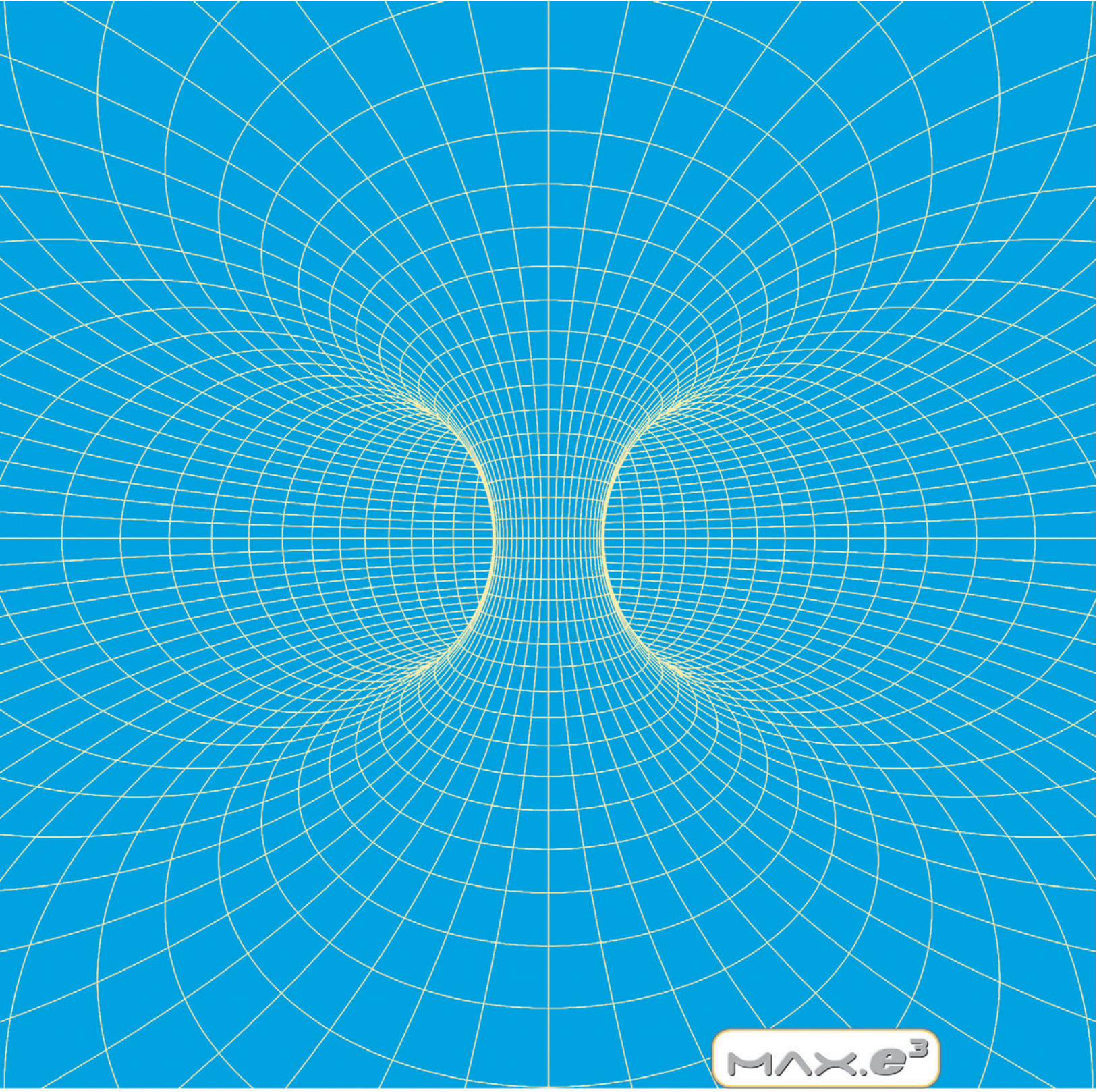


provocation ➡ challenge ➡ new concept?

Damvent
to reach...and exceed

History and Experience

In 2005, Damvent presented the first prototype of **Max.E**. At that time, we were among the first and very few companies in EU that developed such a hybrid solution for fresh air.
Where are we 10 years later?

- More than 800 e-conomizers produced, delivered, installed and commissioned in several EU territories with different climates, such as: Bulgaria, Denmark, UK, Romania, Macedonia, Moldova, Ukraine, Estonia and started activity in BeNeLux and the Middle East region.

- Our experience and confidence comes from **3 generations** of "e-conomizers":**Max.E**; MAX.e², and now MAX.e³ ...

- **DV_Select** - since the very beginning we have developed a specialized selection tool for designers/consultants and engineers, simulating and calculating all processes inside the units. Now we are delivering our 3rd version of it: DV_Select 3.1

- **Focus** - since the first prototype of **Max.E**, we put all our efforts and focus on the continuous development of this solution, *making it **the only one*** in our Product catalogue...

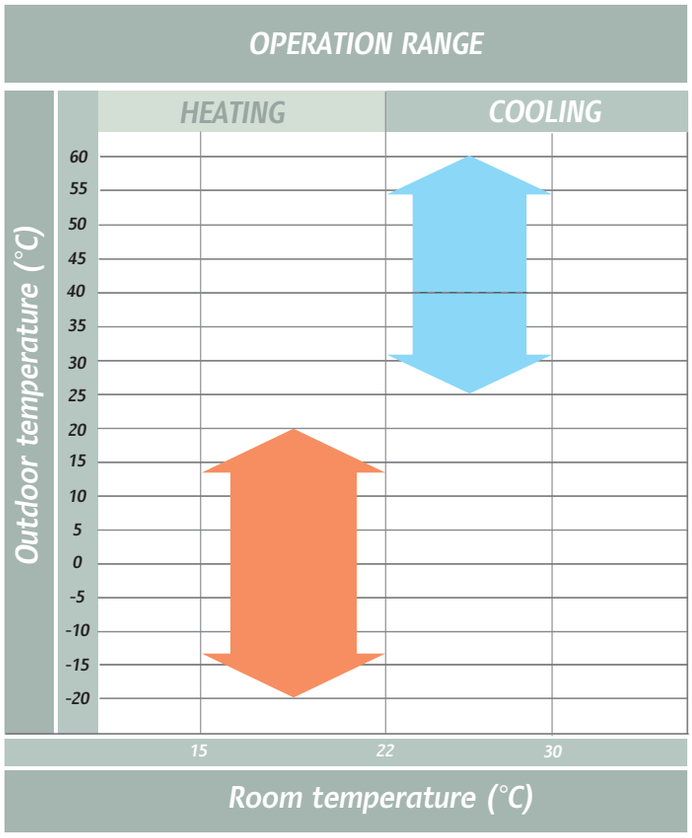
- MAX.e² GULF - a unique e-conomizer, designed especially for the Middle East region (very hot and humid climate) which treats fresh air up to +60°C!

- Beside the **Comfort Ventilation** segment, our e-conomizers are successfully applied in many project sites of the **Process Ventilation** (where T and RH must be maintained in very narrow limits), such as: hospitals, micro-electronics, food industry, chemical industry and more...

Max.E

max.e²


max.e³



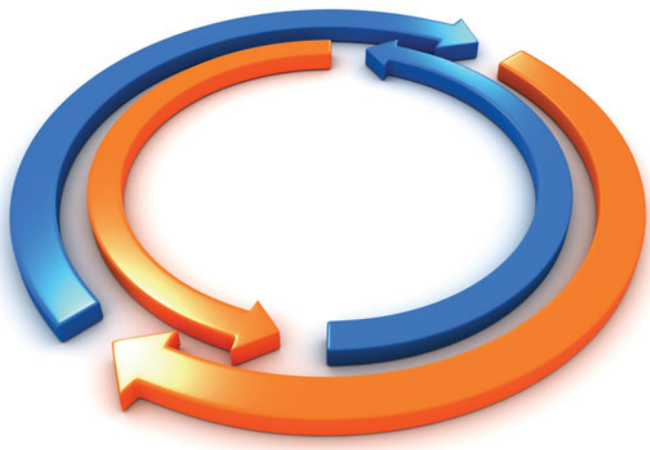
3eConcept

- **Every Climate** from -25°C to +60°C (a widely extended temperature range, in comparison with the MAX.e²), reaching ambient temperatures of up to **+60°C** with the newly developed "e-conomizer" MAX.e²GULF wich is especially designed for a very hot and humid climates such as found in the Middle East.

- **Every Application** - suitable for every application where HVAC and 100% fresh air is needed, by means of covering all possible air-treatment processes, such as:
  - Filtration
  - Recirculation - 0÷100%
  - Heating/cooling/humidity recovery
  - Heating
  - Cooling + Dehumidification
  - Humidification (optional)

- **Every Installation** - suitable for all types of mounting - indoor (machinery rooms, technical floors etc.) and outdoor (roofs).

2-stage heating/cooling/humidity recovery technology



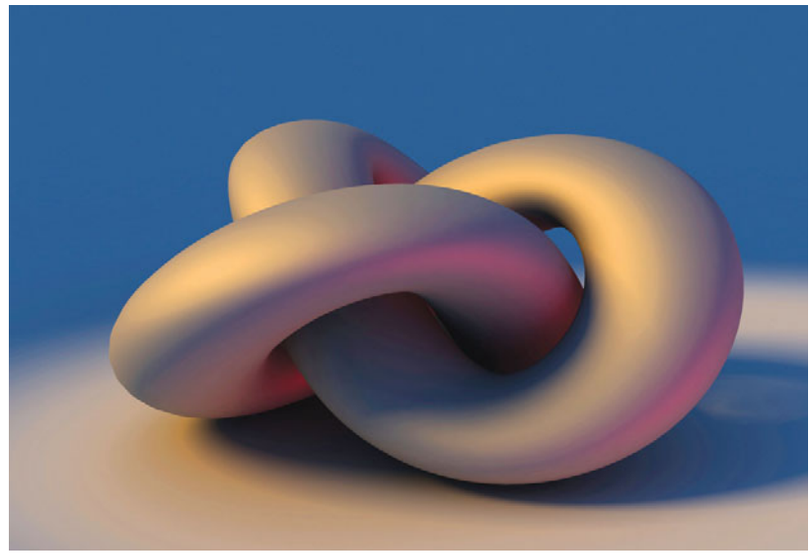
Recovering up to 100% of the extract heating/cooling, achieved - "consecutively" in 2 stages:

- 1st stage - the sorption rotary heat exchanger, recovers more than 70% of the heatig/cooling and humidity.
- 2nd stage - the evaporator/condenser of the air-to-air heat pump, recovers the rest up to 100%.

In relation to the newest EU regulations, which impose the design of the so called Passive or Low Energy Buildings, (where heating losses/cooling loads are reduced to the minimum by using efficient and innovative insulation materials and sun shading systems), then fresh air becomes the only needed source for maintaining the room's microclimate parameters.

"All in 1" concept

A multifunctional concept solution for fresh air, - (as well as for covering heating losses and cooling loads at once), which can practically solve entirely the need for Air-Conditioning, Ventilation and Heating at the project site by using only air as fluid. Thus, radiators/fan coils/cassettes, boilers, chillers/VRF systems, pipes, insulations, pumps, fittings, etc., are no longer required. It only needs a duct system, - (which already exists in every conventional system) - and the correct designing of the necessary air quantity.



100% factory tested

High reliability and reduced installation costs, achieved by 100% factory tests - each unit is tested under factory conditions. The test includes:

- Leakage check,
- Vacuuming and loading the system with the exact refrigerant quantity,
- Functional testing of all fans and com pressors,
- Vibrations,
- Loading the controller`s software,
- Temperature and pressure checks,
- Setting up the required air flow and
- Recording all parameters of the unit on the test list.

100% Plug & Play

A standalone "one-piece" unit, which only needs a duct system and power supply for its start up.

100% DX unit

No additional water, electric or DX heating/cooling coils are needed in the MAX.e³ , which makes it independent to other additional heating/cooling sources (boilers, gas, chillers, VRF systems, etc.)

CE 1853 and PED 97/23/EC, Category II, Module A1- Internal manufacturing checks with monitoring of the final assessment certified by TUV-Rheinland

TÜVRheinland

Savings

Being an “All in 1” concept and having only 1 solution on the project site, MAX.E³ saves:

- **Initial investment costs** - in comparison to conventional HVAC equipment, it reduces the investment costs by removing the need for: radiators/fan coils/cassettes, boilers, chillers/VRF systems, pipes, insulations, pumps, fittings and more.
- **Installation costs and labor**
- **Installed electric power** - it can reduce up to 30% the necessary installed power for a HVAC system.
- **Energy and exploitation costs** - providing COP/EERnet = 5÷15, MAX.E³ ensures the lowest possible energy costs for HVAC (EUR/kWh).
- **Service and Maintenance costs** - Filters are the only components that need to be checked, cleaned and replaced.
- **Time** - it saves time in designing, installation works, start-up and commissioning, service, etc...
- **Space** - whether MAX.E³ - is mounted indoor or outdoor, the absence of additional pipes, provides a “clean roofs” for the buildings.
- **BMS** - significantly reduces the costs for a BMS system, regarding its HVAC part.

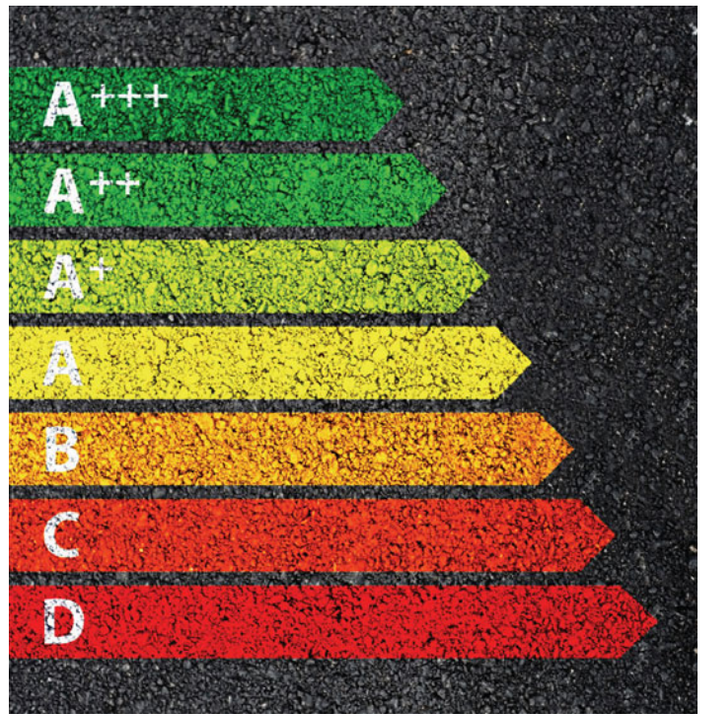
New Models

Together with the already existing models 02, 03, 06 and 09, two new models were developed as “*standard*”: MAX.E³ 15 with maximum airflow of 15.000m^3/h (replacing Max.E-13.0) and 18 with maximum airflow of 18.000m^3/h.
Additionally 3 larger models can be produced,- (based *only on customer request*): MAX.E³ - 25, 30 and 35 with maximum airflows as follows: 25.000m^3/h; 30.000m^3/h and 35.000m^3/h, respectively.

Reliability

Models MAX.E³ -06 and 09 are designed with 2 and 3 fans in parallel per each side (supply and exhaust) and contain 2 compressors in tandem. Models MAX.E³ -15 and 18 are designed with 2 fans in parallel per each side (supply and exhaust) and with 4 compressors in 2 refrigerant circuits. Models MAX.E³ -25, 30 and 35 are designed with 2 fans in parallel per each side (supply and exhaust) and contain 8 compressors in *2 refrigerant circuits*. This generates the highest reliability and safety of the unit in case of failure some of those components, as well as ensuring that the unit works continuously.

COP/SCOP/SPF



Higher than the highest standards!

According to EN14825, the highest Energy Efficiency Class for Heat Pumps is A+++ with a SCOP=3,75 (high temperature) -4,38 (low temperature).
With a SCOP=3.8÷6.5 (of the refrigerant circuit) and a COPnet of the whole system SCOPnet= 5÷15, MAX.e³ is far ahead of the competition.

Note

**SCOPnet- seasonal efficiency of a unit in active heating mode, without supplementary electric heaters which is determined from mandatory conditions given in this EU standard and used for marking, comparison and certification purposes*

Performance

Improvements and advantages of the, MAX.e³ compared to MAX.e² :

- **Airflow** - models 03, 06 and 09 are designed to cover up to 4.000; 8.000 and 11.000m³/h, which respectively is ***25, 14,2*** and ***10% higher*** values than the same models of the MAX.e².
- **Increased** Total Filtration Area (m²) by **45%**.
- **Decreased** Total Internal Pressure Drop (Pa) by **20÷40%**, leading to even lower ***SFP*** numbers and energy consumption of the fans. Total Internal Pressure Drops per side, are lower than 300Pa.
- **Sound Pressure Level** - reduced up to ***5 dB(A)***.
- **Higher** Total Heating Capacity (kW) by ***30÷35%*** and COPnet of the whole system reaching COPnet ≥ 15. This is achieved by using a rotary heat exchanger and lower energy consumption of the fans.

$$COPnet = \frac{Qrotary\ exchanger + Qheat\ pump}{Nfans + Ncompressors}$$

Where:

1. Qheat recovery - recovered heat in the rotary heat exchanger (kW)
2. Qheat pump - heating capacity of the condenser of the heat pump (kW)
3. Nfans - energy consumption of both (supply and exhaust) fans (kW)
4. Ncompressors - energy consumption of the compressors (kW)

- **30÷45% higher Total Cooling Capacity** (kW) and respectively up to ***40%*** higher EERnet = 5.5 in summer mode, thanks to the sorption type rotary wheel.
- **Precise** Condensing Temperature/Pressure control during the summer mode.
- **Up to 78% humidity** recovery during the winter mode, improving the indoor climate comfort and reducing the need of additional humidifiers
- **Step less Capacity Control** (as standard) allows superior Tsupply/Troom (°C) control and increases the efficiency during ***Part-Load*** operations; thus, increases the ***ESEER/IPLV*** and expands the lifetime of the compressors.

Sorption Cooling Recovery Technology

New sorption rotor range, molecular sieve HX1 and HM1 - Molecular Sieve 3Å

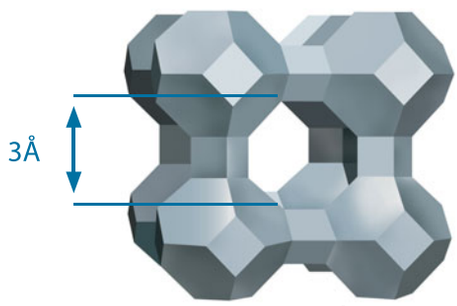
- Lower investment cost in cooling
- Lower energy consumption in cooling period
- Better performance for dry cooling systems
- Lower investment costs and energy savings from day 1
- Helpful solution when cooling capacity is limited in existing systems

High humidity efficiency, up to 80%

Sorption rotors are providing an excellent method to precool and dehumidify the fresh air before entering the DX cooling coil. Both Molecular sieve (HX1) and Mole-cular Sieve (HM1) 3Å sorption wheels are giving exceptional high humidity transfer efficiencies. In general, humidity efficiency is more or less equal to temperature efficiency.

3Å molecular sieve gives high selectivity for absorbing water molecules (HM1 type)

- Molecular Sieve 3Å coating shows a high selectivity for absorbing water molecules.
- It is recommended in cases where cross contamination needs to be avoided.
- No odor problems.



Molecular Sieve, 3Å Molecule

Lower running cost of ventilations and cooling system

- Cooling recovery in summer time.
- Drying supply air with drier exhaust air, less water condensing in cooling coil.
- Efficient dehumidification of fresh air in extreme conditions due to almost constant (humidity efficiency, less need to increase water temperature.

The “Evolution” in the fan Technologies... Continues

Using EC Blue fans, MAX.e³ ensures the highest ***IE4 Premium Efficiency and ErP conformity-2015/EC controller integrated.***

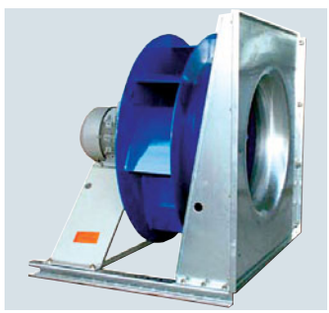
The EC Blue fans are extremely light, stable, durable, quiet and extremely efficient.

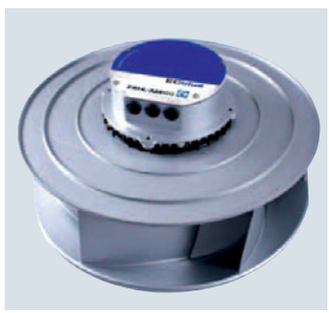
The high-performance composite material **Cpro ZAmid®**, developed using the latest insights, makes the impeller significantly lighter than those made of steel - and offers superior mechanical properties. **ZAmid®**, provides new opportunities for system runtimes, enables lower power consumption and leads to a drastic reduction in noise. **Cpro ZAmid®** is manufactured using a one - shot injection-moulding process in a highly complex injection-moulding machine, resulting in no welded joints. This highly technical process ensures the highest system reliability.

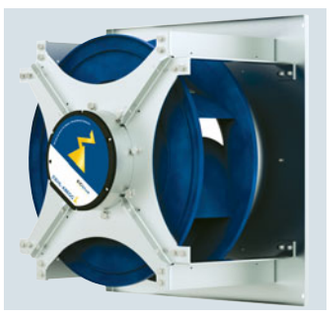
Innovation at a glance

- Significant weight reduction, which reduces motor bearing loads and increases the system service life.
- Drastic reduction in noise generation.
- Significant increase of the impeller efficiency, which reduces the absorbed power.
- Reduced power consumption - Up to 15% energy savings during operation.
- Significant $CO_2\leq$ reduction.
- Improved mechanical properties, in comparsion to steel impellers.
- No weld seams.
- High peripheral velocities up to 70 m/s. Can be combined with various types of motors.
- Tonal noise reduction up to 5dB.
- Suitable for operational temperatures from -20°C to +80°C, in comparsion to steel impellers.
- Corrosion-free
- No toxic gas emissions
- Colour-stable


Standard AHU


Max.E


max.e^2


max.e^3

SFP

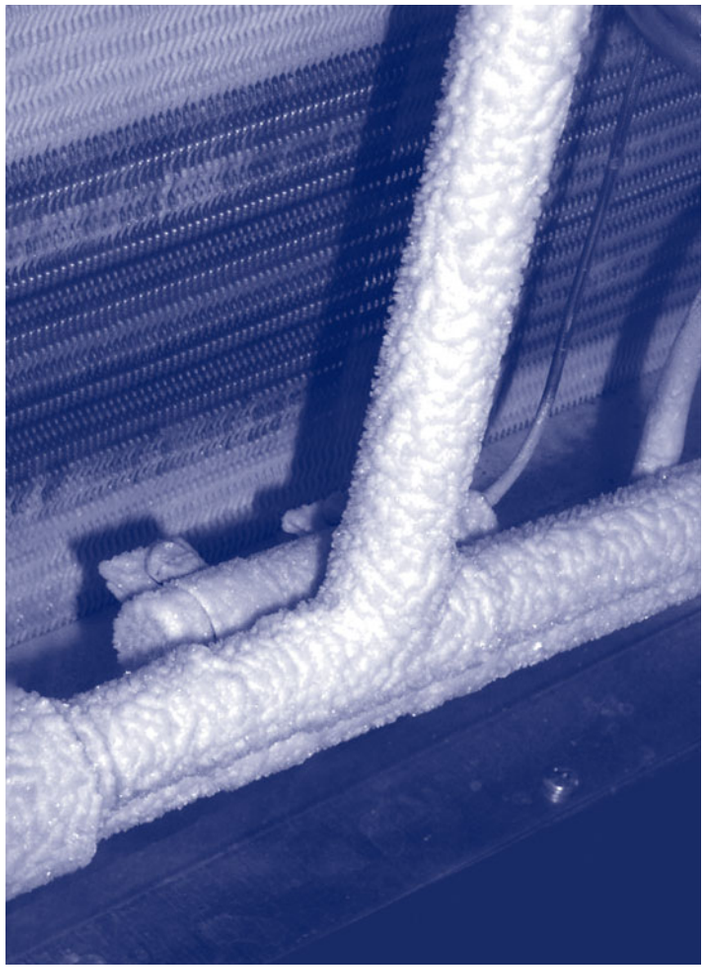
SFPe - even lower values, compared to MAX.e³

Specific Fan Power (SFPe) ≥ **1700** W/m³/s- total for the unit, and lower values can be achieved by MAX.e³

The system's Specific Fan Power (SFPe) calculation is based on clean filters and acc. to EN13779

- SFPe=(Psfm+Pefm)/Qmax [W/m³/s], where:
- Psfm- power supplied to the supply air fan (W); Pefm- power supplied to the exhaust air fan (W)
- Qmax - largest supply or extract airflow through the AHU (m³/h)

Defrost = 0min



When an air-cooled heat pump is operating in heating mode, the outdoor air is relatively cool and the outdoor coil acts as an evaporator. Under certain conditions of temperature and absolute humidity, frost might form on the surface of the evaporator. The layer of frost will interfere with the operation of the heat pump by making the pump work harder and, therefore, inefficiently. The heat pump unit will defrost regularly when frost conditions occur.

The defrost cycle should be long enough to melt the ice, and short enough to be energy-efficient, but still takes ***9-20min/cycle and might happen many times/day***... This reduces the comfort into the air-conditioned room.

MAX.e³ practically has ***Defrost=0min*** , because at any ambient condition, the humidity from the room is absorbed and recovered up to 80% by the rotary heat exchanger and transferred to the supply air, moving the conditions of the air entering the evaporator- away from the frost forming conditions.

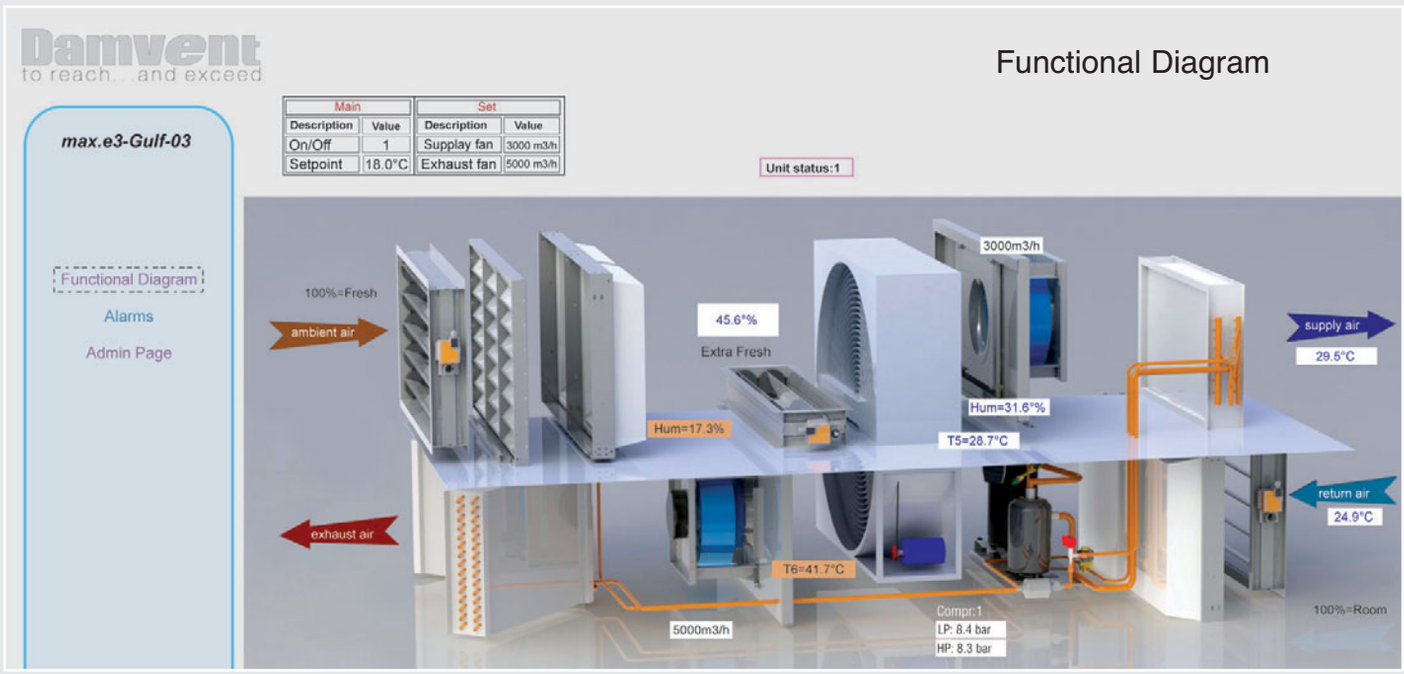
Connectivity and Mobility

The built-in pCO Web circuit board, allows a permanent *Internet connection* to MAX.e3 from any location in the world - and brings the following advantages for the unit:

- Possibility for “Remote Start-up” from the factory - significant reducing the time and costs for this service.
- “Remote Monitoring”- checking all parameters of the unit in real time.
- Software updates and changes of working modes and settings.
- Rapid reaction and diagnostics in case of occurred problems.
- Time schedules, curves and trends
- Overall reducing of Service and mainte nance costs.

BMS - It can interface to the more widely used communication standards, either directly or via gateways (**Modbus®, BACnet®, Johnson Metasys®, DLL for Windows®, TCP/IP, SNMP, LonWorks®**).

In addition, the pCO system controllers are able to receive and send SMS messages using a simple GSM modem.



DV_Select 3.1

The most important tool for every designer/consultant!

Our newly developed **3rd generation of software, DV_Select 3.1, serves as a selection tool for all of our "e-conomizer" units** (MAX.e³, MAX.e MINI and MAX.e³POOL, MAX.e³GULF).

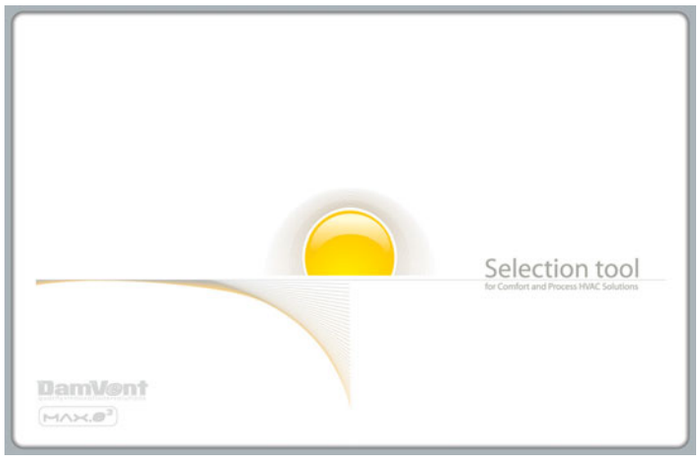
To this day Damvent is ***among the very few companies***, that has successfully developed software for such hybrid solutions.

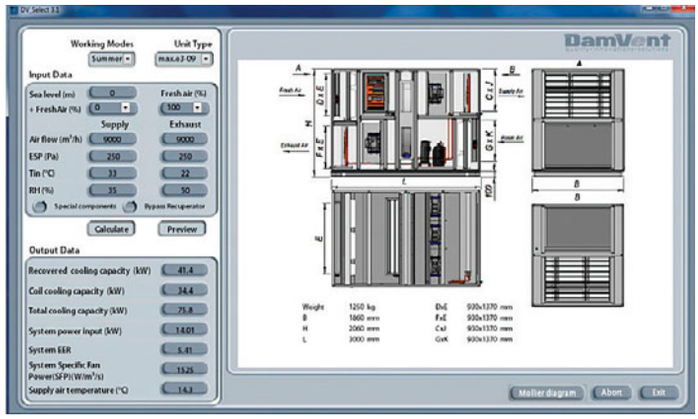
The main characteristics and advantages of **DV_Select 3.1** are:

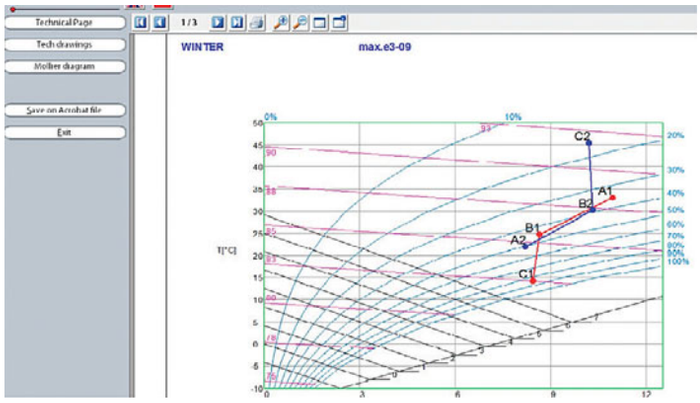
- **Friendly** interface - Light, Fast and **Easy to work** with
- **Winter/Summer** calculations -Technical Data and Drawing printouts - exported to pdf.
- General Data - including the ***most important parameters*** of the unit such as:

Total Cooling/Heating Capacity(kW),
Supply air temperature(°C),
Total Power Input(kW),
COP/EERnet,
Specific Fan Power(SFPe) - total for the unit(W/m³/s),
Refrigerant type,
Unit power supply (V/ph/Hz),
Sound pressure level (dB),

- Visualization of all air-treatment process in the Mollier diagram.







Environment

100% Eco-Friendly System - while using, MAX.e³ only ***air that*** is filtered and thermodynamically treated is supplied to the room. The absence of internal units, totally removes the risk of refrigerant leakage, as well as all related commissioning works.

Low refrigerant content

Each unit size has a limited refrigerant content in accordance with **Regulation No. 842/2006** issued by the European Parliament and Council which make obligatory controls more frequent as the load of each individual circuit increases.

MAX.e³ is only required to be controled **once per year.**

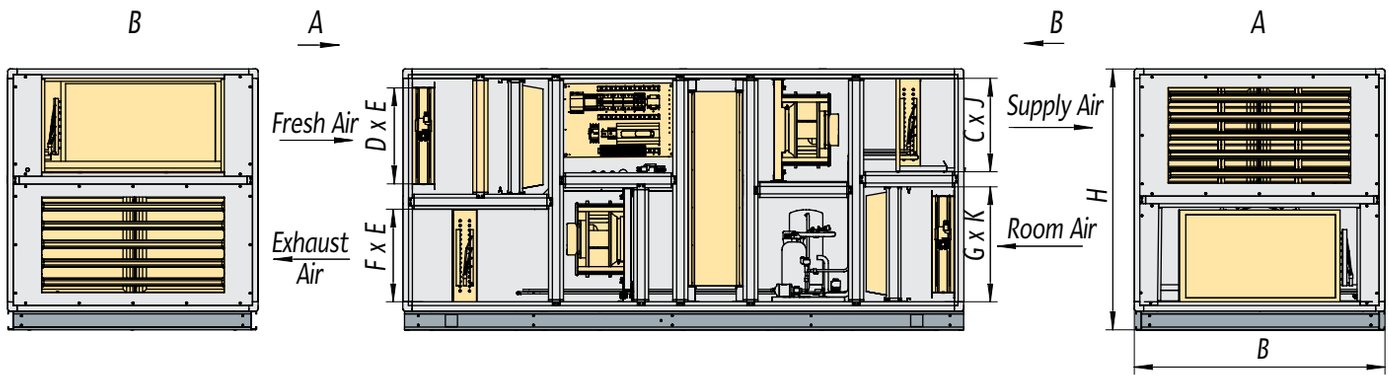
- Refrigerant - eco friendly R407C
- Respect for the environment

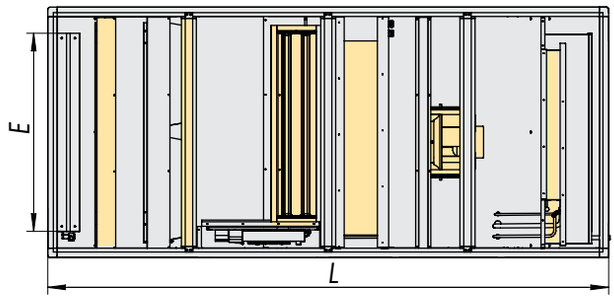
General Technical Data

AHU Type		MAX.e³ 02	MAX.e³ 03	MAX.e³ 06	MAX.e³ 09	MAX.e³ 15	MAX.e³ 18
Min/Max Airflow	m^3/h	1000/2000	2000/3200	4000/7000	5500/10000	9000/15000	13000/18000
General Technical Data							
Nominal Airflow	m^3/h	1500	2500	6000	9000	13000	16000
Total Cooling Capacity (summer mode)	kW	15.3	24.9	57	80.2	120.2	145.7
Total Heating Capacity (winter mode)	kW	26.3	46.6	107.7	156	227.2	275.8
Total Installed Power (compressors + fans)	kW	7.7	10.0	20.0	26.6	37.8	45.6
Total Power Input (compressors + fans) (summer mode)	kW	3.5	6.3	12.3	14.6	25.0	30.7
Full Load Current	A	20.8	22.1	44.2	53.0	85.2	93.6
Unit's Power Supply	V/ph/Hz	400 / 3 /50					
System COP (winter mode)	-	12.0	11.9	13.5	15.4	13.8	13.5
System EER (summer mode)	-	4.36	3.96	4.62	5.48	4.81	4.75
Fans							
Type		EC Plug fan					
Motor Efficiency		IE4 Premium Efficiency, ErP conformity- 2015/EC controller integrated					
Specific Fan Power (SFP)	$W/(m^3/s)$	1726	1450	1460	1554	1620	1804
Supply / Exhaust static pressure Hst	Pa	250	250	250	250	250	250
Installed Motor Power — Supply side	kW	1 x 2.5	1 x 2.5	2 x 2.5	3 x 2.5	2 x 5.4	2 x 5.2
Installed Motor Power — Exhaust side	kW	1 x 2.5	1 x 2.5	2 x 2.5	3 x 2.5	2 x 3.5	2 x 6.0
Installed Current — Supply side	A	1 x 4.0	1 x 4.0	2 x 4.0	3 x 4.0	2 x 5.8	2 x 8.4
Installed Current — Exhaust side	A	1 x 4.0	1 x 4.0	2 x 4.0	3 x 4.0	2 x 8.6	2 x 9.4
Protection Class	IP	55					
Rotary Heat Exchanger – sorption type							
Material		Aluminum fins with sorption molecular sieve HM1					
Efficiency – Temp./Hum. (winter mode)	%	77.1/81.1	76.7/80.7	75.6/79.6	74.4/78.4	74.7/78.7	73.0/76.2
Recovered Heating Capacity (winter mode)	kW	22	36.5	86.2	127.5	184.6	221.3
Mass transfer humidity (winter mode)	l/h	10.8	17.9	42.5	62.8	91	108.4
Compressor							
Type		Rotary	Scroll				
Number of compressors		1	1	2	2	4	4
Number of circuits		1	1	1	1	2	2
Power input – winter mode	kW	1 x 1.46	1 x 2.91	2 x 2.77	2 x 3.11	4 x 2.66	4 x 3.09
Power input – summer mode	kW	1 x 2.82	1 x 5.36	2 x 5.01	2 x 5.47	4 x 4.87	4 x 5.73
Power input – summer mode	A	1 x 12.8	1 x 14.1	2 x 14.1	2 x 14.5	4 x 14.1	4 x 14.5
EER (summer mode)		2.76	3.24	3.61	3.36	2.95	3.07
COP (winter mode)		2.92	3.48	3.89	4.58	4.01	4.41
Filters							
Type		Microcell					
Filtration Class	F	F6	F6	F6	F6	F6	F6
Filtration Efficiency	%	60 - 80	60 - 80	60 - 80	60 - 80	60 - 80	60 - 80
Total Filtration Area	m^2	12.4	18.6	37.2	46.5	65.1	65.1

(summer mode) Room Air 26°C/50%, Fresh Air 34°C/44%
(winter mode) Room Air 22°C/50%, Fresh Air -15°C/80%

Dimensions





MAX.e³ 02	
L	3500mm
B	1050mm
H	1540mm
DxE	515x645
FxE	620x645
CxJ	620x645
GxK	515x645

Weight: 920 kg

MAX.e³ 03	
L	3500mm
B	1340mm
H	1540mm
DxE	515x900
FxE	620x645
CxJ	620x900
GxK	515x900

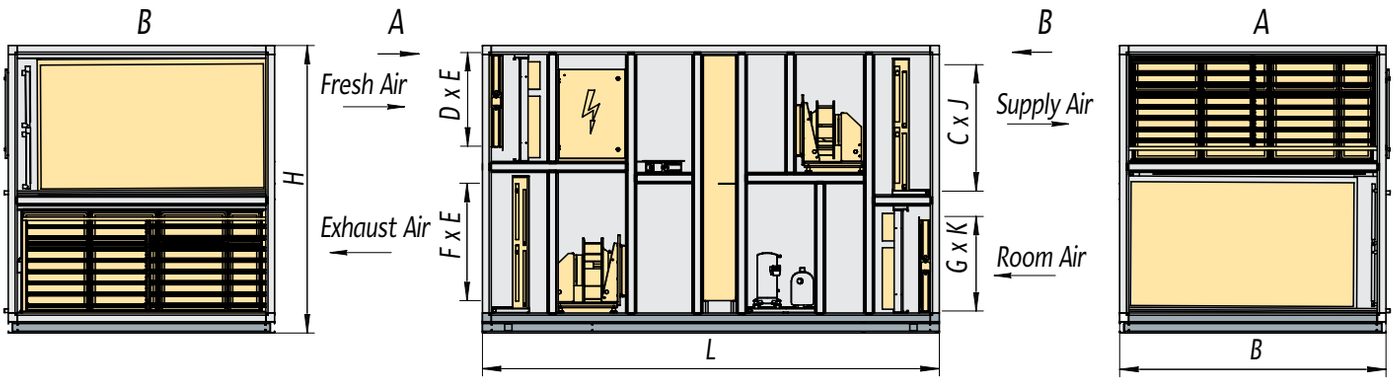
Weight: 1030 kg

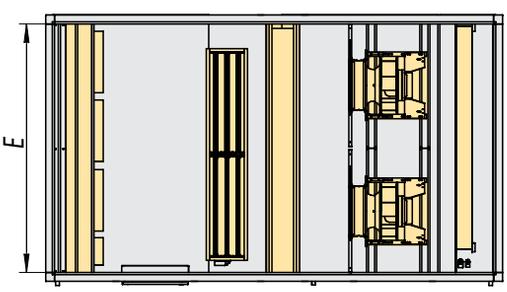
MAX.e³ 06	
L	3600mm
B	1610mm
H	2060mm
DxE	795x1100
FxE	880x1195
CxJ	880x1195
GxK	795x1100

Weight: 1495 kg

MAX.e³ 09	
L	3710mm
B	1860mm
H	2140mm
DxE	815x1360
FxE	945x1360
CxJ	945x1360
GxK	815x1360

Weight: 1770 kg



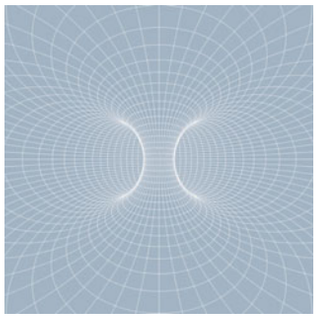


MAX.e³ 15	
L	4000mm
B	2330mm
H	2450mm
DxE	870x1785
FxE	1040x1845
CxJ	1040x1845
GxK	870x1785

Weight: 2660 kg

MAX.e³ 18	
L	4400mm
B	2390mm
H	2550mm
DxE	970x1845
FxE	1070x1845
CxJ	1070x1845
GxK	970x1845

Weight: 3230 kg



MAX.E³ *is the subject of continuing improvement and future development! Following its policy of continuous improvement,* Damvent *reserves the right to make any further changes without the need to inform its customers and partners.*

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