ZETA REV .Ei

29÷84 kW

General
Chillers with DC inverter-controlled brushless compressor.

Configurations
SEi: Compact unit

HEi: High efficiency unit

LN: Low noise unit

Optional hydronic module

Strengths
- Chiller with low refrigerant charge
- Night Shift function for noise control (option)
- Hydraulic module tank (option) to guarantee a minimum volume of water in the system
- BlueThink advanced control with integrated web server. Multilogic function and Blueye® supervision system. (options)
- Flowzer: inverter driven pumps (options)
- Conformity with Ecodesign, Regulation 2016/2281 Tier 2 (2021)

BlueBox

ZETA REV .Ei

EFFICIENCY IS SYNONYMOUS WITH INVERTER

The global push to increase the energy efficiency of buildings and systems is driving the development of all technologies that can make a contribution.

In the HVAC sector, this is realized in the development of technologies that enable the maximum energy saving to be obtained in partial load conditions.

The technology that, more than any other technology, enables considerable efficiency improvements in operation at partial loads is inverter technology applied to compressors. This allows the maximum efficiency to be obtained while maintaining the same operating limits of conventional units.

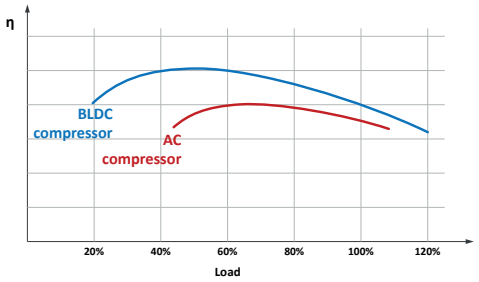
The more variable the load (as in comfort applications), or the longer the operating cycle where source temperatures are variable (as for combined air-water units in industrial applications), the stronger this advantage becomes.

The need to comply with the energy efficiency targets set by environmentally friendly design will increasingly push the adoption of units equipped with this technology.

Zeta Rev *Ei

All the units use a hermetic orbiting spiral scroll compressor with brushless motor controlled by a DC inverter. In the models with two or three compressors, this is connected in tandem or trio with hermetic scroll compressors with asynchronous ON/OFF motor.

In comparison to a compressor with asynchronous motor, a compressor with brushless motor (BLDC motor or PMDC motor) has a rotor containing permanent magnets. These make it intrinsically more efficient thanks to the magnetization energy saving of the rotor and to the fact that there are no rubbing parts.



As can be seen in the diagram, a brushless motor is more efficient than a normal asynchronous motor and its efficiency reaches its maximum when the compressor is working under partial load conditions.

It can also be seen that, since it is specially built to also operate at low speeds, a BLDC compressor has a wider speed adjustment range than a conventional compressor controlled through an AC inverter.

The inverter-controlled compressor can modulate its speed between about 30 and 105 rps.

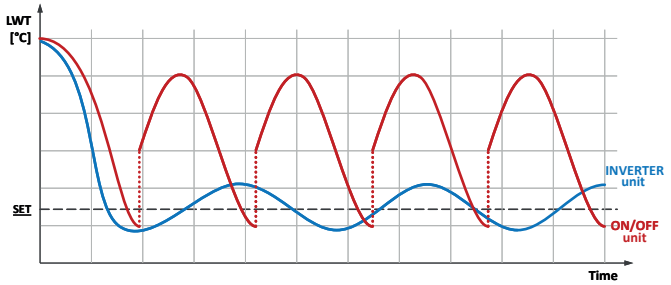
Considering the efficiency performance of the brushless motor and the overall efficiency performance of the unit, we find that the unit can express its best efficiency performance level at a speed of 90rps.

Therefore, if required, the unit can develop a capacity higher than the nominal capacity with a slightly lower efficiency level. This capacity is particularly interesting in all situations where it is necessary to satisfy short load peaks.

The BLDC compressor cannot be powered directly, and must be controlled through a DC inverter that manages the acceleration and deceleration ramps and its starting without inrush currents and ensures that the compressor always works in safe conditions and stays within the allowed operating limits. This is essential to preserve the efficiency and reliability of the compressor.

Management of a variable capacity machine

In addition to the advantage of greater efficiency, the use of a modulating compressor allows the unit to adapt its cooling capacity to the actual heat load to be met.



Normally, the capacity supplied by the unit exceeds the capacity actually required by the system.

In this condition, a machine with ON/OFF compressors will go through a sequence of ON and OFF cycles in an attempt to keep the water temperature within a set differential.

At each subsequent restart, the refrigerant circuit must find the best balance condition and this phase requires a time that ranges from 1 to 3 minutes during which the unit undergoes irreversible energy losses and has a very low energy efficiency.

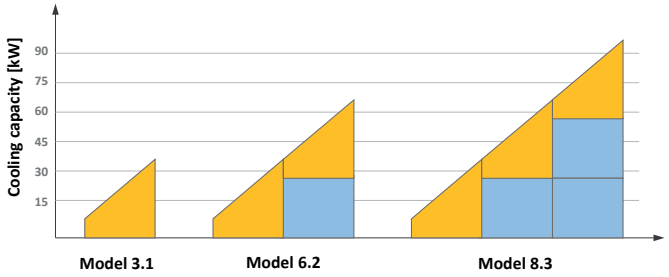
In a different way, a machine with inverter-controlled compressor will be able to modulate its cooling capacity and adapt to the load.

Through control of the water outlet temperature and its variation over time, the controller of the unit can determine the capacity level required by the system and therefore adjust the speed of the compressor through an analogue signal supplied to the inverter.

The further away the water outlet temperature is from the set point, the greater the capacity that will be required by the controller. As the outlet temperature approaches the set point temperature, the controller will slow down the compressor and limit temperature oscillation as much as possible.

In this way, as far as possible, the controller keeps the compressor always running in modulating mode, thereby avoiding the irreversible energy losses of the starts and exploiting the condition in which the brushless compressor works with its maximum efficiency.

For multi-compressor models, the flexibility of multiscroll units is added to the modulation precision of the inverter-controlled compressor.



The controller uses the ON/OFF compressors to come near the required load, and modulates the capacity of the inverter compressor in order to carry out fine control.

ZETA REV .Ei

PRODUCT DESCRIPTION

Chillers with DC inverter-controlled brushless compressor.

BODY

The structure of the unit is made of galvanized sheet-iron coated with polyester powder in RAL 5017/7035 at 180°C, which makes it highly resistant to weather conditions.

The structure is a load-bearing frame, with removable panelling lined with sound absorbing expanded polyurethane matting.

All screws and bolts are stainless steel.

REFRIGERANT

The unit is charged with refrigerant R410A, with GWP=2088 (value at 100 years).

COMPRESSORS

The compressors are hermetic orbiting spiral scroll compressors, each fitted with oil level sight glass.

Depending on the model, there are the following compressor configurations:

- models with just one compressor (x.1) use a single modulating compressor
- models with two compressors (x.2) use one modulating compressor connected in tandem with one ON/OFF compressor
- models with three compressors (x.3) use one modulating compressor connected in trio with two ON/OFF compressors

The modulating compressors are hermetic scroll compressors with permanent-magnet brushless motor and are fitted with oil level sight glass.

The speed of the modulating compressor is varied, depending on the total heat load, roughly between 30 and 105 rps. 30rps and 105rps Its nominal capacity relates to a speed of 90rps. 90rps.

The speed of rotation of the compressor is variable in the range 1.800÷6.300 rpm.

The modulating compressors are controlled through DC inverter. This also has the following functions:

- management of acceleration and deceleration ramps
- management of the operating envelope of the modulating compressor
- management of the alarms and safety devices of the modulating compressor

The use of a modulating compressor allows the total inrush current to be reduced because it is always started with an acceleration ramp. For models with two or three compressors, the starting of the ON/OFF compressors will always take place with the modulating compressor running at low speed, again in order to reduce the inrush current of the unit to a minimum.

The ON/OFF compressors are hermetic orbiting spiral scroll compressors and are fitted with oil level sight glass.

The technical compartment enclosing the compressors is soundproofed by sound absorbing material with interposed soundproofing material. The compressors can be accessed through special panelling that allows maintenance operations to be carried out even with units running.

For units with two or three compressors, there is also an oil equalization line.

All the compressors are fitted with crankcase heating device.

SOURCE-SIDE HEAT EXCHANGER

For the cooling only units, the exchangers are made with microchannel aluminium coils.

The microchannel coils are made using specific aluminium alloys for the tubes and for the fins. This allows the effects of galvanic corrosion to be drastically reduced to always ensure protection of the tubes that confine the refrigerant. The entire coil is also subjected to SilFLUX coating processes (or equivalent) or has zinc added to further increase its corrosion resistance.

E-coated microchannel coils are available as an option. This option is strongly recommended for applications in coastal or highly industrialized areas.

The use of microchannel coils compared to conventional copper/aluminium coils reduces the total weight of the unit by about 10% and gives a reduction in refrigerant charge of at least 30%.

FANS

The fans are axial fans, directly coupled to a three-phase 6-pole electric motor, with integrated thermal overload protection (Klixon®) and IP 54 protection rating.

The fan includes the shroud, designed to optimize its efficiency and reduce noise emission to a minimum, and the safety guard.

USER-SIDE HEAT EXCHANGER

The exchanger is a braze-welded stainless steel plate heat exchanger, insulated with a shroud of closed-cell insulating material.

The exchanger is also equipped with thermostat-controlled anti-freeze heater to protect it from ice formation when the unit is not running.

REFRIGERANT CIRCUIT

Unit provided with a refrigerant circuit that comprises:

- valve on the liquid line
- charging valves
- liquid sight glass
- welded dehydrator filter on sizes 3.1 and 6.2
- replaceable solid cartridge dehydrator filter on size 8.3
- electronic expansion valve
- high and low pressure switches

The pipes of the circuit and the exchanger are insulated with extruded closed-cell expanded elastomer.

ELECTRICAL CONTROL PANEL

The electrical control panel is made in a painted galvanized sheet-iron box with forced ventilation and IP54 protection rating.

The electrical control panel of the basic unit comprises:

- main disconnect switch
- automatic circuit breakers for compressors with fixed calibration
- fuses for protecting the fans and auxiliary circuits
- thermal magnetic circuit breakers for the pumps (if present)
- contactors for compressors, fans and pumps (if present)
- phase-cutting speed adjuster
- phase monitor
- potential-free general alarm contacts
- single potential free operating contacts for compressors, fans and pumps (if present)
- microprocessor controller with display accessible from the outside

All the electrical cables inside the panel are numbered and the terminal board dedicated to the customer's connections is coloured orange so that it can be quickly identified in the panel.

The power supply of the unit is 400V/3~+N/50Hz.

CONTROL BLUETHINK

Main controller functions

The microprocessor control allows the following functions:

- water temperature control, with control of the water leaving the user-side exchanger
- management of the inverter-controlled compressor and its operating range
- compressor timings
- automatic rotation of compressor starting sequence
- freeze protection
- recording of the log of all machine inputs, outputs and states
- automatic rotation of compressor starting sequence
- recording of the alarm log
- digital input for general ON/OFF
- RS485 serial port with Modbus protocol
- Ethernet serial port with Modbus protocol and integrated web server preloaded web page

For further details on available functions and on displayed information, you can refer to the specific documentation of the control.

By default, the serial connections present as standard are enabled only for reading from BMS. Enabling of writing from BMS is to be requested when ordering.

Main functions of the webserver

As standard, the Bluethink controller integrates a webserver with a preloaded web page that is accessed via password.

The web page allows the following functions to be carried out (some of these are available only for users with advanced level rights):

- display of the main functions of the unit such as unit serial n°, size, refrigerant
- display of the general status of the machine: water inlet and outlet temperatures, outside air temperature, evaporating and condensing pressures, suction and discharge temperatures
- display of the status of compressors, fans, pumps, thermostatic valves
- display in real time of the graphs of the main quantities
- display of the graphs of logged quantities
- display of alarm log
- management of users on several levels
- remote ON/OFF
- remote set point change
- remote time band change

Human-Machine Interface

The control has a graphic display that allows the following information to be displayed:

- water inlet and outlet temperature
- set temperature and differential set points
- description of alarms
- hour meter of operation and number of start-ups of the unit, the compressors and the pumps (if present)
- high and low pressure values, and relevant condensing and evaporating temperatures
- external air temperature
- superheating at compressor suction.

CONTROLS AND SAFETY DEVICES

- chilled water temperature probe
- antifreeze probe at outlet of each user-side heat exchanger
- high pressure switch (with manual reset)
- low pressure safety device (with manual reset managed by the controller)
- compressor overtemperature protection
- fan overtemperature protection
- water differential pressure switch

TESTING

All the units are factory-tested and supplied complete with oil and refrigerant.

PACKAGING

The unit is made and shipped on a wooden pallet that allows the unit to be handled using a forklift truck.

VERSIONS

ZETA REV SEi: compact unit

In this version, the unit combines the high seasonal efficiency of a unit with modulating capacity with a small footprint

ZETA REV HEi: high efficiency unit

In this version, the unit uses oversize coils in order to increase efficiency, especially at reduced capacity.

OPTIONS

/LN: silenced unit

The unit with this option has a soundproof casing inserted on the modulating compressor.

HYDRAULIC MODULES

All units can be fitted with hydraulic module in various configurations:

- /1P: hydraulic module with one pump
- /2P: hydraulic module with two pumps
- /1PS: hydraulic module with one pump and buffer tank
- /2PS: hydraulic module with two pumps and buffer tank

All the above-mentioned modules have pumps with standard discharge head.

The following are also available:

- modules /1PM, /2PM, /1PMS and /2PMS that have pumps with increased available discharge head

Hydraulic modules with one pump have:

- one pump
- a gate valve on the delivery side of the pump
- an expansion vessel

Hydraulic modules with two pumps have:

- two pumps
- a check valve on the delivery side of each pump
- a gate valve on the outlet of the delivery manifold
- an expansion vessel

In the version with 2 pumps, these are always with one on standby while the other is working. Switching over between the pumps is automatic and is done by time (to balance the hours of operation of each one) or in the event of failure.

Hydraulic modules with tank also have:

- a gate valve at the inlet of the pump or the suction manifold
- a tank with drain valve and air valve

Refer to the table of configurations that are not possible to check for availability of specific set-ups.

TECHNICAL SPECIFICATIONS

ZETA REV SEi

			6.2	8.3
Cooling (A35°C; W7°C; 90Hz)				
Refrigeration capacity	(1)	kW	58	84
Total absorbed power	(1)	kW	20	28
EER	(1)		2,93	2,95
EER energy class (Eurovent)	(1)		B	B
ESEER			4,47	4,47
Compressors				
Compressors/Circuits		n°/n°	2/1	3/1
Capacity modulation range	(4)	%	17% / 108%	11% / 106%
Refrigerant charge (MCHX)		kg	5	8,5
Refrigerant charge (Cu/Al)		kg	10	17
Fans				
Diameter		mm	630	630
Quantity		n°	2	3
Total air flow for chiller		m³/h	17.000	25.500
User-side heat exchanger				
Quantity		n°	1	1
Water flow (A35°C; W7°C; 90Hz)	(1)	m³/h	10,0	14,5
Pressure drop (A35°C; W7°C; 90Hz)	(1)	kPa	29	27
Noise levels				
Sound power lev.	(2)	dB(A)	85	86
Sound pressure lev.	(3)	dB(A)	54	54
Sound power lev. LN vers.	(2)	dB(A)	83	84
Sound pressure lev. LN vers.	(3)	dB(A)	52	52
Dimensions and weights**				
Length		mm	2.247	3.258
Depth		mm	1.028	1.135
Height		mm	1.788	1.788
Operating weight		kg	486	699

(1) External air temperature 35°C; user-side heat exchanger inlet-outlet water temperature 12-7°C. Values compliant with standard EN 14511.

(2) Unit operating at nominal operating capacity, without any accessories, with external air temperature of 35°C and user-side heat exchanger water inlet-outlet temperature of 12-7°C. Binding values. Values obtained from measures taken according to standard ISO 3744 and to the Eurovent certification programme where applicable.

(3) Values obtained from the sound power level (conditions: note 2), related to a distance of 10 m from the unit in free field with directivity factor Q=2. Non-binding values.

(4) Approximate value. The minimum capacity reached by the unit depends on the operating conditions. The value shown may not be suitable for calculating the minimum volume of water: to do this, consult the “Minimum water content in the system” section.

** Basic CH unit without included accessories

ZETA REV HEi

			3.1	6.2	8.3
Cooling (A35°C; W7°C; 90Hz)					
Refrigeration capacity	(1)	kW	32	61	91
Total absorbed power	(1)	kW	10	19	29
EER	(1)		3,12	3,28	3,11
EER energy class (Eurovent)	(1)		A	A	A
ESEER			4,69	4,67	4,71
Compressors					
Compressors/Circuits		n°/n°	1/1	2/1	3/1
Capacity modulation range	(4)	%	33% / 117%	17% / 108%	11% / 106%
Refrigerant charge (MCHX)		kg	3	7	9
Refrigerant charge (Cu/Al)		kg	5,5	16	17
Fans					
Diameter		mm	630	630	800
Quantity		n°	2	3	2
Total air flow for chiller		m³/h	17.000	25.500	41.000
User-side heat exchanger					
Quantity		n°	1	1	1
Water flow (A35°C; W7°C; 90Hz)	(1)	m³/h	5,5	10,5	15,7
Pressure drop (A35°C; W7°C; 90Hz)	(1)	kPa	24	24	35
Noise levels					
Sound power lev.	(2)	dB(A)	84	85	86
Sound pressure lev.	(3)	dB(A)	52	53	54
Sound power lev. LN vers.	(2)	dB(A)	82	83	84
Sound pressure lev. LN vers.	(3)	dB(A)	50	51	52
Dimensions and weights**					
Length		mm	1.750	3.258	3.258
Depth		mm	1.045	1.135	1.135
Height		mm	1.450	1.788	1.900
Operating weight		kg	355	660	754

(1) External air temperature 35°C; user-side heat exchanger inlet-outlet water temperature 12-7°C. Values compliant with standard EN 14511.

(2) Unit operating at nominal operating capacity, without any accessories, with external air temperature of 35°C and user-side heat exchanger water inlet-outlet temperature of 12-7°C. Binding values. Values obtained from measures taken according to standard ISO 3744 and to the Eurovent certification programme where applicable.

(3) Values obtained from the sound power level (conditions: note 2), related to a distance of 10 m from the unit in free field with directivity factor Q=2. Non-binding values.

(4) Approximate value. The minimum capacity reached by the unit depends on the operating conditions. The value shown may not be suitable for calculating the minimum volume of water: to do this, consult the “Minimum water content in the system” section.

** Basic CH unit without included accessories

ECODESIGN

INTRODUCTION

The Ecodesign/ErP Directive (2009/125/EC) lays down new standards for more efficient energy use.

The Directive contains various regulations; as regards chiller products and heat pumps, the regulations of interest are the following:

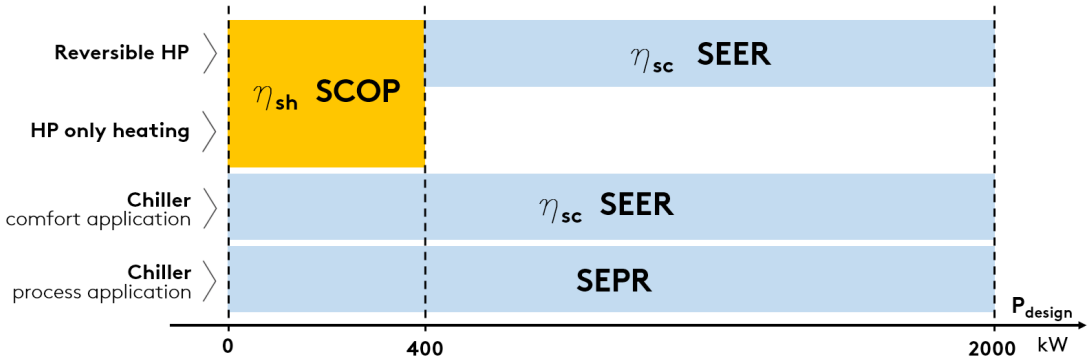
- Regulation 2013/813, for small heat pumps (Pdesign ≤ 400 kW)
- Regulation 2016/2281, for chillers and heat pumps with Pdesign > 400 kW
- Regulation 2013/811, for heat pumps with Pdesign ≤ 70 kW.

The last-mentioned regulation (2013/811) regards the labelling (Ecolabel certification) of small heat pumps.
The other two regulations (2013/813 and 2016/2281) set seasonal efficiency targets that the products must comply with to be sold and installed in the European Union (essential requirement for CE marking).
These efficiency limits are defined through ratios, which are respectively:

- ηsh (SCOP), with reference to regulation 2013/813
- ηsc (SEER) for comfort applications and SEPR for process applications, with reference to regulation 2016/2281.

As regards regulation 2016/2281, with effect from 1st January 2021, the required minimum efficiency limit will be raised (Tier 2) from the current threshold (Tier 1).

The figure below schematically illustrates the correspondence between product and reference energy ratio.



Some notes and clarifications:

For comfort applications, regulation 2016/2281 sets the ηsc (SEER) ratio in two different operating conditions:

- SEER calculated with machine inlet/outlet water temperature of 12/7°C (low temperature application),
- SEER calculated with machine inlet/outlet water temperature of 23/18°C (medium temperature application).

The minimum efficiency requirement is the same, but can be met at condition 12/7°C or at condition 23/18°C, depending on the application envisaged for the machine.

Regulation 2013/813 distinguishes two different types: at low temperature and at medium temperature.
The following refer to the application at low temperature: (low temperature application) all heat pumps whose maximum delivery temperature for heating purposes is lower than 52°C with source at temperature of -7°C and -8°C wet bulb (air-water unit) or inlet 10°C (water-water unit), at the reference design conditions for an average climate.For these, the efficiency ratio is "low temperature application" (outlet water temperature 35°C).
For all the other heat pumps, the efficiency ratio is related to "medium temperature application" (outlet water temperature 55°C).
The ratios must be calculated according to the reference European heating season in average climatic conditions.

The minimum efficiency requirements set by the regulations are indicated below.

REGULATION 2016/2281, comfort application

TYPE OF UNIT		MINIMUM REQUIREMENT			
		Tier 1		Tier 2 (2021)	
SOURCE	**Pdesign**	**ηsc [%]**	**SEER**	**ηsc [%]**	**SEER**
air	< 400kW	149	3,8	161	4,1
air	≥ 400kW	161	4,1	179	4,55
water	< 400kW	196	5,1	200	5,2
water	≥ 400kW and < 1500kW	227	5,875	252	6,5
water	≥ 1500kW	245	6,325	272	7

REGULATION 2016/2281, process application

TYPE OF UNIT		MINIMUM REQUIREMENT	
		Tier 1	Tier 2 (2021)
SOURCE	**Pdesign**	**SEPR**	**SEPR**
air	< 400kW	4,5	5
air	≥ 400kW	5	5,5
water	< 400kW	6,5	7
water	≥ 400kW and < 1500kW	7,5	8
water	≥ 1500kW	8	8,5

REGULATION 2013/813

SOURCE	APPLICATION	MINIMUM REQUIREMENT	
		ηsh [%]	**SCOP**
air	low temperature application	125	3,2
water	low temperature application	125	3,325
air	medium temperature application	110	2,825
water	medium temperature application	110	2,95

The conformity of the product must be checked according to the type of application, whether comfort or process, and at the required outlet water temperature.

The two schematic tables below, respectively for comfort application and for process application, indicate the reference of the required conformity according to the type of product and the set point temperature (reference to regulations 2016/2281 and 2013/813).

Important note: for mixed comfort and process applications, the reference application for conformity is the comfort application.

COMFORT APPLICATION

PRODUCT	OUTLET WATER TEMPERATURE	COMPLIANCE INDEX	REGULATION
Chiller	< 18°C	SEER/ηsc low temperature application	2016/2281
	≥ 18°C	SEER/ηsc medium temperature application	2016/2281
Heat pumps (reversible and only heating) Pdesign≤400kW		SCOP/ηsh	2013/813
Reversible heat pumps Pdesign>400kW	< 18°C	SEER/ηsc low temperature application	2016/2281
	≥ 18°C	SEER/ηsc medium temperature application	2016/2281
Heat pumps only heating Pdesign>400kW		-	-

- = exemption from Ecodesign

PROCESS APPLICATION

PRODUCT	OUTLET WATER TEMPERATURE	COMPLIANCE INDEX	REGULATION
Chiller	≥ +2°C , ≤ 12°C	SEPR	2016/2281
	> 12°C	-	-
	> -8°C , < +2°C	-	-

- = exemption from Ecodesign

Some specifications and notes follow.

Partly completed machinery

The term partly completed machinery refers to all units without a user-side or source-side heat exchanger, and therefore to all LC, LE, LC/HP and LE/HP versions. Since these are "non-complete" machines, conformity with Ecodesign depends on combination with the remote heat exchanger.

All the partly completed machinery is CE marked and accompanied by a declaration of conformity. Installation in European Union countries is therefore allowed; correct selection and installation of the remote heat exchanger must be ensured, in accordance with the above cases.

EC fans:

The only option that positively affects the performance of the unit, by increasing its seasonal energy efficiency ratio, is the VEC accessory.

A unit equipped with EC fans has a higher SEER (ηsc) than the configuration with standard fans.

ZETA REV .EI RANGE

As specifically regards the Zeta Rev Ei range, the regulations of interest for the various units in various configurations are indicated below.

Zeta Rev SEi:
- regulation 2016/2281

Zeta Rev HEi:
- regulation 2016/2281

The tables below give information on the conformity of the units and the seasonal energy performance ratios with regard to the reference regulation.

ZETA REV SEi

			6.2	8.3
REGULATION 2016/2281				
Pdesign	(1)	kW	58	84
Compliance 12/7				
Compliance	(1)		Y	Y
ηsc	(1)	%	163	161,4
SEER	(1)		4,15	4,12
Compliance Tier 2 (2021)	(1)		Y	Y
Compliance 12/7 unit with EC fans				
Compliance	(1)		Y	Y
ηsc	(1)	%	176,7	176,7
SEER	(1)		4,49	4,49
Compliance Tier 2 (2021)	(1)		Y	Y
Compliance 23/18				
Compliance	(2)		Y	Y
ηsc	(2)	%	-	-
SEER	(2)		-	-
Compliance SEPR				
Compliance	(3)		Y	Y
SEPR	(3)		5,53	5,59

ZETA REV HEi

			3.1	6.2	8.3
REGULATION 2016/2281					
Pdesign	(1)	kW	32	61	91
Compliance 12/7					
Compliance	(1)		Y	Y	Y
ηsc	(1)	%	165,2	174,8	161,4
SEER	(1)		4,21	4,45	4,11
Compliance Tier 2 (2021)	(1)		Y	Y	Y
Compliance 12/7 unit with EC fans					
Compliance	(1)		Y	Y	Y
ηsc	(1)	%	178,8	188,6	176,7
SEER	(1)		4,54	4,79	4,49
Compliance Tier 2 (2021)	(1)		Y	Y	Y
Compliance 23/18					
Compliance	(2)		Y	Y	Y
ηsc	(2)	%	-	-	-
SEER	(2)		-	-	-
Compliance SEPR					
Compliance	(3)		Y	Y	Y
SEPR	(3)		6,43	6,17	5,86

Y = unit in compliance with Ecodesign at the indicated condition.

(1) User-side heat exchanger water inlet/outlet temperature 12/7°C (low temperature application), with reference to regulation 2016/2281 and standard EN 14825.

(2) User-side heat exchanger water inlet/outlet temperature 23/18°C (medium temperature application), with reference to regulation 2016/2281 and standard EN 14825.

(3) User-side heat exchanger water inlet/outlet temperature 12/7°C, with reference to regulation 2016/2281 and norm EN 14825.

INSTALLATION ADVICE

The units described in this document are, by nature, strongly affected by the characteristics of the system, the working conditions and the installation site.

Remember that the unit must be installed by a qualified and skilled technician, and in compliance with the national legislation in force in the destination country.

The installation must be done in such a way that it will be possible to carry out all routine and non-routine maintenance operations.

Before starting any work, you must carefully read the "Installation, operation and maintenance manual" of the machine and do the necessary safety checks to prevent any malfunctioning or hazards.

We give some advice below that will allow you to increase the efficiency and reliability of the unit and therefore of the system into which it is inserted.

Water characteristics

To preserve the life of the exchangers, the water is required to comply with some quality parameters and it is therefore necessary to make sure its values fall within the ranges indicated in the following table:

Total hardness	2,0 ÷ 6,0 °f
Langelier index	- 0,4 ÷ 0,4
pH	7,5 ÷ 8,5
Electrical conductivity	10÷500 µS/cm
Organic elements	-
Hydrogen carbonate (HCO3-)	70 ÷ 300 ppm
Sulphates (SO42-)	< 50 ppm
Hydrogen carbonate / Sulphates (HCO3-/SO42-)	> 1
Chlorides (Cl-)	< 50 ppm
Nitrates (NO3-)	< 50 ppm
Hydrogen sulphide (H2S)	< 0,05 ppm
Ammonia (NH3)	< 0,05 ppm
Sulphites (SO3), free chlorine (Cl2)	< 1 ppm
Carbon dioxide (CO2)	< 5 ppm
Metal cations	< 0,2 ppm
Manganese ions (Mn++)	< 0,2 ppm
Iron ions (Fe2+ , Fe3+)	< 0,2 ppm
Iron + Manganese	< 0,4 ppm
Phosphates (PO43-)	< 2 ppm
Oxygen	< 0,1 ppm

Installation of water filters on all the hydraulic circuits is obligatory.

The supply of the most suitable filters for the unit can be requested as accessory. In this case, the filters are supplied loose and must be installed by the customer following the instructions given in the installation, operation and maintenance manual.

Glycol mixtures

With temperatures below 5°C, it is mandatory to work with water and anti-freeze mixtures, and also change the safety devices (anti-freeze, etc.), which must be carried out by qualified authorised personnel or by the manufacturer.

Liquid outlet temperature or minimum ambient temperature	°C	0	-5	-10	-15	-20	-25	-30	-35	-40
Freezing point	°C	-5	-10	-15	-20	-25	-30	-35	-40	-45
Ethylene glycol	%	6	22	30	36	41	46	50	53	56
Propylene glycol	%	15	25	33	39	44	48	51	54	57

The quantity of antifreeze should be considered as % on weight

Minimum water content in the system

For correct operation of the unit, it is necessary to ensure a buffering on the system such as to comply with the minimum operating time considering the greater between the minimum OFF time and the minimum ON time. In short, these contribute to limiting the number of times the compressors are switched on per hour and to preventing undesired deviations from the set point of the delivered water temperature.

Larger amounts of water are in any case always preferable, because they allow a smaller number of starts and switch-offs of the compressors, less wear of them and an increase in the efficiency of the system as a consequence of a reduction in the number of transients.

The following experimental formula allows the minimum water volume of the system to be calculated:

$$V_{min} = \frac{P_{tot} \cdot 1.000}{N} \cdot \frac{300}{\Delta T \cdot \rho \cdot c_p} + P_{tot} \cdot 0{,}25$$

where

Vmin is the minimum water content of the system [l]

Ptot is the total cooling capacity of the machine [kW]

N: number of capacity reduction steps

ΔT: differential allowed on the water temperature. Unless otherwise specified, this value is considered to be 2.5K

ρ: density of the heat-carrying fluid. Unless otherwise specified, the density of water is considered

cp: specific heat of the heat-carrying fluid. Unless otherwise specified, the specific heat of water is considered

Considering the use of water and grouping together some terms, the formula can be re-written as follows:

$$V_{min} = \frac{P_{tot}}{N} \cdot 17{,}2 + P_{tot} \cdot 0{,}25$$

N can assume the following values:

- N=3 for units with just one inverter-controlled compressor (model 3.1)
- N=6 for units with 2 compressors of which one is controlled by inverter (model 6.2)
- N=9 for units with 3 compressors of which one is controlled by inverter (model 8.3)

Installation site

To determine the best installation site for the unit and its orientation, you should pay attention to the following points:

- compliance with the clearance spaces indicated in the official dimensional drawing of the unit must be guaranteed so as to ensure accessibility for routine and non-routine maintenance operations
- you should consider the origin of the hydraulic pipes and their diameters because these affect the radiuses of curvature and therefore the spaces needed for installing them
- you should consider the position of the cable inlet on the electrical control panel of the unit as regards the origin of the power supply
- if the installation includes several units side by side, you should consider the position and dimensions of the manifolds of the user-side exchangers and of any recovery exchangers
- if the installation includes several units side by side, you should consider that the minimum distance between units is 3 metres
- you should avoid all obstructions that can limit air circulation to the source-side exchanger or that can cause recirculation between air supply and intake
- you should consider the orientation of the unit to limit, as far as possible, exposure of the source-side exchanger to solar radiation
- if the installation area is particularly windy, the orientation and positioning of the unit must be such as to avoid air recirculation on the coils. If necessary, we advise making windbreak barriers in order to prevent malfunctioning.

Once the best position for the unit has been identified, you must check that the support slab has the following characteristics:

- its dimensions must be proportionate to those of the unit: if possible, longer and wider than the unit by at least 30 cm and 15/20cm higher than the surrounding surface
- it must be able to bear at least 4 times the operating weight of the unit
- it must allow level installation of the unit: although the unit is installed on a horizontal base, make slopes in the support surface to convey rain water or defrost water to drains, wells or in any case to places where it cannot generate an accident hazard due to ice formation. All heat pump version units are equipped with discharge manifolds for the condensed water; these can be manifolded to facilitate condensate discharge.

The units are designed and built to reduce to a minimum the level of vibration transmitted to the ground, but it is in any case advisable to use rubber or spring anti-vibration mounts, which are available as accessory and should be requested when ordering.

The anti-vibration mounts must be fixed on before positioning the unit on the ground.

In the event of installation on roofs or intermediate floors, the pipes must be isolated from the walls and ceilings.

It is advisable to avoid installation in cramped places, to prevent reverberations, reflections, resonances and acoustic interactions with elements outside the unit.

It is essential that any work done to soundproof the unit does not affect its correct installation or correct operation and, in particular, does not reduce the air flow rate to the source-side exchanger.

Installations that require the use of treated coils

If the unit has to be installed in an environment with a particularly aggressive atmosphere, coils with special treatments are available as options.

- e-coated microchannel coils
- coils with anti-corrosion treatment (accessory available only for units with Cu/Al coil)

A description of the individual accessories is available in the "Description of accessories" section.

The type of coil treatment should be chosen with regard to the environment in which the unit is to be installed, through observation of other structures and machinery with exposed metal surfaces present in the destination environment.

The cross observation criterion is the most valid method of selection currently available without having to carry out preliminary tests or measurements with instruments. The identified reference environments are:

- coastal/marine
- industrial
- urban with a high housing density
- rural

Please note that in cases where different conditions co-exist, even for short periods, the choice must be suitable for preserving the exchanger in the harsher environmental conditions and not in conditions between the worst and best situation.

Particular attention must be given in cases where an environment that is not particularly aggressive becomes aggressive as a consequence of a concomitant cause, for example, the presence of a flue outlet or an extraction fan.

We strongly suggest choosing one of the treatment options if at least one of the points listed below is verified:

- there are obvious signs of corrosion of the exposed metal surfaces in the installation area
- the prevailing winds come from the sea towards the unit
- the environment is industrial with a significant concentration of pollutants
- the environment is urban with a high population density
- the environment is rural with the presence of organic discharges and effluents

In particular, for installations near the coast, the following instructions apply:

- for installations between 1 and 20 km from the coast of units with microchannel coil, we strongly recommend using the accessory "E-coated microchannel coils"
- for installations between 1 and 20 km from the coast of units with Cu/Al coils, we strongly recommend using the accessory "Coil treated with anti-corrosion paints"
- for distances within a kilometre of the coast, we strongly recommend using the accessory "Coil treated with anti-corrosion paints" for all units.

To protect the exchangers from corrosion and ensure optimal operation of the unit, we advise following the recommendations given in the user, installation and maintenance manual for cleaning the coils.

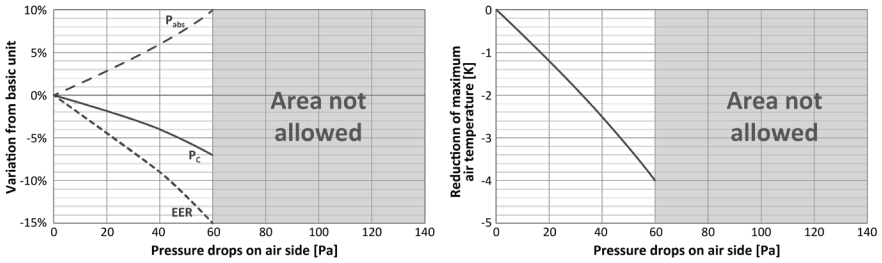
Aeraulic head losses and options available for the ventilating section

With the exception of units for which oversize fans are required, as standard, the units are designed considering that, at the nominal air flow rate, the fans work with null available pressure.

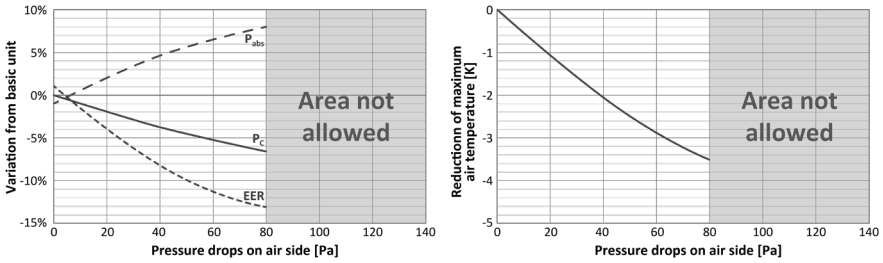
If there are obstacles to free air flow, you should consider the additional aeraulic head losses that will cause a reduction of the air flow rate and a consequent deterioration of performance.

The following diagrams show the trend of cooling capacity (PC), EER, total absorbed power (Pabs) and reduction of the maximum external air temperature in chiller operating mode, depending on the aeraulic head losses that the fans will have to overcome.

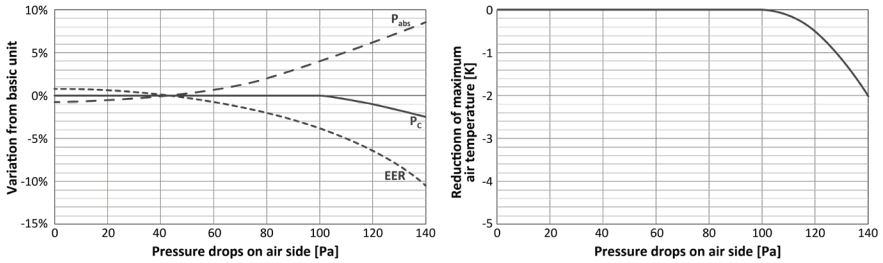
AC fans (Ø 630)



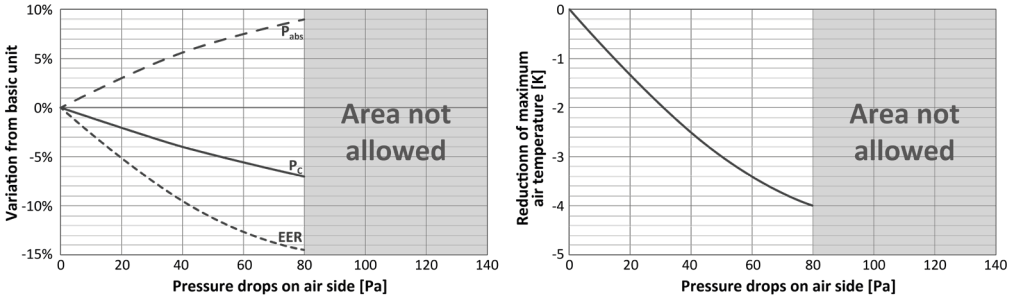
EC fans (Ø 630)



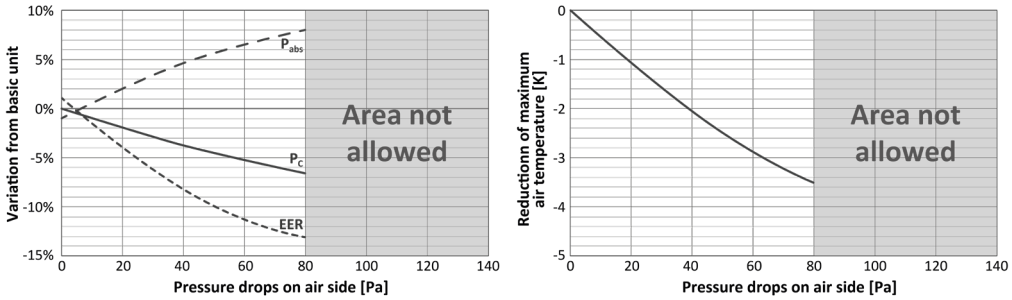
Oversize EC fans (Ø 630)



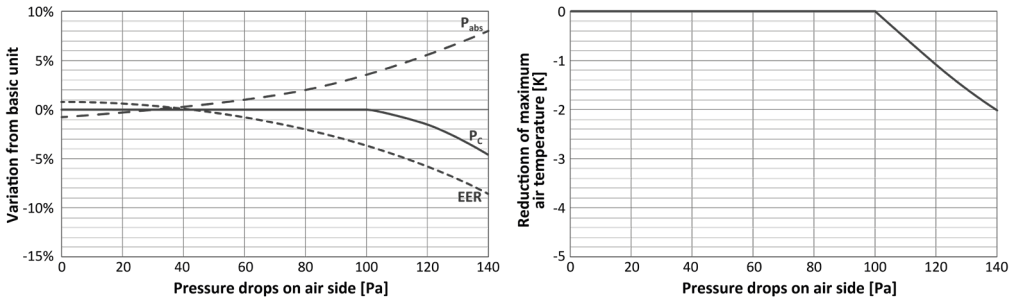
AC fans (Ø 800)



EC fans (Ø 800)



Oversize EC fans (Ø 800)



The indicated values are for the standard machine, without accessories, with AC fans and in any case in the absence of air recirculation.

Example: supposing you expect there to be obstacles that will generate an estimated aeraulic head loss of 60Pa. In this case, there are 3 possibilities:

- use the unit with standard AC fans: compared to ideal conditions, the output power will be reduced by about 5.5%, the total absorbed power will increase by about 7.5%, the EER will be reduced by about 12.5% and the maximum allowed external air temperature for operation at 100% will be reduced by about 3.4K compared to the nominal limit
- use the unit with EC fans: compared to the unit with AC fans working in ideal conditions, the output power will be reduced by about 5%, the total absorbed power will increase by about 6.5%, the EER will be reduced by about 11.5% and the maximum allowed external air temperature for operation at 100% will be reduced by about 2.8K compared to the nominal limit
- use the unit with oversize EC fans: compared to the unit with AC fans working in ideal conditions, the output power of the unit will be unchanged, the total absorbed power will increase by about 1%, the EER will be reduced by about 2% and the maximum external air temperature will remain the one shown in the diagram of the operating limits.

It is emphasized that, as indicated in the diagrams and based on the diameter and type of fan, for aeraulic head losses higher than 60 or 80Pa, only the use of oversize EC fan is allowed.

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