MAX.e²

Two Stage Heat Recovery Economizer

Damvent
to reach...and exceed Benelux

MAX.e²

Not an ordinary product but, a concept solution!

It is obvious that the global climate is changing. Energy costs are exploding and the trend suggests it will continue to increase. Therefore, saving energy is more important than ever! Achieving a comfortable microclimate is directly related to the presence of quality ventilation. Unfortunately, it has been proven that a significant part of the energy consumed within buildings is lost when using poor ventilation systems. This fact produces financial consequences for users and contributes to pollution of the environment.

Theoretical research and standard practices show that reducing energy costs and increasing the efficiency of a ventilation system could easily be achieved by re-using the warmth contained in the extract air within a room.

This is where Damvent's MAX.e² solution becomes important.

It is a fact that people spend most of their lifetime inside buildings. According to some researchers, the time spent inside buildings is equivalent to 90% of our daily lives. Therefore, the quality of indoor air has a great influence on the health of its occupants.

Elderly people and children are particularly sensitive to the quality of indoor air. High quality indoor air has a positive influence on the productivity of occupants. This is especially important within office buildings, banks, conference rooms, classrooms, hospitals, etc.

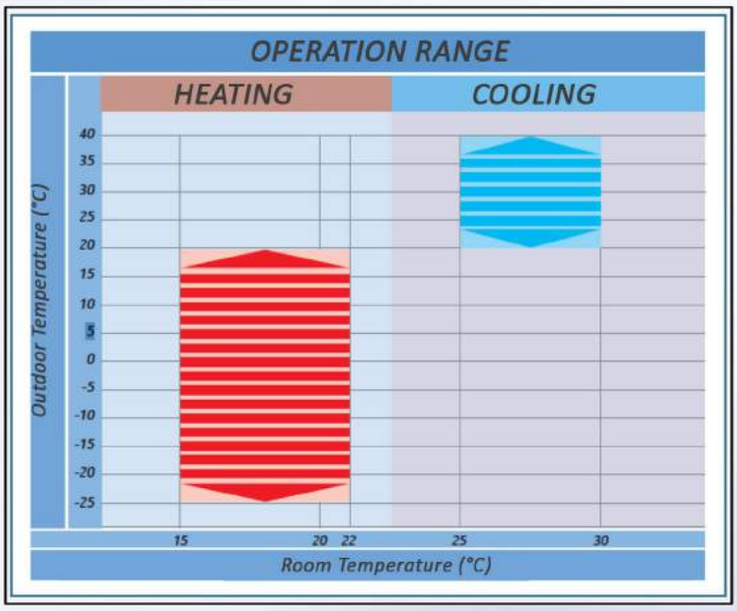
3 e CONCEPTS

***1 e – Every Climate** – from -20°C to +40°C*

***2 e – Every Application** - suitable whenever 100% fresh air is needed, by means of covering all possible air treatment processes:*

- *Filtration*
- *Recirculation*
- *Heat recovery*
- *Heating*
- *Cooling + Dehumidification*
- *Proces Ventilation*

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



3 IN 1 CONCEPTS

The MAX.e² is an autonomous module, heat recovery, ventilation unit containing an implemented heat pump, automation, and control system.

The MAX.e² e-conomizer with 2 stage thermo-dynamic heat recovery technology, recovers up to 100% of the extract heat. This is achieved consecutively in 2 stages:

1st stage – Passive Heat Recovery
Using the air-to-air plate heat exchanger to recover up to 65-80% of the extract heat from the room.

2nd stage – Active Heat Recovery
Using the evaporator of the air-to-air heat pump recovers the remaining 20-35% extract heat from the room.

A conventional air cooled heat pump uses the ambient air for the evaporation process and during the Winter, this air can reach temperatures of -10°C, -15°C or even -20°C.

Extracting heat from the ambient air is an inefficient process. In comparison, the MAX.e² uses the extract air from within the room. Under normal conditions, this air ranges in temperatures between20-24°C. Firstly, 60-65% of the heat is recovered in the plate heat exchanger and then at a temperature between 4-10°C, the air enters the evaporator of the heat pump, thus recovering the remaining 30-35%.

Using this method, we achieve a COPsystem of 10 and avoid frost formation on the evaporator (which commonly occurs in all conventional heat pumps).

Thus, MAX.e² delivers "defrost"= 0min.

$$COPnet = \frac{Q\ plate\ heat\ exchanger + Q\ heat\ pump}{Nfans + Ncompressores}$$

Where:

- Q plate heat exchanger -
  recovered heat from the plate heat exchanger (kW)
- Q heat pump -
  recovered heat from the condensor of the heat pump (kW)
- N fans -
  energy consumed from the fans (kW)
- N compressors -
  energy consumed from the compressors (kW)

100% Factory Test

High reliability and reduced installation costs are achieved by our 100% test procedure. Each unit is tested under factory conditions as follows:

- Leakage check;
- Vacuuming and loading the system with the exact refrigerant quantity;
- Functional testing of fans and compressors;
- Loading the controller's software;
- Temperature and pressure checks;
- Setting up the required air flow; and
- Recording all parameters of the system on the test list.

100% Plug & Play

Standalone, "one-piece" unit which only needs a power supply for its start up.

CONSTRUCTION

MAX.e² is a single, "1 piece" (standalone) unit. The construction is manufactured from high quality profiles made of extruded aluminum characterized by high strength and resistance to adverse weather conditions.
Size 13.0 consists of two blocks.
The connection between the two blocks is carried out by aluminum connection plates.

Each unit is mounted on a C-section base frame of galvanized sheet steel. The standard height of the base frame is 100 mm. The base frame design makes it possible to move and position the unit with a crane or forklift.

The panels of the housing are double-walled. Both the inner and outer wall are comprised of 1.0mm thick galvanized sheet steel with 50mm stone wool insulation material in between, creating a density of 75kg / m3. Both walls are provided with a polymer powder coating. The insulation material is heat and sound insulated, fire and heat resistant rock wool, certified in accordance with **EN1403**.

Gaskets - Closed cell structure gaskets made of Ethylene Propylene Diene Monomer (EPDM) are used for internal insulation and separation between the air flow sides (supply and exhaust), as well as on all doors and panels to protect the unit from internal and external leakages.

The components wherein condensation may occur (such as direct expansion coils and plate heat exchanger), are equipped with a condensate drain pan. The condensate is removed via drain outlets connected to siphons (detailed schematics are provided with the documentation of the unit). The condensate drain pans are a welded steel structure made from 1.2mm thick galvanized steel sheets with a powder coating.

PLATE HEAT EXCHANGER

MAX.e² uses a plate air-to-air heat exchanger made from aluminum fins with a condensate drain pain and a mounted motorized damper (bypass and "free-cooling").

Efficiency (Sensible) – E ≤ 65%÷70%.

DESIGN

The MAX.e² series solution is designed and manufactured in accordance with **EN 1886** - (Ventilation for buildings - Air handling units Mechanical performance).

EUROVENT Certificate: 03.01.242.

Heat Pump

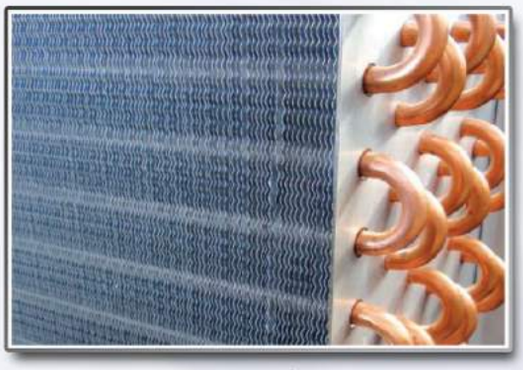
100% DX unit *- The MAX.e² unit needs no additional water, electric or DX heating / cooling coils which makes it independent from additional heating / cooling sources (such as, boilers, chillers, VRF-systemen, etc.)*

Semi-hermetic Refrigerant Circuit *- The refrigerant circuit contains 1 or 2 circuits, depending on the size of the unit. The refrigerant used is eco-friendly.*

The MAX.e² models 03, 06, 09, 13.0 and 20.0 use "Scroll" Compressors (1, 2, 4 or 6 stuks, respectively, depending on unit size). The MAX.e² model 02 uses a "Rotary" compressor.

All of the MAX.e² units contain high efficiency, direct expansion coils made from copper tubes and aluminum fins, and are equipped with a condensate drain pan. Both coils are "epoxy" coated which extends their useful life and provides best levels of performance.

*The coils are **EUROVENT** certified.*



***EUROVENT** Certificate: 10.02.450*

STEPLESS CAPACITY CONTROL

- ***Precise Control and Efficiency - MAX.e² provides continuous, stepless modulation over a wide range (from 10÷100%), with no operating envelope restriction. As a result, ambient temperature and humidity can be tightly controlled for superior comfort and load variations can be quickly followed for improved seasonal efficiency.***
- ***Stepless heating/cooling capacity control.***
- ***Increased European Seasonal Energy Effiecient Ratio / Integrated Part Load Value (ESEER/IPLV) values are achieved by reducing the power input in part load operations.***
- ***Constant Supply Temperature - superior control of the supply air temperature (±0.5÷1°C) is managed, avoiding unpleasant temperature differences, and thus significant improvement to comfort in the room.***
- ***Higher Reliability - Compressor cycling is reduced to a minimum ensuring optimum system efficiency and longer life expectancy of the equipment.***

FANS

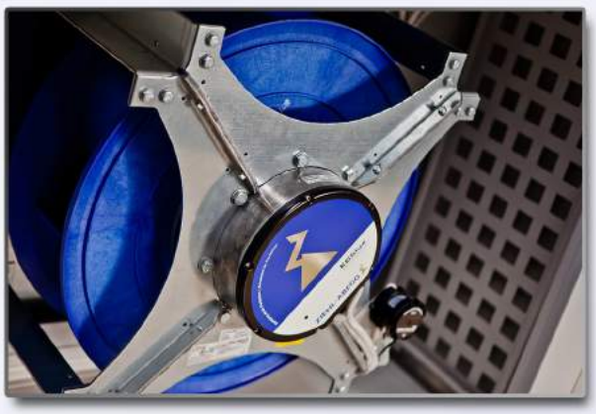
*MAX.e² models 02, 03, 06 and 09 use **EC (Electronically Commutated) Blue Plug Fans** with a Cpro frequency inverter manufactured by Ziehl-Abegg. The fan wheel is statically and dynamically balanced on the axis of the direct-driven motor. Both the fan wheel and the motor are mounted on a common base frame with vibration dampers.*

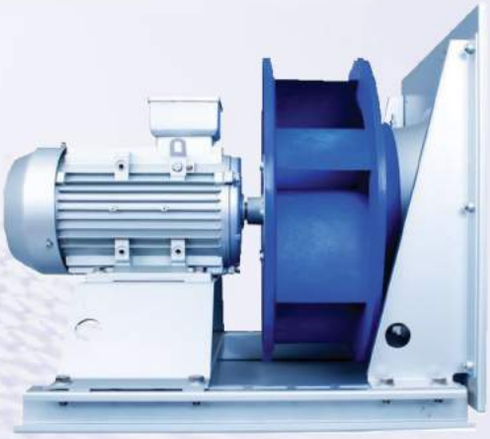
*Using 2nd generation **EC Blue** technology ensures the highest **IE5** motor in accordance with **IEC 60034-30-2**. The high performance composite material **ZAmid®**, developed using the latest insights, makes the impeller significantly lighter compared to traditional steel and offers superior mechanical properties. **ZAmid®** provides new opportunities for system runtimes, enables lower power consumption and leads to a drastic reduction in noise.*

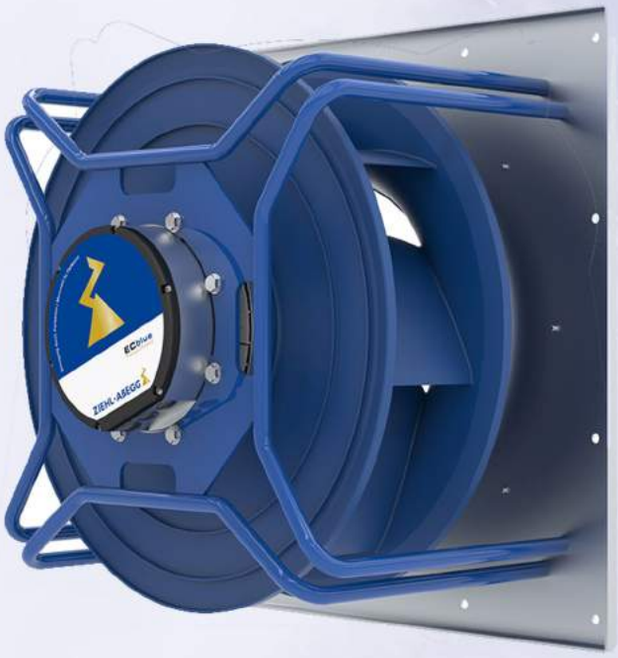
***ZAbluefin** with **ZAmid®** technology is a Bionic, free running wheel, with optimised design and diffusor effect, made of high performance composite material **ZAmid®**, setting new standards in performance. Adapted for intelligent ECblue motor technology **(IE5)** for maximum system efficiency figures and premium characteristics in any application.*

Characteristics of the 2nd Generation EC Blue Fans:

- ***IE5-motor** in accordance with **IEC 60034-30-2** IP55 case.*
- ***Integrated Modbus** - Modbus Basic version includes Auto-addressing*
- ***Data-logging - Vibration Sensor on PCB** - 3 vibration sensors are placed on the main circuit board. These sensors measure the acceleration speed in 3 axes and stores data in the Protocol. The calculated lifetime can be found using a special algorithm.*
- ***New sealing** - Two contact points between the sealing and stator bush.*
- ***New Cooling Ring** - provides better system cooling.*
- ***Slot for BLE Stick** for Bluetooth connection (optional).*
- ***Direct Printed Wiring Diagram** for easier understanding.*

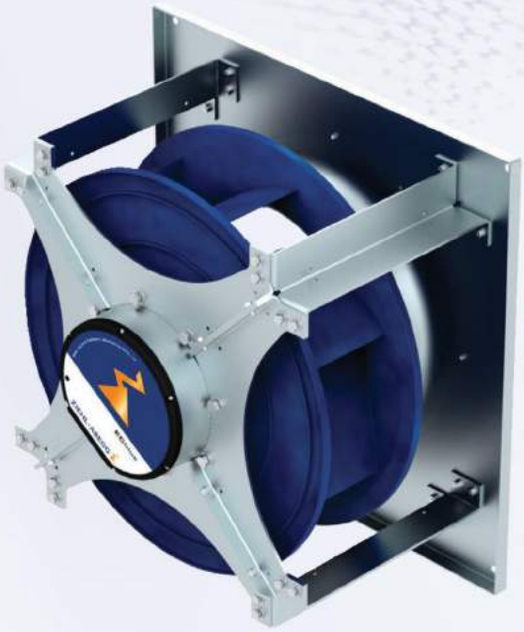






Innovation at a Glance:

- *Significant weight reduction, which reduces motor bearing loads and increases the system service life.*
- *Drastic noise reduction generation leads to tonal noise reduction up to 5 dB.*
- *Significant increase of the impeller efficiency which reduces the absorbed power.*
- *Reduced power consumption - up to 15% energy savings during operation.*
- *Significant CO_2 reduction – improved mechanical properties when compared to steel.*
- *No welding seams - high peripheral velocities up to 70m/s.*
- *Suitable for operational temperatures from -20°C to +80°C, in comparison to steel impellers.*
- *Corrosion free.*
- *No toxic gas emissions.*
- *Colorfast.*



MAX.e² *13.0 uses Plug Fans complete with an IE2 efficiency motor and a separate frequency inverter mounted within the unit. The fan wheel is statically and dynamically balanced on the axis of the direct-driven motor.*

SPECIFIC FAN POWER (SFP)

***SFP** is one of the most important energy indicators for air handling units (AHU).*

The MAX.e² *unit can reach a total **SFP** ≤ 1800 W/m3/s (and lower).*

*The **SFP** values, expressed in W/m3/s, indicate the demand on power efficiency of all supply air and extract air fans used in a building.*

The electrical energy needed for ventilation fans and AHUs, plays an increasing role in the energy demand for buildings. Recent studies show that the electrical energy consumption can be easily reduced from the "traditional" levels (between 2000 en 5000 W/m3/s) to a lower level (from 1600 to 1800 W/m3/s) when using proper design and installation.

MAX.e² *is designed in accordance with the latest EUROVENT requirements for coil face velocities up to ≤ 2m/s, which leads to:*

- *No need for droplet separators on both the supply and exhaust side.*
- *Significant reduction of the total internal pressure drops of the unit by 75 – 100%!*

ICB Controller facts:

- *Exclusively designed by and for Damvent's unique hybrids.*
- *Much more compact design/size.*
- *The entire periphery (inputs / outputs) is galvanically separated from the processor + communcation channels.*
- *3 Modbus channels (integrated) - **RS485** / TCP / IP.*
- *EC declaration of conformity accompanied by complete laboratory tests performed by an accredited laboratory.*
- *Ability to operate in extreme temperature ranges (from -40°C to 50°C).*
- *Built-in logic (developed by Damvent) to manage EEV's, eliminating the need for separate drivers.*
- *The controller enables Supervisory Control and Data Acquisition (SCADA) visualizations on individual client assignments.*
- *Simplified, durable / reliable and easy to repair.*
- *7 inch touch screen.*

AUTOMATION SYSTEM

MAX.e² is fully equipped with all necessary automation and all executive mechanisms. The electric switchboard is integrated into the unit and located on the operation side.

The "brain" of MAX.e² is the controller (especially designed by Damvent), which controls and manages all processes and protects the unit from eventual cut-offs. The software is developed with a high level of know-how and it automates all processes. The user only needs to set the desired supply temperature. The controller will automatically select in which of the 4 working modes (heating, cooling, free cooling / heating) to operate, depending on variable input for the outside temperature, the set point temperature, and the supply and room (return) temperatures.

Building Management System (BMS)

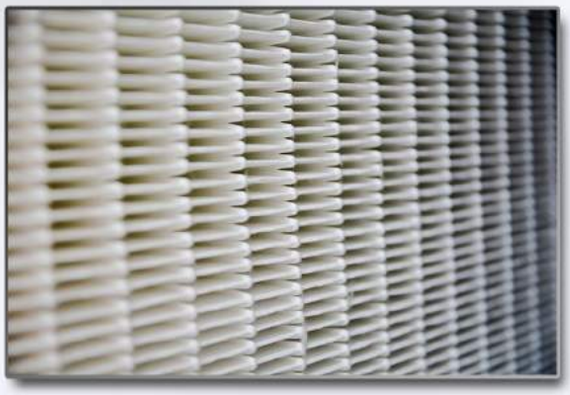
*The automation system is provided with the option to communicate with various BMS, in order to constantly manage and monitor all processes. This option requires different communication protocol types, which demand their relevant convertors. The standard connection and communication with the controller are performed by using **Modbus RS485**.*

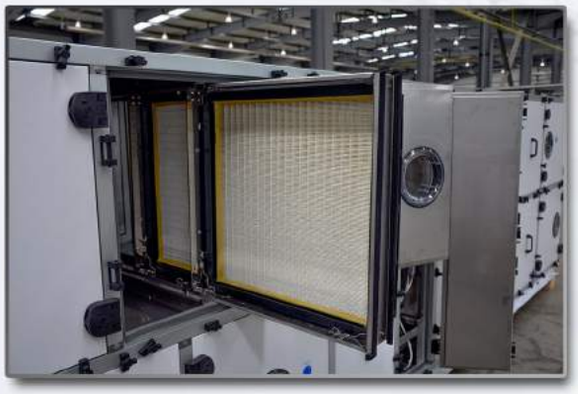
FILTERS

Filters are installed at the entrance of the unit to ensure normal operation of the AHU and to prevent contamination of the components.

*All MAX.e² units use **Microcell** filters. These filters are made with plated microglass paper and spaced using uniformly positioned hotmelt adhesive beads which delivers an optimum airflow. The frame is constructed from composite material (plastic) and 130mm galvanized steel sheets. The classes of filtration are M6 (standard), F7, F8 and F9 (optional).*

*One of the benefits of using this type of filter is that it performs perfectly, despite the turbulence, variable air volume and vibration found within the system. Since the air passes equally through the filters, a maximum service life is achieved. **Microcell** filters are unaffected by fan shut down or start up, can resist up to 1000 Pa. of differential pressure, and work perfectly even in humid conditions.*





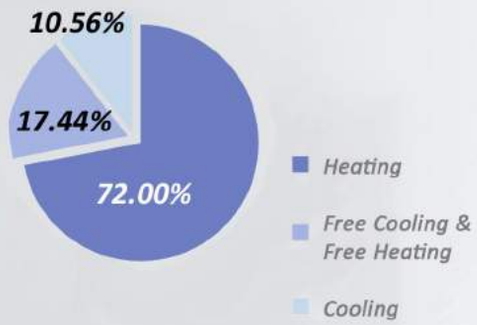
Benefits:

- *More filtration area - 50% higher filtration area in comparison to an M5 bag filter.*
- *Lower pressure drops – being compact and rigid, the pressure drops are lower than that of bag filters.*
- *Higher final pressure drops - resist up to a differential pressure of 1000 Pa.*
- *Longer service life - lower initial and higher final pressure drops will increase the service life.*
- *Reduced labor and service costs - due to shorter time between changing the filters.*
- *Lighter than the nmetal frame version for a smaller environmental impact and easier handling.*
- *Reducing the SFP factor due to lower pressure drops.*
- *Ultra compact – only 130mm.*

*All **Microcell** filters are **EUROVENT** certified.*

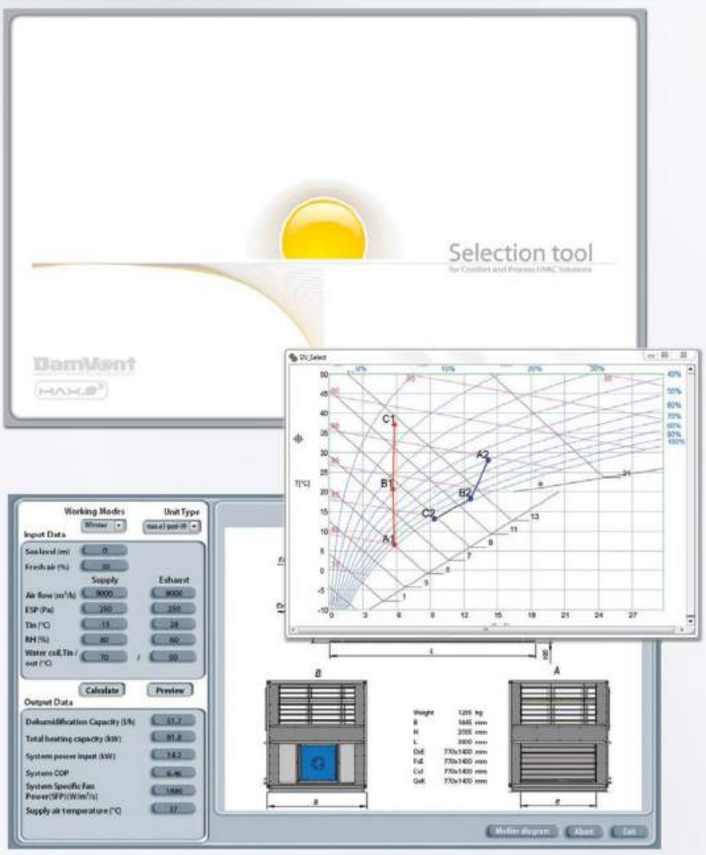
DISTRIBUTION OF WORKING MODES

BASED ON YEARLY OPERATING HOURS (8760 h/y)
(based on yearly operating hours for Central Europe - Vienna)



- *The unit works 72% of the time in Heating Mode, wherein **COP System** = 5 to 8, depending on the ambient temperature.*
- *The unit works 17,44% of the time in Free Cooling and Free Heating Modes, during which the compressors are switched off (non-refrigerant cooling and heating).*

Ambient Temperature (°C)	-15	-10	-5	0	5	10	15	20	20	30	35
Hours (h)	0	21	370	1179	1501	1535	1701	1528	788	131	6
Working Modes	Heating							Free Cooling + Free Heating	Cooling		



DV_SELECT

DV_Select is specialized software used for technical calculations of the "e-conomizer." Damvent is among very few companies that have developed such a powerful tool used to make calculations for AHUs that contain "2 stage heat recovery technology" (air-to-air plate heat exchanger and implemented heat pump) which recover up to 100% of the extract heat.

The main features of the software are:

- *User friendly interface*
- *Light, fast and easy to work with, minimum data input*
- *Winter / Summer mode calculations*
- *Technical data and drawing printouts exported to PDF files*
- *Visualization of the processes in a Mollier's diagram*
- *Printouts contain the following information: pressure drops for all components, plate exchanger, evaporator and condensor, compressor, fans, sound pressure levels, dimensions and weight*
- *General data includes important parameters of the unit, such as: total cooling / heating Capacity (kW), Supply air temperature (°C), Total power input (kW), System COP/EER, Specific Fan Power (SFP) - total for unit (W/m3/s), Refrigerant type and more.*

ADVANTAGES

For Investors:

- Lower initial investment costs
- Reduced installed power
- Lower operating (energy) costs
- Saves space
- Absence of "defrost" mode and maintains continuous working of the unit
- Ease of maintenance (only one unit)
- Monitoring via internet
- 100% Factory Acceptance Test (FAT)
- Low sound parameters

For Designers / Consultants:

- Selection software is available
- Saves time during the design process
- Flexibility in small spaces
- Fast and easy calculations of yearly operation (energy) costs
- Absence of "defrost" mode

For Installing Companies:

- Easy installation (only need air ducts and power supply)
- BMS connection via various protocols
- Settings via internet
- No need for refrigeration work

CAPITAL COST COMPARISON

MAX.e² heat recovery ventilation unit with implemented heat pump automation and control system	AHU with DX / water section
	Air cooled heatpump mounted outside
	Boiler for the water systems (when outside temperatures are very low)
	Pipes, fastenings, insulation, etc.
	Pumps for water systems
	Extra labor
	Common automation and controlling systems
	Higher installed power capacity (higher costs for wiring)
	Higher BMS costs (two or more systems)
	More space for installation

The capital costs of MAX.e² in comparison with the conventional air cooled heat pump is equivalent or lower. Lower energy consumption delivers immediate cost savings.

ENVIRONMENT

- ***Low refrigerant content :***
  Each unit size has a limited refrigerant content, in accordance with EU Regulation No. 842/2006 which makes obligatory control more frequent as the load of each individual circuit increases. MAX.E2 units require only sporadic control of once per year.

- *Refrigerant is eco-friendly* R407C

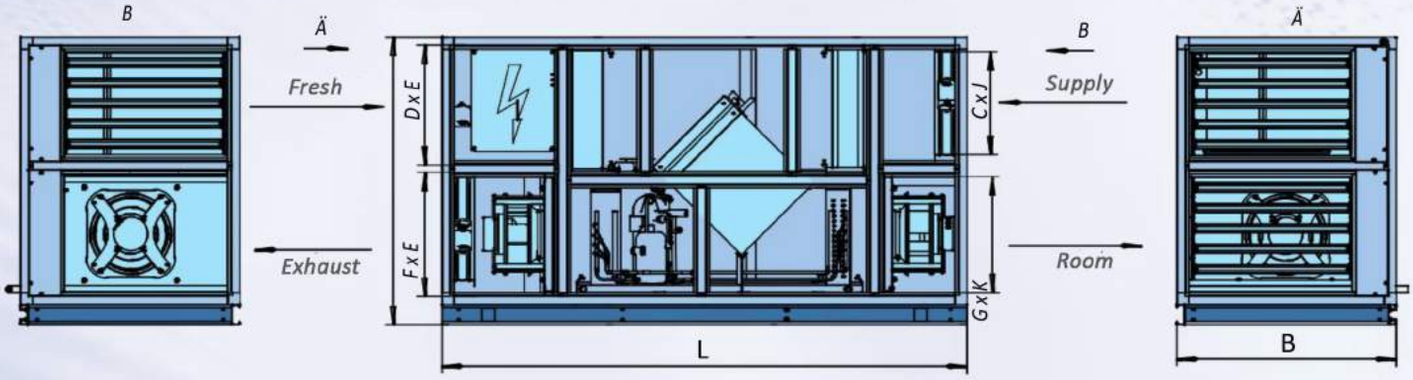
- ***Respect for the environment:***
  The low refrigerant content and the excellent energy performance produce minimal CO_2 emissions into the atmosphere. While producing 1 kW/h of useful heating capacity at an outside temperature of -15°C, MAX.E2 emits only 62 – 65g CO_2.

GENERAL TECHNICAL DATA

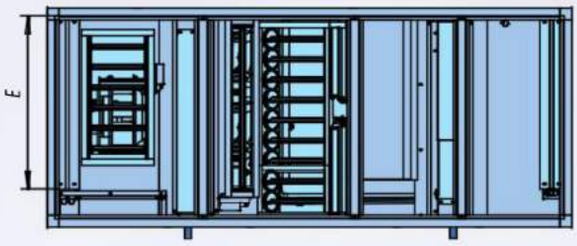
AHU Type		MAX.E2-02	MAX.E2-03	MAX.E2-06	MAX.E2-09	MAX.E2-13
Min/max airflow (m3/h)	m3/h	1000/2000	2000/3200	4000/7000	5500/10000	9000/14500
	General Data					
Nominal Airflow	m3/h	1500	2500	6000	9000	13000
Total Cooling Capacity (1) (Summer mode)	kW	11,1	18,0	40,9	55,7	88,9
Total Heating Capacity (2) (Winter mode)	kW	19,8	34,5	77,9	110,5	161,9
Total Installed Power (comp + vents) (2)	kW	7,7	10,0	16,9	22,4	31,8
Total Power Input (comp + vents) (1)	kW	4,1	7,7	15,0	17,3	33,0
Max. Full Load Current	A	20,8	22,1	39,4	46,2	75,2
EER Net (2) (Summer mode)		2,69	2,34	2,74	3,23	2,70
COP Net (1) (Winter mode)		8,9	9,1	9,4	10,6	8,8
Standard weight (options change weight)	Kg	570	640	1180	1460	2370
Connection Voltage	V/Ph/Hz	400 / 3 / 50				
FANS	Type – EC Plug fan					
Motor Efficiency	%	IE4 Premium Efficiency				
Motor Power: Supply Side Exhaust Side	kW	2,5	2,5	3,5	5,4	6,0
Installed Current: Supply Side Exhaust Side	A	4,0	4,0	5,6	8,6	9,4
Protection Class	IP	55				
Plate Heat Exchanger (sorptie type)	Aluminum Fins with Moleculaire Sieve (HM1)					
Efficiency – Temp / Vocht.	%	68	68	65	65	64
Recovered Heating Capacity – Winter (1)	kW	12,6	21	48,6	72,6	103,5
Mass Transfer Humidity Winter (1)	l/h	5,2	8,7	21	31,3	44,6
COMPRESSOR	TYPE	Rotary	Scroll			
Number of Compressors		1	1	2	2	4
Number of Circuits		1	1	1	1	2
Power Input – Winter	kW	1 x 1,50	1 x 2,80	2 x 2,68	2 x 3,01	4 x 2,57
Power Input – Summer	kW	1 x 3,40	1 x 6,70	2 x 2,68	2 x 3,01	4 x 2,57
Max. Full Load Current	A	1 x 12,8	1 x 14,1	2 x 14,1	2 x 14,5	4 x 14,1
EER – Summer mode (2)		2,59	2,12	2,66	3,31	2,64
COP – Winter mode (1)		4,79	4,82	5,46	6,31	5,68
FILTERS	TYPE	Glass Microfiber		Microcell Rigid Filters		
Classification (EN779:2012)	M	M6	M6	M6	M6	M6
Filtration Efficiency	%	55	55	60 - 80	60 - 80	60 - 80
Total Filtration Area	m2	2,7	4,06	37,2	46,5	37,2

(1) Exhaust Air 22°C / 50%, Fresh Air -15°C / 80%
(2) Exhaust Air 26°C / 50%, Fresh Air 34°C / 44%

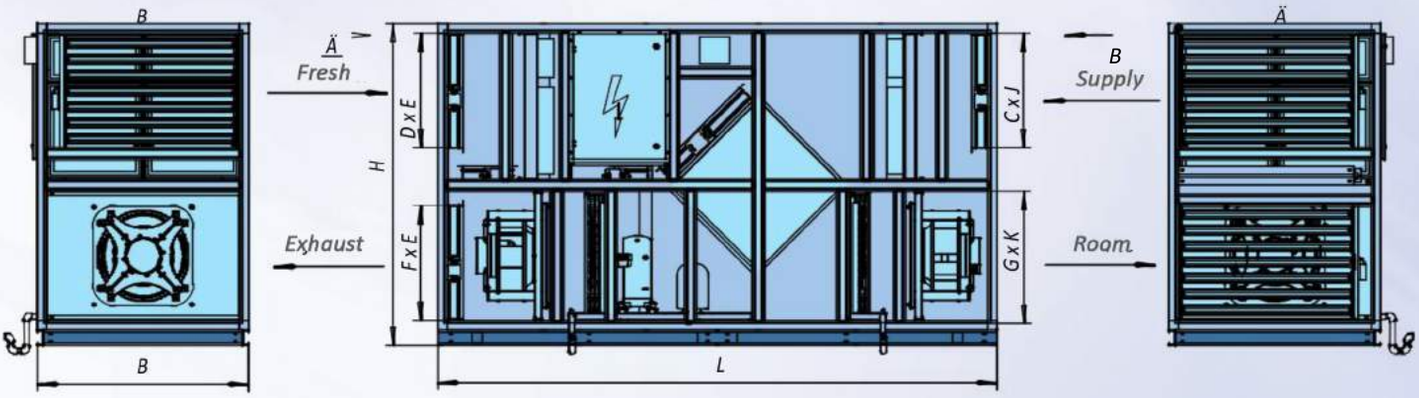
GENERAL APPEARANCE, WEIGHT AND SIZE



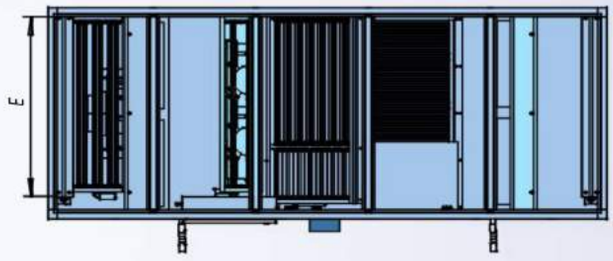
MAX.e² 02
MAX.e² 03



Type	B	H	L	DxE	FxE	CxJ	GxK	Weight
	mm	mm	mm	mm	mm	mm	mm	kg
MAX.e² 02	760	1430	2610	580x535	630x535	580x535	630x535	570
MAX.e² 03	1090	1430	2610	580x845	630x845	580x845	630x845	815

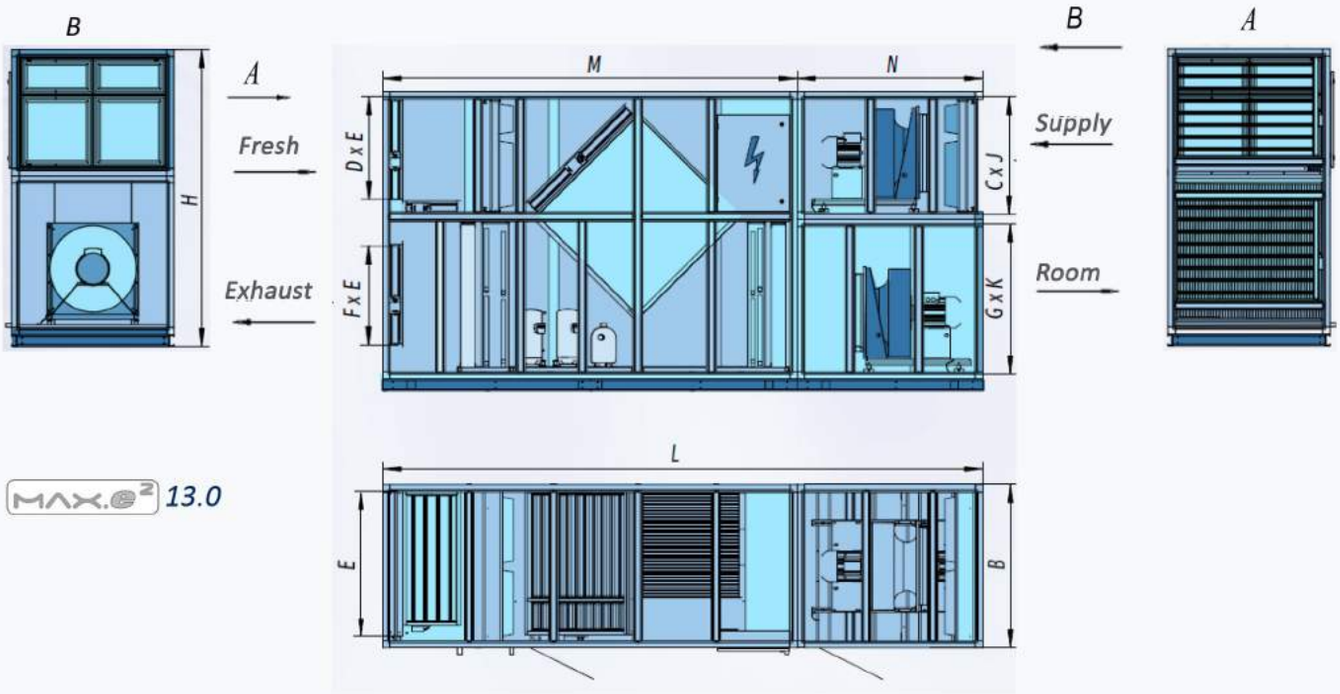


MAX.e² 06
MAX.e² 09



Type	B	H	L	DxE	FxE	CxJ	GxK	Weight
	mm	mm	mm	mm	mm	mm	mm	kg
MAX.e² 06	1345	2045	3550	765x1135	765x1135	765x1135	860x1135	1180
MAX.e² 09	1845	2045	3550	765x1340	765x1340	765x1340	860x1340	1460

These figures are representative and may vary based on customer specifications, components used, and factory improvements.



MAX.e² 13.0

Type	B	H	L	M	N	DxE	FxE	CxJ	GxK	Weight
	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg
MAX.e² 13.0	1345	2470	4920	3400	1520	876x1265	876x1265	970x1265	1240x1265	2200

These figures are representative and may vary based on customer specifications, components used, and factory improvements.

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