MAX.e MINI

RECOVERY
HEAT PUMP UNIT

MAX.e MINI 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 about it.

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Damvent
to reach...and exceed

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!

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

ENERGY EFFICIENCY

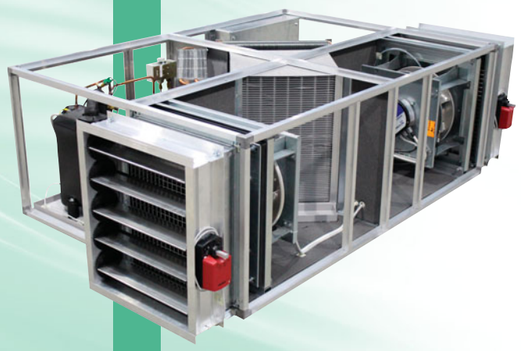
Achieving a comfortable microclimate is directly related to the presence of quality ventilation. Unfortunately, it has been proven that a significant part of the energy consumed within buildings is lost when using poor ventilation systems. This fact produces financial consequences for the users and contributes 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 Daikin's MAX.@MINI solution becomes important.

CONCEPT

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

The MAX.@MINI - "e-conomizer" with "2 stage thermodynamic 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, recovering up to 60 ÷ 65% of the extract heat from the room*
- *2nd stage – "active heat recovery" – using the evaporator of the air-to-air heat pump, recovering between 60 to 100% of the 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.@MINI uses the extract air from within the room. Under normal conditions, this air ranges in temperatures from 20 ÷ 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 recovers the other 35 ÷ 40%. 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.@MINI delivers "defrost" = 0min.

$$COPnet = \frac{Q\ plate\ heat\ exchanger + Q\ heat\ pump}{N\ fans + N\ compressors}$$

where:

- *Qplate heat exchanger - recovered heat from the plate heat exchanger (kW)*
- *Qheat pump – recovered heat from the condenser of the heat pump (kW)*
- *Nfans – energy consumed from the fans (kW)*
- *Ncompressors - energy consumed from the compressors (kW)*

USE AND WORKING PRINCIPLE

MAX.@MINI is a unit designed to treat fresh air only. To handle the cooling load / heating losses of the room due to internal and external heat transmission, an additional cooling / heating source must be added.

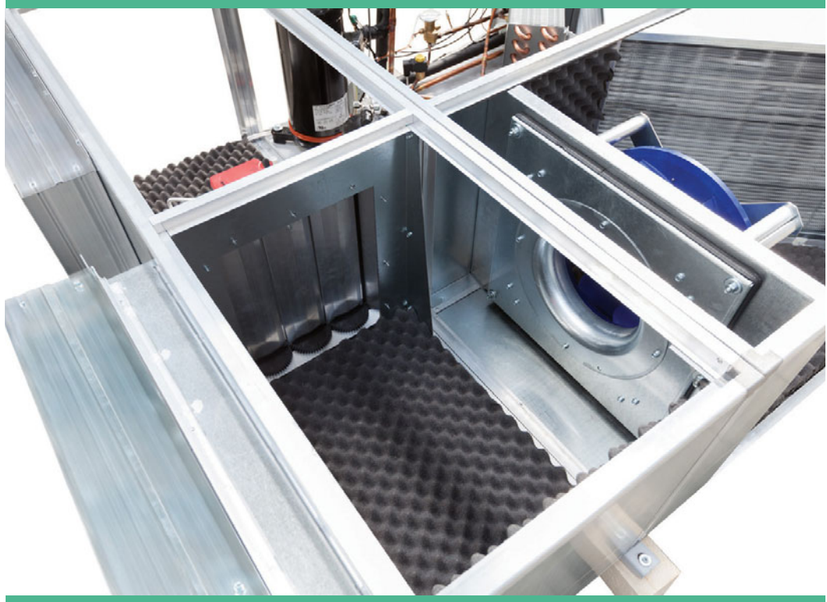
MAX.@MINI is designed and manufactured for internal installations within artificial / false ceilings only.

MAX.@MINI is designed and manufactured with the "standard" operation side left to the air flow. Changing the "standard" operation side is available upon request but extends the delivery time of the unit by 1 ÷ 2 weeks.

This mono-block unit provides the following functions: ventilation, filtering, heat recovery, and heating and cooling (depending on season requirements). Thanks to the built-in refrigerant circuit, MAX.@MINI operates as an independent system, without an outside unit. In order to deliver a constant fresh air supply, the unit must function without interruptions. The secret of our continuous working mode is the absence of a "defrost" cycle (an important advantage of MAX.@MINI in comparison to other similar products).

APPLICATION

The MAX.@MINI is intended for a wide product range with small volume and requirements for regular fresh air supply in bars, restaurants, discos, offices, banks, shops, workshops, showrooms, smoking areas, etc.



CONSTRUCTION

MAX.@MINI *is a single "1 piece" (standalone) unit consisting of aluminum profiles, fastenings, connecting angles and decorative corks which shape the casing.*

Side Panels - single skin, manufactured from 1.2mm galvanised sheet steel mounted to supporting columns with bolts. Side panels are internally lined with sound insulation material only.

Sound Insulation Material - open cell Polyurethane foam, self-extinguishing and impregnated, type Class 1. Standard used: sheets with a Density of 25kg/m^3 and a Thickness of 10mm.

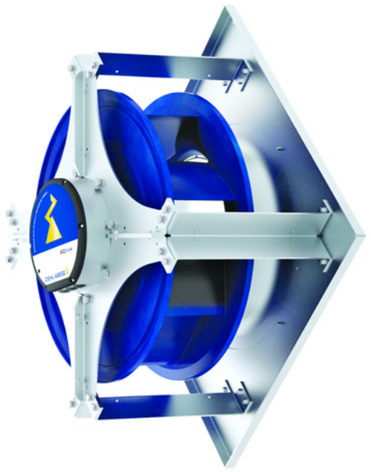
• Option - For advanced / maximized sound absorbing, insulation material with improved shape and thicknesses of 30, 40 50mm are available upon request.

The wet components where condensation may occur (such as the DX coils and plate heat exchanger) are equipped with drain pans. The condensate is taken away through special openings, located on the bottom of the unit.

FANS

Direct driven, double suction, centrifugal fans with 3 speed motors are fitted as standard. Each fan wheel is statically and dynamically balanced on the axis of the direct-driven electric motor. Both the fan wheel and the motor are mounted on a common base frame with vibration dampers.

When higher static pressures or lower sound noise levels are required, EC (Electronically Commutated) Blue Plug Fans - with a Cpro frequency inverter from the company Ziehl-Abegg can be used. 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 EC Blue Plug Fans the MAX.@MINI *ensures the highest IE4 Premium Efficiency and ErP conformity - 2015/EC controller integrated. 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 which results in no welded joints. This highly technical process ensures the highest system reliability.*

Innovation at a glance:

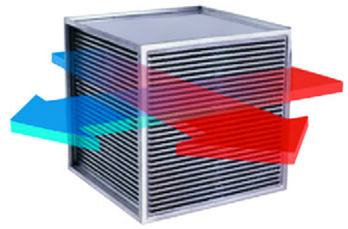
- *Significant weight reduction, which reduces motor bearing loads and increases the system service life*
- *Drastic reduction in noise generation leads to tonal noise reduction up to 5 dB*
- *Significant increase of the impeller efficiency which reduces the absorbed power*
- *Reduced power consumption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

EUROVENT Certificate: 03.01.242.

PLATE HEAT EXCHANGER

All of the MAX.@MINI *units use a plate air-to-air heat exchanger made from aluminum fins with a condensate drain pan.*

Efficiency(Sensible) - E ≤ 55 ÷ 60%



REFRIGERANT CIRCUIT – SEMI-HERMETIC

The heat pump has 1 circuit and uses an eco-friendly refrigerant (R407C). A "Scroll" compressor is used in MAX.@MINI *2 and a "Rotary" compressor is used in* MAX.@MINI *1. It is possible to add capacity control - (optional). This option requires the unit to be equipped with Plug Fans which have a built-in frequency inverter.*

The main components of the refrigerant circuit are: thermal expansion valve, check valves, solenoid valves, filter dryer, receiver, suction line accumulator, thermostats (high/low pressure), differential pressure transmitter (high/low pressure) and etc.

All of the MAX.@MINI *units contain high efficiency direct expansion coils made from copper tubes with aluminum fins and a condensate drain pan. Each coil is dual-mode (reversible) and depending on the operation mode (heating or cooling) of the unit, works as an evaporator / condenser.*

R407C

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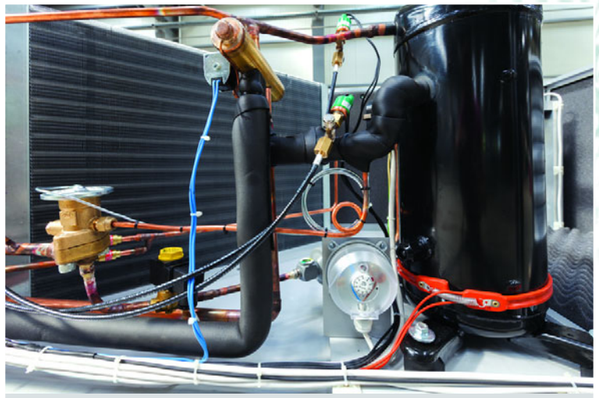
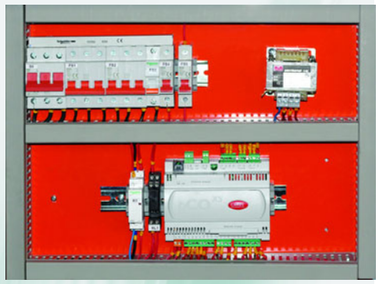


AUTOMATION SYSTEM

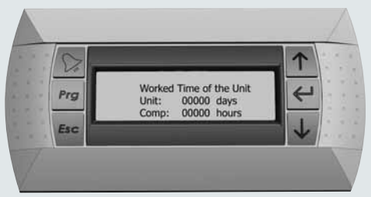


The unit is managed through an electric switchboard located on the operation side of the unit. It includes a pre-programmed controller which manages all modes of the unit, as well as the power and relay-contact equipment. The automation system is standard in each unit and has an additional LCD display with built-in temperature sensor, which is normally mounted into the room.

In the following scenarios:

- *Management of water re-heating coil (optional)*
- *Management of electric heater (optional)*
- *EC (Electronically commutated) Plug Fans (optional) - with frequency inverter (optional)*

The unit will be produced with a free programmable DDC controller (which manages all modes of the unit, the water-heating coil, the electric heater and the EC (Electronically Commutated) Plug Fans), with frequency inverter.



Operation Modes of the Air Handling Unit:

If it is necessary to process the temperature of the air supply, the heat pump receives a start signal. The heat pump works in cooling or heating mode depending on the required need of the supply air. Management of the unit's modes is as follows:

- *Automatic mode - The controller determines whether the unit will be in heating, cooling or ventilation mode according to the set point temperature and the room temperature.*

- *Manual switching mode - The user can manually set the modes (heating or cooling) by using the controller display or the remote display which is mounted outside of the air handling unit.*

- *Management of water - heating coil (optional) - This control is analog. The management is performed by a three-way valve (with different capacity according to the type of water coil) depending on the supply temperature regulation (t° supply) or room temperature (t° room). In both cases, regulation is done by checking the difference between the two temperatures to be maintained. In one case, the supply temperature (t° supply) and set temperature (t° set point); in the other case, room temperature (t° room) and set temperature (t° set point). A thermostat for defrosting is mounted to protect the water re-heating coil from freezing at low temperatures*

- *Management of electric heater (optional) - Switches on at critical low temperatures (if the temperature of the supply air is low).*

The MAX.E MINI unit is designed to treat fresh air for the room needs

Functionality of the Air Handling Unit

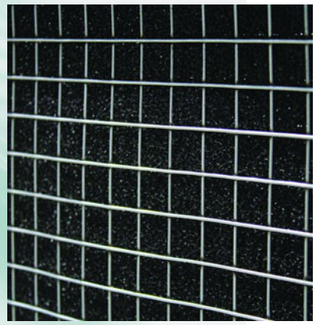
The MAX.E MINI unit is designed to treat fresh air for the room needs, and to provide a comfortable temperature of the supply air. Heating, cooling and dehumidification, or ventilation modes can be operated automatically or manually.

Heating - the unit heats the supply air to the required temperature. When the set point has been reached the unit switches to ventilation mode.

Cooling - the unit cools the supply air to the required temperature. When the set point has been reached the unit switches to ventilation mode.

Ventilation - when the space does not require heating or cooling, the heat pump is switched off and the unit provides untreated fresh air to the space.

Recirculation (Optional – only for winter mode) – This mode is possible only if an additional mixing box is mounted to the body of the unit. It is only used during defrosting of the evaporator and the plate heat exchanger in heating mode at low external temperatures and air supply temperature. The dampers of the fresh air and extract air close and the recirculation's damper opens. One and the same air goes through the unit - air from the room.



FILTERS

For normal operation of the air handling unit and to prevent contamination of the components, air filters are installed at the entrance of the unit.

Filter medium composition:
Polyurethane with possibility for regeneration (washable)
Class of filtration: G2
Cassette thickness: 20 mm

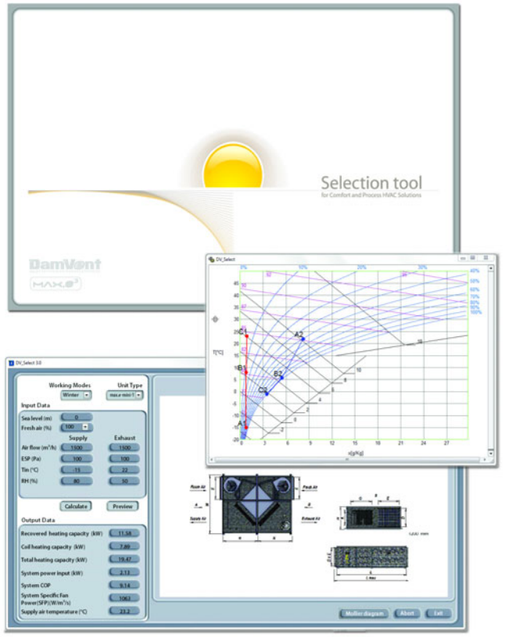
The filters for fresh and extract air are mounted outside of the unit on the duct openings for easy access and maintenance.
Replacing the filters is quick, requires no special knowledge and there is no risk to the operator (all of which minimizes high labor costs).

DV_Select

DV_Select is the specialized software used for technical calculations of the "e-conomizer".

Damvent is among very few companies that have developed such a powerful tool used for calculations in air-handling units 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:

- *Friendly interface*
- *Light, fast and easy to work with, minimum input data*
- *Winter/Summer mode calculations*
- *Technical data and drawing printouts can be exported to a PDF file*
- *Visualisation of the processes in the Mollier's diagram*
- *Printouts consist of detailed info for: pressure drops for all components, plate exchanger, evaporator and condenser, compressor, fans, sound pressure level and dimension and weights*
- *General data includes the most 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:

- *Initial investment cost reduction*
- *Installed electricity power reduction*
- *Lower operating (energy) costs*
- *Saves space - artificial ceilings*
- *Absence of "defrost" mode and maintains continuous working of the unit*
- *Easy maintenance – only one unit*
- *Internet monitoring*
- *100% test in factory conditions*
- *Low sound parameters*

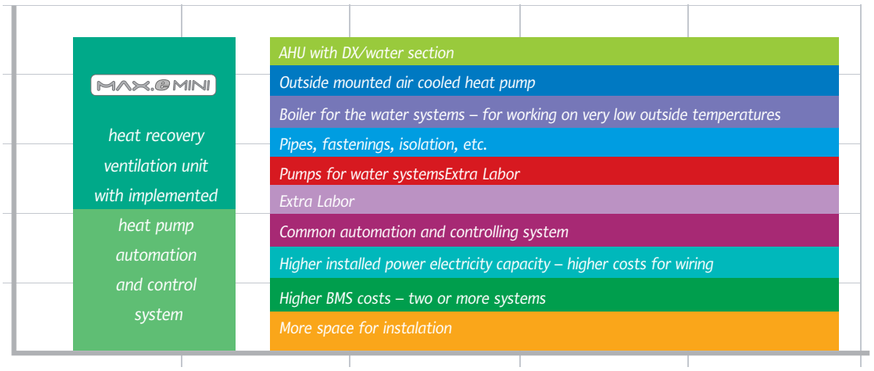
For designers/consultants:

- *Selection software is available*
- *Saving time during the process of design*
- *Flexibility when there is lack of space*
- *Fast and easy calculations for yearly operation (energy) costs*
- *Absence of "defrost" mode*

For installing companies:

- *Easy installation (needs only duct connections and power supply)*
- *BMS connection via different protocols*
- *Settings via internet*
- *No need for refrigeration work*

CAPITAL COST COMPARISON



***The capital cost** of MAX.e MINI compared with the conventional air cooled heat pump is equivalent or lower! The benefits of lower energy consumption with the MAX.e MINI brings immediate cost savings!*

Plug fans with integrated inverter		MAX.G MINI 1			MAX.G MINI 2		
General data							
Airflow	(m^3/h)	1000	1500	2000	2000	2400	3200
Total Cooling Capacity (summer mode)	(kW)	7.5	8.7	12	15.7	17.3	19.7
Total Heating Capacity (winter mode)	(kW)	14.3	18.2	22.0	23.2	26.1	31.6
Total installed power compressor + plug fans	(kW)		5.4			10.0	
Unit's Power Supply	(kW)		3 ~ 400V - 50Hz			3 ~ 400V - 50Hz	
Full Load Current	(A)		26.2			22.1	
Fans			Plug fans				
Quantity			2			2	
Installed Motor Power	(kW)		2 x 1.35			2 x 2.5	
Maximum installed current	(A)		2 x 6.7			2 x 4.0	
Power supply			1 ~ 220V - 50Hz			3 ~ 380V - 50Hz	
External Static Pressure							
Supply side	(Pa)	569	467	289	618	544	445
Exhaust side	(Pa)	544	417	213	526	457	390
Plate Heat Exchanger			Aluminum				
Efficiency (winter mode)	(%)	64.0	62.0	60.0	64.0	63.0	61.0
Recovered Heating Capacity (winter mode)	(kW)	7.5	10.8	14.1	15.0	17.7	22.8
Compressor			Rotary			Scroll	
Power Input (winter mode)	(kW)	1.7	1.5	1.4	1.6	1.6	1.6
Power Input (summer mode)	(kW)	3.2	2.8	2.6	6.0	5.4	4.8
Maximum Full Load Current	(A)		12.8			14.1	
Power supply			1 ~ 220V - 50Hz			3 ~ 400V - 50Hz	
			Regenerating, Polyurethane				
Filtration Class			G2			G2	
Efficiency	(%)		80			80	

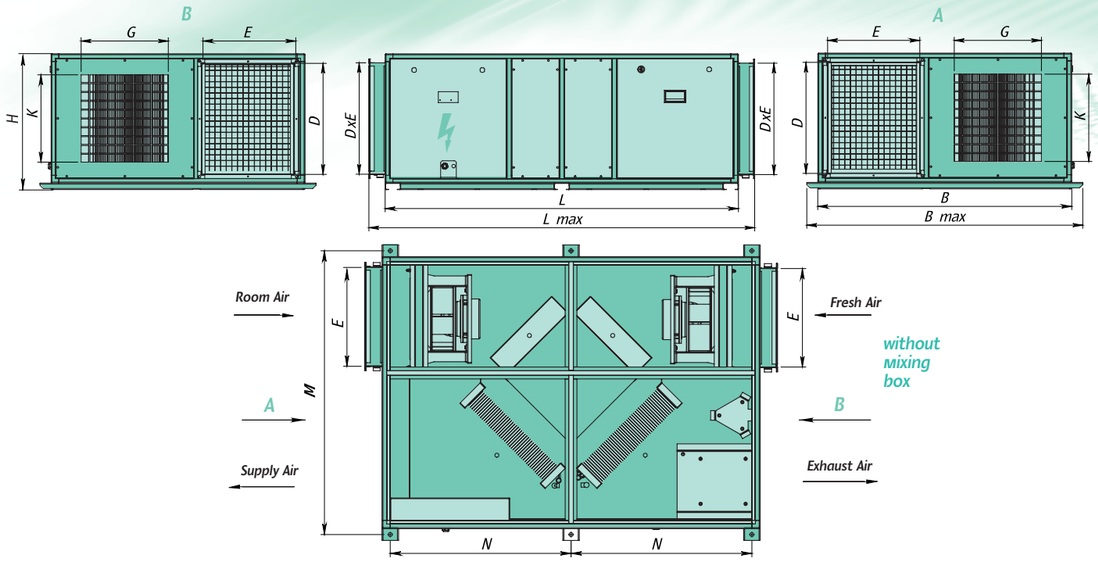
(summer mode) Room Air 26°C/50%, Fresh Air 34°C/44%, (winter mode) Room Air 20°C/50%, Fresh Air -15°C/80%

External pressures for standard MAX.G MINI with direct driven, double suction, centrifugal fans with 3 speed motors

Hst	MAX.G MINI 1			MAX.G MINI 2		
	1000m^3/h	1500m^3/h	2000m^3/h	1600m^3/h	2400m^3/h	3200m^3/h
	SUPPLY			SUPPLY		
I speed	159Pa	-	-	316Pa	-	-
II speed	259Pa	157Pa	-	376Pa	237Pa	-
III speed	279Pa	237Pa	109Pa	416Pa	367Pa	189Pa
	EXHAUST			EXHAUST		
I speed	134Pa	-	-	246Pa	-	-
II speed	234Pa	107Pa	-	352Pa	188Pa	-
III speed	254Pa	187Pa	33Pa	392Pa	318Pa	108Pa

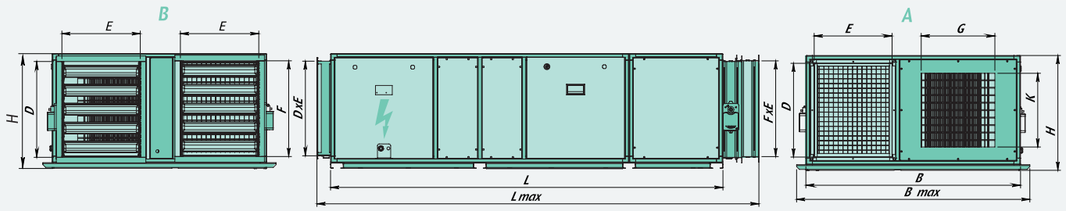
External pressures for MAX.G MINI with EC Plug Fans

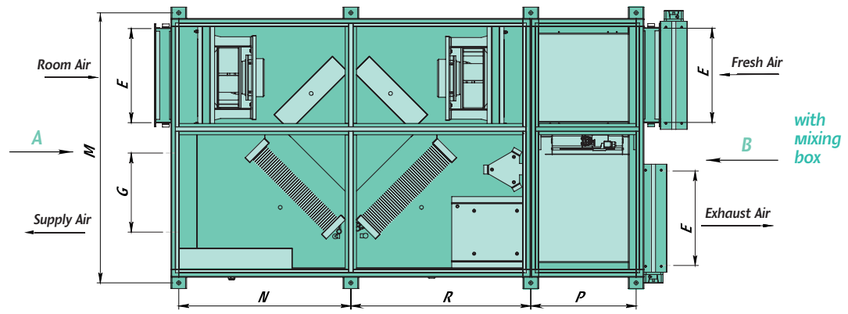
Hst	MAX.G MINI 1			MAX.G MINI 2		
	1000m^3/h	1500m^3/h	2000m^3/h	1600m^3/h	2400m^3/h	3200m^3/h
Supply	569Pa	467Pa	289Pa	618Pa	544Pa	445Pa
Exhaust	544Pa	417Pa	213Pa	526Pa	457Pa	390Pa



Type	B	Bmax	H	L	Lmax	DxE	KxG	M	N	weight
	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg
MAX.G MINI 1	1150	1250	615	1600	1750	500x420	395x395	1200	765	260
MAX.G MINI 2	1550	1640	615	1950	2100	500x600	395x595	1590	940	400

DIMENSIONS AND WEIGHT





Type	B	Bmax	H	L	Lmax	DxE	FxE	KxG	M	N	R	P	weight
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	kg
MAX.G MINI 1 mixing box	1150	1250	615	2105	2370	500x420	513x420	395x395	1200	765	800	468	287
MAX.G MINI 2 mixing box	1550	1640	615	2453	2720	500x600	513x600	395x595	1590	940	975	468	435