SIGMA Zero

20÷70 kW

General
Full inverter reversible chillers and heat pumps with semi-hermetic reciprocating and scroll compressors, and plate heat exchanger. Extended range, versatile applications.

Configurations
Hi: chiller with inverter compressor

Hi OH: Non-reversible heat pump with inverter compressor

Hi HP: reversible heat pump on refrigerating side with inverter driven compressor

Hi HPW: reversible heat pump on water side with inverter driven compressor

Strengths
- Refrigerant R290 - GWP≈0. The refrigerant is a pure natural fluid.
- Reduced refrigerant charge
- Eurovent Certification
- High efficiency and compact dimensions
- Chiller version:
- Versatile application: water temperature from -10°C up to 20°C. Operation in a wide range of environmental conditions
- Heat Pump version:
- High outlet water temperature: up to +75°C
- BlueThink advanced control with integrated web server. Multilogic function and Blueye® supervision system. (options)

BlueBox by Swegon

SIGMA ZERO

SIGMA Zero is a wide range of high efficency chillers and heat pumps, with hermetic scroll or semi-hermetic piston compressor and water source, suitable for both comfort and process applications. The chiller versions can produce chilled water from -10°C up to 20°C, with source temperatures from 25°C up to 75°C. The heat pump versions can produce hot water up to 75°C, with source temperatures from -10°C to 20°C. Units mount variable speed inverter compressors in order to maximize the seasonal efficiency and achieve stable thermodynamic regulation in any load condition. The whole range is characterized by compactness and low refrigerant charge.

Extreme flexibility is also given for combination with different types of sources: evaporative tower, dry-cooler, well or geothermal probe according to the most suitable and expedient convenient source. Depending on the choice and the type of application, the unit can be completed with the available accessories.

SIGMA Zero Hi OH is a high efficiency non-reversible heat pump that is suitable for all applications in which the user needs only heating production. In this set-up, the unit is optimized to operate in heating mode only.

SIGMA Zero Hi HPW is a high efficiency water-side reversible heat pump that is suitable for applications in which the user-side circuit and the source-side circuit can be exchanged with each other. Compared to other solutions, water side reversal has the advantage of keeping the heat exchangers in counter-flow in both chiller and heat pump operating modes.

To make the cycle reversal, the fitter must install a system of valves that will allow the two circuits to be exchanged.

If the seasonal mode change is performed via remote signal or BMS, SIGMA Zero Hi HPW is able to pilot motorized reversing valves (not supplied) in order to make this operation completely automatic.

SIGMA Zero Hi HP is a high efficiency refrigerator-side reversible heat pump: this version always guarantees separation between source and user fluids, thus also allowing different pumps to be used on the various hydronic circuits, does not require external reversing valves and makes the installation operations easier.

REFRIGERANT

SIGMA Zero models are available with R290 refrigerant.

The use of R290 refrigerant is indicated by the acronym "Zero" which indicates a GWP level close to 0.

Refrigerant R290 GWP(Global Warming Potential)≈ 0*

ODP (Ozone Depletion Potential) 0

The refrigerant is a pure natural fluid.

R290 is classified as group 1 fluid according to PED.

It is also classified as A3 according to ASHRAE standard 34:

- non-toxic;
- Highly flammable.

The excellent GWP value may be an advantage in projects where:

- min. targets are adopted for the containment of the environmental footprint;
- it is possible to receive incentives or other benefits that are applicable in some countries or are connected to specific plant design criteria.

(*) GWP (AR6), pursuant to IPCC VI, evaluated over a span of 100 years.

STRUCTURE

The structure consists of a load-bearing frame made of epoxy polyester powder coated steel sheet, coloured with RAL 7035.

All screws and bolts are stainless steel.

The units of the SIGMA Zero series are always closed by means of suitable panels, thus preventing access to surrounding elements in all circumstances and guaranteeing correct reading of the refrigerant leak sensor (installed as standard on the unit) during unit operation. The panels serve as covering and protective elements and they are fully made with sheet metal coated with epoxy-polyester powder, colour RAL 7035. RAL 7035 .

COMPRESSORS

The compressors are hermetic scroll with orbiting spiral for the first 3 sizes, and alternative semi-hermetic for the last 2 sizes. All the compressors are fitted as standard with crankcase heater.

The compressors are enclosed in a dedicated technical compartment, which can be accessed by removing the panelling to allow maintenance operations to be carried out even with units running.

VERSIONS

Hi:
The standard unit SIGMA Zero Hi is a non-reversible chiller for cooling only

Hi OH :
The SIGMA Zero Hi OH unit is a non-reversible heat pump.

Hi HPW:
The SIGMA Zero Hi HPW unit is a heat pump which provides for the cycle inversion on the hydronic side of the system via special 3 or 4-way inversion valves external to the unit (not supplied).
In addition to what is present in the basic version, the HPW set-up includes an OK signal in the terminal board for controlling the group of external reversing valves (not supplied).

Hi HP
The SIGMA Zero Hi HP unit is a reversible heat pump which provides for the cycle inversion on the refrigerant side.

SIGMA Zero Hi (20, 30, 35) - SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH (25, 40, 45)
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 120rps of its nominal capacity.
The speed of rotation of the compressor is variable in the range 1.800÷7.200 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.

SIGMA Zero Hi (40, 50) - SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH (50, 70)
The compressors are semi-hermetic reciprocating in a single circuit coupled with an inverter which modulates the working frequency according to the load. Compressor are optimized for use with propane. All compressors are equipped with crankcase heater, suction and delivery valves as standard.

The compressors are enclosed in a dedicated technical compartment which can be accessed by removing the panels.
Depending on the model, there are the following compressor configurations:

- the models with a single compressor (x.1) require the use of a single compressor with modulating inverter in a circuit.
- the models with two compressors (x.2) require the use of a compressor with modulating inverter for each circuit.

The speed of the modulating compressor is varied, depending on the total heat load, roughly between 30 and 105 rps. 30Hz and 65Hz.
The modulating compressors are driven by inverters. 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.

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 has been designed in such a way as to:

- maximize the EER and COP levels
- reduce the amount of refrigerant used in the unit
- make the unit lighter and more compact
- make its maintenance easier.

The heat exchanger is fitted with a temperature probe for protection against frost and a differential pressure switch for water flow control. .

A paddle flow switch is available as option for water flow control (supplied together with the unit).

SOURCE-SIDE HEAT EXCHANGER

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

For the OH, HPW and HP version units, the exchanger is equipped with a temperature probe for antifreeze protection and a differential pressure switch for water flow control .

REFRIGERANT CIRCUIT

Each refrigerant circuit of the basic unit comprises:

- charging valves
- liquid sight glass
- delivery shut-off valve (for units with alternative semi-hermetic compressors only)
- suction shut-off valve (for units with alternative semi-hermetic compressors only)
- Weld-on filter drier
- electronically-controlled thermostatic expansion valve
- pressure transducers for reading the high and low pressure values and relevant evaporating and condensing temperatures
- User-side differential pressure switch
- high pressure switches
- suction liquid separator
- 4-way reversing valve (applies to HP versions only)

The units are fitted with an electronic expansion valve which helps the machine achieve stability more quickly and provides for better superheating control if compared to a mechanical expansion valve, thus maximising the use of the evaporator in all load conditions.

The evaporator and the compressor suction pipes are always isolated with an extruded closed-cell expanded elastomer. In OH and HPW versions the elastomer isolation above is also applied to the delivery pipes in the compressor and to the condenser.

The copper pipes are sized with increased thicknesses in order to ensure greater reliability and durability over time.

The refrigerant circuit is enclosed in a compartment that contains an ATEX certified leak sensor and an ATEX certified centrifugal extraction fan (the centrifugal fan can also be supplied for outdoor installation).

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 panel is made following the EN60204-1 standard.

The electrical panel is separated from the compressor compartment.

The electrical control panel of the basic unit comprises:

- main disconnect switch
- automatic circuit breakers for compressors with fixed calibration
- fuses to protect the auxiliary circuits
- phase monitor
- potential-free general alarm contacts
- The refrigerant circuit is enclosed in a compartment that contains an ATEX certified leak sensor and an ATEX certified centrifugal extraction fan (the centrifugal fan can also be supplied for external installation).
- digital input for general ON/OFF
- summer/winter selection by digital input
- microprocessor controller with display accessible from the outside
- Warning lights used to warn about voltage being supplied to the leak test circuit, a malfunction of the refrigerant leak sensor, and a refrigerant leak alarm.

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

All cables are supplied with PG elements (cable glands) to increase the safety of the unit and at the same time to reduce the possibility of refrigerant spilling into the electrical panel should refrigerant leak.

Unit power supply is 400V/3~+N/50Hz

CONTROL BLUETHINK

The unit is supplied as standard with an advanced controller (applies to all versions).

Main controller functions advanced

The control allows the following functions:

- water temperature adjustment, with outgoing water control
- freeze protection
- recording of the log of all machine inputs, outputs and states
- automatic rotation of compressor starting sequence
- recording of the alarm log
- RS485 serial port with Modbus protocol
- Ethernet serial port with Modbus protocol and integrated web server preloaded web page
- digital input for general ON/OFF
- digital input for Summer/Winter selection

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, external air temperature, mode (chiller or heat pump), evaporating and condensing pressures, suction and discharge temperatures
- compressor status display
- 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
- remote summer winter mode selection

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
- operating hours counter and number of starts of the unit, and of the compressor
- high and low pressure values, and relevant condensing and evaporating temperatures
- external air temperature
- superheating at compressor suction.

OPTIONS

In the case of standard units for internal installation ("ventilated enclosure" installation class IV according to EN378-1), an ATEX centrifugal fan is mounted in the refrigerant compartment to vent the air from the technical compartment.It is mandatory and the installer's responsibility to install a duct for the correct conveyance of the expelled air into the open air.

/VEES: extraction fan supplied loose

In the case of /VEES units for internal installation ("ventilated enclosure" installation class IV according to EN378-1), the ATEX centrifugal fan for expelling air from the technical compartment is supplied loose.

It is the installer's responsibility to install a duct for the correct conveyance of the expelled air into the open air.

It is the installer's responsibility to install the centrifugal fan upstream of the duct.

/PIE: Arrangement for outdoor installation

The /PIE units are suitable for outdoor installation (installation class III according to EN378-1).

- In the case of /PIE units, the centrifugal fan is replaced with an axial fan, and the air is expelled through shutters on the carpentry

CONTROLS AND SAFETY DEVICES

All the units are fitted with the following control and safety components:

- high pressure switch with manual reset
- high pressure safety device with automatic reset, for a limited number of occurrences, managed by the controller
- low pressure safety device with automatic reset, for a limited number of occurrences, managed by the controller
- high pressure safety valve conveyed outside the unit
- user-side water temperature probe
- antifreeze probe at outlet of each evaporator
- compressor overtemperature protection
- differential flow switch
- ATEX certified leakage sensor
- ATEX certified extraction fan
- In the event that the leak detector identifies a gas leak, the following safety procedures are implemented:
- immediate shutdown of the unit
- interruption of the three-phase main power supply
- activation of the extraction fan
- activation of the ventilation fans of the electrical panel

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.

The unit is wrapped in transparent polyethylene stretch film.

CERTIFICATIONS AND REFERENCE STANDARDS

The manufacturer has implemented and keeps the Management Systems listed below and it is certified against them:

- Quality Management System according to standard UNI EN ISO 9000;
- Environmental Management System according to standard UNI EN ISO 14000;
- Health and Safety Management System according to standard BS OHSAS 18000 (as converted into UNI EN ISO 45000).

These management systems ensure that the company puts in place any and all actions and initiatives to define and monitor the standards defined by its Management, which are stated in its Quality, Environmental and Safety policies.

To meet the safety requirements, the unit was designed and manufactured in compliance with the directives and product regulations below:

- PED Directive: safety criteria to be followed when designing pressure equipment;
- Machinery Directive: safety criteria to be followed when designing machinery;
- Low Voltage Directive: safety criteria to be followed when designing electrical machine parts;
- Electromagnetic Compatibility Directive: electromagnetic compatibility criteria to be followed when designing electrical machine parts;
- WEEE Directive: criteria for product management at the end of its life cycle as waste with a view to environmental protection.

The units are manufactured, tested and checked with reference to the European standards specified in the Declaration of CE Conformity, in accordance with the requirements and procedures of our Quality System.

The transport, installation, use and storage of units with flammable refrigerants (A3 according to ASHRAE 34 standard) must meet European standards and regulations and local regulations where applicable.

For further details, please refer to the "Instruction manual for operation and maintenance".

Responsibilities and exclusive duties of the installation manager:

- to carry out a specific risk assessment according to the European regulations/standards above and/or the local laws in order to define the necessary measures for conformity;
- to comply with the requirements and to take the measures resulting from the outcomes of the risk assessment, pursuant to the relevant regulations and standards.

DESCRIPTION OF ACCESSORIES

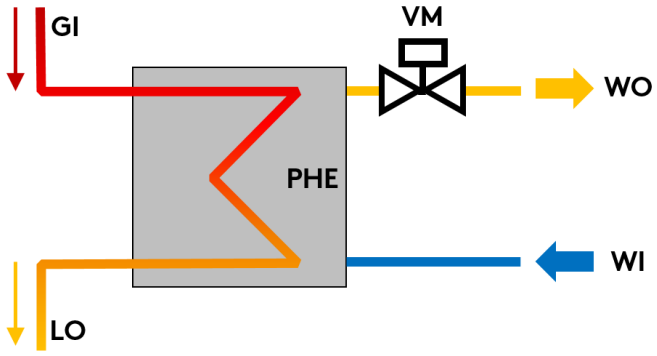
Refrigerant circuit accessories

VM2 Condensation control with 2-way modulating valve

The accessory includes the supply of a 2-way modulating valve complete with servo control to be installed on the source-side hydraulic circuit (installation by the customer). The servo control is controlled via a 0-10V signal from the control depending on the condensing pressure.

This accessory is to be used in applications where it is beneficial, when possible, to reduce the total flow rate of water coming from the source (for example, when well water is used). When the unit reaches the setpoint, the valve will be forced to close.

Accessory supplied loose.



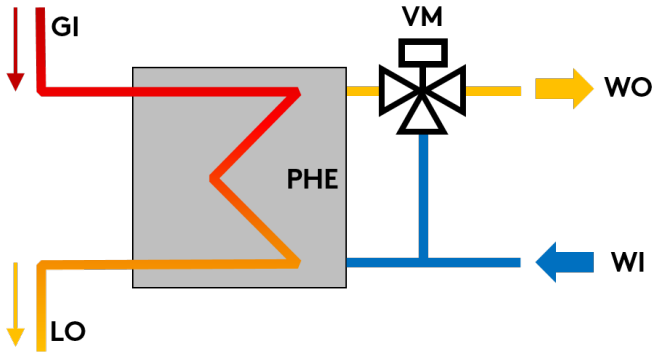
GI: Refrigerant gas inlet
LO: Liquid refrigerant outlet
WI: Water inlet
WO: Water outlet
PHE: Plate heat exchanger
VM: Motor-driven condensation control valve

VM3 Condensation control with 3-way modulating valve

The accessory includes the supply of a 3-way modulating valve complete with servo control to be installed on the source-side hydraulic circuit (installation by the customer). The servo control is controlled via a 0-10V signal from the control depending on the condensing pressure.

This accessory is to be used in applications where it is beneficial, when possible, to reduce the flow rate of water sent to the source-side heat exchanger (for example, when water from a loop is used). When the unit reaches the set point, the valve will be forced to total recirculation.

Accessory supplied loose.



GI: Refrigerant gas inlet
LO: Liquid refrigerant outlet
WI: Water inlet
WO: Water outlet
PHE: Plate heat exchanger
VM: Motor-driven condensation control valve

SCU **Cumulative 0-10V signal for condensation control**

This accessory requires a 0-10V output in the terminal board to carry out condensation control through a device outside the machine (2-way valve, 3-way valve, inverter-controlled pump). The signal is linked to the condensing pressure.

The signal is cumulative and therefore the accessory is suitable for combination on units in which there is a single condensation control device located on the common branch of the source.

Incompatible with condensation control with modulating valve.

DVS **Double safety valve**

With this accessory, instead of each individual safety valve per circuit, there is a "candelabrum" with two safety valves and a diverter valve for choosing the valve in operation. This allows the safety valves to be replaced without having to drain the machine and without having to stop it.

MAFR **Pressure gauges**

The operating pressures of each circuit of the unit can be displayed on the control by accessing the relevant screens. Also, the machine can be fitted with pressure gauges (two for each circuit) installed in a clearly visible position. These allow reading in real time of the working pressures of the refrigerant gas on the low pressure side and on the high pressure side of each refrigerant circuit.

BK **Brine Kit**

This accessory is compulsory if a water temperature set point lower than +3°C is used (if the unit is provided with double set point or variable set point, the lower set point is considered).

The accessory consists of increased insulation and suitable sizing and calibration of some components.

The inlet and outlet temperatures of the user-side exchanger must be given on ordering to allow correct setting of the alarm parameters and verification of the sizing of the expansion valve.

The cooling set point can then be changed by the customer in an interval that, compared to the set point given on ordering, ranges from -1K up to the maximum temperature allowed by the above-stated operating limits.

The unit will be optimized to work at the set point temperature given on ordering. For different set points, the cooling capacity provided and the level of efficiency of the machine could decrease and move away from these conditions.

Hydraulic circuit accessories

Some accessories may be incompatible with each other even if not expressly indicated.

FLUS **Flow switch (instead of the water differential pressure switch)**

As an alternative to the differential pressure switch (standard flow sensor), it is possible to request the paddle flow switch as accessory. This detects when there is no water flow to the user-side exchanger and sends a signal to the control of the unit that will stop the compressors to prevent damage to the exchangers.

The flow switch is supplied loose (installation by the customer) and replaces the water differential pressure switch (standard).

KFW **Water filter kit**

To protect the elements of the hydraulic circuit (in particular, the exchangers), there are Y filters that can stop and settle the particles that are normally present in the water flow and would otherwise settle in the more delicate parts of the hydraulic circuit and damage its heat exchange capacity.

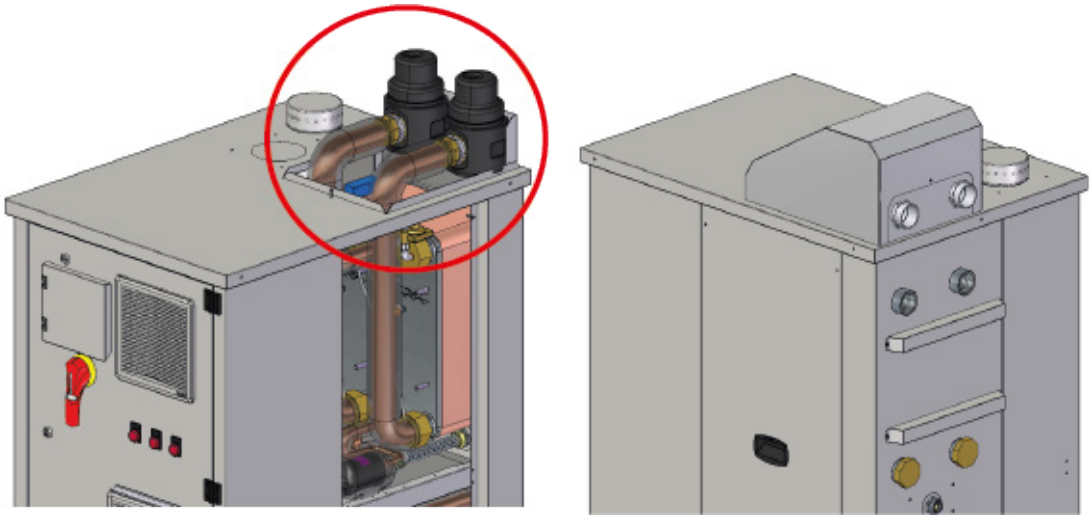
The kit involves the supply of a filter for each exchanger present in the machine.

Installation of the water filter is mandatory even when it is not supplied as an accessory.

Accessory supplied loose.

SARA **Automatic air/refrigerant separator**

Breakage of the heat exchanger may cause the refrigerant to flow into the vector fluid and be transferred to confined spaces; the use of an automatic air/refrigerant separator installed as the first component at the outlet of the plate heat exchanger is mandatory. Automatic air/refrigerant separator has to be installed higher than the plate heat exchanger outlet. For indoor units, an automatic air/refrigerant separator can be installed as option in each heat exchanger featured in the unit. In case of refrigerant expulsion by the separator this is conveyed to the base of the unit, activating the safety chain, and driven out by the extraction fan.

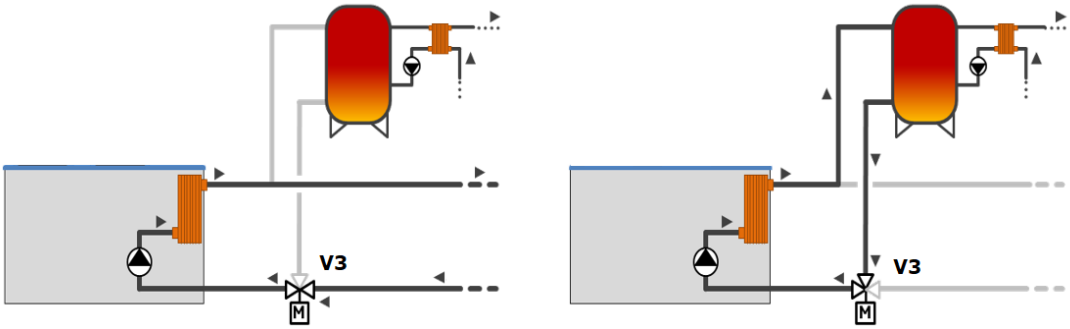


V3 Three-way valve for domestic hot water management

This is a three-way on-off valve, complete with servo control. The unit controller can manage two separate hydraulic circuits through this valve: one for comfort and one for domestic hot water production.

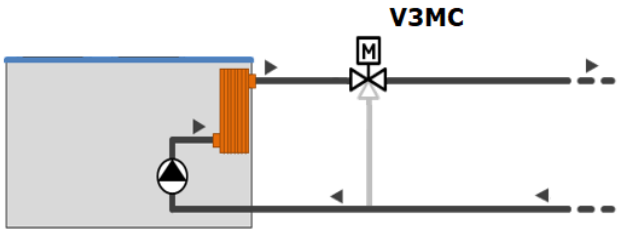
The valve and the servo control are for indoor installation and they require the ambient temperature not to drop below -10°C.

Accessory supplied loose. Installation by the customer.



V3MC 3-way modulating valve on hot circuit

The accessory involves the supply of a 3-way modulating valve to be inserted on the hot circuit in order to check that the temperature of the water entering the exchanger is always higher than the minimum allowed.

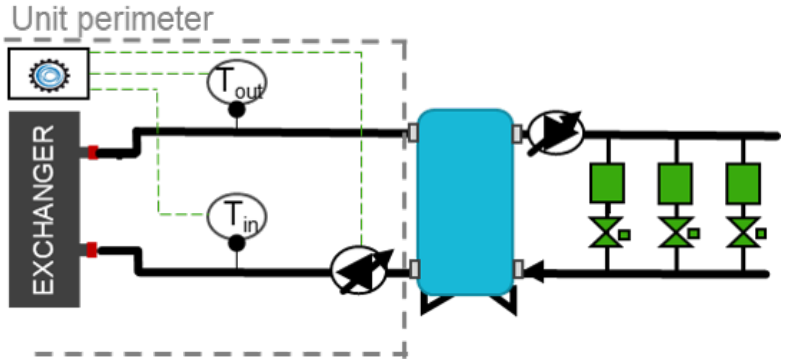


FVDT **FLOWZER VDT - flow rate control with constant TD (difference between input and output temperature in the heat exchanger on the user side) in variable flow pumps, without monitoring the flow rate limits;**

Flowzer VDT uses the temperature sensors installed at the inlet and outlet of the heat exchanger to automatically adjust the pump speed, thus keeping the T delta difference setpoint constant.

The option is not compatible with the Multilogic version. Please refer to the HYZER solutions for the compatibility between variable flow systems and multi-machine systems.

The unit must include the advanced Bluethink controller and just one heat exchanger on the user side.



With the Flowzer VDT, the customer can set, directly on the display, the available delta T value that the unit must maintain. The customer will have to check that, in minimum flow rate conditions (that is, with the maximum number of user points closed), this is always higher than or equal to the minimum flow rate allowed by the unit.

This option is specifically designed for systems in which the system users have similar operating conditions (same temperature difference).

PVX **Variable flow setup for HYZER X**

The dedicated HYZER X controller is designed to manage the different units, devices and components that make up a hydronic system.

Systems featuring this controller require that the PVX option be installed at the ends of the user-side heat exchanger of a differential pressure transducer so that the machine is set up for variable flow rate control.

This option is mandatory in all units making up the system.

For additional information on the product HYZER X, please refer to the specific technical catalogue.

VIX **Shut-off valves for systems with external pumps for HYZER X**

Systems featuring the HYZER X controller enable the selection of the shut-off valve used in systems that have an external pumping unit.

Two shut-off valves are supplied together with water/water machines that need to be installed on the source- and user-side circuits of the unit (installation by customer).

FLMX **User-side flow meter for HYZER X**

Systems featuring the HYZER X controller enable the selection of the flow meter option to calculate the flow rate and the performances of the units.

The option is supplied with the system for installation on the user side (installation by customer).

Electrical accessories

Some accessories may be incompatible with each other even if not expressly indicated.

CSP **Set point compensation depending on external air temperature**

For units fitted with this accessory, the set point of the unit is set so that it can vary between two values, a maximum and a minimum, depending on the external air temperature. The compensation ramp and the maximum and minimum values of the set point can be changed by the user.

Unless otherwise specified in the order, the controller will be set to implement a positive compensation logic according to the temperatures shown in the following diagrams:

LIID **Limitation of the current absorbed by digital input**

When this accessory is requested, a digital input is prepared in the terminal board to activate the forced capacity reduction of the unit to a set fixed level.

This accessory is useful when there is a need to necessarily limit the power absorbed by the unit as regards particular conditions.

We point out that, in some conditions (for example, during defrosting, oil return cycles or hourly compressor rotation procedures), the controller could force the unit to operate at full capacity for limited periods of time.

R1PU **Relay for management of 1 external user-side pump**

This accessory can be requested for units without user-side pumps and allows a pump outside the machine to be controlled.

R2PU **Relay for management of 2 external user-side pumps**

This accessory can be requested for units without user-side pumps and allows two pumps outside the machine to be controlled with a running/stand-by logic by implementing a rotation on the hours of operation.

The two pumps are controlled by two separate relays.

RE1S **Relay for management of 1 external source-side pump**

This accessory can be requested for units without source-side pumps and allows a pump outside the machine to be controlled.

RE2S **Relay for management of 2 external source-side pumps**

This accessory can be requested for units without source-side pumps and allows two pumps outside the machine to be controlled with a running/stand-by logic by implementing a rotation on the hours of operation.

The two pumps are controlled by two separate relays.

RMMT **Maximum and minimum voltage relay**

This accessory constantly monitors the voltage value and the unit's power supply phase sequence. If the supply voltage does not fall within the set parameters or there is a phase reversal, an alarm is generated that stops the machine to prevent damage to its main parts

ENM **Energy meter**

The accessory allows the main electrical quantities (including voltage, current, power) to be read on the three phases, via current transformer.

This accessory communicates with the BlueThink controller to supervise the monitored data. The values measured are then made available through the unit display and the web server.

SETD **Double set point from digital input**

The accessory allows you to preset two different operating set points and manage the change from one to the other through a digital signal.

The set point temperatures must be specified when ordering. For optimization of the unit, reference will be made to the lower set point in chiller mode and the higher set point in heat pump mode.

Unless otherwise specified in the order, the controller will be set at the factory with the following temperatures:

- in chiller mode, set point 1 to 7°C and set point 2 to 12°C
- in heat pump mode (only for HP units) set point 1 to 45°C and set point 2 to 40°C

If the difference between set point 1 and set point 2 is greater than 5K, it is compulsory to ask for the accessory "Electronic expansion valve".

SETV Variable set point with remote signal

The accessory allows the set point to be varied continuously between two preset values, a maximum and a minimum, depending on an external signal that can be of the 0-1V, 0-10V or 4-20mA type.

The set point temperatures and the type of signal to use for the adjustment must be specified when ordering. For optimization of the unit, reference will be made to the lower set point in chiller mode and the higher set point in heat pump mode.

Unless otherwise specified in the order, the controller will be set at the factory with 0-10V analogue input and with the following temperatures:

- in chiller mode, 0V will correspond to a set point of 7°C and 10V will correspond to a set point of 12°C
- in heat pump mode (only for HP units), 0V will correspond to a set point of 45°C and 10V will correspond to a set point of 40°C

If the difference between the minimum set point and the maximum set point is greater than 5K, it is compulsory to ask for the accessory "Electronic expansion valve".

TERM Remote-controlled user terminal panel

This accessory allows the terminal normally situated on the machine to be replicated on a support situated at a distance. It is particularly suitable when the unit is placed in an area that is not easily accessible.

The accessory is supplied loose and is to be installed by the customer at a maximum distance of 120m from the unit. We advise using a cable of the following type: "TECO O.R. FE 2x2xAWG24 SN/ST/PUR".

For this accessory, there is a dedicated serial port.

CSU Enabling for integration heater on user side

The accessory enables management of a heat source outside the unit which is supplementary to the user circuit.

The necessary OK signals for controlling a maximum of four capacity steps are included in the electrical control panel. Activation of the steps takes place depending on the distance from the set heat pump set point.

CSS Enabling for integration heater on tap water side

The accessory enables management of a heat source outside the unit which is supplementary to the domestic hot water circuit.

ENML Energy meter with current limiter

The accessory allows the main electrical quantities (including voltage, current, power) to be read on the three phases, via current transformer.

This accessory communicates with the BlueThink controller to supervise the monitored data. The values measured are then made available through the unit display and the web server.

This accessory is designed to limit the maximum current the unit can absorb. The controller instantly checks the absorption levels and, where necessary, it applies a forced capacity reduction that keeps the absorbed current value below the stored threshold.

IA Automatic circuit breakers (instead of fuses)

This accessory requires the installation of automatic circuit breakers, instead of fuses, for the protection of auxiliary loads. Also, the same accessory uses automatic circuit breakers with adjustable thermal overload protection to protect the compressors.

SV3 Signal for 3-way modulating valve

In the electrical control panel, a 0-10V output is preset to be used to control a 3-way modulating valve inserted on the hot circuit.

If the temperature of the water entering the hot exchanger is too low (for example, after the machine has been stopped for an extended period), through this signal, the controller of the unit will control the valve so as to recirculate part of the flow rate at the outlet and ensure that the unit always works within the operating limits.

The 3-way modulating valve is not included in this accessory, but can be requested as further accessory.

AS Automatic management of domestic hot water

This function enables the unit to control the temperature inside a domestic hot water storage tank and to manage a 3-way valve outside the unit (available as an accessory).

The water temperature in the domestic hot water tank is controlled through a dedicated probe situated in the tank.

Normally, the heat pump operates on the system to meet the comfort requirements of the building, but when the water temperature in the domestic hot water tank falls below a set threshold, the controller switches to domestic hot water production.

If the unit is operating as heat pump for heating, the 3-way valve will be switched and the set point changed.

Once the temperature in the domestic hot water tank has reached the set value, the unit automatically returns to producing water for the heating or air conditioning system.

Domestic hot water production is always given priority.

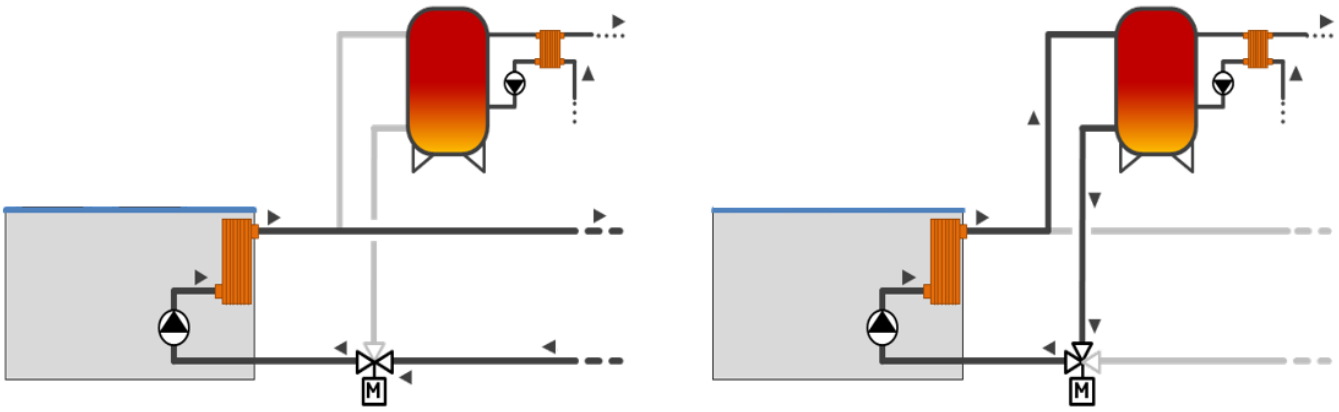
This accessory provides for the presence in the electrical panel of two digital inputs for disabling, respectively, the production of domestic hot water and the production of water for the heating system.

When the unit is working in "domestic hot water only" mode, the pump is normally off and is switched on only for the time required to meet the demand for domestic hot water production.

When this accessory is fitted, the machine must have control of pump operation. This means that either the unit is equipped with one of the hydronic modules available in the catalogue (therefore with at least one pump installed on it) or the relay for external pump management must be requested as accessory.

The probe to be placed in the sanitary tank is supplied with a 12m long cable. The probe is used to measure the water temperature in the hottest part of the tank, so it must be positioned in a specially prepared pocket and secured using heat conducting paste. Installation by the customer.

In case of management with variable water flow, the installation must necessarily be made with the derivation towards the domestic hot water tank upstream of any bypass valve or channel.



FARE **Fast Restart**

The Fast Restart accessory enables the controller to carry out a fast restart of the unit following a blackout, in order to reduce machine down times to a minimum.

This accessory requires the provision of a power supply line dedicated to the controller (uninterruptible power supply unit installed by the customer) and a maximum and minimum voltage relay in the electrical control panel. In this way, the controller of the unit will always remain powered even during a blackout.

Once the main power supply returns after a blackout, the starting of the first compressor takes place within 60 seconds and the full capacity of the unit is reached in about 180 seconds (a time that depends on the number of compressors and the instant load level).

In order to protect component service life, the controller may carry out the Fast Restart procedure no more than 3 times in an hour and 5 times in one day.

Also, to make it easier to carry out any maintenance on the power supply line dedicated to the controller, there is a selector switch inside the electrical control panel to allow the controller to be powered directly from the main power supply of the machine.

CP **Single potential free operating contacts**

For units fitted with this accessory, there are clean contacts available on the terminal board inside the electrical box from which the customer can acquire signals that show the status of the unit's components (compressors, fans, pumps, alarms).

SQE **Heater for electrical control panel**

Electric heaters are positioned inside the electrical control panel and these prevent the formation of ice or condensation inside it.

GFC **FC/NG management**

This option is available only for the basic model (chiller).

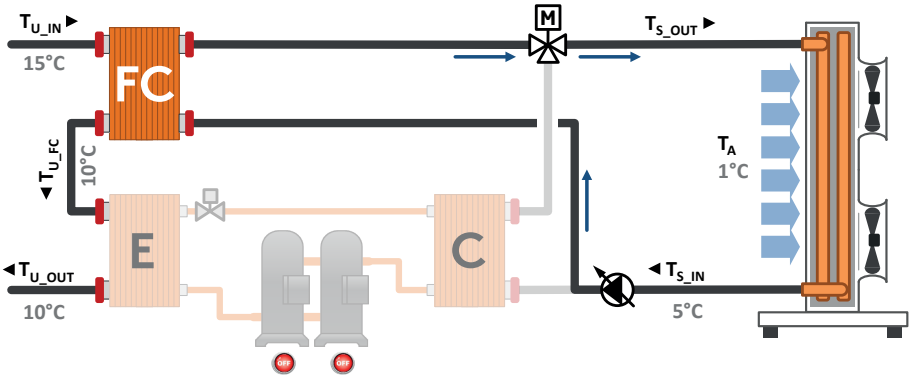
The option includes configuration of the BlueThink controller of the unit, in order to carry out the free-cooling mode, without using glycol.

The option also includes integration in the machine of: free-cooling pump relay, consent for external dry cooler, system return probe and dry-cooler inlet and outlet probes.

The components required for making the system, and also the hydraulic and electrical connections to the unit, are to be provided by the customer.

More specifically, the system will consist of:

- a water-water heat exchanger that carries out the separation between the source side (glycol) and the user side (non-glycol).
- a 3-way modulating valve that feeds the free cooling circuit and carries out condensation control when the unit is working in mixed chiller/free cooling mode.
- a source-side pump



The components required for making the system, and also the hydraulic and electrical connections to the unit, are to be provided by the customer.

Network accessories

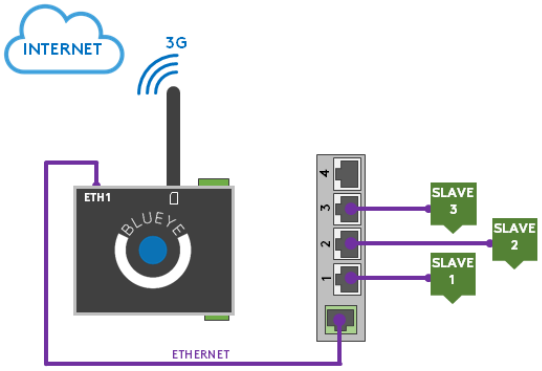
SERI **RS485 serial interface with Modbus protocol**
RS485 serial interface with Modbus protocol.

PBA **BACnet protocol over IP (Ethernet)**
The controller is set for use, in read and write mode, of the BACnet port on IP protocol.
By default, the programming gives read-only access to the control of the unit. Reading / writing access is activable on field with a service level.

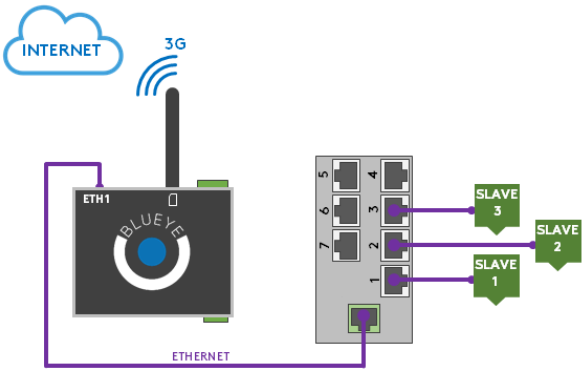
GLO **Modbus Lonworks Gateway**
With this accessory, a RS485/Lon gateway is installed inside the electrical control panel.
By default, the programming gives read-only access to the control of the unit. Reading / writing access is activable on field with a service level.

PSN **SNMP protocol**
The accessory consists of a gateway that allows Ethernet connection to a SNMP manager supervision system.
The use of this accessory causes the RS485 serial port to be unavailable.

SW4P **Network switch with 4 ports**
The accessory includes installation in DIN rail of a professional 4-port network switch.Requires Blueye via Ethernet.

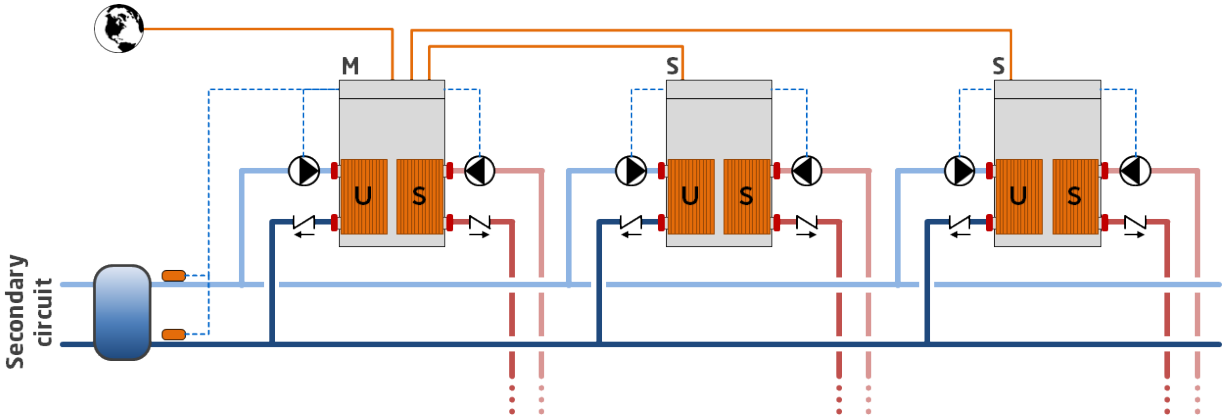


SW8P **Network switch with 8 ports**
The accessory includes installation in DIN rail of a professional 8-port network switch.
Requires Blueye via Ethernet.



FMx Multilogic Function

The Multilogic function allows management of up to 32 units equipped with advanced Bluethink controller and connected in hydraulic parallel with each other.



On the basis of the information recorded by the temperature probes installed on the delivery and return manifolds of the system, with the master unit, a capacity request is generated that is distributed among the units connected in the Multilogic network according to settable priority and optimization logics.

If communication between the units fails or if the master is off-line, the slave units can continue to work according to the set thermoregulation parameters.

The connected units can be different from each other, in terms of capacity and set-up, provided the following rules are complied with:

- if there are both chiller units and heat pumps in the Multilogic network, the Master unit must obligatorily be one of the HP units
- if there are both free cooling and non free-cooling units in the Multilogic network, the Master unit must obligatorily be one of the free-cooling units.

The Multilogic function that can be requested with the unit can be:

- **FM0:** Multilogic function for Slave unit
- **FM2:** Multilogic function for Master unit for managing up to 2 Slaves
- **FM6:** Multilogic function for Master unit for managing up to 6 Slaves

If you need to connect more than 6 slaves (up to 31), you can ask for a quotation from our sales department.

For the slave units, the accessory requires:

- programming of the unit as slave of a system of machines in Multilogic network

For the master units, the accessory requires:

- programming of the unit as master of a system of machines in Multilogic network
- entering of the parameters necessary for connection with the individual slave units
- installation in the electrical control panel of a network switch to allow the units to be connected in a LAN network.
- the supply of 2 temperature probes to be positioned on the delivery and return manifold of the system (supplied separately with it, installation and wiring by the customer)

The connection between the master unit and the slave units made with a CAT cable. 5E/UTP (prepared by the customer) with RJ45 connectors. Maximum cable length 100m.

For further details, please refer to the controller manual.

The time slots can be set from the control depending on installation requirements.

When the unit is working in heat pump mode, in order to maximise the COP and to obtain the widest possible operating limits, the control of the unit forces the fans to the maximum speed also during the night time bands.

BEET Blueye® via Ethernet

Blueye® is a supervision platform that enables remote monitoring of one or more units in the same system interconnected through a network with Modbus protocol.

This accessory features the Blueye device, as already installed and wired in the unit.

The critical variables to be monitored over time are identified for each connected device. These variables are sampled and saved to the cloud so that they are accessible at all times through a web portal or a mobile APP (available for Android and iOS).

The following options can be selected for connection to the internet:

- a LAN (Ethernet) connection - available in the system;
- a connection to a mobile network - at least 3G. The data SIM card is not included.

Three different types of contracts can be signed.

Blueye® Cloud Basic:

- to monitor a max. of 20 variables in total over max. 5 units/peripherals;
- to set a min. sampling frequency of 60 seconds.

Blueye® Cloud Advanced:

- to monitor a max. of 200 variables in total over max. 10 units/peripherals;
- to set a min. sampling frequency of 5 seconds.

Blueye® Connect:

- To monitor up to 10 units/peripherals.

Subscribing to any of the **Blueye® Cloud** enables:

- viewing the history of the monitored variables, in the form of both numerical values and graphs;
- downloading the history of variables in CSV format;
- the creation of automatic reports;
- setting notifications (via APP or mail) with settable thresholds for each variable;
- switching the unit ON/OFF remotely;;
- changing the set point remotely;
- selection of SUMMER/WINTER mode remotely (for reversible units only).

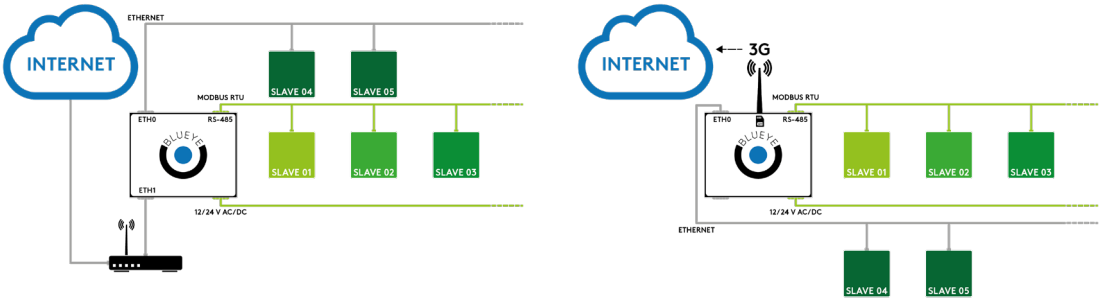
The subscription to the **Blueye® Connect** service offers the advantages below:

- a safe connection (tunnelling) between the user and the remote unit through the Blueye® portal;
- full access to the remote controller;
- real time monitoring;
- software upgrading.

Blueye® via Ethernet is only available for units supplied with an advanced controller and does not include any type of service. This service must be purchased separately based on the number of units/devices to be connected and the number of variables to be monitored. In order to connect multiple units to **Blueye® device, the network switch is required (this accessory is sold separately).**

Units can also be connected to the Blueye device through the RS485 network featuring a Modbus RTU protocol (for this option, refer to BERS accessory).

For further details, refer to the specific Blueye® documentation.



SMAR Smartlink function predisposition

This accessory makes it possible to connect the controller of the unit with the controller of a Swegon GOLD™ air handling unit via a simple serial cable, so allowing their operating logics to be merged into a single consciousness that pursues the maximum energy efficiency of the system. The RS485 serial interface is already included and dedicated to connection with Swegon units.

The option is incompatible with:

- double set point
- variable set point with remote signal
- summer/winter selection by digital input
- set point compensation depending on external air temperature
- multilogic
- all communication protocols.

SMAP Setup of Smartlink+ functions

This option is used to connect the controller in the unit with the controller of a Swegon GOLD™ air handling unit via the Ethernet port TCP/IP, so allowing the operating logics of hydronic and ventilation systems to be merged into a single logic for the achievement of maximum energy efficiency and comfort. This option is only available for units featuring an advanced controller and it is compatible with Multilogic and Hyzer systems only if the machine is the Master.

The option is incompatible with:

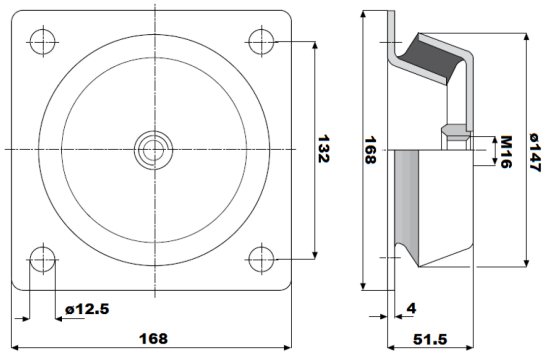
- double set point
- variable set point with remote signal
- set point compensation depending on external air temperature
- all communication protocols.

Other accessories

Some accessories may be incompatible with each other even if not expressly indicated.

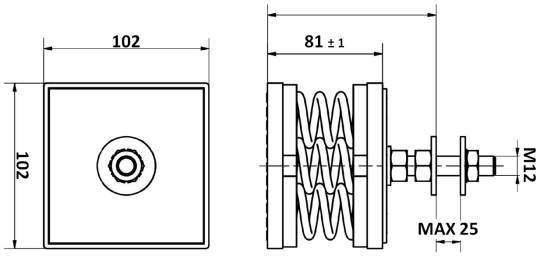
AG **Rubber anti-vibration mounts**

These allow you to reduce the vibrations transmitted from the unit to the surface it is standing on.
Accessory supplied loose.



AM **Spring anti-vibration mounts**

These allow you to reduce the vibrations transmitted from the unit to the surface it is standing on.
Accessory supplied loose.



SLIT **Special pallet/skid for container shipment**

The unit is placed on a skid that makes the container loading and unloading operations easier.
The accessory is mandatory if shipping by container is required

BOO BoosterLink

BoosterLink is the ideal solution to manage the "Temperature Booster" unit when using a Swegon heat pump as a source. The use of the "Boosterlink" guarantees the correct management of the units and prevents inefficiencies in the hydraulic system and failures.

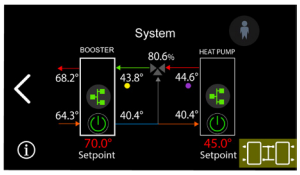
BoosterLink consists of an independent electrical panel which contains a programmable controller with dedicated software, a 4.3” Touch interface and an Ethernet switch.

BoosterLink connects via Ethernet to the "Temperature Booster" unit and to the source heat pump unit.

Main features of BoosterLink:

- 3-way mixing valve management installed on the source side of the "Temperature Booster" in order to correctly adjust the temperature of the evaporator inlet water
- Automatic compensation of the water production set point of the "Temperature Booster" in order to avoid excessive cooling of the evaporator side circuit which could cause malfunctions on the source heat pump
- Synchronization of the start-up and shutdown phases of the 2 units ("temperature Booster" and source heat pump)
- Set-point configuration and alarm display of the two units

BoosterLink is equipped with a user friendly Touch interface that allows you to configure the system and monitor its operation through a synoptic that displays the user-side and source-side system water temperatures and the percentage of opening of the mixing valve.



V3B 3-way valve for BoosterLink

It is a modulating three-way valve complete with actuator. This valve is controlled using the "BoosterLink" accessory in order to correctly adjust the inlet water temperature to the evaporator of the "Temperature Booster" unit in systems where a Swegon heat pump is used as the source unit.

The valve and the servo control are for indoor installation and they require the ambient temperature not to drop below -10°C.

Accessory supplied. Installation by the customer.

TECHNICAL SPECIFICATIONS

SIGMA Zero Hi

			20	30	35	40	50
Cooling							
Refrigeration capacity	(1)	kW	20,1	31,6	36	40,2	58
Total absorbed power	(1)	kW	4,5	8,3	9,7	10,3	14,6
EER	(1)		4,44	3,81	3,7	3,9	3,97
Compressors							
Compressors/Circuits		n°/n°	1/1	1/1	1/1	1/1	1/1
Minimum capacity reduction step	(2)	%	27	17	17	46	46
Refrigerant charge	(3)	kg	1,3	1,8	2	2,1	4
User-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	3,56	5,52	6,31	7,24	10,44
Head loss	(1)	kPa	7,7	10,4	8,8	11,3	12,5
Source-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	4,2	6,8	7,8	8,7	12,5
Head loss	(1)	kPa	11,2	17,3	14,3	17	19,1
Noise levels							
Sound power lev.	(4)	dB(A)	75	78	78	76	76
Sound pressure lev.	(5)	dB(A)	60	63	63	60	60
Dimensions and weights**							
Length		mm	712	712	712	712	712
Depth		mm	1023	1023	1023	1023	1023
Height		mm	1450	1450	1450	1450	1450
Operating weight		kg	282	296	308	393	432

(1) Source side heat exchanger inlet/outlet water temperature 30/35°C; user side heat exchanger inlet/outlet water temperature 12/7°C. Values compliant with standard EN 14511

(2) 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.

(3) The indicated refrigerant charge is calculated. The refrigerant charge can vary according to different versions/accessories and product updates.

(4) Unit operating at nominal operating capacity, without any accessories, with source-side heat exchanger inlet-outlet water temperature 30-35°C and user-side heat exchanger inlet-outlet water temperature 12-7°C.Binding values. Values obtained from measures taken according to standard ISO 3744 and to the Eurovent certification programme where applicable.

(5) Values obtained from the sound power level (condition in note 4), referred to a distance of 1 m from the unit in free field with directivity factor Q = 2. Non-binding values.

** Basic unit without included accessories

SIGMA Zero Hi HP

			25	40	45	50	70
Cooling							
Refrigeration capacity	(1)	kW	19,4	30,4	34,7	38,5	55,9
Total absorbed power	(1)	kW	4,9	8,8	10,5	10,8	15,4
EER	(1)		4	3,46	3,3	3,56	3,63
Heating							
Heating capacity	(2)	kW	22,8	37	42,7	45,1	66,1
Total absorbed power	(2)	kW	5,9	10,5	12,4	12,3	17,6
COP	(2)		3,86	3,52	3,44	3,67	3,76
Compressors							
Compressors/Circuits		n°/n°	1/1	1/1	1/1	1/1	1/1
Minimum capacity reduction step	(6)	%	27	17	17	46	46
Refrigerant charge	(3)	kg	1.3	1.8	2	2.1	4
User-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	3,3	5,2	6	6,6	9,6
Head loss	(1)	kPa	6,8	9,5	8	9,6	10,8
Water flow rate	(2)	m³/h	4,9	7,6	8,7	9,4	14
Head loss	(2)	kPa	13,5	18,8	15,8	18,3	21,2
Source-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	4,2	6,7	7,8	8,4	12,2
Head loss	(1)	kPa	10,3	15,2	13,1	15,3	17
Water flow rate	(2)	m³/h	3,9	6,3	7,3	7,7	11,4
Head loss	(2)	kPa	9	13,3	11,4	12,6	14,4
Noise levels							
Sound power lev.	(4)	dB(A)	75	78	78	76	76
Sound pressure lev.	(5)	dB(A)	60	63	63	60	60
Dimensions and weights**							
Length		mm	712	712	712	712	712
Depth		mm	1023	1023	1023	1023	1023
Height		mm	1450	1450	1450	1450	1450
Operating weight		kg	282	296	308	393	432

(1) Source-side heat exchanger inlet/outlet water temperature 30/35°C; user-side heat exchanger inlet/outlet water temperature 12/7°C. Values compliant with standard EN 14511

(2) Source-side heat exchanger inlet/outlet water temperature 10/7°C; user-side heat exchanger inlet/outlet water temperature 40/45°C. Values compliant with standard EN 14511

(3) The indicated refrigerant charge is calculated. The refrigerant charge can vary according to different versions/accessories and product updates.

(4) Unit operating at nominal operating capacity, without any accessories, with source-side heat exchanger inlet-outlet water temperature 30-35°C and user-side heat exchanger inlet-outlet water temperature 12-7°C.Binding values. Values obtained from measures taken according to standard ISO 3744 and to the Eurovent certification programme where applicable.

(5) Values obtained from the sound power level (condition in note 4), referred to a distance of 1 m from the unit in free field with directivity factor Q = 2. Non-binding values.

(6) 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 unit without included accessories

SIGMA Zero Hi HPW

			25	40	45	50	70
Cooling							
Refrigeration capacity	(1)	kW	20,1	31,6	36	40,2	58
Total absorbed power	(1)	kW	4,5	8,3	9,7	10,3	14,6
EER	(1)		4,44	3,81	3,7	3,9	3,97
Heating							
Heating capacity	(1)	kW	23,3	37,7	43,6	46,3	67,8
Total absorbed power	(1)	kW	5,6	10,1	11,8	11,9	17,1
COP	(1)		4,13	3,73	3,69	3,89	3,96
Compressors							
Compressors/Circuits		n°/n°	1/1	1/1	1/1	1/1	1/1
Minimum capacity reduction step	(2)	%	27	17	17	46	46
Refrigerant charge	(3)	kg	1.3	1.8	2	2.1	4
User-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	3,5	5,4	6,2	6,9	10
Head loss	(1)	kPa	7,3	10,1	8,5	10,4	11,5
Water flow rate	(2)	m³/h	5,1	7,9	9,1	9,9	14,6
Head loss	(2)	kPa	14,6	20,2	17,2	20	23
Source-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	4,2	6,8	7,8	8,7	12,5
Head loss	(1)	kPa	11,2	17,3	14,3	17	19,1
Water flow rate	(2)	m³/h	4	6,5	7,5	8	11,6
Head loss	(2)	kPa	9,8	15,2	12,6	14,1	16,4
Noise levels							
Sound power lev.	(4)	dB(A)	75	78	78	76	76
Sound pressure lev.	(5)	dB(A)	60	63	63	60	60
Dimensions and weights**							
Length		mm	712	712	712	712	712
Depth		mm	1023	1023	1023	1023	1023
Height		mm	1450	1450	1450	1450	1450
Operating weight		kg	282	296	308	393	432

(1) Source side heat exchanger inlet/outlet water temperature 30/35°C; user side heat exchanger inlet/outlet water temperature 12/7°C. Values compliant with standard EN 14511

(2) 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.

(3) The indicated refrigerant charge is calculated. The refrigerant charge can vary according to different versions/accessories and product updates.

(4) Unit operating at nominal operating capacity, without any accessories, with source-side heat exchanger inlet-outlet water temperature 30-35°C and user-side heat exchanger inlet-outlet water temperature 12-7°C.Binding values. Values obtained from measures taken according to standard ISO 3744 and to the Eurovent certification programme where applicable.

(5) Values obtained from the sound power level (condition in note 4), referred to a distance of 1 m from the unit in free field with directivity factor Q = 2. Non-binding values.

** Basic unit without included accessories

SIGMA Zero Hi OH

			25	40	45	50	70
Heating							
Heating capacity	(1)	kW	23,3	37,7	43,6	46,3	67,8
Total absorbed power	(1)	kW	5,6	10,1	11,8	11,9	17,1
COP	(1)		4,13	3,73	3,69	3,89	3,96
Compressors							
Compressors/Circuits		n°/n°	1/1	1/1	1/1	1/1	1/1
Minimum capacity reduction step	(2)	%	27	17	17	46	46
Refrigerant charge	(3)	kg	1.3	1.8	2	2.1	4
User-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	4	6,5	7,5	8	11,6
Head loss	(1)	kPa	9,8	15,2	12,6	14,1	16,4
Source-side heat exchanger							
Quantity		n°	1	1	1	1	1
Water flow rate	(1)	m³/h	5,1	7,9	9,1	9,9	14,6
Head loss	(1)	kPa	14,6	20,2	17,2	20	23
Noise levels							
Sound power lev.	(4)	dB(A)	75	78	78	76	76
Sound pressure lev.	(5)	dB(A)	60	63	63	60	60
Dimensions and weights**							
Length		mm	712	712	712	712	712
Depth		mm	1023	1023	1023	1023	1023
Height		mm	1450	1450	1450	1450	1450
Operating weight		kg	282	296	308	393	432

(1) Source exchanger inlet-outlet water temperature 10/7 ° C; user exchanger inlet-outlet water temperature 40/45 ° C. Values compliant with standard EN 14511

(2) 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.

(3) The indicated refrigerant charge is calculated. The refrigerant charge can vary according to different versions/accessories and product updates.

(4) Unit operating at nominal operating capacity, without any accessories, with source-side heat exchanger inlet-outlet water temperature 30-35°C and user-side heat exchanger inlet-outlet water temperature 12-7°C.Binding values. Values obtained from measures taken according to standard ISO 3744 and to the Eurovent certification programme where applicable.

(5) Values obtained from the sound power level (condition in note 4), referred to a distance of 1 m from the unit in free field with directivity factor Q = 2. Non-binding values.

** Basic 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.

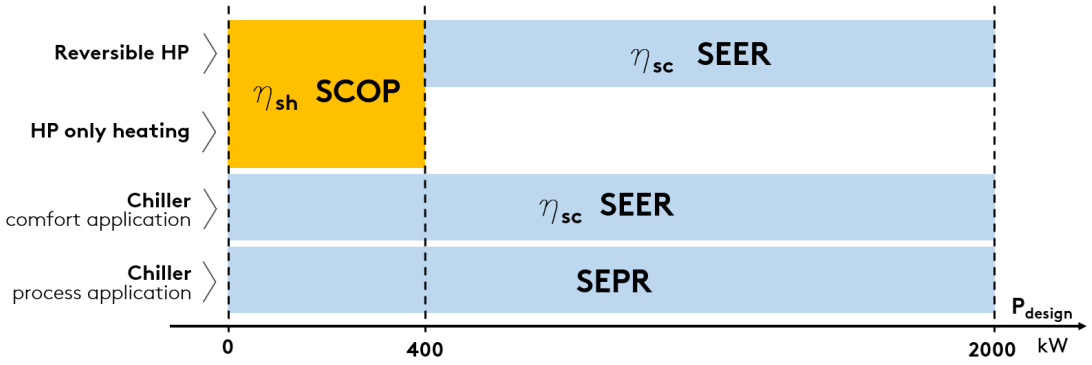
The other two regulations (2013/813 and 2016/2281) set seasonal efficiency targets that the products must comply with to be sold and installed in the European Union (essential requirement for CE marking).

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	4,975	200	5,075
water	≥ 400kW and < 1500kW	227	5,75	252	6,375
water	≥ 1500kW	245	6,2	272	6,875

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		-	-

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.

GAMMA SIGMA ZERO

In the specific instance of the SIGMA Zero series, the regulations that apply to the various units in the various configurations are as follows.

SIGMA Zero Hi:

- regulation 2016/2281

SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH:

- regulation 2013/813 and 2013/811

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

SIGMA Zero Hi

			20	30	35	40	50
REGULATION 2016/2281							
Pdesign	(1)	kW	20,1	31,6	36	40,2	58
COMFORT							
ηsc	(1)	%	258,8	254,2	260,1	202,4	205,5
SEER	(1)		6,545	6,430	6,578	5,135	5,213
Compliance Tier 2 (2021)	(1)		Y	Y	Y	Y	Y
PROCESS							
SEPR	(3)		(RFQ)	(RFQ)	(RFQ)	(RFQ)	(RFQ)
Compliance Tier 2 (2021)	(3)		Y	Y	Y	Y	Y

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

N = unit not in compliance with Ecodesign at the given condition: it can be installed only in non-EU countries.

(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.

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

SIGMA Zero Hi HP

			25	40	45	50	70
REGULATION 2013/813							
Low Temperature Application							
Pdesign	(1)	kW	33.2	39	44.7	48.9	70.7
ηsh	(1)	%	221.9	230.4	229.5	211.6	210.0
SCOP	(1)		5.75	5.96	5.94	5.49	5.45
Compliance	(1)		Y	Y	Y	Y	Y
Medium Temperature Application							
Pdesign	(2)	kW	28.9	34.5	39.8	37.9	61.1
ηsh	(2)	%	160.8	172.0	167.7	159.8	163.2
SCOP	(2)		4.22	4.50	4.39	4.20	4.28
Compliance	(2)		Y	Y	Y	Y	Y
REGULATION 2013/811							
Ecolabel LT	(3)		A+++	A+++	A+++	A+++	-
Ecolabel MT	(4)		A++	A++	A++	A++	A++

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

N = unit not in compliance with Ecodesign at the given condition: it can be installed only in non-EU countries.

(1) User-side heat exchanger water inlet/outlet temperature 30/35°C, Average climate profile, with reference to regulation 2013/813 and norm EN 14825.

(2) User exchanger water inlet / outlet temperature 47/55 ° C (SCOP MT), Average climate profile, with reference to regulation 2013/813 and to EN 14825.

(3) Energy efficiency class with reference to regulation 2013/811, conditions of note (1) - (low temperature applications).

(4) Energy efficiency class in reference to regulation 2013/811, conditions of note (2) - (medium temperature applications).

SIGMA Zero Hi HPW

			25	40	45	50	70
REGULATION 2013/813							
Low Temperature Application							
Pdesign	(1)	kW	33.8	39.5	45.4	50.1	72.1
ηsh	(1)	%	244.2	251.6	253.2	229.8	225.8
SCOP	(1)		6.31	6.49	6.53	5.95	5.85
Compliance	(1)		Y	Y	Y	Y	Y
Medium Temperature Application							
Pdesign	(2)	kW	31.4	35.7	41.4	41.7	63.4
ηsh	(2)	%	181.72	189.92	187.4	178.12	177.52
SCOP	(2)		4.74	4.95	4.89	4.65	4.64
Compliance	(2)		Y	Y	Y	Y	Y
REGULATION 2013/811							
Ecolabel LT	(3)		A+++	A+++	A+++	A+++	-
Ecolabel MT	(4)		A+++	A+++	A+++	A+++	A+++

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

N = unit not in compliance with Ecodesign at the given condition: it can be installed only in non-EU countries.

(1) User-side heat exchanger water inlet/outlet temperature 30/35°C, Average climate profile, with reference to regulation 2013/813 and norm EN 14825.

(2) User exchanger water inlet / outlet temperature 47/55 ° C (SCOP MT), Average climate profile, with reference to regulation 2013/813 and to EN 14825.

(3) Energy efficiency class with reference to regulation 2013/811, conditions of note (1) - (low temperature applications).

(4) Energy efficiency class in reference to regulation 2013/811, conditions of note (2) - (medium temperature applications).

SIGMA Zero Hi OH

			25	40	45	50	70
REGULATION 2013/813							
Low Temperature Application							
Pdesign	(1)	kW	33.8	39.5	45.4	50.1	72.1
ηsh	(1)	%	230.40	236.80	239.32	208.32	211.20
SCOP	(1)		5.96	6.12	6.18	5.41	5.48
Compliance	(1)		Y	Y	Y	Y	Y
Medium Temperature Application							
Pdesign	(2)	kW	31.4	35.7	41.4	41.7	63.4
ηsh	(2)	%	173.7	180.6	178.7	162.4	167.4
SCOP	(2)		4.54	4.72	4.67	4.26	4.39
Compliance	(2)		Y	Y	Y	Y	Y
REGULATION 2013/811							
Ecolabel LT	(3)		A+++	A+++	A+++	A+++	-
Ecolabel MT	(4)		A+++	A+++	A+++	A+++	A+++

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

N = unit not in compliance with Ecodesign at the given condition: it can be installed only in non-EU countries.

(1) User-side heat exchanger water inlet/outlet temperature 30/35°C, Average climate profile, with reference to regulation 2013/813 and norm EN 14825.

(2) User exchanger water inlet / outlet temperature 47/55 ° C (SCOP MT), Average climate profile, with reference to regulation 2013/813 and to EN 14825.

(3) Energy efficiency class with reference to regulation 2013/811, conditions of note (1) - (low temperature applications).

(4) Energy efficiency class in reference to regulation 2013/811, conditions of note (2) - (medium temperature applications).

ELECTRICAL SPECIFICATIONS

SIGMA ZERO HI

			20	30	35	40	50
General electrical specifications							
Max. absorbed power (FLI)	(1)	kW	12,3	12,3	14,2	13,0	18,0
Max. absorbed current (FLA)	(1)	A	19,0	19,0	21,4	21,6	34,0
Rated current (Inom)	(2)	A	7.9	12.11	14.28	17.13	28.14
cosφ standard unit	(2)		0.8	0.97	0.97	0.88	0.84
Max. inrush current (MIC)	(3)	A	5	5	5	10	10
Power supply			400/3~+N/50				
Power supply for auxiliary circuits			230V-24V / 1ph / 50 Hz				
Suggested line section	(5)	mm²	5G4 FG16OR16	5G4 FG16OR16	5G6 FG16OR16	5G6 FG16OR16	5G10 FG16OR16
Suggested line protection	(6)		CH10gG 25A	CH10gG 25A	CH14gG 32A	CH14gG 32A	CH14gG 40A

(1) Data regarding the unit without accessories working in maximum power absorption conditions

(2) Data referring to the basic unit without any accessory operating in standard conditions

(3) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + LRA of the largest compressor)

(4) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + 0.6 x LRA of the largest compressor)

(5) These values are determined for cables with operating temperature of 40°C, EPR insulation and a line with a maximum length of 50m. The line section must be determined by a qualified technician based on the protection devices, the length of the line, the type of cable used and the type of installation.

(6) The correct line protection part must be determined by a qualified technician based on the length of the line, the type of cable used and the type of installation.

SIGMA ZERO HI HP

			25	40	45	50	70
General electrical specifications							
Max. absorbed power (FLI)	(1)	kW	12,3	12,3	14,2	13,0	18,0
Max. absorbed current (FLA)	(1)	A	19,0	19,0	21,4	21,6	34,0
Rated current (Inom)	(2)	A	8.56	13.1	15.49	18	29.61
cosφ standard unit	(2)		0.8	0.97	0.96	0.88	0.84
Max. inrush current (MIC)	(3)	A	5	5	5	10	10
Power supply			400/3~+N/50				
Power supply for auxiliary circuits			230V-24V / 1ph / 50 Hz				
Suggested line section	(5)	mm²	5G4 FG16OR16	5G4 FG16OR16	5G6 FG16OR16	5G6 FG16OR16	5G10 FG16OR16
Suggested line protection	(6)		CH10gG 25A	CH10gG 25A	CH14gG 32A	CH14gG 32A	CH14gG 40A

(1) Data regarding the unit without accessories working in maximum power absorption conditions

(2) Data referring to the basic unit without any accessory operating in standard conditions

(3) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + LRA of the largest compressor)

(4) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + 0.6 x LRA of the largest compressor)

(5) These values are determined for cables with operating temperature of 40°C, EPR insulation and a line with a maximum length of 50m. The line section must be determined by a qualified technician based on the protection devices, the length of the line, the type of cable used and the type of installation.

(6) The correct line protection part must be determined by a qualified technician based on the length of the line, the type of cable used and the type of installation.

SIGMA ZERO HI HPW

			25	40	45	50	70
General electrical specifications							
Max. absorbed power (FLI)	(1)	kW	12,3	12,3	14,2	13,0	18,0
Max. absorbed current (FLA)	(1)	A	19,0	19,0	21,4	21,6	34,0
Rated current (Inom)	(2)	A	7.9	12.11	14.28	17.13	28.14
cosφ standard unit	(2)		0.8	0.97	0.97	0.88	0.83
Max. inrush current (MIC)	(3)	A	5	5	5	10	10
Power supply			400/3~+N/50				
Power supply for auxiliary circuits			230V-24V / 1ph / 50 Hz				
Suggested line section	(5)	mm²	5G4 FG16OR16	5G4 FG16OR16	5G6 FG16OR16	5G6 FG16OR16	5G10 FG16OR16
Suggested line protection	(6)		CH10gG 25A	CH10gG 25A	CH14gG 32A	CH14gG 32A	CH14gG 40A

(1) Data regarding the unit without accessories working in maximum power absorption conditions

(2) Data referring to the basic unit without any accessory operating in standard conditions

(3) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + LRA of the largest compressor)

(4) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + 0.6 x LRA of the largest compressor)

(5) These values are determined for cables with operating temperature of 40°C, EPR insulation and a line with a maximum length of 50m. The line section must be determined by a qualified technician based on the protection devices, the length of the line, the type of cable used and the type of installation.

(6) The correct line protection part must be determined by a qualified technician based on the length of the line, the type of cable used and the type of installation.

SIGMA ZERO HI OH

			25	40	45	50	70
General electrical specifications							
Max. absorbed power (FLI)	(1)	kW	12,3	12,3	14,2	13,0	18,0
Max. absorbed current (FLA)	(1)	A	19,0	19,0	21,4	21,6	34,0
Rated current (Inom)	(2)	A	9.92	14.93	17.46	19.63	32.09
cosφ standard unit	(2)		0.8	0.96	0.96	0.9	0.85
Max. inrush current (MIC)	(3)	A	5	5	5	10	10
Power supply			400/3~+N/50				
Power supply for auxiliary circuits			230V-24V / 1ph / 50 Hz				
Suggested line section	(5)	mm²	5G4 FG16OR16	5G4 FG16OR16	5G6 FG16OR16	5G6 FG16OR16	5G10 FG16OR16
Suggested line protection	(6)		CH10gG 25A	CH10gG 25A	CH14gG 32A	CH14gG 32A	CH14gG 40A

(1) Data regarding the unit without accessories working in maximum power absorption conditions

(2) Data referring to the basic unit without any accessory operating in standard conditions

(3) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + LRA of the largest compressor)

(4) Maximum effective RMS value of the current when the last compressor starts (FLA of the entire unit - FLA of the largest compressor + 0.6 x LRA of the largest compressor)

(5) These values are determined for cables with operating temperature of 40°C, EPR insulation and a line with a maximum length of 50m. The line section must be determined by a qualified technician based on the protection devices, the length of the line, the type of cable used and the type of installation.

(6) The correct line protection part must be determined by a qualified technician based on the length of the line, the type of cable used and the type of installation.

FLOW RATE RANGES OF HEAT EXCHANGERS

The units are sized and optimized for the following nominal conditions:

- inlet-outlet of the source-side heat exchanger 30/35°C
- inlet-outlet of the user-side heat exchanger 12/7°C

The units can work at design conditions different from nominal conditions, provided that:

- the design condition falls within the operating limits specified below
- the unit is equipped with all the accessories necessary for operation of the unit (e.g. brine kit, condensation control)
- the flow rate at design conditions (that is, of the specific application) must always come within the allowed flow rate ranges specified below. If the design conditions require a water flow rate that does not come within the allowed operating range, you must contact our sales department that will identify the most suitable solution for the specific application.

SIGMA Zero Hi

	User-side heat exchanger		Source-side heat exchanger	
	Qmin	Qmax	Qmin	Qmax
	m³/h	m³/h	m³/h	m³/h
20	1.8	5.7	2.2	6.5
30	2.8	8.8	3.5	10.4
35	3.2	10.1	4	11.9
40	3.6	11.6	4.5	13.5
50	5.2	16.7	6.5	19.5

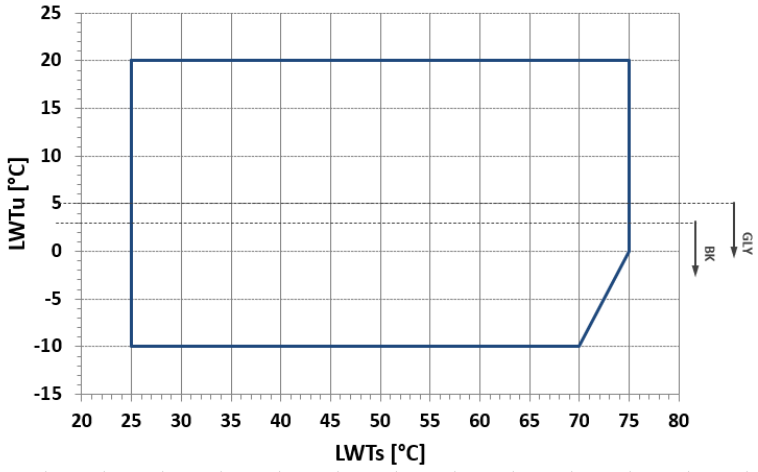
SIGMA Zero Hi HP - SIGMA Zero Hi HPW - SIGMA Zero Hi OH

	User-side heat exchanger		Source-side heat exchanger	
	Qmin	Qmax	Qmin	Qmax
	m³/h	m³/h	m³/h	m³/h
25	2,1	6,4	1,7	5,5
40	3,4	10	2,6	8,5
45	3,9	11,8	3	9,7
50	4,4	13,2	3,4	11
70	6,4	19,1	5	16,1

OPERATING LIMITS

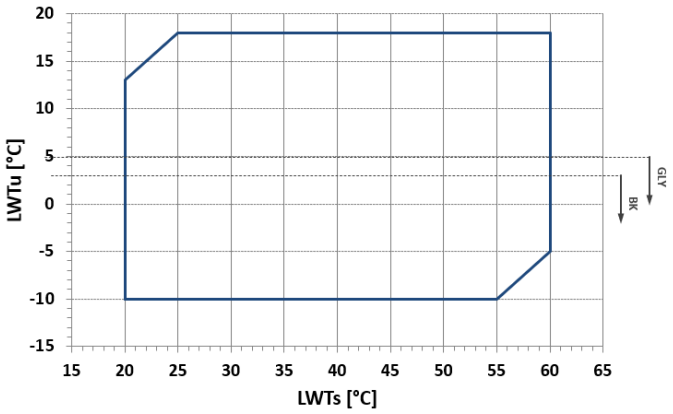
SIGMA Zero Hi (20-30-35)

COOLING



SIGMA Zero Hi (40-50)

COOLING



LWTs: water outlet temperature from the source-side heat exchanger

LWTu: water outlet temperature from the user-side heat exchanger

LWTr: water outlet temperature from the recovery exchanger

BK: For LWTu below +3°C, it is mandatory to fit the "Brine Kit" accessory

HWT: For certain operating conditions it is necessary to select the HWT accessory. Refer to the dashed operating envelope where HTW is necessary.

For LWTu below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the exchanger.

For LWTs below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the heat exchanger.

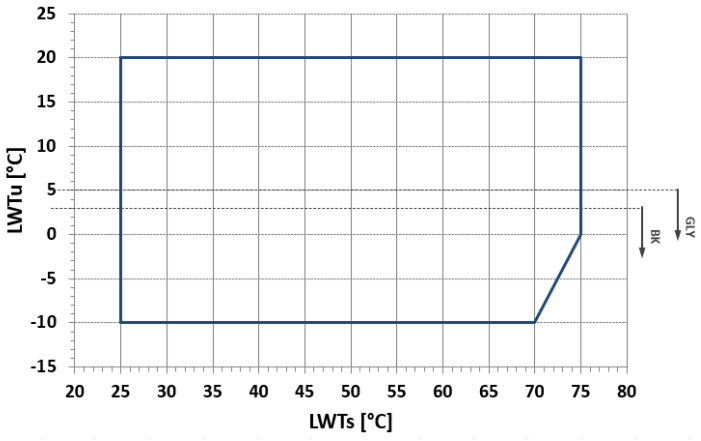
The inlet and outlet temperatures of the user-side exchanger must be given on ordering to allow correct setting of the alarm parameters and verification of the sizing of the expansion valve.

The cooling set point can then be changed by the customer in an interval that, compared to the set point given on ordering, ranges from -1K up to the maximum temperature allowed by the above-stated operating limits.

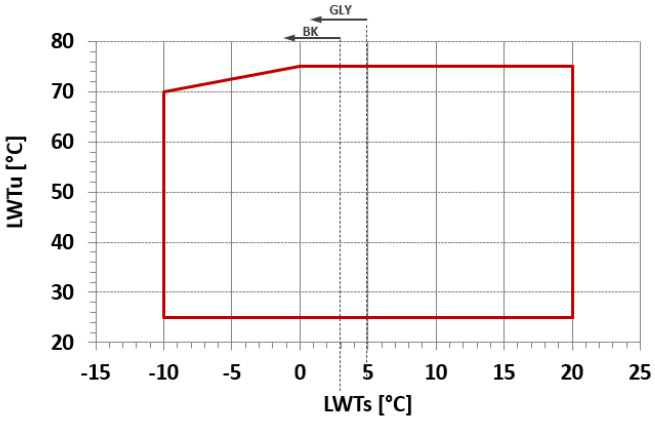
The unit will be optimized to work at the set point temperatures given on ordering. For different set points, the cooling capacity provided and the level of efficiency of the machine could decrease and move away from these conditions.

SIGMA Zero Hi HP - SIGMA Zero Hi HPW (25-40-45)

COOLING



HEATING



LWTs: water outlet temperature from the source-side heat exchanger

LWTu: water outlet temperature from the user-side heat exchanger

LWTr: water outlet temperature from the recovery exchanger

BK: For LWTu below +3°C, it is mandatory to fit the "Brine Kit" accessory

HWT: For certain operating conditions it is necessary to select the HWT accessory. Refer to the dashed operating envelope where HTW is necessary.

For LWTu below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the exchanger.

For LWTs below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the heat exchanger.

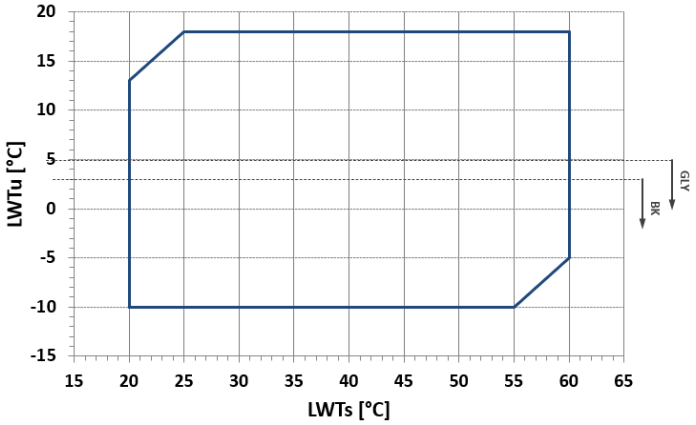
The inlet and outlet temperatures of the user-side exchanger must be given on ordering to allow correct setting of the alarm parameters and verification of the sizing of the expansion valve.

The cooling set point can then be changed by the customer in an interval that, compared to the set point given on ordering, ranges from -1K up to the maximum temperature allowed by the above-stated operating limits.

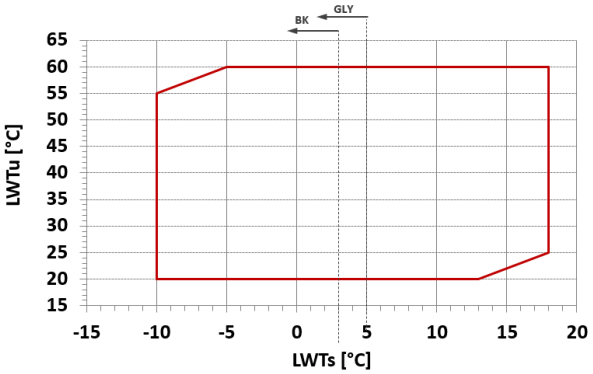
The unit will be optimized to work at the set point temperatures given on ordering. For different set points, the cooling capacity provided and the level of efficiency of the machine could decrease and move away from these conditions.

SIGMA Zero Hi HP - SIGMA Zero Hi HPW (50-70)

COOLING



HEATING



LWTs: water outlet temperature from the source-side heat exchanger

LWTu: water outlet temperature from the user-side heat exchanger

LWTr: water outlet temperature from the recovery exchanger

BK: For LWTu below +3°C, it is mandatory to fit the "Brine Kit" accessory

HWT: For certain operating conditions it is necessary to select the HWT accessory. Refer to the dashed operating envelope where HTW is necessary.

For LWTu below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the exchanger.

For LWTs below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the heat exchanger.

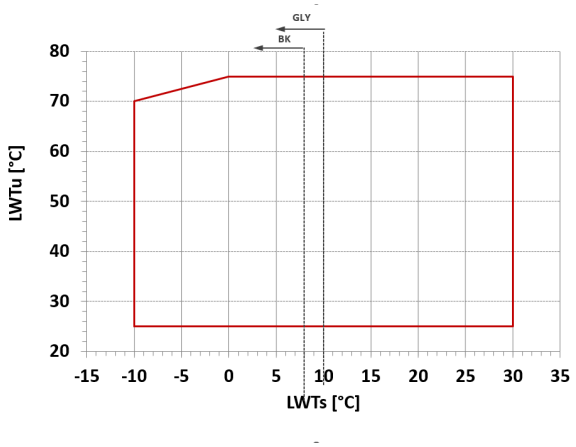
The inlet and outlet temperatures of the user-side exchanger must be given on ordering to allow correct setting of the alarm parameters and verification of the sizing of the expansion valve.

The cooling set point can then be changed by the customer in an interval that, compared to the set point given on ordering, ranges from -1K up to the maximum temperature allowed by the above-stated operating limits.

The unit will be optimized to work at the set point temperatures given on ordering. For different set points, the cooling capacity provided and the level of efficiency of the machine could decrease and move away from these conditions.

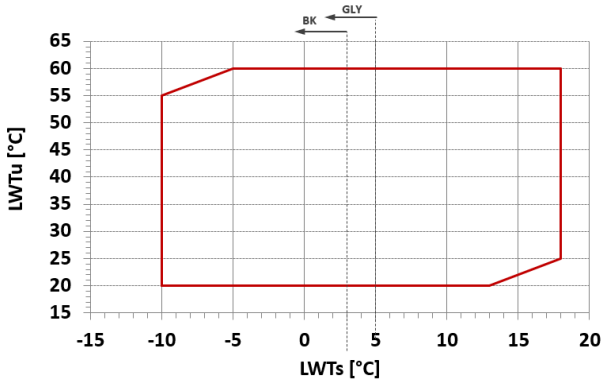
SIGMA Zero Hi OH (25-40-45)

HEATING



SIGMA Zero Hi OH (50-70)

HEATING



LWTs: water outlet temperature from the source-side heat exchanger

LWTu: water outlet temperature from the user-side heat exchanger

LWTr: water outlet temperature from the recovery exchanger

BK: For LWTu below +3°C, it is mandatory to fit the "Brine Kit" accessory

HWT: For certain operating conditions it is necessary to select the HWT accessory. Refer to the dashed operating envelope where HTW is necessary.

For LWTu below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the exchanger.

For LWTs below +5°C, it is compulsory to use suitable percentages of antifreeze additives (glycols) to prevent ice formation in the heat exchanger.

The inlet and outlet temperatures of the user-side exchanger must be given on ordering to allow correct setting of the alarm parameters and verification of the sizing of the expansion valve.

The cooling set point can then be changed by the customer in an interval that, compared to the set point given on ordering, ranges from -1K up to the maximum temperature allowed by the above-stated operating limits.

The unit will be optimized to work at the set point temperatures given on ordering. For different set points, the cooling capacity provided and the level of efficiency of the machine could decrease and move away from these conditions.

NOISE LEVELS

SIGMA Zero Hi

	Octave bands [dB]																Total [dB(A)]	
	63 Hz		125 Hz		250 Hz		500 Hz		1000 Hz		2000 Hz		4000 Hz		8000 Hz			
	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw_tot	Lp_tot
20	62.9	47.3	73.5	57.9	48.4	32.8	62.1	46.5	70.8	55.2	70.9	55.3	64.6	49	62.2	46.6	**75**	**60**
30	56.8	41.2	73	57.4	52.1	36.5	64.9	49.3	71.7	56.1	74.6	59	68.4	52.8	66.7	51.1	**78**	**63**
35	56.8	41.2	73	57.4	52.1	36.5	64.9	49.3	71.7	56.1	74.6	59	68.4	52.8	66.7	51.1	**78**	**63**
40	76.3	60.7	73.3	57.7	72.8	57.2	76.5	60.9	70.2	54.6	58.7	43.1	57.1	41.5	54.9	39.3	**76**	**60**
50	76.3	60.7	73.3	57.7	72.8	57.2	76.5	60.9	70.2	54.6	58.7	43.1	57.1	41.5	54.9	39.3	**76**	**60**

SIGMA Zero Hi HP - SIGMA Zero Hi HPW - SIGMA Zero Hi OH

	Octave bands [dB]																Total [dB(A)]	
	63 Hz		125 Hz		250 Hz		500 Hz		1000 Hz		2000 Hz		4000 Hz		8000 Hz			
	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw	Lp	Lw_tot	Lp_tot
25	62.9	47.3	73.5	57.9	48.4	32.8	62.1	46.5	70.8	55.2	70.9	55.3	64.6	49	62.2	46.6	**75**	**60**
40	56.8	41.2	73	57.4	52.1	36.5	64.9	49.3	71.7	56.1	74.6	59	68.4	52.8	66.7	51.1	**78**	**63**
45	56.8	41.2	73	57.4	52.1	36.5	64.9	49.3	71.7	56.1	74.6	59	68.4	52.8	66.7	51.1	**78**	**63**
50	76.3	60.7	73.3	57.7	72.8	57.2	76.5	60.9	70.2	54.6	58.7	43.1	57.1	41.5	54.9	39.3	**76**	**60**
70	76.3	60.7	73.3	57.7	72.8	57.2	76.5	60.9	70.2	54.6	58.7	43.1	57.1	41.5	54.9	39.3	**76**	**60**

Reference conditions: source-side heat exchanger inlet-outlet temperature 30/35°C; user side heat exchanger inlet/outlet water temperature 12/7°C. Unit operating at nominal operating capacity, without any accesories.

Lw: sound power levels. Lw_tot is the only binding value. Values obtained from measures taken according to standard ISO 3744.

Lp: sound pressure levels calculated from sound power levels, related to distance of 1m from the unit in free field with directivity factor Q=2. Non-binding values.

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
	1,2 ÷ 3,4 °d
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.

It should also be pointed out that, for air-water units working in heat pump mode, the minimum amount of water must consider the need of the unit to carry out defrosting. Having an adequate buffering volume will allow prevention of too high drifts of the delivered water temperature at the end of the defrost cycle.

Please check "water Volume Design" Tool for a correct estimation of minimum water content of the system in "heat pump" working mode.

The following experimental formula allows to calculate the minimum water volume of the plant.Formula refers to unit operation in cooling mode and is also valid for heating mode if defrosting cycles are not taken in account.

SIGMA Zero Hi (20, 30, 35) - SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH (25, 40, 45)

$$Vmin = \frac{P_{tot} \cdot 1000}{N} \cdot \frac{180}{\Delta T\ \rho\ C_p} + P_{tot} \cdot 0.25$$

SIGMA Zero Hi (40, 50) - SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH (50, 70)

$$Vmin = \frac{P_{tot} \cdot 1000}{N} \cdot \frac{300}{\Delta T\ \rho\ C_p} + P_{tot} \cdot 0.25$$

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:

SIGMA Zero Hi (20, 30, 35) - SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH (25, 40, 45)

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

SIGMA Zero Hi (40, 50) - SIGMA Zero Hi HP, SIGMA Zero Hi HPW, SIGMA Zero Hi OH (50, 70)

$$Vmin = \frac{P_{tot}}{N} \cdot 28.66 + P_{tot} \cdot 0.25$$

For units with inverter compressor:

- N=3 for units featuring one inverter-piloted compressor only;

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
- compliance with the respect spaces indicated in the installation, use and maintenance manual must be guaranteed, in relation to units with highly flammable A3 refrigerant
- 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.

Installation types

Generally, an air conditioning unit is installed in rooms that are normally occupied by people, in general-purpose rooms or in dedicated technical room such as **machinery rooms**. Another possible option is unit installation **outdoors, in the open air**. Also, several access categories are defined for each installation. The type of installation and access category determine the maximum permitted refrigerant charge for the installation, depending on the type of refrigerant in use.

This guide specifically addresses:

- hydronic climate control units; chillers and heat pumps for **Class III outdoor** installations (open space installations). In the case of Class III installation in open field where all the standard and manufacturer's standards relating to the installation of the unit are respected, there is no restriction on the amount of charge of the installed unit if the access category and type "c" (authorized access).

For further information regarding installation classes, access categories and the charge limit, consult the Standard EN378-1.

Compliance with class III is also linked to the fact that the hydraulic system that carries the fluid that is heated or cooled by the unit to the various users complies with the requirements defined by EN 378-1 in section 5.5. 2 to avoid the possibility of a leak of refrigerant flowing into occupied rooms. See the section "Hydraulic Connections" for a description of the various solutions that are applicable to our types of unit.

Failure to comply with the provisions regarding the hydraulic system will result in the installation being downgraded to Class I or Class II, in which case the refrigerant charge limits are lower than in Class III (Ref. EN 378-1, Annex C).

In general, **the person in charge of the installation** (generally the designer), must ensure compliance with the standard requirements by carrying out a risk assessment mainly according to the manufacturer's instructions and standards, such as EN378-1, EN378-3, or IEC 60335-2-40:2018 when applicable. All other considerations aside, the installation must also conform with the applicable local or national regulations.

The installation technician must install the units as defined in the project. Before starting to install the units, the installation technician must carry out his/her own assessment, within the limits of his/her technical qualifications and issue the Declaration of Conformity once the work is complete.

The installation supervisor is responsibility for guaranteeing the conformity of the system.

We strongly recommend that a consultant/qualified third-party body be involved in the installation conformity assessment process, based on the type and quantity of refrigerant used.

In order to ensure complete safety of the application, it is fundamentally important to respect the type of installation the unit has been designed for.

Where more stringent than the provisions set out in the applicable regulations, the installation shall conform to the local/national regulations.

Definitions

For reasons of clarity, it has been deemed helpful to introduce a series of additional definitions; This section simply lists the additional definitions that have been introduced, which are important when conducting the risk assessment.
The technical handbook contains further information about the various components used.

- **User terminal side heat exchanger/Desuperheater**

This type of heat exchanger is used to transfer heat from or to the hydraulic circuit vector fluid and, hence, heat or cool the climate controlled environments. The desuperheater is a dedicated heat exchanger used to heat a specific hydraulic circuit. Such units normally consist of a brazed plate heat exchanger. Other types of heat exchanger may be used.

- **Source-side heat exchanger**

This type of heat exchanger is used to transfer the heat extracted from/yielded to the user terminal side hydraulic circuit vector fluid towards the outdoor air when cooling/heating the climate controlled environments. Usually, finned or micro-channel coils. Other types of heat exchanger may be used. For example, in the case of water dissipation type source units, either brazed plate or tube bundle heat exchangers may be used.

- **Refrigerant leaks**

Refrigerant gas escaping from the container/object used to store it; in the case of Chillers or Heat Pumps, the gas will escape from the refrigerating circuit or one of its components. As the refrigerants in question are flammable, under certain circumstances gas leaks may result in the formation of flammable or explosive atmospheres. Such instances include, but are not limited to:

refrigerant gas leaks from the unit refrigerating circuit due to one of its components malfunctioning or being damaged;

refrigerant gas leaks caused by the unit safety valve being activated;

refrigerant gas leaks caused by the unit heat exchanger or finned battery being damaged;

accidental release of refrigerant gas from the refrigerating circuit, or cylinders used to store the gas, during maintenance activities.

- **Installation Class (Ref EN378-1)**:

The Standard defines for Installation Classes.

- **Access Category (Ref EN378-1)**:

a = public; **b =** restricted or supervised; **c =** controlled or authorised.

- **Charge Limit (Ref EN378-1)**:

The Standard defines maximum refrigerant charge limits, depending on the installation class, access category and type of refrigerant in use.

- **LFL (Rif EN378-1)**:

The lowest percentage of a substance in air that can lead to flame propagation.

- **The safety class or category of a refrigerant fluid (EN 378-1)**:

categorization of a substance as flammable or non-flammable, toxic or non-toxic.

- #B#ATEX Zone 2 (Ref. EN 60079-10-1 and IOM) and Safety Zone (Ref IOM):

see section: "Class III hydronic unit installations in open air environments".

- **Ignition Sources (Ref EN378-2)**:

External sources that could lead to flame propagation in a combustible atmosphere.

- **Installation**:

Installation is defined as the unit positioned and installed correctly and operational as set out in the IOM manual. This definition **does not** include the activities involved in preparing the installation (construction of the hydraulic and electrical systems, realising the infrastructure, etc.)In addition to the reference standards, further information may be found in the Appendix to this document.

- **Electrical control panel**

Electrical control panel QE. For further details, see the dedicated chapter.

- **Technical compartment**

Technical compartment VT. The refrigeration circuit is enclosed in a compartment that contains an ATEX certified leak sensor and an ATEX certified extraction fan.

Class IV installations (indoor units)

To ensure that indoor installations consisting of units containing flammable, non toxic refrigerants may be considered Class IV, the **installation supervisor (customer, installation technician, consultant, etc.)** must evaluate the following additional factors to guarantee that hazardous situations cannot arise in the event of a gas leak note1].

The unit includes an internal "Atex" fan, which is used to expel the air from the technical compartment.

The regulations require that the installation technician install a channel which ensures the air expelled from the technical compartment is conveyed to the open air correctly.

It is essential to ensure that the air is not expelled in proximity to storm drains, manholes, or any other opening that may contain refrigerant; in proximity to fresh air intakes, doors or similar openings, or in proximity to ignition sources, as defined by the Standard EN378-2.

here is an obligation to convey the discharge of the safety valves via piping compliant with national and/or European directives, the area of which the refrigerant escapes must comply with the same requirements described above valid in the event of a leak.

Class III hydronic unit installations in open air environments

In order for the outdoor installation of units containing flammable and non-toxic refrigerant to be considered class III, the following are some of the additional assessments that the **responsible for the installation (customer, installer, consultant, ...)# bb#, must do to ensure that any gas leak does not generate dangerous situations [note**1 **] .**

1. The units must be positioned so as to prevent any refrigerant leaks from reaching the enclosed spaces, creating temporarily flammable zones or harming persons or property. Leaks must be prevented from flowing into manholes and storm drains and directly onto personnel and must not be directed towards air vents designated to serve enclosed spaces. Leaks must also be kept away from fresh air intakes, doors or similar openings, as well as ignition sources as defined by the Standard EN378-1. here is an obligation to convey the discharge of the safety valves via piping compliant with national and/or European directives, the area of which the refrigerant escapes must comply with the same requirements described above valid in the event of a leak.

The installation, use and maintenance manual and the dedicated documentation offer a detailed explanation of how the drainage channel must be created and calculated and any identification requirements required, but it must be remembered that the responsibility falls in any case on the person in charge of the installation.

Standard EN13136:2019 should be referenced for the calculation and sizing of the safety valve exhaust.

The conveying must be done with a pipe whose diameter must be at least that of the valve outlet, and the weight of the pipe must not be borne by the valve.When positioning the safety valve discharge line, it should be taken into account that the Atex Zone 2 (note2**) generated by the emissions from a safety valve differs from the Atex Zone 2 defined for the unit.**

Zone 2 forming from the emissions of a safety valve may extend horizontally up to 10 metres and vertically up to 11 metres.

The assessment of the risk areas is the responsibility of the installation supervisor.

Exhausted material must not be conveyed close to ignition sources, as defined in standard EN378-2.

Where the existing local regulations are more stringent, these should be taken as reference.

Always use the appropriate type of fire extinguishers for the refrigerant in use in proximity to the unit.

Notes

1 **For further details and a complete list of requirements, refer to EN378-3: Paragraph 4.2, Paragraph 6.2.14 and Annex K. Paragraphs 4.3, 5.1 and 5.14 in the case of leaks as indicated in point 2 below (leaks underground or inside cavities). In addition, national directives, if any, must always be observed.**

2 **Zone 2 according to the Atex directive is an area in which the formation of an explosive atmosphere of air and flammable substances in the form of gas, vapor or mist is not likely during normal activities and, if it occurs, it is only of short duration.**

2. If the refrigerant leak can stagnate, for example, underground or inside cavities, the installation must comply with the requirements for gas detection and ventilation of engine rooms and where applicable , also compliant with the requirements for ignition sources as defined by EN378-2.Reference to the section on machinery rooms in standard EN 378-3 should be made in this case.

3. Where the unit is installed in the open air, but under a shelter, ventilation must be guaranteed.

4. If the unit installed is inside a room, where at least one of the longest walls is open to outside air for at least 80% of the wall area (or equivalent if more of a wall must be outdoors) and covered by slats/grids with at least 75% free area, is considered as an outdoor installation.

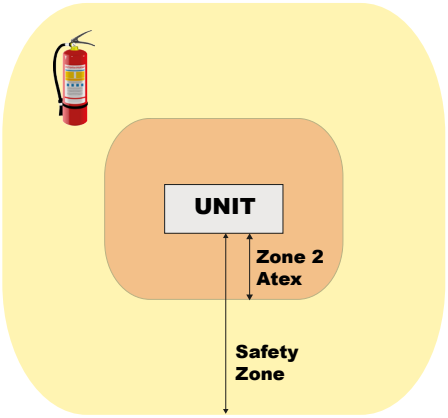
5. When conducting the risk assessment, the installation supervisor must also take the following indications into account.

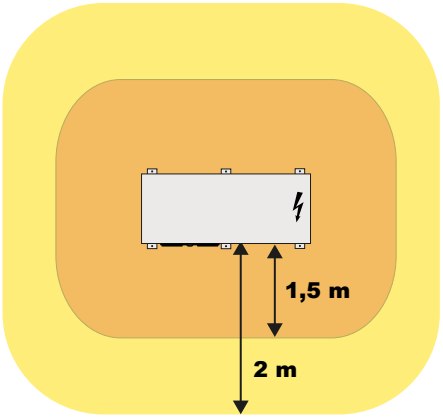
- In the event of leaks, the unit gives rise to an Atex "zone 2" classified environment around the machine.
- Based on the above, the designation of a safety "zone/area" around the machine is deemed to be appropriate.

In a "zone 2":

- installation of equipment unsuitable for use in such potentially explosive zones must be avoided (the minimum equipment requirements are: 3G IIB T4);
- naked flames, sparks and hot work must be avoided;
- sources of ignition that are due to processes must be avoided, since they are likely to give way to remote ignition (ionizing and non-ionizing radiation);
- direct and indirect effects of electrocution must be avoided;
- electrostatic charges must be avoided;
- interference must be avoided with elements that may be hazardous, including sewage systems, openings towards stone retaining walls, underground spaces, power lines, flammable material warehouses, railways, motorways, etc.

In the safety "zone/area", storage of refrigerant bags must be avoided in spaces such as sewage systems, manholes, water traps, openings towards stone retaining walls, underground spaces, etc.
Refer to national or local regulations on this issue, where applicable.





For further details, please refer to the "Instruction manual for operation and maintenance".

6. Confirm that noise barriers or other protection systems, if any, cannot create areas where leaks can stagnate.

7. Also take into account the possible leaks that can occur on parts of the circuit that are normally closed, for example from panels that can be removed or from doors that can be left open during maintenance activities.

To guarantee the correct functioning of the unit, it is mandatory to guarantee the clearances specified in the dimensional drawings. Always check the Atex Zone 2 and the respect/safety zone and any installation limitations in the Installation, Use and Maintenance manual.
Access restriction is part of correct installation to eliminate residual risks during normal operation.

Hydraulic Connections

The chillers and heat pumps are normally used to heat and/or cool a closed water circuit connected to system terminals such as fan coils, etc., which are usually located in occupied spaces. The plumbing then connects the building utilities with the refrigeration machine, so in Class III installations, for compliance to occur, the installer must take extra precautions to prevent a refrigerant leak into the hydraulic circuit through the heat exchanger then flows inside occupied rooms and or generates a flammable mixture, as required by EN 378-1 and EN378-3.

- The hydraulic system must be protected against accidental damage.
- There must be a vent system using suitably calibrated safety valves, so that any refrigerant is discharged outdoors in compliance with all the prescriptions relating to refrigerant discharge already indicated in the section "Class III outdoor installations for hydronic units" . The calibration setting must take into account the operating pressure of the hydraulic circuit, the altitude and the type of refrigerant fluid. All safety requirements applicable to sources of leakage from the unit also apply to the hydraulic system.
- Hydraulic components, accumulator tanks and any other open type components or elements that could release refrigerant as a consequence of a leak from the heat exchanger must be installed outdoors. The same safety precautions must be implemented as for any other potential source of leaks from the unit. If it is not possible to install such elements outdoors, they must be replaced with equivalent, watertight components.
- If there is a hydraulic decoupling device installed between the primary and secondary circuits, assess whether it is sufficient to implement the above precautions to the primary circuit only.

In the event that the installation solutions defined in the previous points are not possible but these devices are confined within a machine room, it is the duty of the installation manager to carry out a flammability assessment and classification of the danger area for the room technical as required by the EN378-3 standard".

The precautions implemented on the desuperheater hydraulic circuit must be the same as those adopted for the main heat exchanger.

Guidelines for the risk assessment

The purpose of this section is to provide all elements specific to the Swegon Operations S.r.L. production units. with A2, A2L and A3 refrigerants to allow the installation manager to carry out the risk assessment associated with the installation and, consequently, to determine the prevention, protection and management measures to be adopted to pursue the following safety objectives:

- minimise the causes of fires or explosions;
- guarantee the stability of the supporting structures for a predetermined period of time;
- limit the instance and spread of fires inside the building;
- limit the spread of fires to adjacent buildings;
- limit the effects of explosions;
- ensure that occupants are able to leave the building unassisted or receive assistance in other ways;
- ensure that emergency services are able to intervene in conditions of safety.

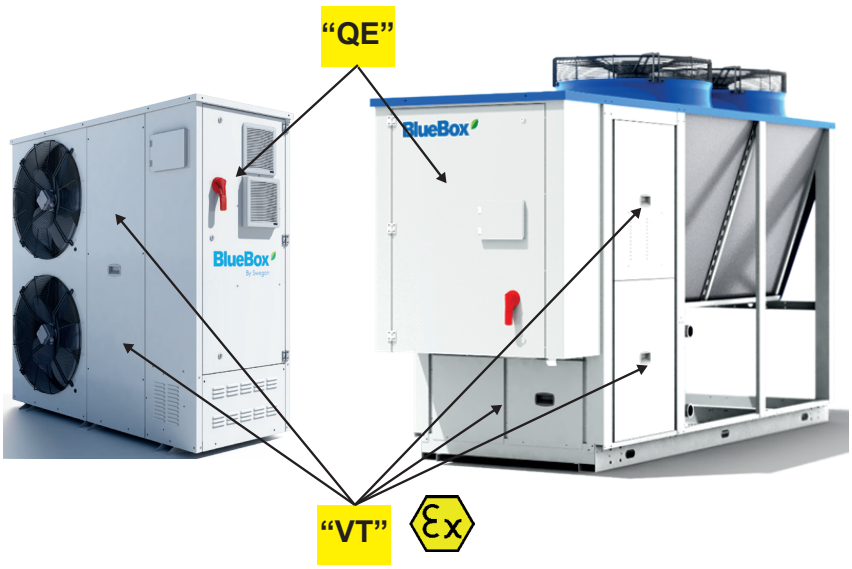
The installation supervisor is responsible for compiling the installation risk assessment.

The information is in accordance with the European standard EN378 with particular reference to the effects on the environment and on the safety of people and things in the context linked to the installation of Swegon Operations S.r.L. production units. containing refrigerants classified A2L, A2 and A3.

The Technical Handbook includes information regarding the manufacturing specifications, technical and performance data, available accessories and all the other elements necessary for a full understanding of the units.

The Installation, Operating and Maintenance manual contains the information necessary to install, operate and service the units.

The technical data label, the additional labels, the wiring diagram, the refrigeration diagram, the hydraulic diagram, the dimensional diagram, the instructions concerning handling and the accompanying documentation show technical data, dimensions, clearances, data and electrical characteristics and hydraulics, utility connections, handling information and much more.



Thus, when defining the project and conducting the risk assessment, it is necessary to take various situations into account, including:

- how to properly convey any gas exhausted by the safety valves and how any leakage from the coils or any exhaust from the technical compartment (VT) may be made to flow to the safe area, as described above;
- a check that any leak in the “VT” is sensed by the refrigerant sensor a the time when the concentration exceeds 10% the LFL. The three-phase power supply is cut out and the unit consequently switches off. The extraction fan in the “VT” is started so that the air-refrigerant mix is expelled to the outside. The fans in the electric panel (QE) are switched on, if they are not already. The rest of the unit is off and the safety device chain only is active. The unit reports the leak condition by means of a light indicator and through a potential-free contact. After the leak is cleared safely, the sensor requires resetting, which is done by cutting out power to the sensor. When the sensor is energised again, a “warm-up” procedure gets started. A reading test is recommended after a leak has been identified;
- where a leak external to the “VT”, originating from the unit batteries, is not detected by the refrigerant sensor but is prevented from entering the “QE” due to it being isolated. If the leak were to reach the axial fans, the speed of the air and effect of dilution would cause it to be dispersed. If the leaking gas manages to access the “VT”, the previous case applies;
- if the sensor experiences a malfunction or power to it is cut out, but the unit is energised, the system basically starts the same actions listed for any leakage detected inside the “VT”. Dedicated warning lights/messages are activated in this case, which are different from those relating to a leak;
- a blackout of the three-phase line switches the entire unit off, safety device chain included;
- a short blackout does not normally require an inspection by a qualified technician before the power line is restored;
- if the power failure lasts for a long time, we strongly recommend that a skilled technician be asked to test the unit for leaks on site: this evaluation must be part of the risk analysis;
- in any case, as soon as power is restored, the sensor runs the warm-up procedure, at the end of which an OK signal is output, where no leaks are identified, to restore power to the rest of the unit.

Despite the requirements adopted in units containing A3 flammable refrigerants, and although some components may be ATEX compliant, Swegon Operations units containing A3 **refrigerants are not suitable** to be installed in explosive environments as required by the ATEX directive.

Applicable standards and regulations and reference documents

The main regulatory framework is given by the complete EN378, while for a complete regulatory framework it is useful to refer to the final part of the Swegon guides on flammable refrigerants.

EN378: refrigerating systems and heat pumps

- EN378-1: Basic requirements, definitions, classification and selection criteria.
- EN378-2: Design, construction, testing, marking and documentation.
- EN378-3: Installation site and personal protection.
- EN378-4: Operation, maintenance, repair and recovery.

It is also useful to include a list of the principal reference documents that should be adopted when drawing up the risk assessment (complete with the respective abbreviations).

The following documents constitute an integral part of the machine documentation. The documents are indicated by the abbreviations used to refer to them in the risk assessment.

- **IOM**: Installation, Operating and Maintenance manual This is the document where it is possible to find information relating to product safety and the correct way of operating, information on installation, Atex zone 2, safety zone and on the specific prescriptions relating to flammable refrigerant, start-up and maintenance of the units, as well as information on the competent personnel who may operate. This document is essential for personnel assigned install and operate the unit.
- **DimDiag**: The dimensions diagram illustrates the physical dimensions of the unit and the respective operating spaces.
- **ELDiag**: The electrical circuit diagram includes all the information regarding the unit electrical connections and the external connections to the unit.
- **Declaration of Conformity**: this document indicates the various EEC Directives and Regulations the unit conforms to.
- **PDoc**: an assessment conducted by the installation technician or other personnel responsible for the installation site.
- **TH**: Technical handbook or catalogueThis document covers the technical and electrical data, the hydronic units and pumps; it includes the unit operating limits and various other information. This document is essential when designing a unit installation, especially in the case of projects that include units containing flammable refrigerants.

It is important to recall that, when installing units containing A3 classified refrigerants, it may be necessary to obtain permission from the relevant Authority.

Installation risk assessment

Transport, positioning and storage are not included in the scope of the installation risk assessment. The section "Reception, handling and storage of units containing flammable refrigerants" of this document provides information of performing these phases correctly and as safely as possible.

The residual risks described in the Installation, Operating and Maintenance manual must also be taken into account when conducting the risk assessment.

The following table contains a series of indications designed to assist the installation supervisor in conducting the risk assessment, and in minimising the risks themselves.

How to minimise fire risks in the installation.

Installing the unit

The unit must be installed in a workmanlike manner, by a certified and titled company, respecting the manufacturer's specific instructions given in the IUM manual and adopting all the necessary fire prevention, protection and management measures.

The unit must be installed outdoors in such a way as to prevent any refrigerant leaks from reaching the enclosed spaces, creating temporarily flammable zones or harming persons or property. Suitable fire extinguishing systems, corresponding to the type of refrigerant in use, must be installed in the vicinity of the unit.

Ignition sources

There **must not** be any ignition sources present **inside** the Atex Zone 2 of the unit, if such a zone is defined for the unit/installation being assessed. If no Atex Zone 2 is defined, the installation supervisor is responsible for assessing the presence/vicinity or otherwise of ignition sources, depending on the type of unit, the refrigerant in use, the installation, etc.

Refrigerant stagnation areas

There **must not** be any refrigerant stagnation areas, where refrigerant could be trapped in the event of a leak, present **inside** the unit safety zone.

Refrigerant leaks

From the unit refrigerating circuit.

The unit refrigerating circuit, which is housed inside the technical compartment, is fitted with a refrigerant detector that is tripped if the concentration exceeds 10% of the LFL. The technical compartment is purged by expelling the refrigerant, which mainly builds up under the finned coils. The refrigerant is expelled by means of Atex fans. **The Atex Zone 2 and Safety zone must be respected.**

From the source side heat exchanger.

The leak is external to the unit and, if it does not enter the technical compartment, the unit continues to operate. In this case, the electrical components in the technical compartment are not affected by the leak. The leak cannot reach the electrical panel if the installations specifications have been respected. It should be taken into account the fact that, if the installation is located nearby marine environments or in the presence of aggressive atmospheres, and the coils are not treated accordingly, there is a greater chance of leaks. **If defined, the Atex Zone 2 and Safety zone must be respected.**

From the user terminal side heat exchanger.

The refrigerant leak flows from the refrigerating circuit towards the hydraulic system via the heat exchanger. The leak is not detected and the unit continues to operate. It **is obligatory** to respect the provisions relating to the hydraulic system. If the installation includes vents or deaerators, the risk assessment may also involve defining specific Atex 2 zones.

From the safety valve vent.

Correct discharge of the refrigerant vented by the safety valves plays a **fundamental** role in minimising fire risks. Such leaks must be routed as set out in the IOM manual, taking into account the fact that the outlet of the discharge line gives rise to an additional **Atex 2 Zone, which must also be respected**

External to the unit but not deriving from it

The unit is not suitable for use in flammable atmospheres. The leak must be detected as set out in the applicable standards and the unit made safe; for example, the unit must be completely isolated from its electrical power supply until the fault has been corrected and the flammable atmosphere eliminated.

#B#Main procedures that should be adopted:

- The use of either forced or natural ventilation helps to dilute the refrigerant and dissipate it in the surrounding air more rapidly.
- The electrical power supply to all devices not designed to be operated in flammable atmospheres should be interrupted if they are affected by the leak.
- All potential ignition sources that may be affected by the leak must be removed, if present.
- Avoid creating areas where build ups of refrigerant may accumulate, resulting in localised zones where flammable atmospheres may be present.
- Refrigerant must be prevented from reaching closed or occupied spaces, fresh air intakes, windows and other openings.
- The refrigerant Propane-R290 is heavier than air, which means that it tends to build up close to ground level.
- Additional safety procedures may be implemented, depending on the specifics of the individual installation site.

Unit refrigerant detector fault

When a detector fault is identified, the unit enters safe mode, disconnecting all the electrical components not designed to be operated in flammable atmospheres from their power supply. The unit stops working. Only the technical compartment extractor fans, the electrical panel cooling fans and the leak sensor remain energised. This is **not** a leak condition, but it is necessary to check the refrigerant detector and restore correct operation as soon as possible.

Generic unit fault

A generic fault does not give rise to a refrigerant leak. A fault that does give rise to a leak falls with the description provided above.

Fault on the extractor fan

The unit handles a potential refrigerant leak in safe mode, as described above, disconnecting all the electrical components not designed to be operated in flammable atmospheres from their power supply. Refrigerant leaks from the technical compartment are slower, but spread to all parts of the compartment, rather than being concentrated mainly under the finned coil.**If defined, the Atex Zone 2 and Safety zone must be respected.**

Electrical power supply absent

Since it is not energised, the unit is safe, meaning that any leaks that may occur in this condition cannot come into contact with potential ignition sources. In this condition, the refrigerant sensor and the Atex extractor fan are deactivated. When the unit is switched on again, check there is no refrigerant present before supplying the rest of the unit. **If defined, the Atex Zone 2 and Safety zone must be respected.**

Presence of flammable material

The presence of flammable material is prohibited within the Safety zone. Check the refrigerant safety data sheet to assess which other substances may represent a hazard if they come into contact with the refrigerant.

Suggestions for conducting and drawing up the risk assessment

This section contains an example that highlights the possible requirements to be complied with and the minimum information that must be filled in by the installation manager when drafting the risk assessment for a typical installation.

The abbreviations describe the contents to be inserted in the various columns.

- **App.** = applicability of the provision (complete the empty fields according to the type of installation).
- **A** = the provision is applicable. It is possible to indicate a limit, a threshold, a distance, etc. that must be respected. If no indications are present, the provision is applicable but it is not necessary to respect any limits. For example, if an Atex zone 2 is defined, there is a minimum distance to respect and this is the limit to indicate, while in the case of the presence of fire extinguishers, it is sufficient that the fire extinguishers are present, therefore there is no limit to indicate. **Attention:** where they are more stringent, always refer to the local regulations for clarification regarding the applicability of the provisions. Since they are applicable for this type of installation, certain provisions are already indicated as applicable in the following example.
- **Conf.** = prescription compliance. Indicate whether the prescription is complied with or not. All non-conformities must be described in detail in the list at the bottom of the table, in correspondence with the number of the note specified when assigning responsibility for the non-conformity.
- **Doc.** = prescription reference document (fill in the empty fields in accordance with the assessment specifying any additional documents).
- **Note** = indicate a note reference, to be included in the footer list with explanation of the item, if necessary. It is also possible to insert a brief description in the case of applicability and conformity.

The risk assessment must include the following fields:

- Name of the installation site.
- Town/City.
- Address.
- Proprietor.
- Intended use.
- Person responsible for the risk assessment.
- Date.

So the risk assessment could be drafted as follows and contain, for example, the following information:

Unit model:	App.	Doc.	Conf.		Notes
Serial No.: SB.....			**Yes**	**No**	
Type of Refrigerant:					
Quantity of refrigerant (kg):					
Circuit 1 = ...					
Circuit 2 = ...					
Circuit 3 = ...					
Circuit 4 = ...					
Classification (A2L, A3, Other):					
Installation specifications.					
Operative clearance spaces - single unit.	A	SchDI			
Operative clearance spaces - adjacent units.	A	IOM			
ATEX 2 Zone Refrigerant leak - refrigerating circuit.	A	IOM			
ATEX 2 Zone Safety valves discharge: horizontal.	A	IOM			
ATEX 2 Zone Safety valves discharge: vertical.	A	IOM			
Safety zone.	A	IOM			
Type of installation (indicate class and access category).	A	IOM			
Charge limit (indicate charge limit value).	A	EN378-1			
Access to the area around the unit is restricted to qualified personnel only.	A	IOM			
Fire extinguishers suitable for use on Propane in the vicinity of the unit.	A	IOM EN378-3			
Ventilation guaranteed.	A	IOM EN378-3			
It is forbidden to smoke or carry out any activities that involve introducing ignition sources into the Atex 2 zone.	A	IOM EN378-3			
Presence of one or more emergency circuit breakers for interrupting the power supply to the unit.		EN378-3			
Presence of refrigerant detectors in the installation (indicate trip setting level and area covered).					
Refrigerant leaks must not occur in the vicinity of ignition sources, fresh air inlets, closed and/or occupied spaces, doors or similar openings, manholes, storm drains or any other opening that could contain the refrigerant.		IOM EN378-3			
The installation site conforms to the fire prevention directives (indicate reference document).					
The escape routes must conform to the requirements of the fire prevention directive (indicate reference document).					
Other, depending on the characteristics of the installation.					
Unit safety valves.					
Safety valve discharge line.	A	Pdoc			

Unit model: ……..……..	App.	Doc.	Conf.		Notes
Serial No.: SB……			**Yes**	**No**	
i. Manufactured according to IUM, dimensional scheme and national directives.	A	IOM			
ii. Inner diameter not less than the diameter of the safety valve outlet.	A	SchDI			
iii. The weight of the pipe must not weigh on the safety valve.	A	IOM			
iv. Sealed from the surrounding environment.	A	IOM			
	A	EN378			
v. There must be no sources of ignition inside the exhaust pipe.	A	IOM			
	A	EN378			
vi. Calculation and sizing of the drain.	A	EN13136:			
	A	2013			
vii. Escaping refrigerant must not be in the vicinity of sources of ignition, fresh air intakes, confined and/or occupied spaces, doors or similar openings of drains, manhole covers and any other openings which may contain refrigerant.	A	IOM			
		EN378-3			
viii. The drain must not cause damage to people or things.	A	IOM			
		EN378-3			
Unit equipment.					
Installing accessories.					
• Accessories suitable for use in flammable atmospheres.		Pdoc			
• Accessories not suitable for use in flammable atmospheres.		Pdoc			
• Other, according to unit configuration.					
Unit equipped with refrigerant leak sensor.	A	IOM			
• Read/run check at start up.	A	IOM			
• Periodic reading/operation check.	A	IOM			"e.g.(2)"
Unit equipped with ATEX cable glands.	A	IOM			
• Start-up tightening check.	A	IOM			
• Periodic tightening check.	A	IOM			

Unit model: ……..……..	App.	Doc.	Conf.		Notes
Serial No.: SB……			**Yes**	**No**	
Hydraulic circuits 1					
Hydraulic circuit in conformity with EN378-32.	A	IOM EN378-3			
• It is compulsory to use systems in the hydraulic system capable of eliminating the presence of refrigerant gas in the event of a leak (vents, safety valves, degassers, other). These systems must be outside or safely conveyed outside according to requirements similar to points **iv, v, vii and viii** of the item "safety valve discharge".	A	IOM EN378-3			
• The conveying pipe, if present, must be correctly sized and made according to the indications of the reference standard.	A	Pdoc			
• Open-type components connected to the plumbing system must be installed outdoors or replaced by sealed equivalents.	A	IOM EN378-3			
• Comply with the Atex zone 2 of the vents or safety valves of the hydraulic system (indicate the Atex Zone 2 limit).	A	Pdoc			
• Respect zone 2 Atex open components of the hydraulic system installed outdoors (indicate Zone 2 Atex limit).	A	Pdoc			
• Comply with Atex Zone 2 due to loss of refrigerant from the hydraulic system (indicate Atex Zone 2 limit).	A	Pdoc			
• Other, according to the characteristics of the hydraulic system.	A	Pdoc			
Electrical connections.					
The electrical connections must be realised in a professional manner by operators who are qualified to design and install electrical systems, in accordance with applicable international and national standards.	A	IOM			
The system must be connected to earth.	A	IOM SchEL			
Power supply voltage and frequency corresponding to the electrical data specified for the unit (indicate nominal values).	A A	IOM SchEL			
The weight of the cables must not be borne by the electrical connection system.	A	IOM			
The cross-section of the cable and the line protection devices must correspond to those indicated in the wiring diagram.	A A	IOM SchEL			
The passage of any cable from the outside to the inside of the electrical panel must only take place using cable glands suitable for the diameter of the cable; any free cable glands available in the electrical panel are suitable. Do not insert more than one cable per gland; do not use sheaths inside the cable glands.	A	IOM			
The electrical panel must not be drilled, modified or tampered with in any way; do not leave any apertures.	A	IOM			
Additional provisions regarding the installation site					
…					
Other					
…					

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