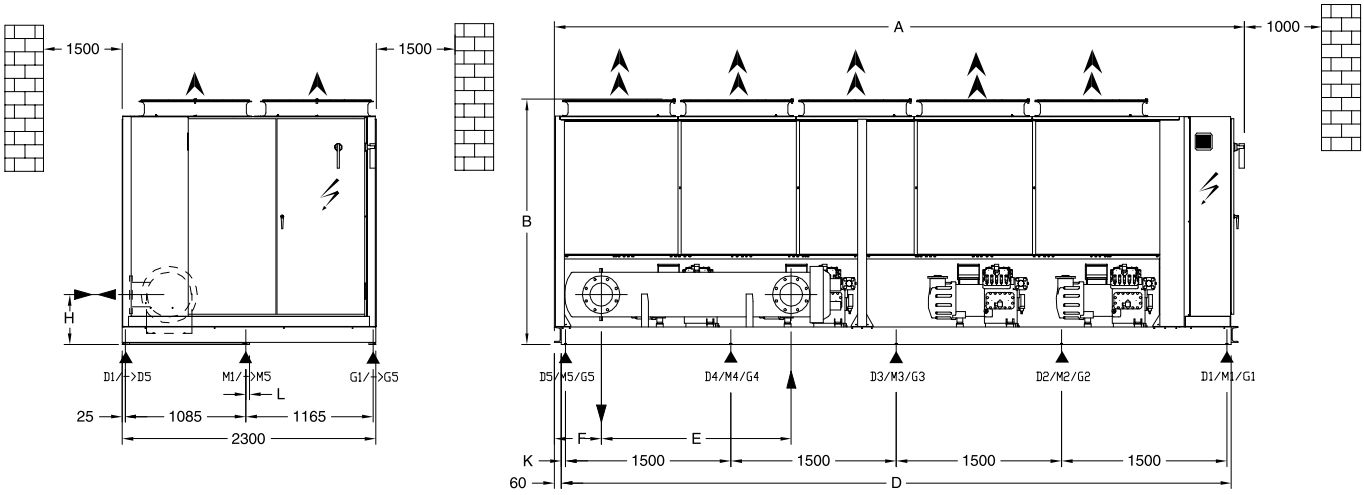
## EVAPORATORS PRESSURE DROPS




| MODEL | ECOMAX HE | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Curve* | | A | B | C | C | D |

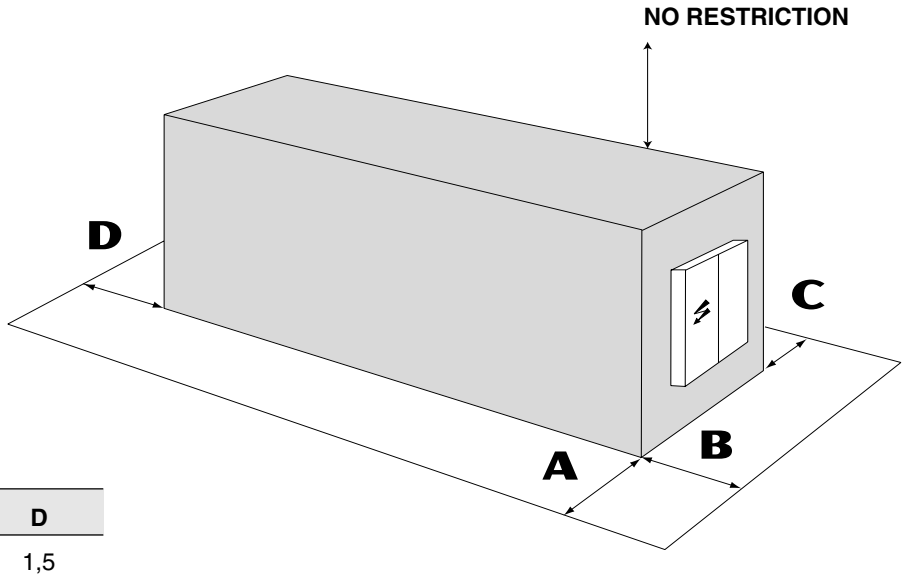
*Pressure drops are given for informations only. A tolerance of +/- 20kPa must be considered when selecting water pumps.*

## DIMENSIONAL DATA



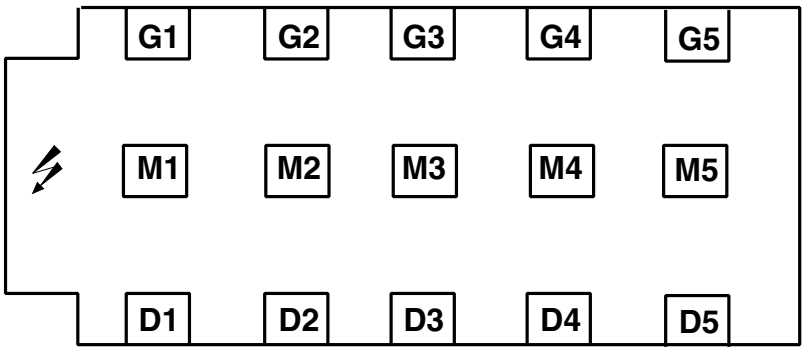

| ECOMAX HE | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| **A** | mm | 4050 | 5050 | 5050 | 5050 | 6260 |
| **B** | mm | 2410 | 2410 | 2410 | 2410 | 2410 |
| **D** | mm | 3390 | 3390 | 4390 | 4390 | 6080 |
| **E** | mm | 2253 | 1723 | 2223 | 2223 | 1724 |
| **F** | mm | 293 | 813 | 303 | 303 | 424 |
| **H** | mm | 390 | 405 | 405 | 405 | 450 |
| **K** | mm | 192 | 695 | 695 | 695 | 40 |
| **n Ø 20** | | 3x3 | 3x3 | 3x4 | 3x4 | 3x5 |

## CLEARANCES




| A | B | C | D |
|---|---|---|---|
| (m) 1,5 | 1,5 | 1,5 | 1,5 |

## LOAD DISTRIBUTION (KG - OPERATING WEIGHTS)




Lennox recommend load distribution as detailed above.
To avoid the M point load, it is possible to support the unit Gi and Di point only. In that case, the new value G'i and D'i will be :

$$G'i = Gi + \frac{Mi}{2}$$

$$D'i = Di + \frac{Mi}{2}$$

| Ecomax HE | *Weight without water* | *Operating weight* | D1 | D2 | D3 | D4 | D5 | M1 | M2 | M3 | M4 | M5 | G1 | G2 | G3 | G4 | G5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 2976 | 3070 | 430 | 350 | 270 | - | - | 390 | 400 | 340 | - | - | 260 | 310 | 320 | - | - |
| **412PK** | 3441 | 3550 | 620 | 340 | 220 | - | - | 550 | 400 | 370 | - | - | 350 | 290 | 410 | - | - |
| **462PK** | 4237 | 4370 | 650 | 460 | 500 | - | - | 570 | 470 | 560 | - | - | 340 | 310 | 510 | - | - |
| **532PK** | 4237 | 4370 | 650 | 460 | 500 | - | - | 570 | 470 | 560 | - | - | 340 | 310 | 510 | - | - |
| **622PK** | 5193 | 5360 | 310 | 390 | 400 | 350 | 270 | 360 | 440 | 460 | 440 | 400 | 250 | 210 | 270 | 380 | 430 |

## NOISE LEVELS

| ECOMAX HE | *Spectrum per octave band (dBA)* 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz | *Global sound power* dBA |
|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 68 | 80 | 88 | 88 | 93 | 91 | 85 | 78 | **97** |
| **412PK** | 68 | 80 | 88 | 89 | 92 | 91 | 92 | 90 | **98** |
| **462PK** | 69 | 82 | 89 | 90 | 93 | 93 | 92 | 90 | **99** |
| **532PK** | 69 | 82 | 89 | 90 | 93 | 93 | 93 | 91 | **100** |
| **622PK** | 70 | 83 | 90 | 91 | 96 | 94 | 88 | 81 | **100** |

Global sound power level measured in compliance with ISO standard 3744.
Only the sound power spectrum and the global sound power value are used in determining pressure characteristics at owner land limit.

## OPERATING LIMITS

| MODEL ECOMAX HE | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Leaving chilled water temperature (1)* | | Minimum : + 5°C / Minimum with 30% glycol : -10°C<br>Maximum : +12°C | | | | |
| *Chilled water entering temperature* | | Minimum : (2)<br>Maximum : +20°C | | | | |
| *Difference chilled water inlet/outlet* | | Minimum : (3)<br>Maximum : +8 °C | | | | |
| *Maximum water flow rate* | $m^3/h$ | **89,3** | **153,5** | **153,5** | **153,5** | **153,5** |

(1) *Below +5°C, add glycol to the heating fluid.*

(2) *Value corresponding to the minimum of 5°C chilled water leaving temperature at considered flow rate*

(3) *Corresponding to the evaporator acceptable maximum flow rate*
*APART FROM THESE VALUES, PLEASE CONSULT US*

### MAXIMUM AMBIENT AIR TEMPERATURE

*Temperatures are calculated according to start-up units conditions, with two differents configurations*

❶ Full load starting : maxi.conditions (1)

❷ HP offloading operation

***Maxi ambient air temperature (°C)***

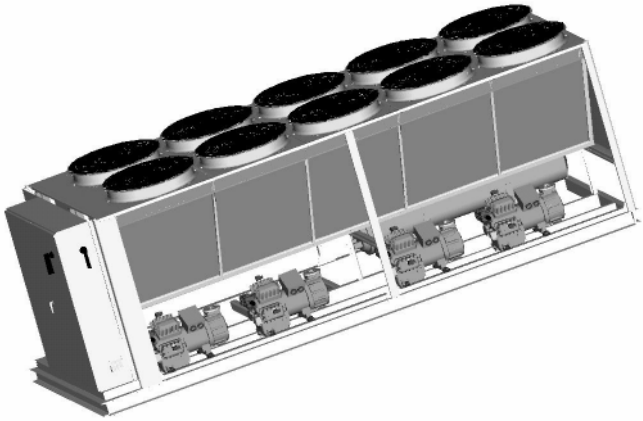
| ECOMAX HE | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|
| Configuration ❶ | 44 | 40,5 | 43,5 | 41,5 | 42 |
| Configuration ❷ | 49 | 47 | 51,5 | 50,5 | 51 |

(1) : Operating limits R407C : 12°C/60°C

# CONTENTS



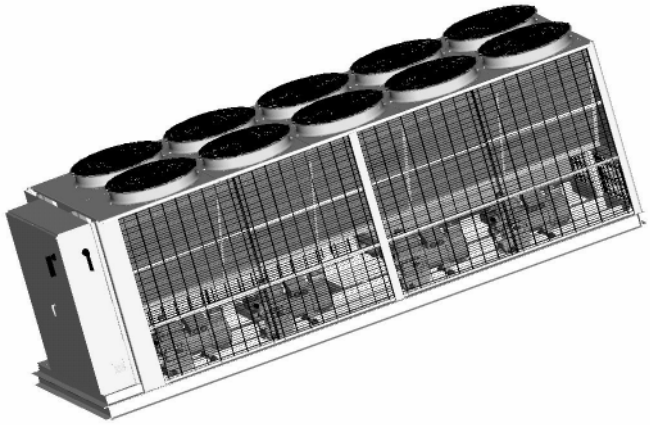
***EcoMax High Ambient***



**ECOMAX HA unit**

The ECOMAX™ high ambient range of chillers is engineered to operate at the high ambient conditions of the Middle East and North Africa. The high ambient units can also be utilized when the application or positioning of the chillers results in the chiller being exposed to high condenser supply air temperatures. The EcoMax high ambient range utilises the same components as the EcoMax standard range. Additional condenser coil surface is used together with 950rpm condenser fans are used to enhance performance for high ambient operation. The use of reciprocating compressors with suction gas cooled motors guarantees long motor life in high ambient conditions. The Climatic II controller is supplied as standard with the KP02 controller.

The power and control panel is ventilated via a thermostatically controlled IP55 ventilation fan. This helps prevent electrical components from over heating. The Condenser coil is easily cleanable so that sand and debris can be washed away. The combination of Climatic II and the Expansion valve technology allows the chillers to start under high ambient conditions and high chilled water temperatures an important feature for high ambient operation. The full range is able to operate at full load conditions with standard chilled water temperatures in ambient as high as 50°C. The high ambient range is subject to the same demanding quality and factory testing requirements as the rest of the EcoMax range.



**ECOMAX HA unit with anti intrusion grill**

## PERFORMANCE TABLES

| ECOMAX HA | Water outlet temp. °C | Air inlet temperature | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 30 °C | | 35 °C | | 38°C | | 42°C | | 46°C | | 48°C | | 50°C | |
| | | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa | Qo | Pa |
| 322PK | 5 | 358 | 115.4 | 336 | 122 | 323,4 | 126 | 305,6 | 130 | 286,7 | 135 | ***279*** | ***126*** | ***272*** | ***117*** |
| | 7 | 384 | 118.3 | 361,2 | 125 | 346,5 | 129 | 327,6 | 134 | 308,7 | 139 | ***300*** | ***130*** | ***292*** | ***121*** |
| | 9 | 411 | 121 | 386,4 | 129 | 371,7 | 133 | 351,8 | 138 | 331,8 | 143 | ***322*** | ***134,5*** | ***312*** | ***126*** |
| | 11 | 438 | 124 | 412,7 | 132 | 396,9 | 136 | 375,9 | 142 | 354,9 | 147 | ***343*** | ***138,5*** | ***331*** | ***130*** |
| 412PK | 5 | 435 | 142 | 406,4 | 150 | 390,6 | 154 | 369,6 | 160 | 348,6 | 165 | ***340*** | ***156,5*** | ***331*** | ***148*** |
| | 7 | 466 | 146 | 436,8 | 154 | 420 | 159 | 396,9 | 165 | 373,8 | 169 | ***364*** | ***161*** | ***355*** | ***153*** |
| | 9 | 499 | 150 | 468,3 | 159 | 450,5 | 164 | 426,3 | 170 | 401,1 | 173 | ***391*** | ***166,5*** | ***380*** | ***160*** |
| | 11 | 532 | 154 | 499,8 | 163 | 480,9 | 168 | 456,8 | 175 | 429,5 | 177 | ***417*** | ***172*** | ***405*** | ***167*** |
| 462PK | 5 | 499 | 158 | 467,3 | 168 | 448,4 | 174 | 424,2 | 181 | 400,1 | 188 | ***389*** | ***176*** | ***378*** | ***164*** |
| | 7 | 536 | 162 | 501,9 | 173 | 483 | 179 | 456,8 | 186 | 431,6 | 194 | ***419*** | ***182,5*** | ***406*** | ***171*** |
| | 9 | 573 | 166 | 538,7 | 177 | 517,7 | 184 | 491,4 | 192 | 464,1 | 199 | ***449*** | ***188*** | ***434*** | ***177*** |
| | 11 | 613 | 170 | 576,5 | 181 | 554,4 | 188 | 526,1 | 196 | 498,8 | 204 | ***480*** | ***193,5*** | ***462*** | ***183*** |
| 532PK | 5 | 569 | 188 | 533,4 | 199 | 513,5 | 205 | 486,2 | 212 | 459,9 | 219 | ***445*** | ***209*** | ***431*** | ***199*** |
| | 7 | 610 | 194 | 573,3 | 205 | 551,3 | 211 | 522,9 | 219 | 491,4 | 227 | ***480*** | ***215,5*** | ***468*** | ***204*** |
| | 9 | 652 | 200 | 614,3 | 211 | 591,2 | 217 | 560,7 | 226 | 522,9 | 234 | ***512*** | ***223*** | ***502*** | ***212*** |
| | 11 | 696 | 205 | 656,3 | 217 | 632,1 | 224 | 600,6 | 232 | 562,8 | 241 | ***549*** | ***230,5*** | ***536*** | ***220*** |
| 622PK | 5 | 693 | 228 | 650,0 | 240 | 623,7 | 247 | 588 | 256 | 552,3 | 264 | ***539*** | ***250*** | ***525*** | ***236*** |
| | 7 | 741 | 234 | 696,2 | 247 | 668,9 | 255 | 631,1 | 264 | 593,3 | 273 | ***578*** | ***259*** | ***563*** | ***245*** |
| | 9 | 792 | 240 | 744,5 | 254 | 716,1 | 263 | 677,3 | 273 | 637,4 | 282 | ***620*** | ***268*** | ***602*** | ***254*** |
| | 11 | 844 | 246 | 794,9 | 261 | 764,4 | 270 | 723,5 | 281 | 682,5 | 291 | ***663*** | ***277*** | ***644*** | ***263*** |

XXX *Water T = 5°C*

***XXX*** *High pressure offloading operating*

**Qo :** *Cooling capacity in kW*

**P :** *Total power*

***Fouling factor*** **:** 0,044 m²C/kW

## COMPRESSORS AND REFRIGERANT CIRCUITS

| *TYPE* ECOMAX HA | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Compressor type* | | Semi-hermetic reciprocating | | | | |
| *Number of compressors / Number of circuits* | | 2/2 | 3/2 | 4/2 | 4/2 | 4/2 |
| *Capacity steps for the unit* | % | 0-37-50-87-100 | 0-33-66-100 | 0-25-50-75-100 | 0-25-50-75-100 | 0-25-50-75-100 |
| *Refrigerant charge per circuit* | ***circuit*** kg | **a :** 65 **b :** 65 | **a :** 86 **b :** 45 | **a :** 86 **b :** 86 | **a :** 86 **b :** 86 | **a :** 111 **b :** 111 |
| *Oil charge per compressor* | l | 7,7 | 7,7 | 7,7 | 7,7 | 7,7 |

## EVAPORATORS

| TYPE ECOMAX HA | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Number* | | 1 | | | | |
| *Water volume* | $dm^3$ | 94 | 113 | 137 | 137 | 137 |
| *Water piping* | (1) | DN 150 | DN 200 | DN 200 | DN 200 | DN 200 |
| *Test pressure - Bar* | *Water* | 15 | 15 | 15 | 15 | 15 |
| | Refrigerant | 34 | 34 | 34 | 34 | 34 |
| *Operating pressure - Bar* | *Water* | 10 | 10 | 10 | 10 | 10 |
| | Refrigerant | 17 | 17 | 17 | 17 | 17 |

(1) : PN 16 flanges

## CONDENSERS

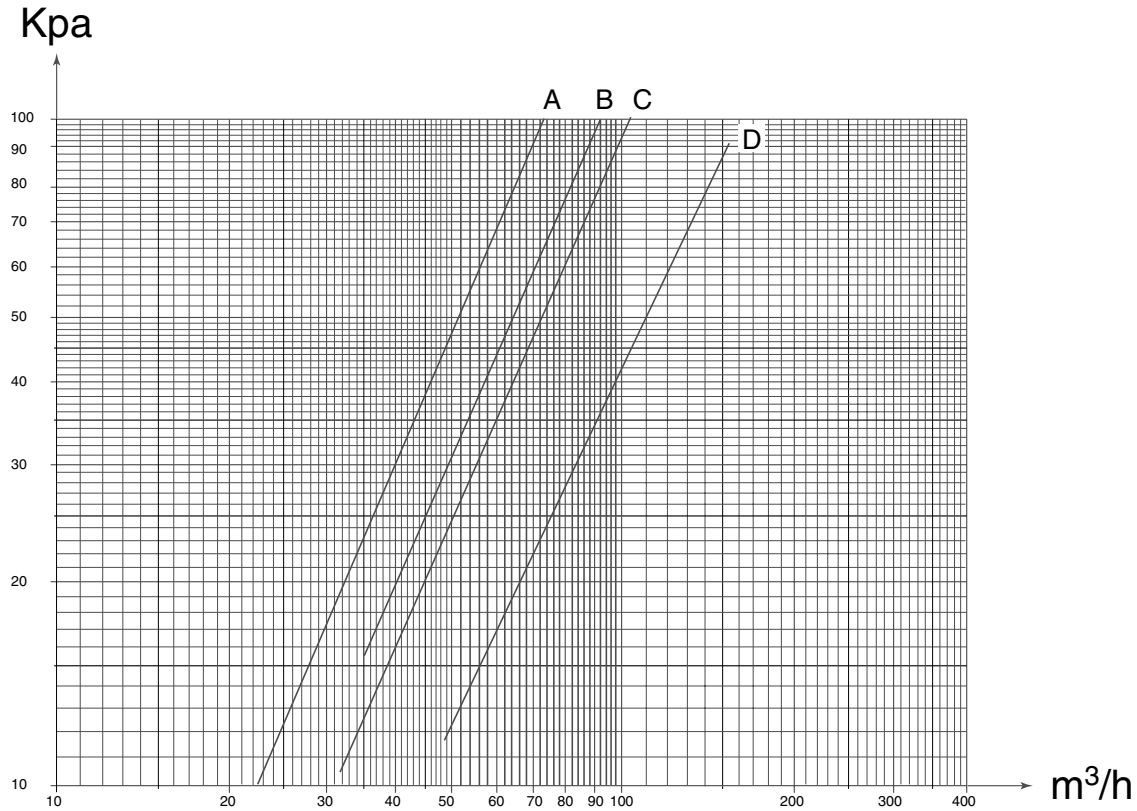
| TYPE | ECOMAX HA | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Ventilation type* | | Axial - Direct coupling 950 tr/mn | | | | |
| *Fan number* | | 6 | **a** : 4<br>**b** : 2 | 8 | 8 | 10 |
| *Air flow rate* | $m^3/h$ | 182 000 | 182 000 | 241 200 | 241 200 | 305 200 |
| *Total input* | kW | 19,8 | 19,8 | 26,4 | 26,4 | 33 |
| *Each fan nominal load current* | A | 6,2 | 6,2 | 6,2 | 6,2 | 6,2 |

## ELECTRICAL DATA

| TYPE | ECOMAX HA | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Maxi power* | *kW* | 157 | 189 | 212 | 252 | 309 |
| *Maxi current* | *A* | 293 | 356 | 401 | 473 | 569 |
| *Start-up intensity* | *A* | 645 | 690 | 675 | 805 | 925 |

*Maximum current and power calculated at 400V/3/50Hz for compressor operation at +12/60°C*
*Max starting current is when last compressor starts up plus all the remaining system is at full load with all condenser fans running.*

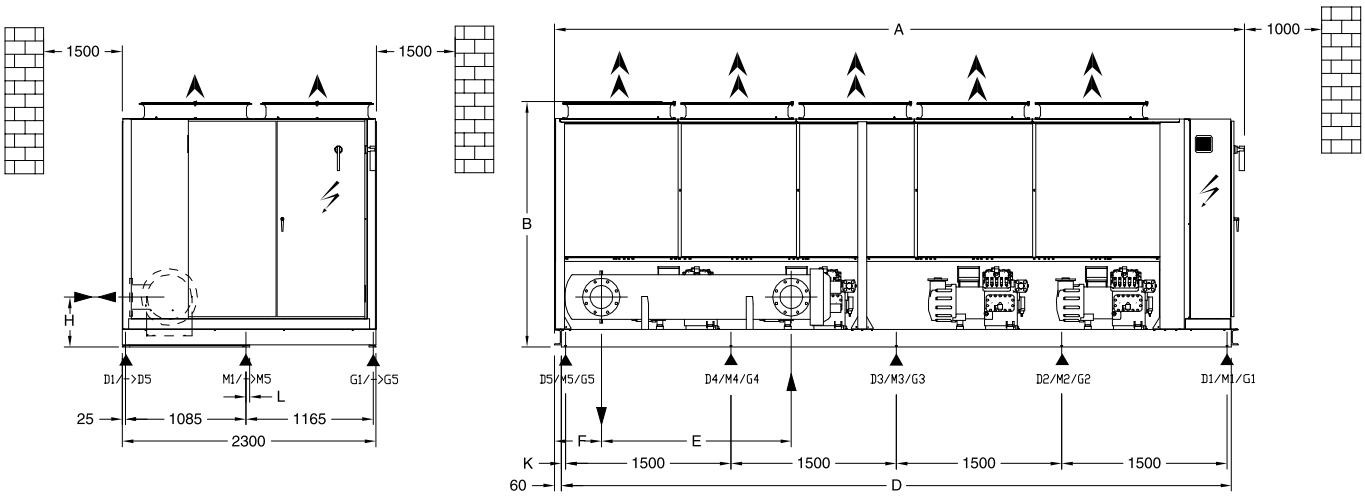
## EVAPORATORS PRESSURE DROPS




| MODEL | ECOMAX HA | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| *Curve* | | A | B | C | C | D |

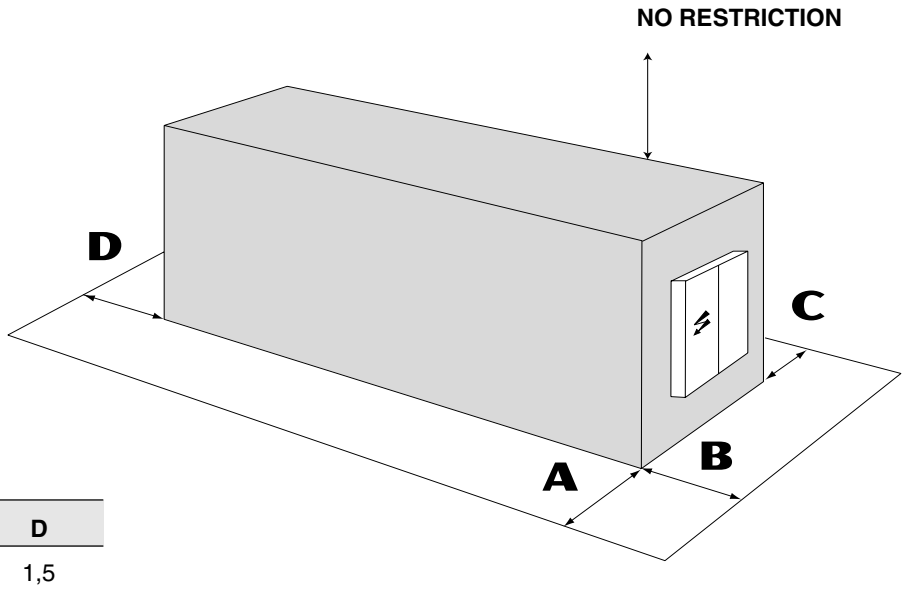
*Pressure drops are given for informations only. A tolerance of +/- 20kPa must be considered when selecting water pumps.*

## DIMENSIONAL DATA



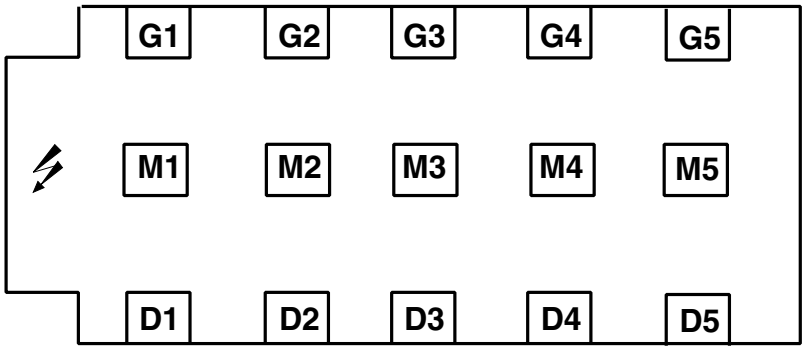

| ECOMAX HA | | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|---|
| **A** | mm | 4050 | 5050 | 5050 | 5050 | 6260 |
| **B** | mm | 2213 | 2213 | 2213 | 2213 | 2213 |
| **D** | mm | 3390 | 3390 | 4390 | 4390 | 6080 |
| **E** | mm | 2253 | 1723 | 2223 | 2223 | 1724 |
| **F** | mm | 293 | 813 | 303 | 303 | 424 |
| **H** | mm | 390 | 405 | 405 | 405 | 450 |
| **K** | mm | 192 | 695 | 695 | 695 | 40 |
| **n Ø 20** | | 3x3 | 3x3 | 3x4 | 3x4 | 3x5 |

## CLEARANCES




| A | B | C | D |
|---|---|---|---|
| (m) 1,5 | 1,5 | 1,5 | 1,5 |

## LOAD DISTRIBUTION (KG - OPERATING WEIGHTS)




Lennox recommend load distribution as detailed above.
To avoid the M point load, it is possible to support the unit Gi and Di point only. In that case, the new value G'i and D'i will be :

$$G'i = Gi + \frac{Mi}{2}$$

$$D'i = Di + \frac{Mi}{2}$$

| Ecomax HA | *Weight without water* | *Operating weight* | D1 | D2 | D3 | D4 | D5 | M1 | M2 | M3 | M4 | M5 | G1 | G2 | G3 | G4 | G5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 2956 | 3050 | 430 | 350 | 270 | - | - | 390 | 390 | 340 | - | - | 260 | 300 | 320 | - | - |
| **412PK** | 3431 | 3540 | 620 | 340 | 220 | - | - | 550 | 400 | 370 | - | - | 340 | 290 | 410 | - | - |
| **462PK** | 4167 | 4300 | 650 | 450 | 490 | - | - | 560 | 460 | 560 | - | - | 330 | 300 | 500 | - | - |
| **532PK** | 4167 | 4300 | 650 | 450 | 490 | - | - | 560 | 460 | 560 | - | - | 330 | 300 | 500 | - | - |
| **622PK** | 5173 | 5340 | 310 | 390 | 400 | 350 | 270 | 350 | 440 | 460 | 440 | 400 | 250 | 200 | 270 | 380 | 430 |

## NOISE LEVELS

| ECOMAX HA | *Spectrum per octave band (dBA)* 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1000 Hz | 2000 Hz | 4000 Hz | 8000 Hz | *Global sound power* dBA |
|---|---|---|---|---|---|---|---|---|---|
| **322PK** | 75 | 87 | 96 | 97 | 97 | 96 | 90 | 85 | **103** |
| **412PK** | 75 | 87 | 96 | 97 | 97 | 96 | 93 | 91 | **103** |
| **462PK** | 76 | 88 | 97 | 98 | 98 | 98 | 94 | 91 | **105** |
| **532PK** | 76 | 88 | 97 | 98 | 98 | 97 | 94 | 92 | **105** |
| **622PK** | 77 | 89 | 98 | 99 | 100 | 98 | 92 | 87 | **105** |

Global sound power level measured in compliance with ISO standard 3744.
Only the sound power spectrum and the global sound power value are used in determining pressure characteristics at owner land limit.

## OPERATING LIMITS

| MODEL ECOMAX | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|
| *Leaving chilled water temperature (1)* | Minimum : + 5°C / Minimum with 30% glycol : -10°C<br>Maximum : +12°C | | | | |
| *Chilled water entering temperature* | Minimum : (2)<br>Maximum : +20°C | | | | |
| *Difference chilled water inlet/outlet* | Minimum : (3)<br>Maximum : +8 °C | | | | |
| *Maximum water flow rate* $m^3/h$ | **89,3** | **153,5** | **153,5** | **153,5** | **153,5** |

(1) *Below +5°C, add glycol to the heating fluid.*

(2) *Value corresponding to the minimum of 5°C chilled water leaving temperature at considered flow rate*

(3) *Corresponding to the evaporator acceptable maximum flow rate*

*APART FROM THESE VALUES, PLEASE CONSULT US*

### MAXIMUM AMBIENT AIR TEMPERATURE

*Temperatures are calculated according to start-up units conditions, with two differents configurations*

❶ Full load starting : maxi.conditions (1)

❷ HP offloading operation

***Maxi ambient air temperature (°C)***

| ECOMAX HA | 322PK | 412PK | 462PK | 532PK | 622PK |
|---|---|---|---|---|---|
| Configuration ❶ | 45,5 | 42,5 | 45 | 42,5 | 43,5 |
| Configuration ❷ | 50 | 48 | 52,5 | 52 | 51,5 |

(1) : Operating limits R407C : 12°C/60°C

To supply and install, where specified in the project n° …. unit(s) air-cooled water chiller with cooling capacity of …. kW, to cool …. m3/sec. of water from …. °C to …. working with …. °C ambient temperature. The unit should work with electricity at …. V. 3ph. 50Hz. The electrical power absorbed should not overcome …. kW. The units COP will be at least …. at the working conditions of the project. Part load COP will be at least …. at the working conditions of the project. For the units with 2, 3 and 4 compressors the chillers will have 2 independent refrigerant circuits, with the respective electronic microprocessor will allow the starting of the compressors and the control of the chiller. Each chiller will be factory assembled on a robust base frame made of zinc coated steel, protected by an epoxy coated paint, with zinc coated steel panels. The unit will be tested at full load in the factory at the nominal working conditions and water temperatures. Before shipment a full refrigerant test will be held to avoid any losses, and the units will be filled with oil and …… refrigerant.

### *General*

Units are leak and pressure-tested at 24.5 bars (350 psi) high side and 14 bars (200 psi) low side, and then evacuated and charged. Packaged units ship with a full operating charge of oil and refrigerant. Unit panels, structural elements, and control boxes are constructed of 1.5 to 3 mm (11 to 16 gauge) galvanized sheet metal. The chiller is constructed on a solid rugged base frame constructed of "C" section steel beams welded together to form a ridged base. The base is structurally able to carry the unit weight and is torsion ally ridged with no vibrating sections. The base is hot dipped galvanised for corrosion protection. The chiller is lifted, moved and mounted via the base frame that contains AVM mounting and lifting points as standard. Unit panels and control boxes are finished with baked-on powder paint, and the structural-steel base is finished with an air-dry paint. The unit is painted to RAL 2009 as standard. The unit will have one single DX evaporator with 2 independent refrigerant circuits, the evaporator water connections are flanged as standard. All the internal surfaces are coated in a clear urethane lacquer to protect the insulation and pipework. The units must be constructed to meet European norms and standards specifically EN 60204-1, NR 2037/2000, ISO9001, ISO 3744 & Eurovent certification performance standards

### *Compressors*

*Motor* - The compressor motors are refrigerant gas cooled, with integral temperature-sensing solid-state overload protection in each phase. The terminal boxes are to IP54 weather protection. Gas flow is sufficient at all times to cool the motor.

*Housing* - The compressor housing is cast iron, and contains: Removable cylinder heads with internal muffling, suction and discharge service valves, crankcase sight glass and heater, oil and suction strainers, and internal relief valves.

*Crankshaft* - The crankshaft is ductile (nodular) iron, drilled for positive oil distribution, with integral counterweights for balancing. The main bearings are insert type, steel-backed
Babbitt. The thrust bearing is bronze with a Babbitt surface.

*Cylinder Assemblies* - Suction and discharge valves are high-quality, non-flexing, stainless steel. The pistons are aluminum alloy with two piston rings. The connecting rods are aluminum alloy with replaceable shell bearings at the big end. Cylinder liners are removable.

*Lubrication* **-** The lubrication is force-fed by a reversible oil pump to all crankshaft and bearing surfaces through a fine mesh stainless steel oil strainer. Compressors must be fitted with an oil differential pressure cut out

*Capacity Contro*l **-** Capacity control is provided by solenoid-actuated, capacity control valves, which are controlled by the microprocessor center.

*Isolation* **-** Each compressor is mounted on isolator pads to reduce vibration transmission to the structure and gas muffler in the discharge line to reduce noise. Compressors can be fitted with suction and discharge isolation valves as an option. Compressors are installed in pairs each set is fitted with an equalized oil balance line to maintain a common oil level when the compressors are operating together or independently.

### *Evaporator*

The single evaporator is a tube-in-shell heat exchanger design, with internally finned copper tubes roller-expanded into the tube sheet. The evaporator is designed, tested, and stamped in accordance with the appropriate pressure-vessel code approval. The evaporator is designed for a waterside working pressure of 10 bars (146 psi) and refrigerant side 17 bars (250psi). Water connections are flanged for simple site connection the water connections must be sealed for shipping. Each shell includes an air vent, a drain, and fittings for temperature control sensors, and is insulated with 13mm (1/2 inch) (K-0.26). Optional evaporator heaters with thermostats are provided to protect the evaporator from freezing at ambient temperatures down to -25°C (-13°F). The evaporator is designed to operate with a flow detection device. Options are for a paddle type (supplied loose fitting by others) or a factory fitted differential pressure type switch. The evaporator will have 2 independent refrigerant circuits.

### *Condenser coil*

The condenser coils are constructed with internally enhanced seamless copper tubes having an "W" configuration and arranged in a staggered row pattern and mechanically expanded into rippled aluminum fins with full fin collars for higher efficiencies. A collar that will increase the surface area in connection with the tubes, protecting them from ambient corrosion, gives the spacing between the fins. The coils have to be washable to maintain operating efficiency. The coils has an integral subcooler circuit which provides sufficient subcooling to effectively eliminate the possibility of liquid flashing and increase the unit's efficiency of 5 to 7% without an increase in power absorbed, and the surface area will be dimensioned in a way to permit a law air velocity.

### *Condenser fans*

The condenser fans are direct drive vertical discharge Hushtone helical type with multiple aerofoil blades for higher efficiencies and lower noise. The fan blade will be of the sickle end type mounted in a bell mouth orifice. The air discharge is vertical and each fan will be coupled to the electrical motor, supplied as standard to IP55 class "F" insulation with 6 poles and capable to work to ambient temperatures of -20°C to +65°C max humidity 80%. The fans are direct driven via a three phase motor with permanently lubricated ball bearings. The motors are designed for external operation and are available in 3 different speeds with the option of two-speed motor.

### *Control panel*

Field power connection, controls interlock terminals, and unit control system shall be centrally located in a IP55 weatherproof cabinet accessible through a key locked door. Power and starting controls shall be separate from safety and operating controls in different compartments of the same panel. All 3-phase connections shall be fully shrouded to prevent accidental contact. Power and starting controls shall include lockable individual thermal overloads and contactors for each compressor winding and fan motors. Operating and safety controls shall be via Climatic II plus solid-state protection for compressor motor; high and low pressure cut-out switch (for each refrigerant circuit); anti-freeze thermostat. The control enclosure will include a mechanical ventilation system with thermostatic control standard on HA and option Std, LN & HE. Standard single point power connections include main three-phase power to the compressors, condenser fans, and (optional) control power transformer, and (optional) connections are available for the 230-volt single-phase power for freeze protection on the evaporator heaters. All internal cables must be mounted on cable tray and tied. The chillers will have full earth bonding between isolated metal parts.

### *Control & capacity regulation*

Will be via the ClimaticII with a weatherproof LCD crystal backlit display 240x128 pixels. Monitoring upto 2050 points

Control interface will be via push button and menu screens with graphic icons for simple use

All alarms and fault are in full written display, fault codes are not acceptable

Functions

1.A full screen display of all operating conditions in a graphic layout

2.Status of Pumps graphic display (chilled water, condenser water and secondary system)

3.Fault history for each refrigeration circuit (last 24 occurrences)

4.Fault history for pumps

5.Hours run

6.Automatic balance of compressor run hours

7.Time clock, day, date for auto scheduling of the chiller

8.Chilled water set point, with programmable predictive PID control

9.Programmable auto reset of chilled water set point based on ambient temperature

10.Programmable condenser fan staging

11.Start and stop of pumps (run and standby)

12. Auto switching if lead pump fails

13.Display of all refrigerant temperature and pressure values, Ambient and Chilled water temperatures

14.Display of timer status (Start and anti recycle)

15.Display of chilled water temperature curve over 24Hrs

16.Adaptive logic to avoid nuisance fault trips with pre alarm display

17.General machine faults; chilled water flow, loss of power, freeze protection

18.Refrigeration circuit faults; Hp & Lp and high discharge temperature

19.Compressor faults; Motor temperature, phase protection,

20.Capacity staging, plus loading delay on start, and predictive control logic

21.Common alarm

22.Fan circuit breaker trip

23.Pump circuit breaker trip

24.Insufficient chilled water flow

25.Programmable temperature difference set point between flow and return water

26.Freeze protection

27. Programmable Minimum and maximum water set point

28.Self diagnostic on sensors and communications

29.Self diagnostic on electronic expansion valves

30.Adaptive Control of Electronic TEV

31.Phase protection

32.Password protection

33.Options for remote control and BMS interface.

### *Refrigerant piping*

Each refrigerant circuit shall include a factory insulated suction line, manual compressor discharge isolation valve(option), manual liquid line isolation valve with charging connection; a replaceable core refrigerant filter drier, sensor indicator; liquid line solenoid valve, electronic thermostatic expansion valve, a discharge line gas muffler and 27 bar relief valve. All refrigerant pipework must be clamped to prevent vibration and all small-bore lines should be high pressure plastic with aircraft type fittings. The refrigerant lines should contain independent Schrader valve test points for maintenance. Each refrigerant circuit must contain a refrigerant circuit economizer to ensure maximum operating efficiency.

#### *Electronic expansion valve*

Each refrigerant circuit will be equipped with an electronic expansion valve, this type of system allows a simple control system that quickly interacts at load variations. This valve combines two functions as a liquid solenoid and electronic expansion valve. It shall be managed directly by the ClimaticII microprocessor

LCA P

On units supplied as condensing units there is no HE version. The LCA units are identical to the LCH P units but do not have the Evaporator, expansion valve, Refrigerant Drier, liquid line solenoid valve fitted.

There is the option to have a refrigerant liquid receiver fitted on the unit.

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