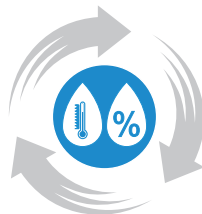


**Damvent**  
to reach...and exceed



**MAX.e<sup>3</sup>dh**

HYBRID HVAC SOLUTION



## Hybrid HVAC solutions for fresh air!



## WHO ARE WE ?

We are Damvent – A Bulgarian Technology company, 100% privately owned, with more than 30 years of experience in the field, specialized in the production of the highest/premium class energy – efficient /saving solutions for ventilation and air conditioning



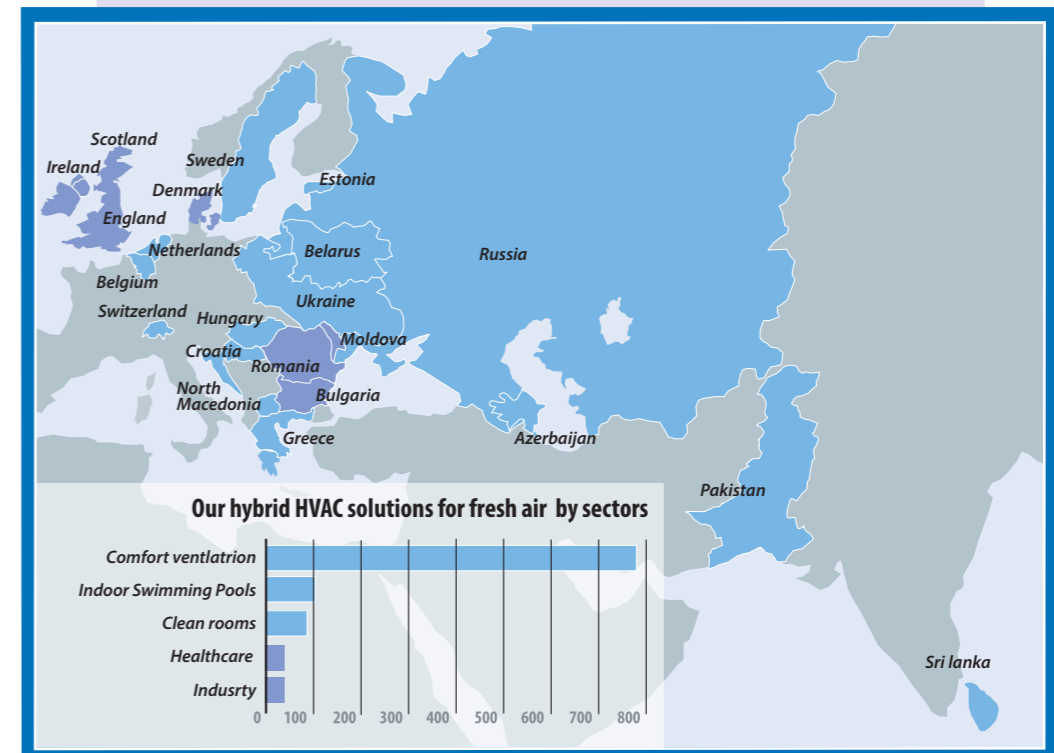
More than 1400 hybrids for fresh air delivered, installed and commissioned.  
Biggest reference list in EU!



**Airflow** 7 000 000 m<sup>3</sup>/h



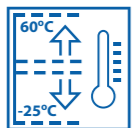
**22 Countries**  
We have clients and partners in over 22 countries in the EU and Asia!



With **MAX.e<sup>3</sup>dh**, We Damvent prove once again our position as  
**The Technology Leader in the Hybrid, Integrated Solutions for Fresh Air.**



It is a **unique 3 stage Heat/Cool/Humidity Recovery Hybrid**, designed to closely control the RH(%) and T(°C) of the supply air within narrow limits ( $T_{supply} = \pm 0,5 - 1^{\circ}\text{C}$  and  $RH_{supply} = 1,5 - 2\%$ ). It is part of our "Process Ventilation" hybrid model's.



\* **MAX.e<sup>3</sup>dh** is designed to maintain T/RHsupply (°C/%) around the world, throughout the whole year, passing through different modes absolutely automatically.  
 \*The best and min., that could be achieved and maintained with **MAX.e<sup>3</sup>dh** is

**T/RHsupply = 5°C/100%, corresponding to an absolute humidity of  $x = 5,2 - 5,6$  g/kg.**

The additional re-heater, that is integral part of the refrigerant circuit and recovers heat from it, the re-heated air is supplied with the desired parameters (e.g. T/RHsupply = 18°C/50%), without using any electric or water source...

Unlike **MAX.e<sup>3</sup>**, which is a 2 stage Heat/Cool/Humidity Recovery Hybrid, **MAX.e<sup>3</sup>dh** adds another stage and becomes a **3 stage Heat/Cool/Humidity Recovery Hybrid**:

**1.** Cool/Humidity Recovery in the rotary wheel + **2.** Deep cooling and dehumidification in the evaporator (down to 5°C/100%) + **3.** Re-heating in the additional re-heater (condenser) **in summer, spring and autumn modes**

and

**1.** Heat/Humidity recovery in the rotary wheel + **2.** Heating in the Condenser + **3.** Humidification in the Steam Humidifier **in winter mode.**

\***Practically has 2 main modes:** 1. Cooling + Dehumidification in summer, spring and autumn and 2. Heating + Humidification in winter.

\*There are **NO Standard Models and Sizes**. Each unit is specifically designed, based on the customer project requirements and location, the configuration, dimensions, technical parameters and performance will differ from projects to project.

\***Selection**- All technical selections for max.e3-DH are made with a combination of specialized selection software + detailed manual calculations. The technical data, required to start the design/calculation process is:

Air change ratio ( $n=h^{(-1)}$ ) of the room; Min and Max Air Flow (m<sup>3</sup>/h); Dimensions of the room (BxHxL-mm); Cooling Loads (kW); Heating Losses(kW); Supply/Exhaust distribution scheme; External static pressure ESP(supply/exhaust) (Pa); T/RH<sub>out</sub> Summer; T/RH<sub>out</sub> Winter; required T/RHsupply, required T/RHroom; Dimension limitations for the unit (BxHxL-mm) if any.



\***Offer response time** - Starting from 1 week and more, depending on the complexity of the application.



\***Standard Delivery Time** - starting from 10 weeks and more, depending on the complexity of the application

**Same as max.e3... but not really**

The name and configuration of max.e3-DH looks similar to max.e3, but the differences are more than the similarities.

**MAX.e<sup>3</sup>dh** has:

significantly higher cooling capacity (kW)+ dehumidification capacity(kg/h) and refrigerant quantity(kg), bigger length (with several additional sections), bigger and more complex refrigerant circuit and automation system, more complex automation processes and higher control accuracy.



**Applications:** Hospitals, Operation Theaters, Pharmaceutical, Laboratories, Microelectronics, Food Industry and others...



**Outstanding efficiency and energy savings** - Despite much higher capacities than max.e3, max.e3-DH provides outstanding efficiency throughout the whole year, exceeding any conventional systems.

- EERnet = 5,7-6,2 in cooling + dehumidification mode throughout summer, spring and autumn. The most important energy indicator of the unit, includes the Rotary wheel, evaporator and re-heater capacities, as well as the Power Input of the compressors and fans.

- COPnet  $\geq 15$  and higher in the heating + humidification mode, even at the lowest ambient temperatures (e.g.  $T_{out} = -15^{\circ}\text{C}$ )

\*Please see the sample technical data in the printout below. It is a calculation for a hot and humid EU climate.  
 The most important energy indicators and efficiencies are marked for ease.

Date : 01.04.2020

Reference:

Issued by :



SUMMER max.e3-09-DH

GENERAL DATA	Supply Side	Exhaust Side
AirflowUnit	6000 m3/h	6000 m3/h
Extra fresh		6000 m3/h
Total Capacity	144.9 kW	
Specific Fan Power(SFP)-total for unit	1.385 W/m3/s	
System EER	5.69	
Total power input (without aux. electric heater)	25.45 kW	
Refrigerant	R407C	
Unit power supply	400 V/3 ph/50 Hz	
Sea level	0 m	

The system's Specific Fan Power (SFP) calculation is based on clean filter

**DIMENSIONS AND WEIGHT**

Width	mm
Height	mm
Lenght	mm
Weight	kg

**PRESSURE DROP**

Filter	(F7 Microcell Rigid Filters L=130)		
Clean Filter	39 Pa	39 Pa	
Dirty Filter for replacing	300 Pa	300 Pa	
Filter	(F9 Microcell Rigid Filters L=130)		
Clean Filter	52 Pa		
Dirty Filter for replacing	450 Pa		

	Supply Side	Exhaust Side
Working point pressure drop (clean filters) F7	39 Pa	39 Pa
Rotary Heat Exchanger	141 Pa	141 Pa
Evaporator	46 Pa	
Mixing Box		25 Pa
Condenser		102 Pa
Re-heater (DX Condenser)	40 Pa	
Working point pressure drop (clean filters) F9	52 Pa	
<b>Total Internal Pressure Drops</b>	<b>318 Pa</b>	<b>307 Pa</b>
<b>External Static Pressure (ESP)</b>	<b>300 Pa</b>	<b>300 Pa</b>

**FILTERS**

	F7	F7
Class of filtration	F7	F7
Total Filtration Area	46.5 m2	46.5 m2
Class of filtration	F9	
Total Filtration Area	46.5 m2	

**ROTARY HEAT EXCHANGER**

Incoming Temperature	32.0 °C
Incoming Relative Humidity	60 %
Incoming Temperature	22.0 °C
Incoming Relative Humidity	50 %
Recovered Cool	61.2 kW
Temp. Eff.(Dry)Hum. Eff.	84.7 %\ 86.9 %
Outgoing Temperature	23.5 °C
Outgoing Relative Humidity	53 %
Outgoing Temperature	30.5 °C



Outgoing Relative Humidity		61 %
Mass Transfer Humidity	0.0 l/h	9.1 l/h
Temperature to frost	- °C	

**MIXING BOX**

Inlet Temp. from Heat Recovery	- °C	30.5 °C
Inlet Rel. Hum. from Heat Recovery	- %	61 %
Inlet Temp. from Recirculation Damper	- °C	32 °C
Inlet Rel. Hum. from Recirculation Damper	- %	60 %
Outlet temperature	- °C	31.0 °C
Outlet relative humidity	- %	57 %
Fresh air percentage		100.0 %

**EVAPORATOR**

Incoming Temperature	23.5 °C
Incoming Relative Humidity	53 %
Outgoing Temperature	4.9 °C
Outgoing Relative Humidity	99 %
Cooling capacity	57.5 kW

**CONDENSER**

Incoming Temperature	31.0 °C
Incoming Relative Humidity	57 %
Outgoing Temperature	44.4 °C
Outgoing Relative Humidity	28 %
Condensing capacity	52.4 kW

**COMPRESSORS**

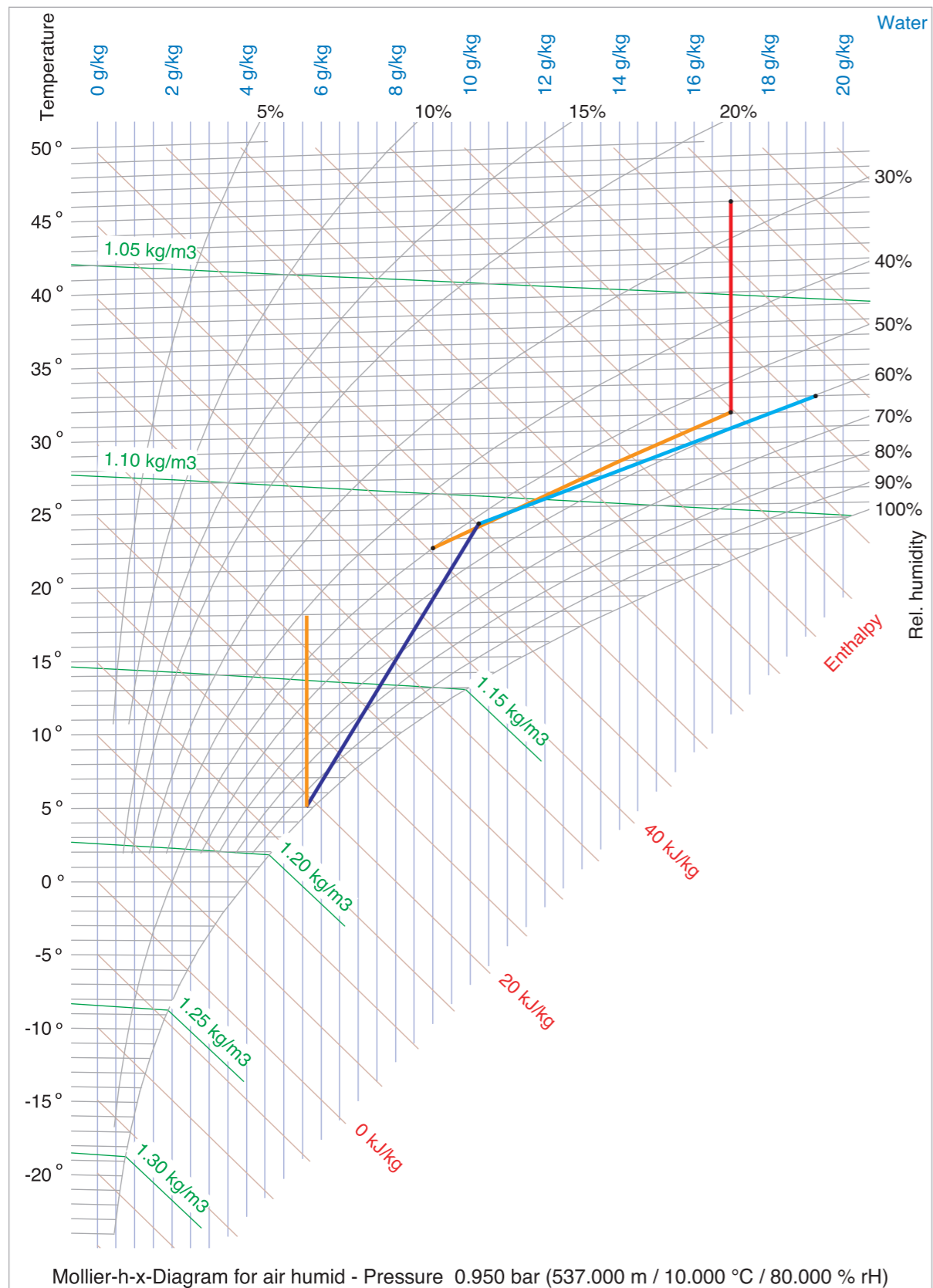
Quantity	4 n°	Compressors COP	2.759
Power supply	400 V/3 ph/50 Hz	Operating Current	4 x 9.0 A
Power input	4 x 5.21 kW	Full load Current	4 x 14.50 A
Circuits	2	Locked rotor Current	4 x 66.00 A

**RE-HEATER (DX CONDENSER)**

Incoming Temperature	4.9 °C
Incoming Relative Humidity	99 %
Supply Air Temperature	18 °C
Supply Air Relative Humidity	42 %
Re-Heating capacity	26.2 kW

**FAN**

	Supply Side	Exhaust Side
Type: Plug Fan		
Air flow	6000 m3/h	12000 m3/h
Total Pressure	618 Pa	607 Pa
Fan speed	2100 rpm	2272 rpm
Fan Efficiency	68.0 %	66.7 %
(Static Eff. Impeller incl. motor and controller)		
Power absorbed at fan shaft	2 x 0.790 kW	3 x 1.012 kW
Motor Duty	2 x 2.5 kW	3 x 2.5 kW
Motor Efficiency		
ErP conformity- 2015/EC controller integrated		
Full load Current	2 x 4.0 - 3.2 A	3 x 4.0 - 3.2 A
K-factor for air flow measuring	140	140
Power supply	400 V/3 ph/50 Hz	



## Factory Test

Do you want to overcome the lack of a Dedicated Standard for Hybrids? There is only one way... With the Ultimate Factory Test (FT).

Every single Hybrid that we produce goes through a full Factory Test in factory conditions to make sure it is ready to work..

It includes the following features:

- Vacuuming of the refrigerant circuit and filling up the exact quantity of refrigerant, without extra activity on site.
- Functional checks of all executive mechanisms and sensors
- Setting up the exact airflow (CAV), or pressure (VAV) required by the customer
- EEV fine settings
- Measuring and recording all air and refrigerant temperatures (°C) and pressures (bar), voltage (V), currents (A) and power input (kW) of the different components and the unit as a whole.
- Simulation of heating/cooling, ventilation and or dehumidification modes
- Tsupply control simulation
- Capacity control adjustments (compressors and additional heaters if fitted)
- LCD display User settings and connectivity
- Fine adjustments of frequency inverters of: fans, compressors, rotary wheel
- Filter settings
- Alarm checks
- Remote control check
- BMS settings
- Labeling of the unit
- Final internal cleaning
- Providing the necessary documentation (manuals, declarations of conformity etc.), plus additional accessories
- Packaging
- ... last but not least, comparison between the theoretical performance in the selection software printout and the real measured values during the FT





### 3E - Concept

**1e - Every Climate** – from -30°C to +55°C

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

- Filtration • Recirculation 0÷100% • Heating • Cooling + Dehumidification • Process Ventilation.

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

### 3 STAGE HEAT/COOL/HUMIDITY RECOVERY TECHNOLOGY



achieved - "consecutively" in 3 stages:

**1<sup>st</sup> stage** - Cool/Humidity Recovery in the rotary wheel +

**2<sup>nd</sup> stage** - deep cooling and dehumidification in the evaporator +

**3<sup>rd</sup> stage** - re-heating by the additional re-heater (condenser) in summer-spring and autumn seasons and 1.Heat/Humidity recovery by the rotary wheel + 2.Heating by the Condenser + 3.Humidification by the Steam Humidifier by the Steam Humidifier in the winter season.



ALL IN ONE

### All in 1

**max.e** - multifunctional concept solution for fresh air with built-in reversible heat pump and integrated automation system.



100%  
FACTORY TESTED

### 100 % Factory tested

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

The factory test includes:

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



100%  
PLUG AND PLAY

### 100% Plug and play

Stand alone "one-piece" unit, which only needs a duct system and power supply for start up.

### For the Investor

- Significant reduction in initial investment costs
- Significant reduction of installed power
- Low operating (energy) costs
- Saved Space
- Easy maintenance – mono-block unit
- Internet monitoring
- 100% Factory Tested
- Low noise performance

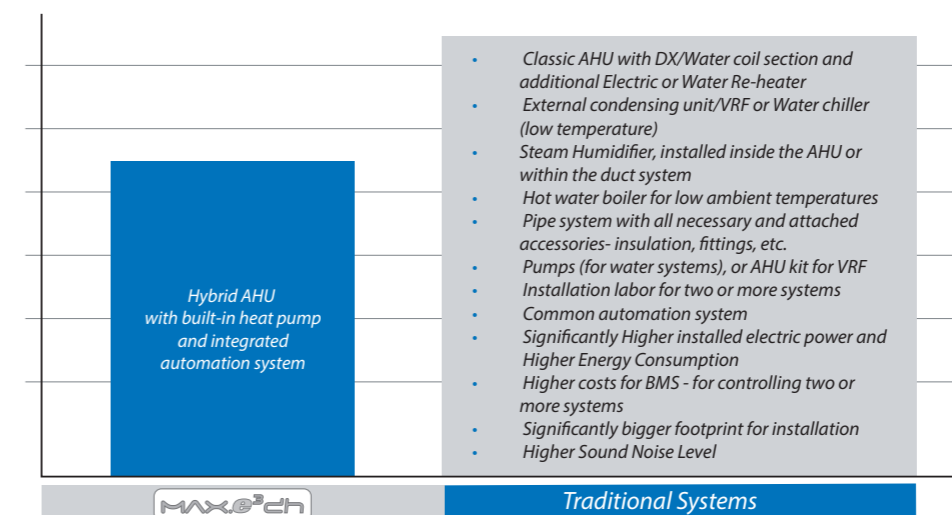
### For Designers and Consultants

- Significant reduction in initial investment costs
- Significant reduction of installed power
- Low operating (energy) costs
- Saved Space
- Easy maintenance – mono-block unit
- Internet monitoring
- 100% Factory Tested
- Low noise performance
- Specialized Selection Software available and free to use
- Saves design time
- Flexibility of installation on site for the unit
- Fast and easy calculation of energy consumption on an annual basis

### For installation companies

- Easy installation on site (needs only connection to the ducts system and power supply)
- Connection to the BMS system through different protocols
- Setting up the unit through the internet
- Lack of working with refrigerants on site

### Capital Cost Comparison



## DESIGN

*max.e3-DH is designed as a system with the structure of the unit, manufactured as a mono-block, consisting of aluminum profiles (anodized optionally), supporting elements, connection angles and locking accessories. Larger sizes (over 18,000m<sup>3</sup>/h), are produced in sections. Unit enclosure panels are double skinned and manufactured from galvanized sheet steel. Both the inner and outer skins have a powder polymer coating or are made of stainless steel. All internal surfaces are powder coated as standard or are made of stainless steel.*



## AUTOMATION SYSTEM

*max.e3-DH is fully equipped with all necessary automation and executive mechanisms. The electric switchboard is integrated into the unit and located on the operation (access) side. The "Brain" of the max.e3-DH is a specially designed by Damvent controller (ICB), which controls and manages all automatic processes.*



## INTEGRATED STEAM HUMIDIFIER

*During the winter season, we recover up to 85% of the extract RH(%) from the room, but still an additional steam humidifier must be implemented into the max.e3-DH to reach the necessary RH<sub>room</sub>(%) or to produce the required humidity when the unit is being started up. The humidifier could be fully integrated within the unit, or could be installed within the building, but in both cases controlled by our ICB.*

## FANS

*All sizes of max.e use the latest high-tech generation EC Blue (Electronically Commutated) Plug Fans – with built-in frequency controller (inverter) by Ziehl-Abegg. Fan wheel is statically and dynamically balanced on the axis of the direct-driven motor. Fan wheel together with the motor is mounted on a common base frame with vibration dampers. Using second-generation EC Blue fans, max.e delivers the highest energy efficiency class - IE5 according to IEC 60034-30-2.*

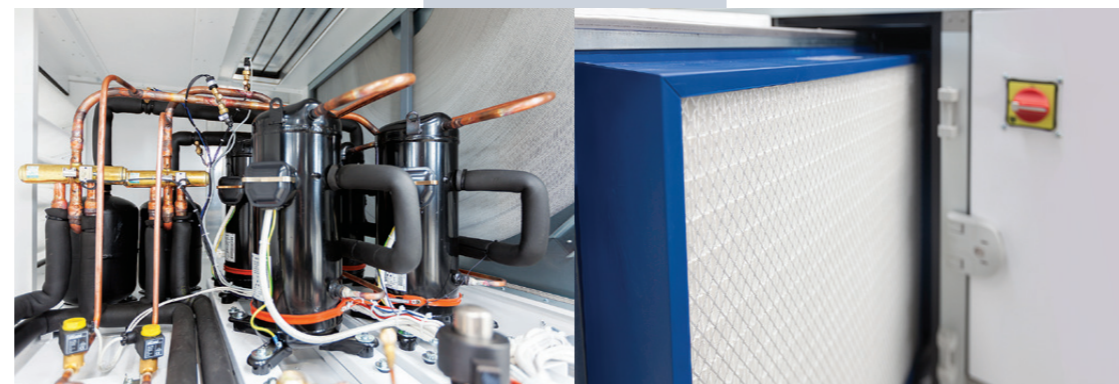


## SORPTION ROTARY HEAT EXCHANGER

*An air-to-air rotary heat exchanger- Sorption type, made from aluminum foil and 3Å molecular sieve, which gives high sensitivity for absorbing water molecules (HM1 type) is used. Sorption rotor provides an excellent method to pre-cool and dehumidify the fresh air before entering the DX cooling coil.*

## REFRIGERANT CIRCUIT

*max.e3-DH contains high efficiency direct expansion coils, which are made from copper tubes and aluminum fins and are equipped with a condensate drain pan. The coils are "epoxy" coated, extending their useful life and also their best levels of performance. Hermetic scroll compressors (on/off), Capacity controlled compressor (inverter driven), Electronic expansion valves, Suction Line Accumulator, Liquid line receiver, Filter Dryer, 4 way valve, check valves, solenoid valves etc. are designed and assembled in a specific configuration to achieve the best results.*

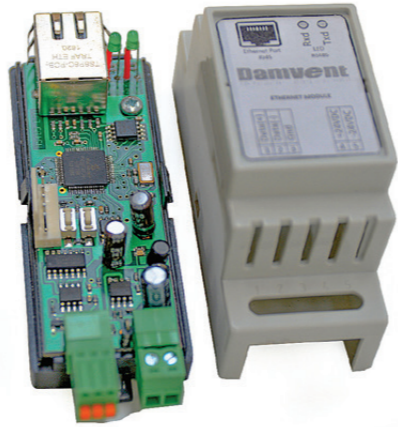


## FILTERS

*Filters are installed at the inlet of the unit to ensure normal operation of the AHU and to prevent contamination of the components. Microcell filters are used in the max.e3-DH units. These filters are made of plated micro glass paper and spaced with hot melt adhesive beads, which are uniformly positioned to deliver optimum airflow. The frame is constructed from a composite material (plastic) and 130mm Galvanized steel sheets. The Classes of filtration are F7 (standard), F8 and F9 (optional).*

## Permanent internet connection

All hybrid units allow an internet circuit board to be connected to the ICB controller for internet connection. The built-in circuit board allows for a permanent internet connection to each max.e from any location in the world. This option helps you/us react to situations that require fast and accurate solutions to the problem.



## Opportunities provided by WEB communicator



### Possibility for remote start-up and 72 hours monitoring period

The air-handling unit can be started and adjusted via the Internet, it would be monitored until it reaches and maintains the set parameters.



### Software updates

Updates are possible for the controller's software, if the customer requires additional settings or parameter adjustment. These additional settings and updates would be managed/performed over the Internet.



### Archive (history) of working and service parameters

This option would create History logs/archives containing data about the operation of the AHU, using the Supervisory Control and Data Acquisition (SCADA).



### Monitoring of the variables, working parameters

Monitoring the status of all variables accessible to the client and the unit's display.

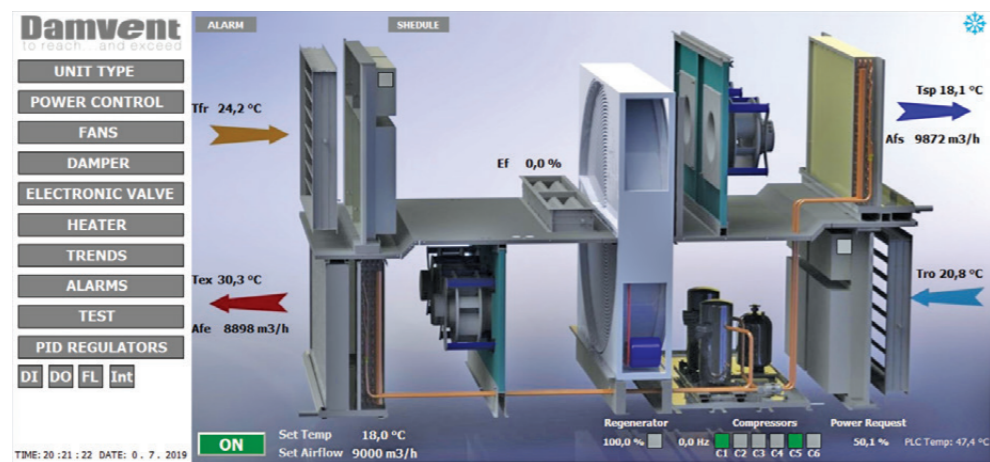


### Diagnosis of problems, arising during the operation of the air-handling unit

By analysing the information and data from the history menu, the source of the issue or the reason which triggered it can be found. The problem is solved via the Internet when physical access to the AHU is not required.

### Functional diagram

Take a detailed look at how the unit is connected with all its components. It is fascinating how a little technology can have such a big impact on the performance and maintenance of the complete system.



## Belfield Office Park - Beech Hill Road, next to University College Dublin.

The first project in Ireland - 3 hybrid AHU for Total humidity and temperature control - max.e3-dh. With up to 100% recovery of heating/cooling/dehumidification energy, running costs are lower than traditional AHUs. Installation costs are also lower. And since filters are the only components that needs to be checked, maintenance is minimal.



## Ophthalmology clinic - Chirurgie Oculaire Liege, Belgium max.e3-DH-04 - 4000 m3/h

The AHU will operate in an Ophthalmology clinic in Liege, Belgium. The characteristics of this AHU are that due to the specifics of the site - it was necessary to install the additional steam humidifier in the housing of the unit. This was a big challenge, as the steamer itself had to be protected in low winter conditions. The entire steam-humidification section is made of stainless steel, as well as other sections of the AHU such as condensing trays, filter sections and etc.



## Ophthalmology clinic - Herent, Belgium clinic OKIO max.e3-04-DH (up to 4000m3/h) is custom made hybrid according to the specific requirements for the operating theater of a newly built ophthalmology clinic OKIO in the city of Herent, Belgium.

The management of the clinic entrusted the cooling, heating, humidity control and the fresh air in the operating theater of the clinic to Damvent's max.e3-04-DH. Another requirement for the AHU is to maintain the room temperature (tC) and the Relative Humidity (RH%) in narrow limits, namely troom=18÷20C and RH=50÷60%. The treated fresh air is being supplied to the operating theatre through a laminar ceiling for a better and even distribution, in order to provide the most comfortable ambiance for the surgeons.



## Sjukhusomrade Hospital - Malmo, Sweden

Damvent developed the design and completed the delivery and installation of 3 of ours hybrid AHUs for total temperature and humidity control - max.e3-dh-09 for 2 x Operation Theatres, 1 x Preproom, (non) sterile (storage) rooms, central sterile room into the newly built Modular building solution. Due to the COVID-19 restrictions in the beginning of the 2020 all the units were commissioned remotely via the Internet.



## National Blood Centre Sanquin - 555/5D Elvitigala Mawatha, Colombo 00500, Sri Lanka

Damvent developed the design and completed the delivery and installation of the first ever hybrid AHUs for Sanquin Bloodcentre Cleanroom, non-sterile storage rooms, central sterile room. The project includes 2 hybrid AHUs - one for 18.000 m3/h and the other for 6.000 m3/h. Both units are equipped with the internet circuit board that makes it possible to remotely control the units when it is necessary. This is the first ever EU ISO 7 Cleanroom in Sri Lanka.



The complete list of projects by Damvent can be found on the website: [www.damvent.com](http://www.damvent.com) - in the section References

