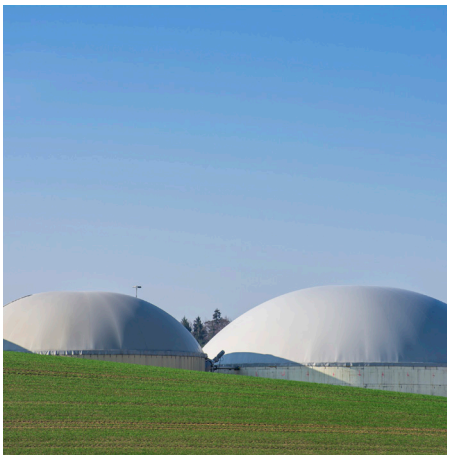
TEAM AIR POWER

# Biogas Dehumidification System

## Skid-Mounted Packages for Biogas and Landfill Gas Cooling Applications



Biogas, originating from biomass, sewage plants and landfill sites is gaining increasing worldwide importance as a recognised renewable energy source. Generally, biogas is saturated with water vapour and contains other impurities which, when used as fuel, must be removed to prevent corrosion and damage to equipment and systems and improve cogeneration unit efficiency.

Biogas is primarily composed of methane and carbon dioxide with smaller amounts of hydrogen sulphide and ammonia. Trace amounts of other gases like hydrogen, nitrogen or carbon monoxide are also present in the biogas. Usually the mixed gas is saturated with water vapour and may contain dirt particles.

**The selection of effective biogas treatment equipment is therefore particularly important, both in optimising the cogeneration of electrical and thermal energy, making the most of the available renewable energy, and reducing energy consumption and operating costs to a minimum.**

Parker's solution is to dry the gas, firstly by cooling using a water-cooled heat exchanger working with an air-cooled water chiller and secondly, by removing the condensed water with a cyclonic water separator. The cooled gas can then be reheated to reduce the relative humidity and thus meet the technical demands of gas engines, turbines and other downstream equipment such as the Parker PpTek Siloxane Removal System and Biogas Upgrading System components


## Product Description

- The Parker Biogas Dehumidification System is a compact, robust and easy to handle plug & play gas conditioning package ensuring significant cost savings in investment, management and operation
- Available in a wide range of sizes from 50 $Nm^3/h$ to 1500 $Nm^3/h$, the Parker system has performances and flow rates aligned with typical biogas plant designs and CHP capacities
- All gas-side components are constructed from stainless steel (AISI304 or AISI316L) with additional pickling and passivation treatment in order to ensure highly reliable and continuous operation even in the harshest site conditions
- Designed using thermodynamic and fluid dynamic principles to ensure a high efficiency heat exchange and separation whilst maintaining low pressure drop
- Flexibility to use a wide range of cooler/chiller combinations ensures the closest match to customer requirements thus delivering constant dewpoint performance regardless of fluctuations in operating conditions.

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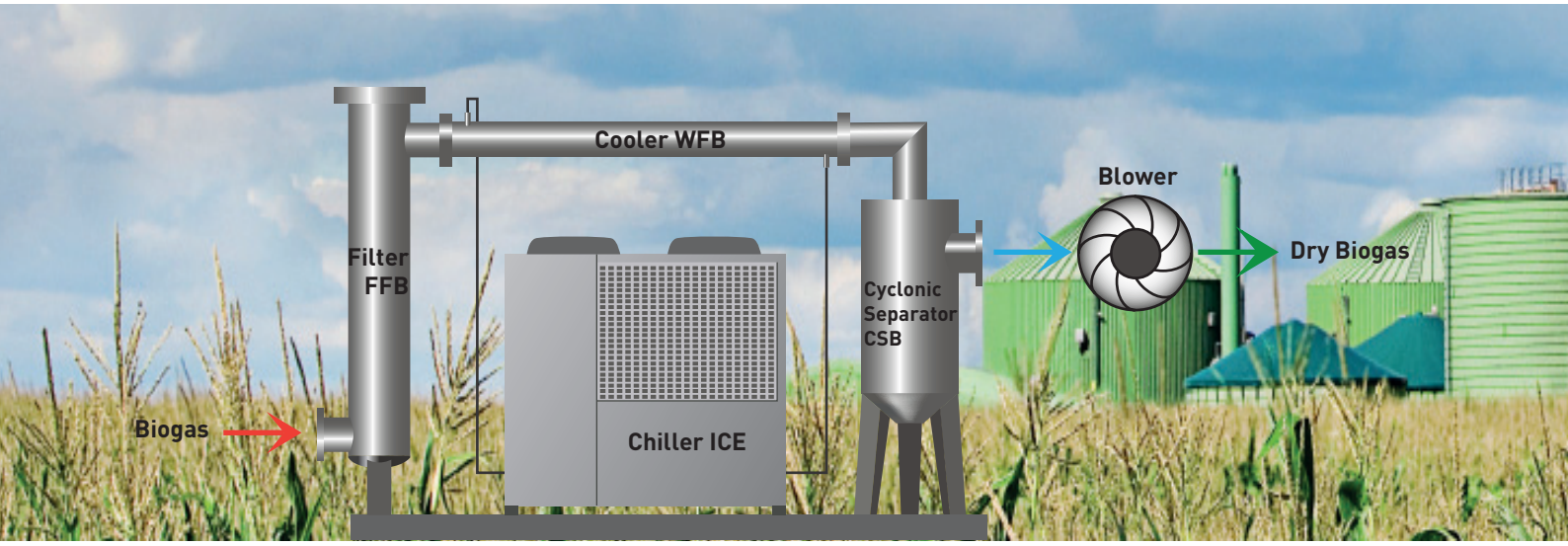
# Biogas Dehumidification System

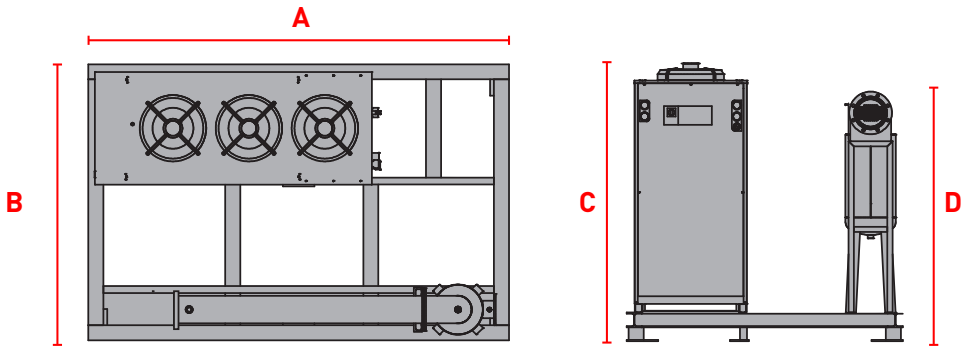
The standard Biogas Dehumidification System cools biogas to a user defined dew point, using a Hypercool BioEnergy heat exchanger working with Hyperchill BioEnergy chiller and removing the condensed water with the Hypersep BioEnergy separator. Insulation, Hyperfilter BioEnergy and Hyperdrain BioEnergy can be provided as options.

This configuration is designed for installations where a blower is installed downstream of the Dehumidification System, taking advantage of its position to increase the temperature of the biogas and thus decrease its Relative Humidity.




| Biogas Dehumidification System | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Model | Biogas Flow Rate ($m^3/h$) | Gas inlet * connections | Gas outlet connections | Condensate removed (kg/h) | A (mm) | B (mm) | C (mm) | D* (mm) | Weight* (kg) |
| skd60-007 | 60 | DN80 | DN50 | 3,1 | 2500 | 1700 | 1615 | 1640 | 558 |
| skd105-010 | 105 | DN80 | DN50 | 5,3 | 2500 | 1700 | 1615 | 1640 | 638 |
| skd165-014 | 165 | DN125 | DN80 | 8,4 | 2500 | 1700 | 1615 | 1635 | 690 |
| skd265-024 | 265 | DN125 | DN80 | 13,5 | 2500 | 1700 | 1615 | 1635 | 795 |
| skd240-029 | 240 | DN125 | DN80 | 12,8 | 3300 | 1800 | 1594 | 1695 | 880 |
| skd360-039 | 360 | DN200 | DN125 | 19,2 | 3300 | 1800 | 1562 | 1975 | 941 |
| skd510-057 | 510 | DN200 | DN125 | 27,2 | 3300 | 1800 | 1579 | 1975 | 1166 |
| skd720-076 | 720 | DN200 | DN125 | 38,4 | 3350 | 2200 | 2214 | 1995 | 1451 |
| skd1110-116 | 1110 | DN300 | DN200 | 59,2 | 3350 | 2200 | 2214 | 2102 | 1732 |
| skd1620-116 | 1350 | DN300 | DN200 | 71,6 | 3350 | 2200 | 2214 | 2102 | 1788 |

Performances refer to operation with clean cooler and separator, gas flow rate at 20 °C/1 $bar_g$. Nominal working conditions: 60 % $CH_4$, 40 % $CO_2$, gas inlet temperature 40 °C saturated, refrigerant inlet water temperature 1 °C, ambient temperature 35 °C, gas outlet temperature at nominal conditions 8 °C (from model skd60-007 to model skd265-024) and 4 °C (from model skd240-029 to model skd1620-116). Average pressure drop without filter 11 mbar +/-2 for all models, average pressure drops with filter 14 mbar +/- 2 for all models.
*Data refer to skid without filter.

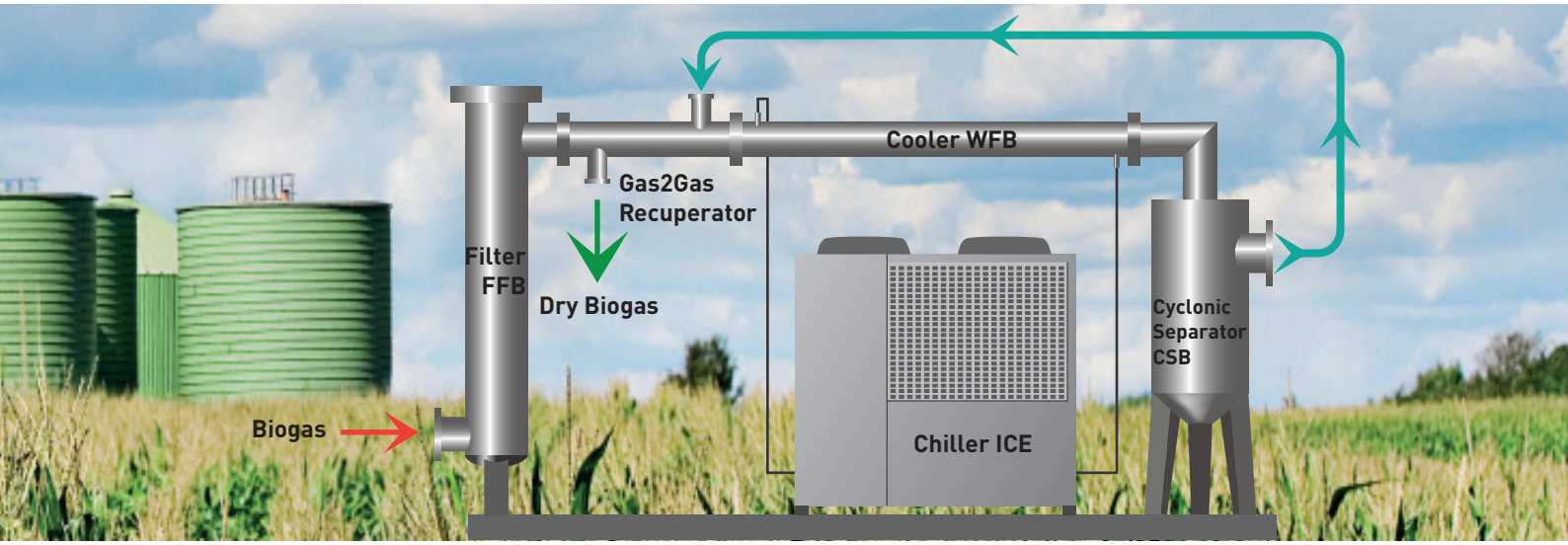


# Biogas Dehumidification System

## with ‘Gas2Gas’ Recuperator

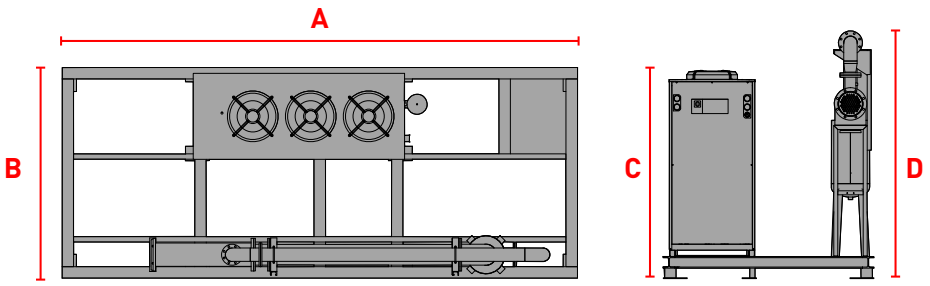
The Biogas Dehumidification System with ‘Gas-2Gas’ Recuperator BioEnergy cools biogas to a user-defined dew point and reheats the gas to a Relative Humidity lower than 50%. Insulation, Hyperfilter BioEnergy and Hyperdrain BioEnergy can be provided as options.

This configuration is designed for installations where a blower is installed upstream of the Dehumidification System with the ‘Gas2Gas’ Recuperator providing free-cooling to save energy and free-heating to reduce the Relative Humidity of the biogas - without the need for auxiliary heating.




| Biogas Dehumidification System with ‘Gas2Gas’ Recuperator | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Model** | **Biogas Flow Rate ($m^3/h$)** | **Gas inlet * connections** | **Gas outlet connections** | **Condensate removed (kg/h)** | **A (mm)** | **B (mm)** | **C (mm)** | **D* (mm)** | **Weight* (kg)** |
| **skd60-007-R** | 60 | DN80 | DN40 | 3,1 | 3750 | 1700 | 1615 | 1982 | 703 |
| **skd105-010-R** | 105 | DN80 | DN40 | 5,4 | 3750 | 1700 | 1625 | 1982 | 711 |
| **skd165-014-R** | 165 | DN125 | DN50 | 8,5 | 3750 | 1700 | 1615 | 2040 | 772 |
| **skd265-024-R** | 265 | DN125 | DN50 | 13,5 | 3750 | 1700 | 1615 | 2040 | 785 |
| **skd240-029-R** | 240 | DN125 | DN50 | 12,8 | 4900 | 1800 | 1594 | 2100 | 1089 |
| **skd360-039-R** | 360 | DN200 | DN100 | 19,3 | 4900 | 1800 | 1562 | 2567 | 1264 |
| **skd510-057-R** | 510 | DN200 | DN100 | 27,3 | 4900 | 1800 | 1580 | 2567 | 1391 |
| **skd720-076-R** | 720 | DN200 | DN100 | 38,5 | 5382 | 2200 | 2214 | 2587 | 1887 |
| **skd1110-116-R** | 1110 | DN350 | DN150 | 59,4 | 5382 | 2200 | 2214 | 2878 | 2394 |
| **skd1620-116-R** | 1350 | DN350 | DN150 | 68,5 | 5382 | 2200 | 2214 | 2878 | 2450 |

Performances refer to operation with clean cooler and separator, gas flow rate at 20 °C/1 $bar_g$. Nominal working conditions: 55 % CH4, 45 % $CO_2$, gas inlet temperature 50 °C (40 °C saturated), gas inlet pressure 75 $mbar_g$, refrigerant inlet water temperature 1 °C, ambient temperature 35 °C, gas dew point at nominal conditions 8 °C (from model skd60-007 to model skd265-024) and 4 °C (from model skd240-029 to model skd1620-116), gas outlet relative humidity below 50 %.
*Data refer to skid without filter.



# Hyperchill BioEnergy

## Water Chillers for Biogas and Biomethane Gas Cooling Applications

Bioenergy is renewable energy stored in organic materials such as plant matter and animal waste, known as biomass. The wide variety of biomass fuel sources include agricultural residue, pulp/paper mill residue, urban wood waste, forest residue, energy crops, landfills and animal waste. Anaerobic digestion is the process that occurs when bacteria decompose organic materials in the absence of oxygen to generate biogas.

Biogas is primarily composed of methane and carbon dioxide with smaller amounts of hydrogen sulphide and ammonia. Trace amounts of other gases like hydrogen, nitrogen or carbon monoxide are also present in the biogas. Usually the mixed gas is saturated with water-vapour and may contain dirt particles. For biogas as a fuel, most of the impurities have to be removed, as they can cause contamination, deposits and damage to equipment. In particular, biogas needs to be dried by cooling it to temperatures close to 5°C, using water-cooled heat exchangers fed by water chillers. Hyperchill Bioenergy is a key component in this biogas treatment process.

Extremely compact and easy to use, Hyperchill Bioenergy ensures an accurate control of the water temperature. It has been specifically designed for Biogas applications and provides safe and reliable operation in the harshest of environments, typically found in Anaerobic Digesters and landfill Biogas production areas.

## Benefits

- Special protective treatment of condensers and copper piping to ensure reliable operation in the most aggressive of ambient atmospheres at biogas plants and landfill sites.
- Pump and tank installed inside the chiller provides a compact and easy to install solution.
- Precise water temperature control with high working limits and low running costs.
- Non-ferrous hydraulic circuit on ICEP-E range enhances the reliable operations maintaining the quality of the coolant ensuring stable working conditions.
- Large built-in water tank that provides a large thermal mass/ storage capacity thus reducing the number of refrigerant compressor stop/starts and short cycling and thereby increasing the compressor and chiller lifetime.
- Designed to provide cooling water where low temperature water is required as standard (air conditioning units do not normally need to provide water at less than 10°C).
- Use of compliant scroll compressors designed specifically for high efficiency and long life in industrial applications.
- Use of Safety Class A1 non flammable refrigerant in compliance with F-Gas Regulation.
- Low ambient speed-control on fan-motor ensures constant performances at different temperatures, long lifetime of the fans and a reduction in absorbed power when ambient temperature is low.
- Maximum working ambient temperature up to 48°C for ICEP-E models, up to 45°C for ICE models, prevents downtime even under extremely harsh conditions.

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# Hyperchill BioEnergy

The performance of biogas as a fuel depends on effective cooling and treatment.

Saturated biogas contains water and impurities that need to be removed to avoid damage to equipment and to reach more efficient combustion, whilst maintaining the desired dew point.

## Product Features

- **Water and refrigerant manometers** permit full control of the working conditions.
- **Microprocessors:** allow complete control of the unit parameters. Proprietary software provide a wide range of programming and remote monitoring options.
- **Compliant scroll compressors:** with less moving parts and compliant technology, they provide excellent efficiency, high reliability, and very low noise levels.
- **Air cooled with axial fans:** suitable for outdoor installation.
- **Water pump (std 1,5 bar):** available with different head pressures to suit the end-users application. Configurable as a twin-system, for 100% redundancy.
- **Mesh filters:** condenser protection against dirt and contamination, reduces maintenance costs and the risk of downtime.


- **Evaporator:** located inside the water tank from ICE150 - reduces the overall dimension of the unit, increases the efficiency and improves temperature control.
- **Water by-pass:** protects the pump and supplies constant flow to the evaporator, avoiding alarms and freezing.
- **Water tank:** stainless steel up to ICEP120E generously dimensioned to guarantee high reliability and improved temperature-control.
- Models from ICEP022E to ICEP120E are designed with **fan control** to work as standard in low ambient temperatures down to -10°C.
- **Maximum ambient temperature** 48°C up to ICEP120E, 45°C from ICE150.
- **MODBUS RTU** interface fitted on ICEP-E models; optional for ICE models

## Options and Accessories

- **Special and multiple-pumps:** higher head pressure available to suit different hydraulic circuits. Double stand-by pump for greater reliability.
- **Antifreeze heating:** avoids freezing when the unit is switched off. Can also be used as a heater to warm up the system.
- **Water fill-kits:** pressurized, automatic or ambient manual kits, for water filling in any installation.
- **Remote control kits:** base version for remote ON/OFF and general alarm monitoring. Advanced version for complete remote unit management.
- **Wheels (up to ICEP015E BioEnergy):** for ease of transport.
- **Control panel cover:** for additional display protection from aggressive ambient.

# Technical Data

| Model | | ICEP-E | | | | | | | | | | | | ICE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 008E | 011E | 015E | 022E | 027E | 034E | 041E | 055E | 065E | 080E | 100E | 120E | 150 | 183 | 230 | 310 | 360 |
| Cooling capacity[1] | kW | 7,8 | 11,1 | 15,0 | 21,9 | 26,6 | 33,1 | 40,2 | 56,3 | 65 | 78,3 | 103,7 | 120,6 | 149,2 | 182,3 | 228 | 305,1 | 359,7 |
| Total abs. power[1] | kW | 1,6 | 2,3 | 3,6 | 5,0 | 5,7 | 6,7 | 8,3 | 12,8 | 15,3 | 18,5 | 24,2 | 29,8 | 38,8 | 48,1 | 61,7 | 71,17 | 87,9 |
| SEPR HT[2] | | 4,79 | 4,78 | 4,10 | 4,40 | 4,64 | 4,95 | 4,82 | 4,55 | 4,25 | 4,25 | 4,10 | 4,04 | 5,35 | 5,04 | 5,02 | 5,51 | 5,73 |
| Cooling capacity[3] | kW | 4,5 | 6,5 | 8,8 | 12,7 | 14,9 | 18,2 | 22,6 | 32,0 | 36,9 | 44,8 | 60,4 | 72,1 | 85,3 | 104,2 | 130,2 | 180,5 | 205,7 |
| Tota abs. power[3] | kW | 1,6 | 2,4 | 3,7 | 5,0 | 6,0 | 7,3 | 9,0 | 13,7 | 16,0 | 19,3 | 24,7 | 29,0 | 32,5 | 41,4 | 55,1 | 63,4 | 83,2 |
| Power Supply | V/ph/Hz | 400/3/50 | | | | | | | | | | | | 400/3/50 | | | | |
| Protection index | | IP54 | | | | | | | | | | | | IP54 | | | | |
| Refrigerant | | R513A | | | | | | | | | | | | R407C | | | | |

## Compressor

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | | hermetic scroll | | | | | | | | | | | | hermetic scroll | | | | |
| Compressors/ circuit | | 1/1 | | | | | | | 2/1 | | 2/2 | | | 4/2 | | | | |
| Max.abs.power (1 compressor) | kW | 2,5 | 3,5 | 5,4 | 6,5 | 8,7 | 10,8 | 11,3 | 10,8 | 11,3 | 13,1 | 17,9 | 22,1 | 11,1 | 13,7 | 16,8 | 23,3 | 28,7 |

## Axial fans

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantity | no. | 1 | | | 2 | | | | | | 3 | | | 2 | | 3 | 4 | |
| Max.abs. power (1 fan) | kW | 0,23 | 0,23 | 0,46 | 0,46 | 0,46 | 0,77 | 0,77 | 0,77 | 0,77 | 0,77 | 0,77 | 0,77 | 2 | 2 | 2 | 2 | 2 |
| Air flow | m³/h | 3325 | 3325 | 5028 | 7823 | 10865 | 17337 | 17057 | 17057 | 17110 | 26832 | 26082 | 26082 | 47000 | 46000 | 66000 | 88000 | 88000 |

## Pump P15

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Type | | Centrifugal | | | | | | | | | | | | Centrifugal | | | | |
| Max.abs.power | kW | 0,7 | 0,7 | 0,7 | 0,7 | 0,9 | 0,9 | 0,9 | 1,0 | 1,0 | 1,4 | 1,4 | 1,4 | 1,5 | 1,5 | 2,2 | On Request | |
| Water flow (nom./ max)[1] | m³/h | 1,3/ 5,4 | 1,9/ 5,4 | 2,6/ 5,4 | 3,8/ 5,4 | 4,6/ 10,8 | 5,7/ 10,8 | 6,9/ 10,8 | 9,7/ 18 | 11,2/ 18 | 13,6/ 24,3 | 17,8/ 24,3 | 20,7/ 24,3 | 25/ 44 | 30/ 44 | 39/ 48 | | |
| Head pressure (nom./max)[1] | m $H_2O$ | 20/ 15 | 19/ 15 | 18,8/ 15 | 17/ 15 | 19/ 12,5 | 17,8/ 12,5 | 16/ 12,5 | 15,7/ 10,4 | 15/ 10,4 | 14,7/ 9,2 | 13/ 9,2 | 11,5/ 9,2 | 12/ 6 | 10/ 6 | 14/ 8 | | |

## Weights and Dimensions

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Width | mm | 756 | 756 | 756 | 756 | 756 | 856 | 856 | 856 | 856 | 1050 | 1050 | 1050 | 1287 | 1287 | 1287 | 1500 | 1500 |
| Depth | mm | 806 | 806 | 806 | 1206 | 1206 | 1956 | 1956 | 1956 | 1956 | 2500 | 2500 | 2500 | 3000 | 3000 | 3260 | 4200 | 4200 |
| Height | mm | 1430 | 1430 | 1430 | 1430 | 1430 | 1680 | 1680 | 1680 | 1680 | 2012 | 2012 | 2012 | 2298 | 2298 | 2298 | 2240 | 2240 |
| Connections in/out | in | ¾" | ¾" | ¾" | 1" | 1" | 1½" | 1½" | 1½" | 1½" | 2" | 2" | 2" | 2½" | 2½" | 2½" | 4" | 4" |
| Tank capacity | l | 65 | 65 | 65 | 100 | 100 | 200 | 200 | 200 | 200 | 400 | 400 | 400 | 1000 | 1000 | 1000 | 400 | 400 |
| Weight (axial)[4] | kg | 165 | 175 | 180 | 235 | 250 | 485 | 510 | 580 | 595 | 875 | 1010 | 1030 | 1500 | 1800 | 2100 | 2900 | 2900 |

## Noise level

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sound pressure (axial)[5] | dB(A) | 50 | 50 | 51 | 52 | 52 | 53 | 54 | 55 | 55 | 58 | 59 | 59 | 62 | 62 | 64 | 65 | 65 |

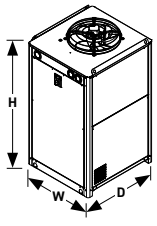
1) At water in/out temperature 20/15°C, glycol 0%, either 25°C ambient temperature.

2) Value calculated in accordance with the European regulation (EU) 2016/2281 with regards to Ecodesign requirements for high temperature process chillers

3) At water in/out temperature 5/1°C, glycol 10%, ambient temperature 35°C.

4) Includes refrigerant charge and pallet (version without options and accessories).

5) Sound pressure: average value obtained in free field on a reflective surface at a distance of 10 m from the condensate side of the machine and at a height of 1.6 m from the unit support base. Values with tolerance ± 2 dB. The sound levels refer to operation of the unit under full load in nominal conditions.

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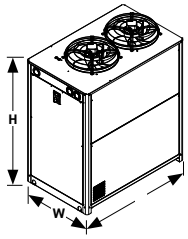
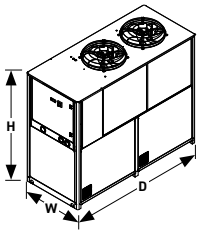



ICEP 022-027E

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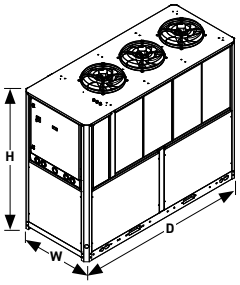


ICEP 080-100-120E

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For additional information and support, please contact your local applications engineer.

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