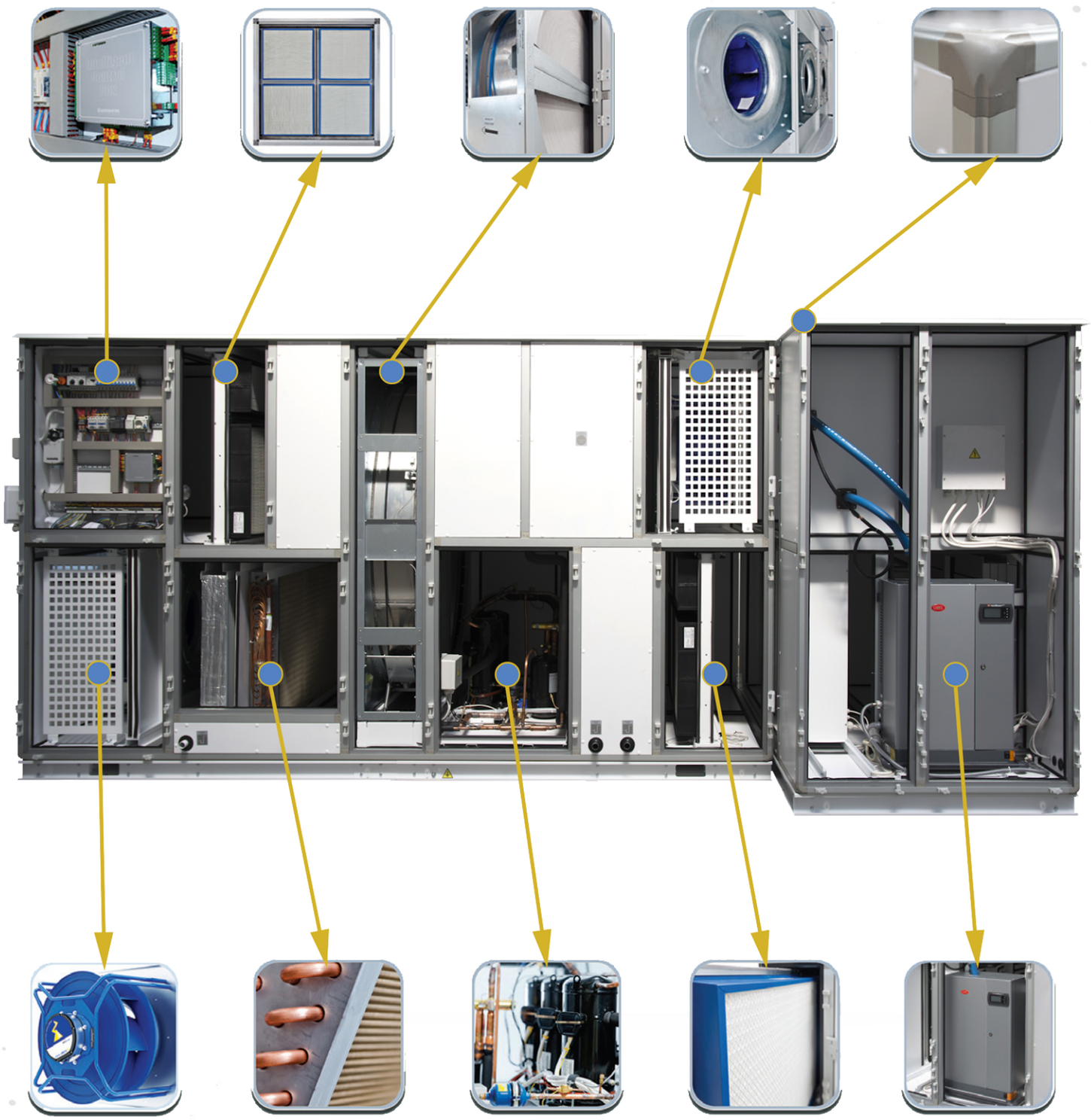
Damvent

to reach . . . and exceed Benelux

MAX.e³dh

HYBRID HVAC SOLUTION

Hybrid HVAC Solutions for Fresh Air



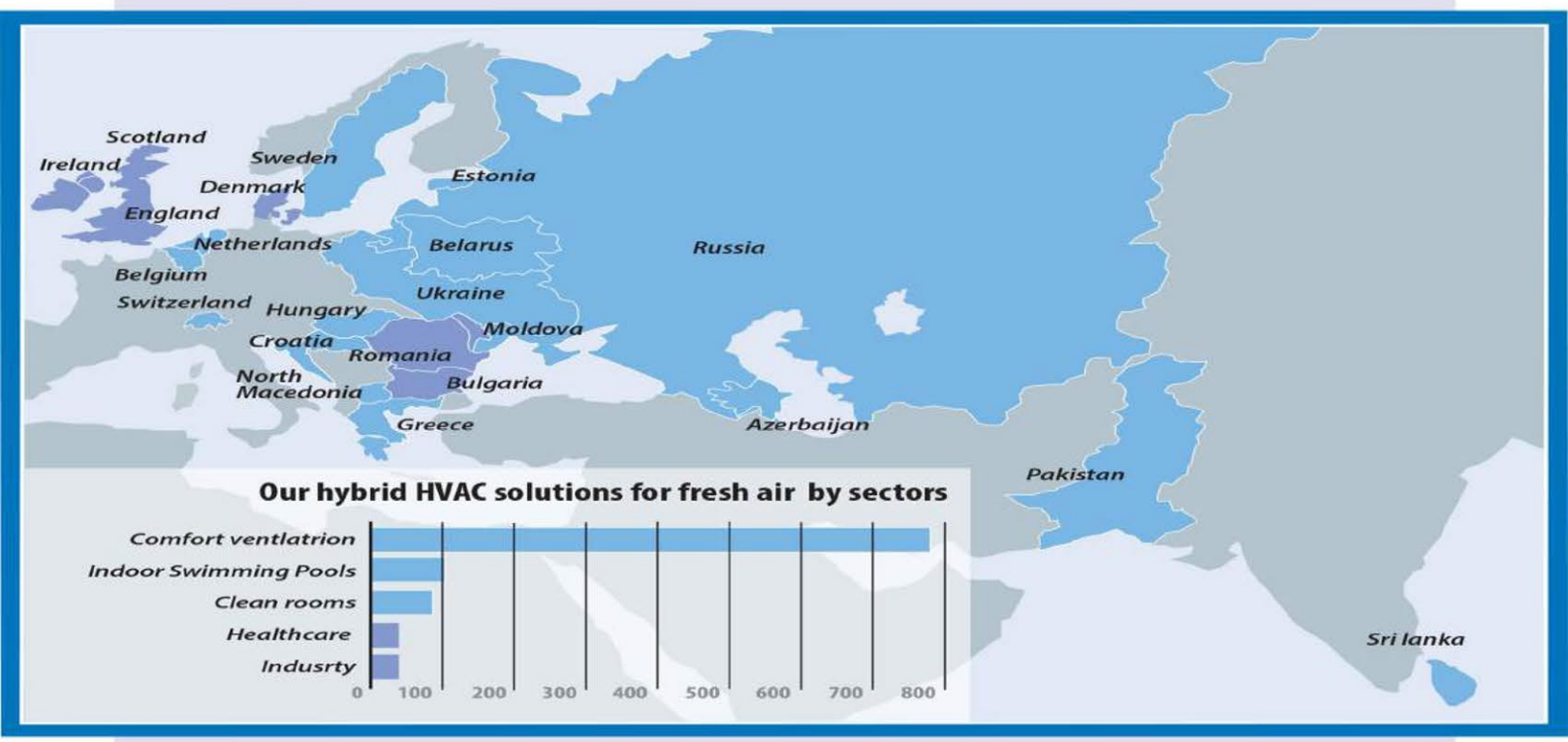
WHO ARE WE ?

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 solutions for ventilation and air conditioning.

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

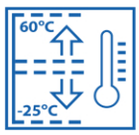
Airflow ***7 000 000*** m^3/h

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



*Our latest development and design, the max.e³dh , solidifies our position as the **technology leader** for **Hybrid Integrated Solutions** using fresh air.*

It is an unique 3 stage (heat/cool/humidity) recovery hybrid, designed to control the RH (%) and T(°C) of the supply air within narrow limits (Tsupply = ± 0,5 - 1°C and RHsupply = 1,5 - 2%).
It is part of our "process ventilation" hybrid models.



* *max.e³dh is designed to maintain T/RHsupply (°C / %) around the world, throughout the year, passing through its different modes automatically.*

* *The best and minimum achieved and maintained are:*

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

The additional reheater (an integral part of the refrigerant circuit) recovers heat from the circuit and the reheatd air is given desired parameters (e.g., T/RHsupply = 18°C/50%), without using additional electric or water sources.

*Unlike max.e³ , which is a **2 stage** (heat/cool/humidity) recovery hybrid, max.e³dh adds another stage to become 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%); and*
3. *Reheating in the additional reheater (condensor) in **Summer, Spring and Fall** modes.*

AND

1. *Heat/Humidity recovery in the rotary wheel;*
2. *Heating in the condensor; and*
3. *Humidification in the steam humidifier in **Winter** mode.*

* ***Practically has 2 main modes:** (1) Cooling + Dehumidification in Summer, Spring and Fall; and (2) Heating + Humidification in Winter.*

* ***No standard models and sizes -** Each unit is specifically designed based on project requirements and location, the configuration, ,dimensions, technical parameters and performance (all of which differ from project to project).*

* ***Selection** - All technical selections for max.e³dh are made using a combination of specialized selection software and detailed manual calculations. The technical data we require in order to start the design process is as follows:*

Air change ratio (n=h^(-1)) of the room; Min and Max Air Flow (m3/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_{out} Summer; T/RH_{out} Winter; required T/RHsupply, required T/RHroom; Dimension limitations for the unit (BxHxL-mm) if any.

***Offer response time** - Minimal 1 week plus more, depending on the complexity of the application.*

***Standard Delivery Time** - Minimal 10 weeks plus more, depending on the complexity of the application.*

***In comparison with** max.e³ :*

Although the name and configuration of the max.e³dh unit looks similar to the max.e³ , there are significant differences.

The max.e³dh offers:

- *significantly higher cooling capacity (kW) and dehumidification capacity (kg/h);*
- *increased quantity of refrigerant (kg);*
- *greater length (several additional sections);*
- *larger and more complex refrigerant circuit and automation system; and*
- *more complex automation processes and better accuracy control.*

***Applications** - Hospitals, Operation Theaters, Pharmaceutical, Laboratories, Microelectronics, Food Industry, and more.*

***Outstanding efficiency and energy savings** - Despite having higher capacities than the max.e³ unit, the max.e³dh unit provides outstanding efficiency throughout the entire year, and exceeds any conventional system.*

- 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 ≥ 15 and higher in the heating + humidification mode, even at the lowest ambient temperatures (e.g. Tout= -15°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.

TECHNICAL PRINT OUT

Date : 01.04.2020
Reference:
Issued by :

Damvent
to reach...and exceed

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	
Total Internal Pressure Drops	318 Pa	307 Pa
External Static Pressure (ESP)	300 Pa	300 Pa

FILTERS		
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

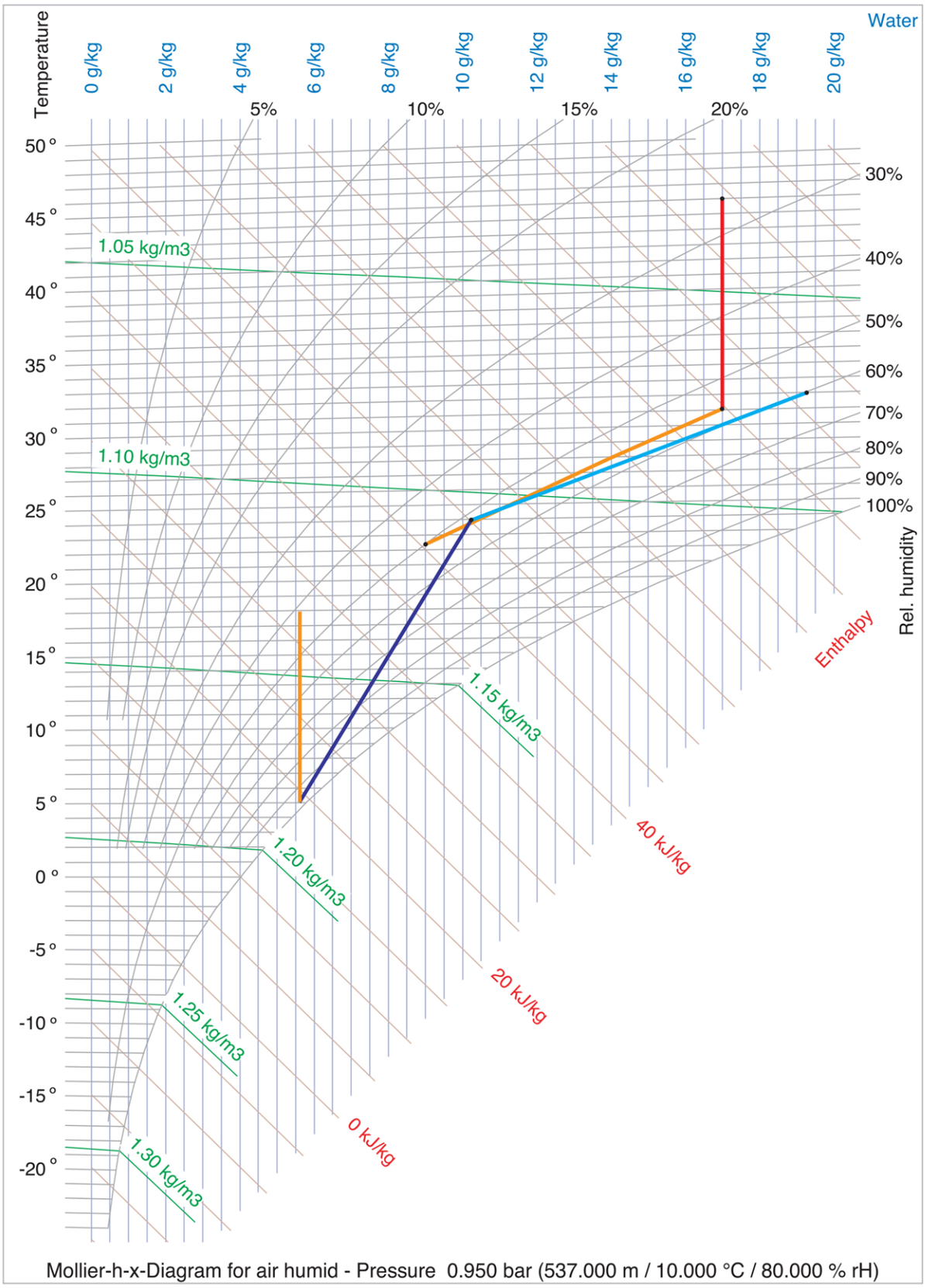
Quantity	4 n°	Compressors COP	2.759
Power supply	400 V/3 ph/50 Hz	Operating Current	4 x 9.0 A
Power input	4 x 5.21 kW	Full load Current	4 x 14.50 A
Circuits	2	Locked rotor Current	4 x 66.00 A

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	

MOLLIER DIAGRAM



Mollier-h-x-Diagram for air humid - Pressure 0.950 bar (537.000 m / 10.000 °C / 80.000 % rH)

Factory Test (FAT)

Every hybrid that we produce goes through a full FAT, under factory conditions, to make sure all is working properly.

Description of FAT:

- *Vacuuming of the refrigerant circuit and filling with 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) requested by the customer*
- *EEV detail settings*
- *Measuring and recording all air and refrigerant temperatures (°C) and pressures (bar), voltage (V), current (A) and power input (kW) of the various 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 adjustment of frequency inverters of fans, compressors, and rotary wheel*
- *Filter settings*
- *Alarm checks*
- *Remote congtol check*
- *BMS settings*
- *Labeling of the unit*
- *As built clinical cleaning*
- *Providing the necessary documentation (manuals, declarations of conformity, etc.) plus additional accessories*
- *Packaging*
- *Last, but not least, comparison made between the theoretical performance in the selection software printout and the real measured values during the FAT*

3E CONCEPT

1E - Every Climate *- from -30°C to +55°C*
2E - Every Application *- suitable wherever HVAC and 100% fresh air is needed by providing all possible air treatment processes, such as:*

- *Filtration*
- *Recirculation from 0 - 100%*
- *Heating / cooling / dehumidification*
- *Process ventilation*

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

3 STAGE RECOVERY TECHNOLOGY

This process is achieved consecutively in stages:

1st stage *- Cool/Humidity recovery in the rotary wheel*
2nd stage *- Deep cooling and dehumidification in the evaporator*
3rd stage *- Reheating by the additional reheater (condenser) in Summer, Spring and Fall. In the Winter the stages are (1) heat/humidity recovery by the rotary wheel; (2) heating by the condenser; and (3) humidification by the steam humidifier.*

ALL IN ONE

ALL IN ONE

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

100% FACTORY TESTED (FAT)

Performing a FAT results in high reliability and reduced installation costs. Each unit is tested under factory conditions as follows:

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

100%
FACTORY TESTED

100% PLUG AND PLAY

A standalone “one-piece” unit which only requires a duct system and power supply for its start up.

100%
PLUG AND PLAY

FOR THE INVESTOR

- Significant reduction of initial investment costs
- Significant reduction of installed power
- Low operating (energy) costs
- Saves space
- Easy maintenance due to mono-block unit
- Monitoring via internet
- 100% factory tested
- Low noise performance

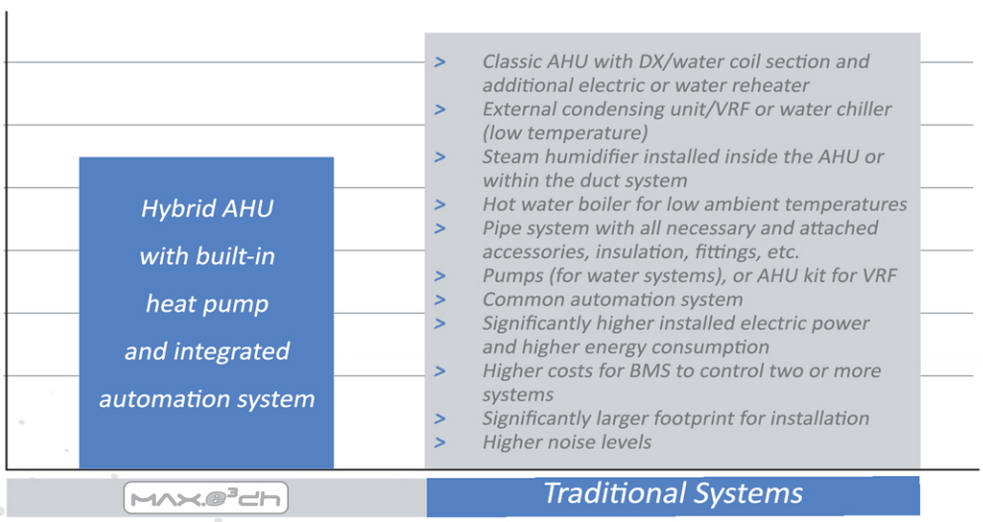
FOR DESIGNERS AND CONSULTANTS

- Significant reduction of initial investment costs
- Significant reduction of installed power
- Low operating (energy) costs
- Saves space
- Easy maintenance due to mono-block unit
- Monitoring via internet
- 100% factory tested
- Low noise performance
- Specialized selection software available and free to use
- Saves designing time
- Flexibility of installation on site
- Fast and easy calculation of energy consumption on an annual basis

FOR INSTALLATION COMPANIES

- Easy installation on site (only need to connect duct system and power supply)
- Connection to BMS system through different protocols
- Setting up the unit through the internet
- No need to work with refrigerants on site

CAPITAL COST COMPARISON



DESIGN

MAX.e³ch *is designed as a system within the structure of the unit, manufactured as a mono-block, consisting of aluminum profiles (anodized D1/L1/T2/TB2 DIN EN 1886), supporting elements, connection angles and locking accessories.*

Larger sizes (over 18,000 m3/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 integral surfaces are powder coated as standard or are made of stainless steel.

FANS

All sizes of the MAX.e *series use the latest generation high-tech Electronically Commutated (EC) Blue Plug Fans with a built-in frequency controller (inverter), manufactured by Ziehl-Abegg. The fan wheel is statically and dynamically balaned 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,* MAX.e *is able to deliver the highest energy efficiency class of IE5 in accordance with IEC 60034-30-2.*

REFRIGERANT CIRCUIT

MAX.e³ch *contains high efficiency direct expansion coils made from copper tubes and aluminum fins and equipped with a condensate drain pan. The coils are "epoxy" coated which extends their useful life and best levels of performance.*

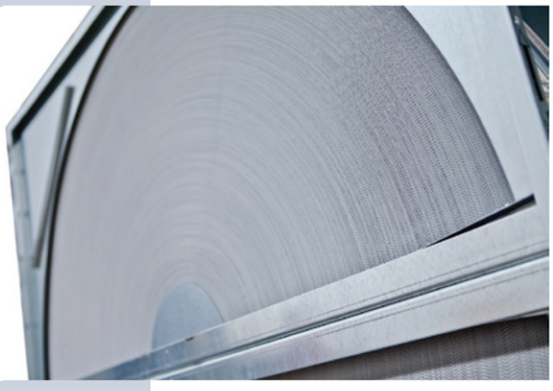
In order to achieve the best results, the following components are designed and assembled in a specific configuration: hermetic scroll compressors (on/off); capacity controlled compressor (inverter driven); electronic expansion valves; suction line accumulator; liquid line receiver; filter dryer; 4 way valve; check valves; solenoid valves; etc.

AUTOMATION SYSTEM

MAX.e³ch *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.e³ch *is a specially designed controller (ICB), developed by Damvent, which controls and manages all automatic processes.*

INTEGRATED STEAM HUMIDIFIER

During the Winter, we recover up to 85% of the extract RH(%) from the room. However, an additional steam humidifier must be implemented into the MAX.e³ch *to reach the necessary RHroom(%) or to produce the required humidity when the unit is being started up. The humidifier could be fully integrated within the unit or installed within the building, but in both cases, controlled by our ICB.*



SORPTION ROTARY HEAT EXCHANGER

An air-to-air rotary heat exchanger, sorption type, made from aluminum and 3A 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.

FILTERS

Filters are installed at the inlet of the unit to ensure normal operation of the AHU and prevent contamination of the components. MAX.e³ch *units are equipped with Microcell filters. These filters are made of plated microglass paper and spaced with hot melt adhesive beads, which are uniformly positioned to deliver optium airflow. The filter frame is construtced from a composite material (plastic) and 130mm galvanized steel sheets. The filtration classes are F7 (standard), F8 and F9 (optional).*

MOBILITY

PERMANENT INTERNET CONNECTION

All our 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 connection to reach MAX.e series units from any location in the world. This option assists us when responding to situations that require fast and accurate solutions.

WEB COMMUNICATOR BENEFITS

Possibility for remote start-up and 72 hours monitoring period

The AHU can be started and adjusted via the internet. It would be monitored until the set parameters have been reached and maintained.

Software updates

Updates are possible for the controller software, if the customer requires additional setting or parameter adjustments. These additional settings and updates would be managed through the internet.

Archive of working and service parameters

This option creates history logs / archives which contain data regarding the operation of the AHU using the Supervisory Control and Data Acquisition (SCADA).

Monitoring variables and working parameters

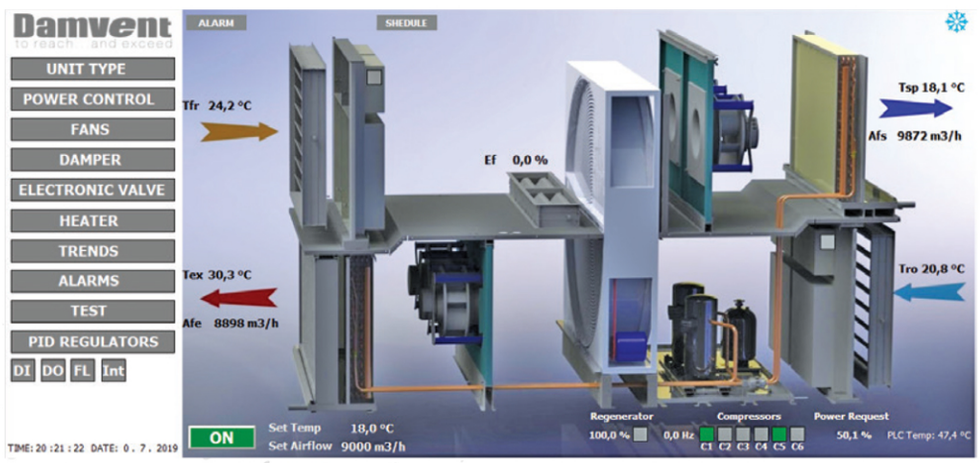
Monitoring status of all variables accessible to the client and the unit's display.

Diagnosis of AHU operation problems

By analysing the information and data from the history menu, the source of the issue or the reason that 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 an impact on the performance and maintenance of the complete system.



Laser Refractie Centrum

Clinic Dr. F. Kesteloot, Harelbeke, Belgium
max.e3-09 DH = 9000 m3/h

Characteristics: *Design, delivery and installation of HVAC systems for 2 operating rooms, a general dressing room, nonsterile (storage) rooms, a central sterile room, and recovery rooms.*
Customer requested that the air handling unit and duct work on the roof be painted in black.

OpthalmologyClinic

Chirurgie Oculaire, Liege, Belgium
max.e3-04-DH = 4000m3/h

Characteristics: *Installation of the additional steam humidifier placed in the housing of the unit. This was a challenge as the steamer must be protected during low Winter conditions.*
The entire steam-humidification section is made of stainless steel, as well as other sections of the AHU (condensation trays, filter sections, etc.)

OpthalmologyClinic

OKIO Clinic, Herent, Belgium
max.e3-04-DH = 4000m3/h

Characteristics: *Complete air treatment of the operating theater with emphasis on maintaining room temperature (tC) and relative humidity (RH%) within narrow limits (troom = 18-20°C and RH = 50-60%). Treated air is supplied to the OT through a laminar ceiling to provide even distribution and create the most comfortable ambiance for the surgeons and patients.*

Hospital

Sjukhusomrade Hospital, Malmö, Sweden
max.e3-09-DH = 7000m3/h

Characteristics: *Developed, installed and delivered 3 hybrid AHUs for total temperature and humidity control within two operation theatres, a prep-room, nonsterile storage rooms, and the central sterile room inside the newly constructed modular building units. Due to the COVID-19 restrictions in early 2020, all of these units were commissioned remotely via internet.*

Clinic

Blood Center Sanquin, Colombo, Sri Lanka
max.e2-18, 18.000 m3/h
max.e2-06, 6.000 m3/h

Characteristics: *Developed, delivered and installed our first ever hybrid AHUs for the clinic's cleanroom, nonsterile (storage) rooms, and central sterile room. Both units were equipped with the internet circuit board, making it possible to remotely control the units when necessary. This was the very first* ***EU ISO7*** *cleanroom built in Sri Lanka.*

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