



# HYBACO®

Hybrid dry coolers



# Contents

<b>Application area</b> .....	Seite	4
<b>Advantages</b> .....	Seite	4
<b>Designs</b> .....	Seite	5
H-shape		
V-shape		
<b>Hybaco® V-shape</b> .....	Seite	6
Layout diagram		
Components		
<b>Hybaco® Wetting equipment</b> .....	Seite	8
<b>Regulation</b> .....	Seite	9
<b>Accessories and options</b> .....	Seite	9
<b>Design principles</b> .....	Seite	10
<b>Technische Daten, Auslegungsbeispiele</b> .....	Seite	11
Hybaco® dry cooler HV2-60; Laboratory GHZ Schlieren		
Hybaco® dry cooler HV3-60; KSA Aarau		
Hybaco® dry cooler HV4-60; Ivoclar Vivadent, Schaan		
<b>Transport, unloading, assembly and commissioning</b> ...Seite		17
<b>Tender text</b> .....	Seite	18
<b>Water quality of makeup and recirculation water</b> .....Seite		20
<b>References</b> .....	Seite	21
<b>Mollier h-x diagram</b> .....	Seite	26
<b>Request for quotation</b> .....	Seite	27



FHNW, MuttENZ

# HYBACO

---

Mountair has been designing and making hybrid dry coolers for over twenty years now. Each project that we have done is unique and has been designed, constructed and assembled precisely according to customer requirements. This is true for a single hybrid dry cooler with an output of 200 kW or even a multi-compressor refrigeration system with 6 MW. Mountair realises your individual needs.

Mountair's expertise and service experience make it possible to react to events quickly. Be it replacement of wearing parts, system conversions due to changing influences on the operating parameters or repairs to system components due to defects or adjustments in the I&C area of regulation - Mountair is your competent partner.



Grabs Hospital

## Field of application

In most cases, hybrid dry coolers are installed in combination with cooling units. The dry coolers are the cooling source for the cooling units, to which the absorbed thermal energy can be transferred at a higher temperature level.

The air required to cool the medium (water or water-glycol mixture) is loaded with significantly more thermal energy in hybrid dry coolers than in other recooling systems. Hybrid dry coolers manage with a lower air flow rate than dry coolers. This means fewer fans, which has a positive effect on noise levels and overall energy consumption.

## Advantages

Compared to dry coolers and adiabatic dry coolers, hybrid dry coolers have some significant advantages. The main advantage is that significantly lower recooling temperatures can be achieved. This significantly improves the COP of the cooling unit. This reduces the power requirement and therefore also the operating costs of the entire refrigeration system.

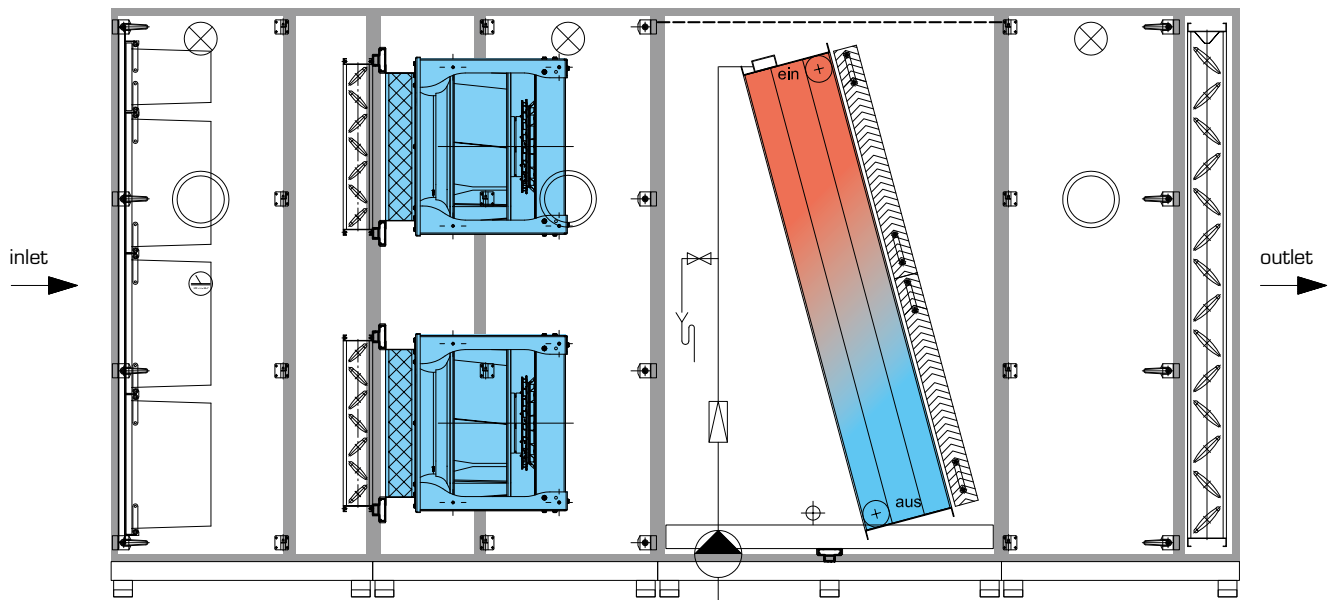
Furthermore, evaporative cooling can transfer a significantly higher thermal energy into the air flow than is possible with dry coolers or adiabatic dry coolers (see h-x diagram). Hybrid dry coolers are an extremely compact unit that makes it possible to dissipate large capacities in a small space.

## Design

### H-shape

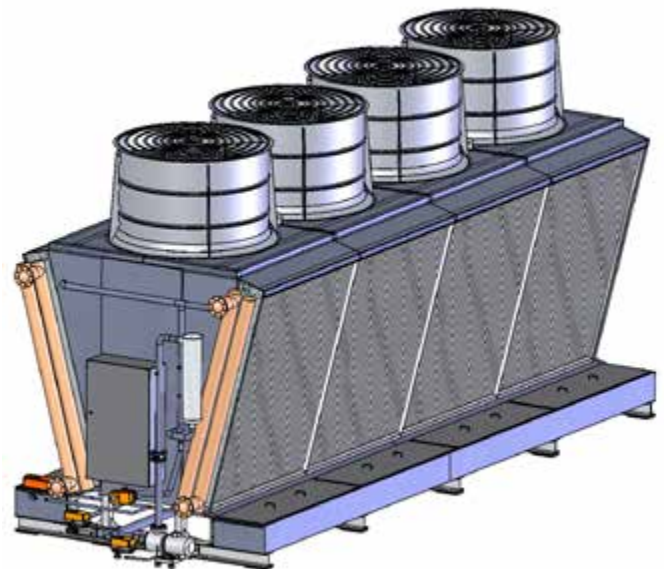
The Hybaco® H-shape is a hybrid dry cooler integrated in an insulated housing. The housing is comparable to that of conventional ventilation and air conditioning units and has the same characteristics. The advantage of this design is that such systems can also be installed indoors.

Intake and exhaust ducts can be connected to the unit as usual with ventilation and air conditioning units and can be routed in/out according to requirements. With this variant, the sound pressure must also be reduced to any level specified by the planners using splitter sound attenuators.



### V-shape

The Hybaco® V-shape corresponds to the familiar dry cooler design for outdoor installation (often on a roof area provided for this purpose). The two heat exchangers inclined to form a 'V' make a compact unit. As a result, the V-shape dry coolers make it possible to dissipate large capacities on a small installation surface. With the patented Hybaco® wetting system, the finned tube heat exchangers are evenly wetted and the air is humidified.



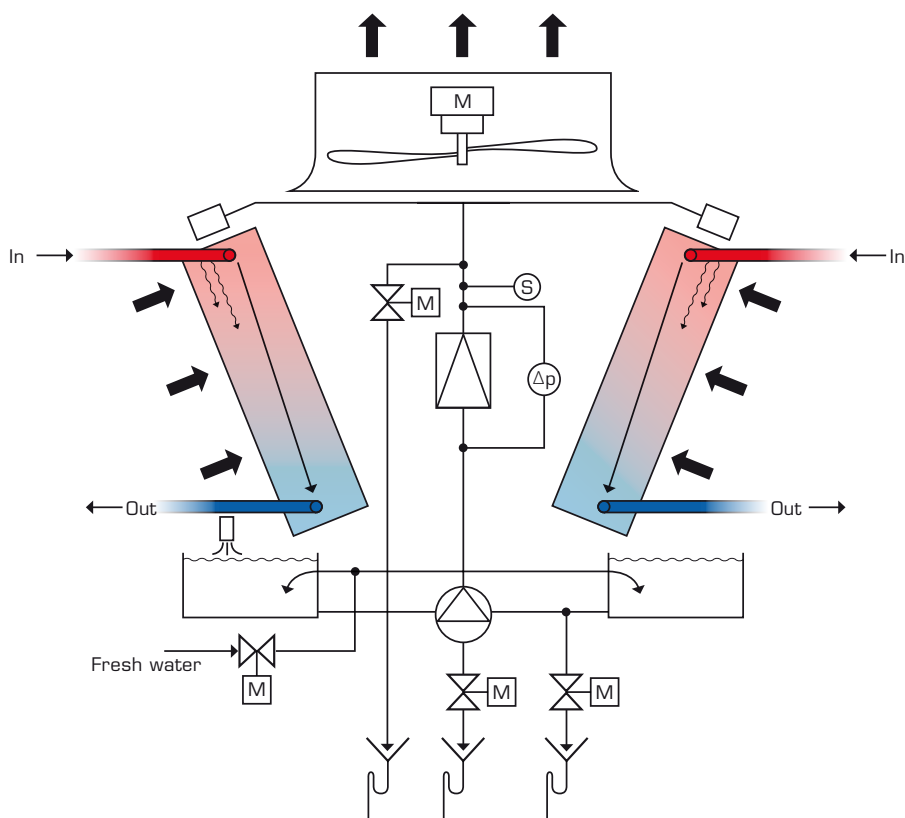


Münsterlingen Cantonal Hospital

## Hybaco® V-shape

### Layout diagram

- Heat exchanger in V arrangement
- Silent-running axial fans
- Highly efficient EC drive motors
- Hybaco® Wetting equipment
- Water trays
- Circulation pump [1 unit/dry cooler]
- Water level measurement
- Conductivity measurement
- Water filter system
- Fresh water and drain valves



## Components

### Heat exchanger

The central element of dry coolers must fulfil the highest requirements. High-quality materials are used so that the Hybaco® dry coolers are "saltwater-proof". Hydrophilic AlMg3 fins and tin-plated copper tubes achieve excellent corrosive resistance as well as the best heat transfer properties, which is what makes the high performance level possible in the first place.

Features at a glance:

- Fin material: AlMg3
- Pipe material: Cu tinned
- Frame material: V2A - AlMg3
- Connecting flanges
- Circuit: on request
- Design according to project-specific layout

### Pump

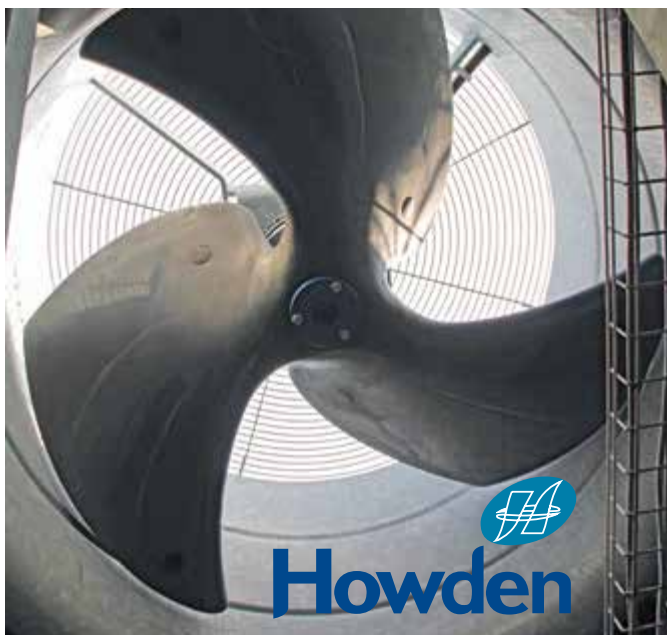
Hybaco® dry coolers work with just one circulation pump. The properties of the circulating water to be pumped are decisive for selecting the pump. Mountair uses chrome steel standard close-coupled pumps.

Features at a glance:

- 1 × pump / dry cooler
- Stainless steel standard close-coupled pump
- Flange connections
- FI operation

### Fans

The crucial element. Acoustic requirements that are often very high nowadays can only be achieved with the best ventilators. Mountair relies on continuity here and installs silent-running axial fans made of glass fibre reinforced plastic (GRP). These fans are designed for precisely such applications: high air volume, low pressure loss, outstanding insulation values and excellent efficiency. Our powerful partner – Howden.



Features at a glance:

- Silent-running axial fans
- Material: GRP
- Directly driven
- Speeds: between 300 and 500 rpm, depending on the design
- Outstanding insulation values
- High efficiency

### EC motors

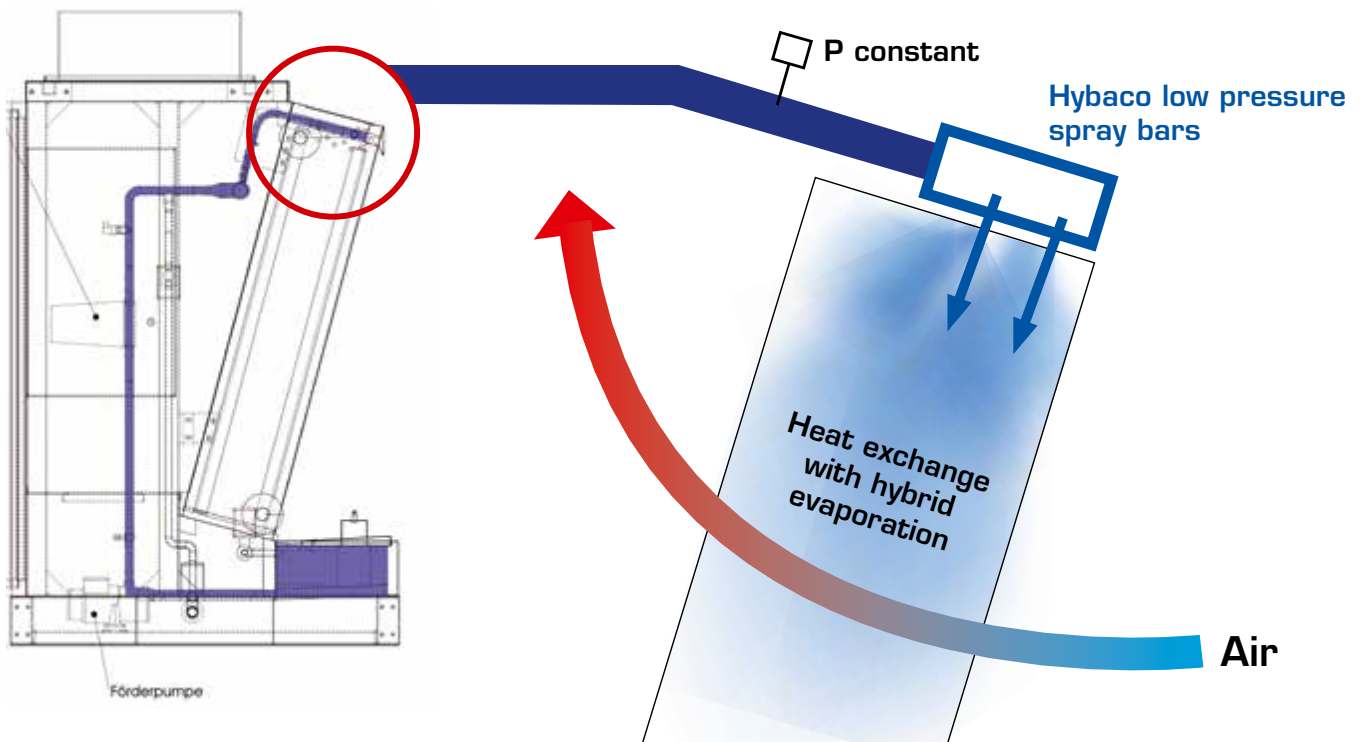
Mountair hybrid dry coolers are designed with the latest technology motors. Mountair fully relies on EC motors. They achieve a very high degree of efficiency (equivalent to class IE4). EC motors can also be used very efficiently, especially in the partial load range. In addition, they have a large adjustment range and can be operated variably between 5 % and 100 % without an external frequency inverter. Fans are flanged directly onto the motor shaft and do not require any additional drives (belts). The motor bearings are designed for a long service life and work for 100,000 operating hours.

Features at a glance:

- Latest EC technology
- Highly efficient (equivalent to class IE4)
- Drive power up to 6 kW
- No external frequency inverter required
- Simple 0-10 V signal



## Hybaco® Wetting equipment



The circulating water required for air humidification is fed onto the heat exchangers from above. The spray bars are operated with a constant overpressure so that the water is evenly applied to the fins and ensures uniform contact humidification.

The water runs down along the heat exchanger fins at right angles to the direction of the air. It is sucked inwards by the air flow. The operating parameters are set in such a way that there are no so-called flying droplets (vapour-free) and the water flows completely into the water trays arranged at the bottom. The trays are also used to store the circulating water and are monitored using ultrasonic sensors. The water is returned to the Hybaco® wetting bars via pipes, pump and water filter and from there it is fed back to the air-water heat exchanger.

To ensure trouble-free operation, the water quality and the water level are constantly monitored. If the quality no longer meets the specifications, sludge is removed and fresh water is added at the same time. This is also the case if the water level falls below the minimum water level due to evaporation.



## Regulation

Hybaco® dry coolers are equipped with their own regulation. All system parameters are monitored and the system is regulated according to specifications. The operating mode is adjusted depending on the outside temperatures, return flow temperatures or other external signals. Automatic regulation takes place in stages, first by increasing the air volume, then by switching on the humidification. Day and night programmes are programmed as standard. It is possible to implement remote maintenance. The regulation of the hybrid dry coolers is equipped with a BUS interface.

### Features

- Regulation: t.a.c Siemens S7, Beckhoff
- Autonomous control unit for each recooling system (master-slave)
- Standard version with potential-free contacts
- BUS interface for master-slave function and integration into the GLS

### Messages from outside (standard):

- Setpoint temperature cooler outlet (continuous)
- Approval for dry operation
- Approval for wet operation
- Water supply line is closed



### Messages to outside (standard):

- Operating message Regulation
- Pump operating message
- Collective alarm
- Status message Voltage On
- Water requirement
- Manual operation

## Accessories and options

Mountair Hybaco® dry coolers contain all the components required for operation. The systems can be operated without additional components. Moreover, there are various accessories and system expansion options. They are customised and are designed, constructed and built according to the customer's ideas.

These accessories and system expansion options can be, for example, the following additional options:

- Air sealing dampers
- Blinds/roller shutters
- UV disinfection systems
- Frost protection equipment for operation with 100 % water
- Disaster equipment
- Dosing systems
- Silencer for fans
- GLS integration via BUS interface



## Basis of the design

Various factors are crucial for the precise and customised design of hybrid dry coolers. The more detailed information is provided to the manufacturer, the better the initial designs and quotations can be prepared. The crucial design factors are listed below.

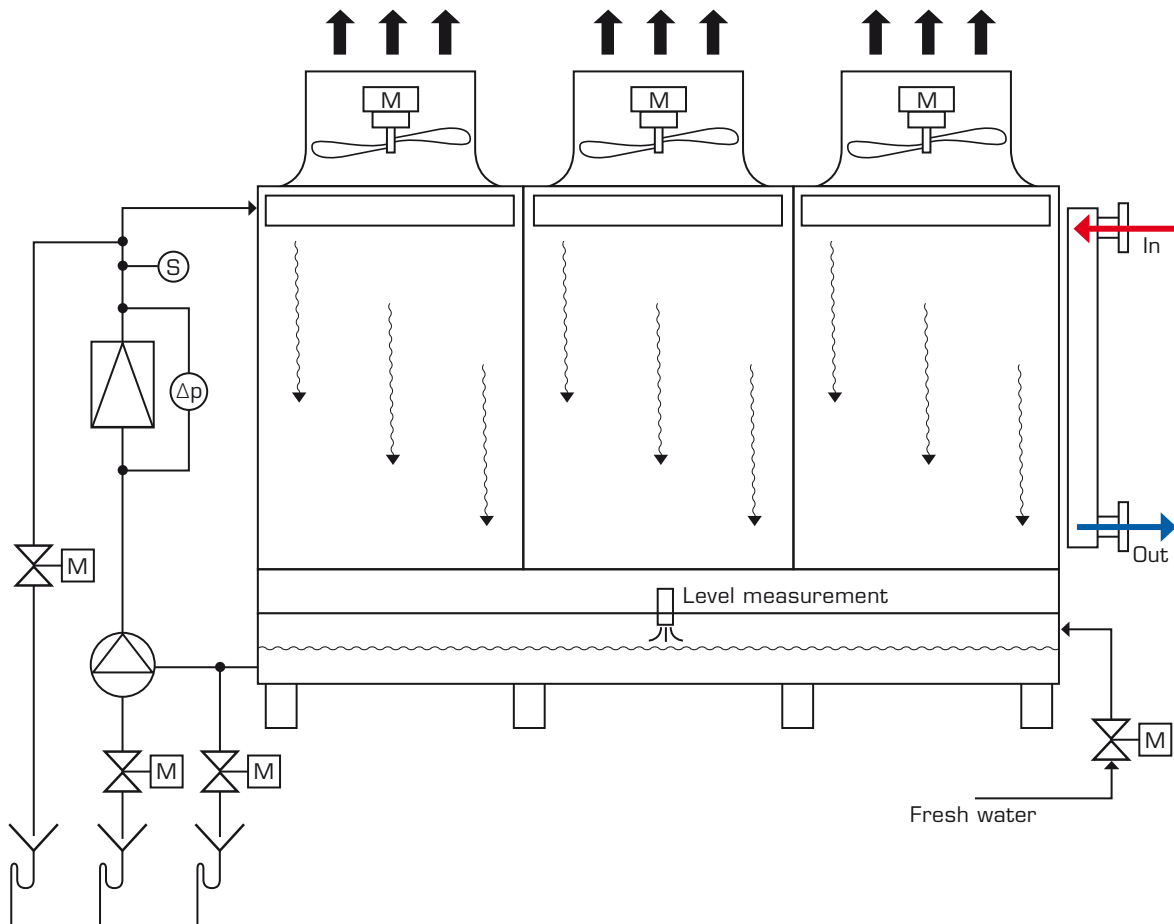
### Mandatory information required:

- Altitude above sea level
- Wet bulb temperature
- (Outside air conditions: temperature and humidity)
- Recooling capacity
- Feed/return temperatures
- Medium (glycol content)

### Other very important system parameters:

- Permissible sound power
- (sound pressure at a distance of 10 metres)
- Hydraulic pressure loss
- Required/maximum installation area
- Maximum system height
- System weight

The lower the wet bulb temperature, the more power can be dissipated with a dry cooler of the same design. The mean logarithmic temperature difference between the wet bulb temperature and feed/return temperature is decisive. The lower the feed/return temperatures are set, the higher the COP of the cooling unit. Larger dry coolers are therefore required to reach lower temperature levels, which generates higher investment costs but reduces operating costs over the entire service life of the system. This is an investment for the future.



## Technical specifications, design examples

Mountair Hybaco® dry coolers are available in the power range between 400 kW and 2.5 MW. The design and the components used achieve their best values in these performance parameters. Of course, the performance depends on the design principles described and may vary for the same system size.

For this reason, Mountair does not pursue the philosophy of offering standard dry coolers and manufacturing them according to a catalogue. **No, every Hybaco® that is made is designed, constructed and built specifically according to the customer's requirements.** Three design examples are therefore shown below.

### Hybaco® dry cooler HV2-60; GHZ Schlieren laboratory

#### Design

Location	Schlieren
Altitude above sea level	400 m
Outside air temperature	33 °C
Outside air humidity	37 % r.h.
Wet bulb temperature	21.6 °C

#### Data for each dry cooler

Medium	65 %	Water
	35 %	Propylene glycol
Medium temperatures Feed to the dry cooler		34 °C
Return flow from the dry cooler		29 °C
Cooling capacity		470 kW

#### Hydraulic

Medium flow rate	85.8 m <sup>3</sup> /h
Pressure loss	59 kPa
Flow velocity	1.34 m/s

#### Air flow rate

##### Hybrid operation

Air volume (90 %)	22.7 m <sup>3</sup> /s
Pressure loss	83 Pa
Air outflow temperature	28.14 °C
°C Air outflow humidity	85 %

##### Dry operation

Air volume (100 %)	27.3 m <sup>3</sup> /s
Pressure loss	82 Pa
Switchover point	15.7 °C
Air outflow temperature	30.6 °C

#### Wetting

Evaporation	0.85 m <sup>3</sup> /h
-------------	------------------------

#### Fully softened

Thickening (0 °fH)	¼ times
Blowdown volume	0.29 m <sup>3</sup> /h
Makeup water consumption	1.14 m <sup>3</sup> /h

#### Osmosis water

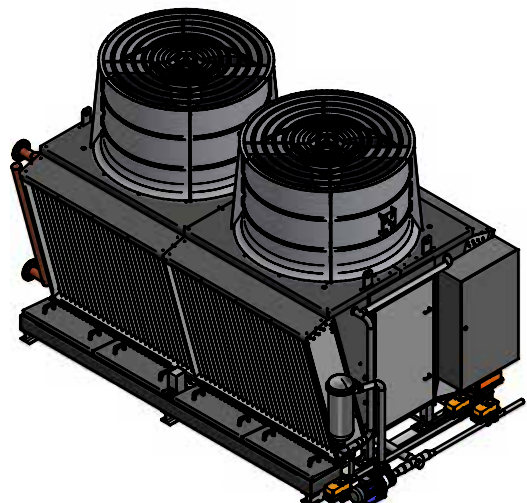
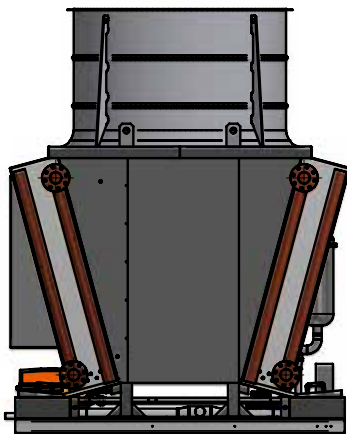
Thickening (20 micro-S)	1/10 times
Blowdown volume	0.10 m <sup>3</sup> /h
Makeup water consumption	0.95 m <sup>3</sup> /h

#### Free cooling

Medium	65 %	Water
	35 %	Propylene glycol

#### Air volume

Dry operation (100 %)	28.8 m <sup>3</sup> /s
Medium temperatures Feed to the dry cooler	17 °C
Return flow from the dry cooler	11 °C



**Heat exchanger**

Hydraulic circuit	6 channels
Heat exchanger circuits	1 circuit
Battery connections	4 units
Connecting flanges	DN 80 (3")
Operating/test pressure	PN6
Fin material	AlMg3
Material of tubes	Cu tinned
Frame material	1.4301
Fin thickness	0.2 mm
Fin partition	2.8 mm
Tube wall thickness	0.4 mm

**Fans**

Number of fans per dry cooler	2 units
Fan speed (100 %)	410 rpm
Shaft power (100 %)	1.9 kW

**Insulation values**

Single fan sound power level (100 %)	72.8 dB(A)
Dry cooler sound power level	75.8 dB(A)

**Frequency band (single fan)**

63 Hz	79.3	dB
125 Hz	73.7	dB
250 Hz	72.9	dB
500 Hz	70.7	dB
1000 Hz	68.2	dB
2000 Hz	63.7	dB
4000 Hz	57.7	dB
8000 Hz	49.9	dB

**Drive**

EC motor*	Directly driven
Stepless speed control	0-10 V (no FI required)
Rated power	4.2 kW
Rated current	6.8 A
Number of motors per dry cooler	2 units
Operating speed (100 %)	410 rpm
Power consumption (100 %)	2.1 kW
Voltage	400 V
Frequency	50 Hz
Protection class	IP 54

\*The EC motor has a factory-set nominal speed of 550 rpm, which is limited to the "100 % speed" by the software and on a project-specific basis.

**Pump**

Number of wetting pumps	1 Stück
Rated power of a wetting pump	2.2 kW

**Dimensions**

Length over support beam	3840 mm
Overall length	4600 mm
Width over support beam	2400 mm
Height (excl. structure-borne sound insul. panels)	3070 mm
<i>Dimensional tolerance ± 20 mm</i>	

**Weight**

Tare weight	3150 kg
Medium filling heat exchanger	470 kg
Filling wetting water max.	500 kg
Operating weight max.	4120 kg
<i>Weight tolerance ± 200 kg</i>	

Massflow (m³/h)	dP_Medium (kPa)	17 - 11		Freecooling (=Trodden)	100'000 m³/h
71.6	50	470	kW	-2.9	°C
60.9	38	400	kW	-0.9	°C
53.3	30	350	kW	0.4	°C
45.7	23	300	kW	1.6	°C
38.1	16.8	250	kW	2.3	°C
30.5	11.5	200	kW	2.5	°C
22.85	7.2	150	kW	4.9	°C
15.2	4.6	100	kW	7.3	°C

## Hybaco® Dry cooler HV3-60; KSA Aarau

### Design

Location	Aarau
Altitude above sea level	400 m
Outside temperature	37.0 °C
Outside humidity	34.0 %r.F.
Wet bulb temperature	23.7 °C
Medium	70 % water 30 % Glyco

### Data for each dry cooler

Cooling capacity normal operation	790 kW
Emergency operation* (feed/return = 35.5/29.5)	830 kW
kW Medium temperatures, Feed to the dry cooler	35 °C
Return flow from the dry cooler	29 °C

### Hydraulic

Medium volume flow	120.9 m <sup>3</sup> /h
Pressure loss	32 kPa

### Air flow rate

#### Hybrid operation

Air volume (100 %)	43.8 m <sup>3</sup> /s
Pressure loss in the system	95 Pa
Air outflow temperature	28.9 °C
Air outflow humidity	89 %

#### Dry operation

Air volume (100 %)	47.5 m <sup>3</sup> /s
Pressure loss	75 Pa
Switching point	17.4 °C
Air outflow temperature	31.7 °C

### Wetting

Evaporation	1.71 m <sup>3</sup> /h
-------------	------------------------

### Fully softened

Thickening (0°fH)	¼ times
Blowdown volume	0.57 m <sup>3</sup> /h
Total water consumption	2.28 m <sup>3</sup> /h

### Osmosis water

Thickening (20 micro-S)	¼ <sub>10</sub> times
Blowdown volume	0.19 m <sup>3</sup> /h
Total water consumption	1.90 m <sup>3</sup> /h

### Free cooling

#### Dry operation (100 %)

Medium temperatures, Feed to the dry cooler	19 °C	48.0 m <sup>3</sup> /s
Return flow from the dry cooler	13 °C	
Outside temperature	0 °C	
Power	840 kW	
Medium volume flow	128.8 m <sup>3</sup> /h	
Pressure loss	40 kPa	

Outside temperature	2 °C
Power	730 kW
Medium volume flow	112.0 m <sup>3</sup> /h
Pressure loss	31 kPa

Aussentemperatur	4 °C
Power	620 kW
Medium volume flow	95.1 m <sup>3</sup> /h
Pressure loss	23 kPa

Outside temperature	6 °C
Power	500 kW
Medium volume flow	76.7 m <sup>3</sup> /h
Pressure loss	16 kPa

Outside temperature	8 °C
Power	365 kW
Medium volume flow	56.0 m <sup>3</sup> /h
Pressure loss	9 kPa

Outside temperature	10 °C
Power	150 kW
Medium volume flow	23.0 m <sup>3</sup> /h
Pressure loss	2 kPa

#### Hybrid operation (100 %)

Medium temperatures, Feed to the dry cooler	19 °C	46.4 m <sup>3</sup> /s
Return flow from the dry cooler	13 °C	

Outside temperature	10 °C
Outside humidity	65 % r.F.
Power	640 kW
Medium volume flow	98.2 m <sup>3</sup> /h

Outside temperature	11 °C
Outside humidity	60 % r.F.
Power	600 kW
Medium volume flow	92.0 m <sup>3</sup> /h

**Fans**

Number of fans per dry cooler	3 units
Fan speed (100 %)	432 rpm
Shaft power (100 %)	2.4 kW
<hr/>	
Sound power level of a single fan (100 %)	73.8 dB(A)
Sound power level of a dry cooler (100 %)	78.5 dB(A)

**Frequency band**

**Single fan (100 %)**

63 Hz	80.1	dB
125 Hz	74.6	dB
250 Hz	73.8	dB
500 Hz	71.6	dB
1000 Hz	69.0	dB
2000 Hz	64.5	dB
4000 Hz	58.2	dB
8000 Hz	50.3	dB

**Optional fitting**

**Inline silencer**

Type	CLR, NW 1540
Total height	500 mm (net)

**Silencer**

Insertion attenuation	
63 Hz	2.0 dB
125 Hz	2.5 dB
250 Hz	5.5 dB
500 Hz	10.5 dB
1000 Hz	11.0 dB
2000 Hz	7.5 dB
4000 Hz	5.5 dB
8000 Hz	4.0 dB

**Drive**

EC motor	Direct drive
Stepless speed control	0-10 V (no FI required)
Rated power	4.2 kW
Rated current	6.8 A
Number of motors per dry cooler	3 units
Operating speed (100 %)	432 rpm
Power consumption (100 %)	2.8 kW

**Heat exchanger**

Hydraulic circuit	4 channels
Heat exchanger circuits	1 circuit
Battery connections	4 units
Connecting flanges	DN 100 / PN16
Operating/test pressure	PN6
<hr/>	
Fin material	AlMg3
Tube material	Cu tinned
Frame material	stainless steel 1.4301
Fin thickness	0.2 mm
Fin partition	2.8 mm
Tube wall thickness	0.4 mm

**Pump**

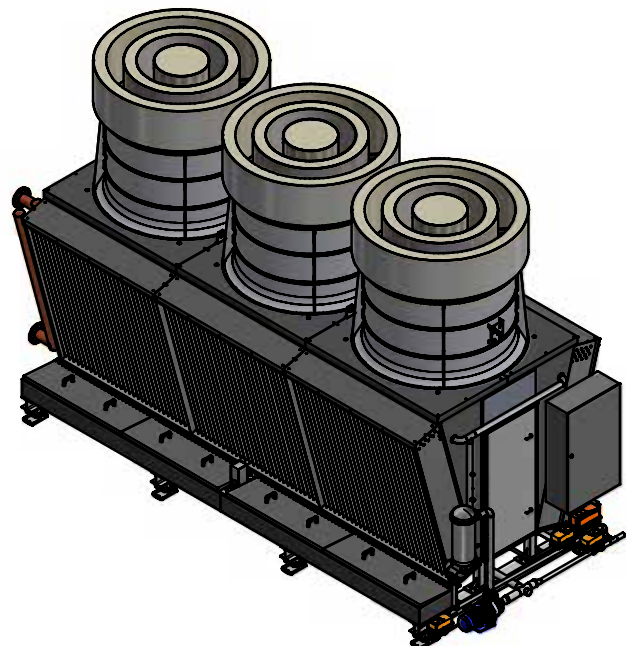
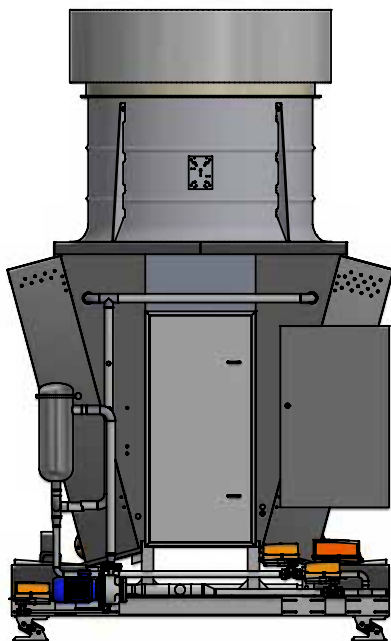
Number of wetting pumps	1 Stück
Power	2.2 kW

**Dimensions**

Length over support beam	5720 mm
Width over support beam	2600 mm
mm Height (excl. structure-borne sound insulation panels)	3600 mm

**Weight**

Tar weight	5100 kg
Medium filling heat exchanger	900 kg
Circulation of wetting water approx.	800 kg
Operating weight	6800 kg
Operating weight with 3 x silencers	7500 kg



## Hybaco® dry coolers HV4-60; Ivoclar Vivadent, Schaan

### Design

Location	Schaan
Altitude above sea level	450 m
Medium	70 % Water 30 % Glycol

### Machine operation

Outside temperature	35.0 °C
Outside humidity	35.0 % r.F.
Wet bulb temperature	22.5 °C

Power	1000 kW
-------	---------

Medium temperatures, Feed to the dry cooler	33 °C
Return flow from the dry cooler	27 °C

### Hydraulic

Medium volume flow	153.1 m <sup>3</sup> /h
Pressure loss	45 kPa
Flow velocity	1.06 m/s

### Air flow rate

#### Hybrid operation

Air volume (90 %)	64.0 m <sup>3</sup> /s
Pressure loss	70 Pa
Air outflow temperature	28.04 °C
Air outflow humidity	84 %

#### Dry operation

Air volume (100 %)	74.5 m <sup>3</sup> /s
Pressure loss	67 Pa
Switchover point	18.48 °C
Air outflow temperature	30.05 °C

### Wetting

Evaporation	2.15 m <sup>3</sup> /h
Thickening (fully softened)	1/3 fach
times Blowdown volume	0.54 m <sup>3</sup> /h
Makeup water consumption	2.7 m <sup>3</sup> /h

### Free cooling

Outside temperature	18.0 °C
Outside humidity	29.0 % r.F.
Wet bulb temperature	9.0 °C

Power	800 kW
-------	--------

Medium temperatures, Feed to the dry cooler	19 °C
Return flow from the dry cooler	13 °C

### Hydraulic

Medium volume flow	122.7 m <sup>3</sup> /h
Pressure loss	34 kPa
Flow velocity	0.85 m/s

### Free cooling

#### Hybrid operation

Air volume (97 %)	71.0 m <sup>3</sup> /s
Pressure loss	72 Pa
Air outflow temperature	14.1 °C
Air outflow humidity	89 %

#### Dry operation

Air volume (100 %)	75.1 m <sup>3</sup> /s
Pressure loss	63 Pa
Switchover point	6.36 °C
Air outflow temperature	15.65 °C

### Wetting Free cooling

Evaporation	1.59 m <sup>3</sup> /h
Thickening (fully softened)	1/3 times
Blowdown volume	0.4 m <sup>3</sup> /h
Makeup water consumption	1.99 m <sup>3</sup> /h

### Heat exchanger

Hydraulic circuit	4-flutig
Heat exchanger circuits	1 circuit
Battery connections	4 units
Connecting flanges	DN 125

Fin material	AlMg3
Tube material	Cu verzinkt
Frame material	inox 1.4301
Fin thickness	0.2 mm
Fin partition	2.8 mm
Tube wall thickness	0.4 mm

### Fans

Number of fans per dry cooler	4 units
Fan speed (100 %)	480 rpm
Shaft power (100 %)	3.1 kW

### Insulation values

Single fan sound power level (100 %)	75.2 dB(A)
Dry cooler sound power level	81.2 dB(A)

### Frequency band

#### Single fan

63 Hz	81.6 dB
125 Hz	76.0 dB
250 Hz	75.2 dB
500 Hz	73.1 dB
1000 Hz	70.5 dB
2000 Hz	66.0 dB
4000 Hz	59.7 dB
8000 Hz	51.8 dB

**Drive**

EC motor	Directly driven
Stepless speed control	0-10 V (no FI required)
Rated power	4.2 kW
Rated current	6.8 A
Number of motors per dry cooler	4 units
Operating speed (100 %)	480 rpm
Power consumption (100 %)	3.7 kW
Voltage	400 V
Frequency	50 Hz
Protection class	IP 54

**Pump**

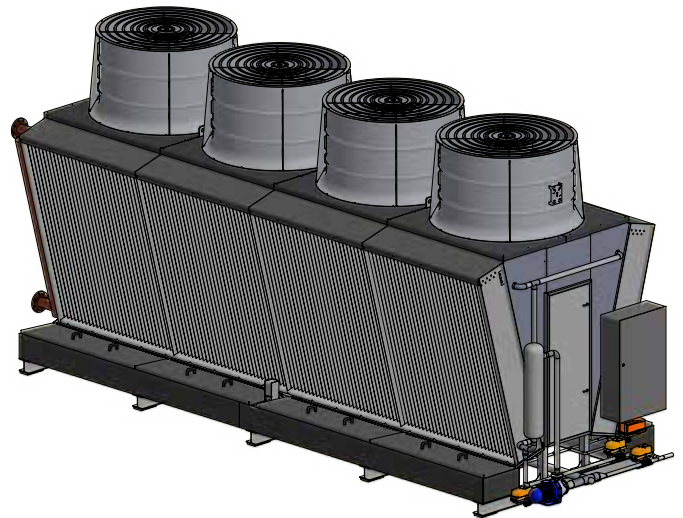
Number of wetting pumps	1 Stück
Rated wetting pump power	2.2 kW

**Dimensions**

Length over support beam	7600 mm
Length over connecting flanges	7920 mm
Width over support beam	2800 mm
Height (excl. structure-borne sound insulation panels)	4080 mm
<i>Dimensional tolerance +/- 20 mm</i>	

**Weight**

Tare weight	7500 kg
Medium filling heat exchanger	1500 kg
Filling Wetting water max.	1800 kg
Max. operating weight	10'800 kg
<i>Weight tolerance +/- 200 kg</i>	





## Transport, unloading, assembly and commissioning

The dry coolers are transported according to their height. In some cases, it is necessary to dismantle the axial fans and reassemble them on site, because otherwise the maximum transport height for motorways is exceeded. The fans are disassembled and assembled before loading and directly upon unloading on the construction site.

The complete Hybaco® dry coolers are lifted to their destination in one piece and set up according to the planner's specifications. Readjustments and final assembly must be carried out after final installation of the systems.

The systems must be levelled at their final installation location before any further work is carried out by other departments around the dry coolers.

Once the systems have been connected on site and supplied with power, the final commissioning is carried out. All functions are tested and the definitive water level for the circulating water circuit is set and recorded.



## Tender text

The medium is re-cooled in a closed circuit in finned heat exchangers. Post-evaporation on the outer surface lowers the relevant air temperature and increases heat transfer to the air. The escaping air is vapour-free and transports the heat subtly and latently to the surroundings. Automatic regulation takes place in stages, first by increasing the air volume, then by switching on the humidification.

### Design: Hybaco® V-shape dry cooler

Hybrid dry coolers of V design are suitable for outdoor installations. Thanks to their compact design, large capacities can be dissipated on a small installation surface. The free air inflow and the free upward air discharge minimise installation costs. The systems are built in one piece, delivered and installed on site. Hybaco® V-shape dry coolers are equipped with the patented Hybaco® wetting system, which applies the water required for air humidification directly to the heat exchanger fins, resulting in uniform wetting.

#### Supporting structure

Re-cooling modules consisting of welded steel frame/beam constructions. Load-bearing components are completely hot-dip galvanised.

### Inspection aisle

A lockable inspection door with integrated door circuit breaker (door contact) allows access to the interior of the dry cooler. The walk-on floor is made of aluminium chequer plates. This ensures controlled drainage of accumulating (rain) water and safe accessibility in damp/wet conditions. The Mountair Hybaco® wetting equipment can be accessed through this inspection aisle. The spray bars used for wetting can be removed from the inside, cleaned and replaced if necessary.

For all maintenance and repair work, an override switch is fitted next to the inspection door for each fan.

#### Panelling

The covers fitted for the airtight casing of the dry coolers are corrosion-resistant. They can be powder-coated in the desired RAL colour.

### Water trays

The circulating water required for heat exchanger wetting (air humidification) is collected in two trays (one tray per heat exchanger). These trays are immediately used for storage (tank) and are designed in the appropriate size. The circulating water is fed to the Hybaco® wetting equipment via pipes, pump and water filter and flows back into the water trays after the wetting process.

The trays and associated system components are made of stainless steel and pickled in an immersion bath.

The protective grille for the trays is designed as a perforated plate. This serves to protect against contamination.

The protective grille can be removed.

### Pipelines

Complete dry cooler-internal pipework with connections for draining and fresh water.

Drainage, blowdown and fresh water pipes are made of stainless steel and pickled in an immersion bath. Cleaning nozzles for dirt removal are integrated into the pipework system.

### Water filter

Hybaco® dry coolers are equipped with a water filter unit. Accumulating dirt is filtered out continuously. The filter bags or cartridges can be replaced depending on how dirty they are (dp) or periodically.

### Wetting

Hybrid dry coolers from Mountair are equipped with the patented Hybaco® wetting system. The system works with a constant overpressure. Perfect sprinkling of the finned heat exchangers is guaranteed.

The Hybaco® wetting spray bars are geometrically arranged in such a way that the heat exchanger fins are evenly wetted.

### Heat exchanger

The finned heat exchangers are equipped with AlMg3 fins and tinned copper pipes. Frame components of the finned heat exchangers are made of stainless steel (or AlMg3). The finned heat exchangers are therefore "saltwater-proof" and fulfil both corrosive and electrochemical requirements.

### Fans

Hybaco® dry coolers are equipped with silent-running axial fans made of glass fibre reinforced plastic (GRP). Thanks to an optimised blade shape and the low weight of the fans, low noise levels are achieved and the energy consumption is very low.

### Motors

The axial fans are driven by directly flanged EC motors. EC motors achieve efficiency values equivalent to class IE4 and can also be operated with very good efficiency levels, especially in the partial load range.

Speeds can be reached and operated variably without external frequency inverters.

### Pump

Standardised close-coupled pumps according to EN 733 made of stainless steel with PTC thermistor protection are used. The pump can be adjusted variably using a frequency inverter.

### **Control valves**

The fresh water requirement as well as the blowdown and emptying of the system is regulated via motorised 2-way ball valves.

The fresh water valve is equipped with a spring return function so that the fresh water supply is stopped in the event of a power failure.

All ball valves are equipped with a protective housing and obtain the protection class IP 66.

### **Water level**

The water level in the two trays is measured using ultrasonic sensors. Six levels can be programmed (tray empty, dry run protection, lower, upper working level, overflow, tray full).

The measuring device is designed to be protected from UV radiation (measuring errors) and environmental influences (waves caused by wind).

### **Water quality**

The circulating water quality is measured after the filter unit and before the wetting system using a conductivity probe. If the water quality exceeds a limit value, the blowdown valve is opened and fresh water is added.

### **Control cabinet**

Mountair Hybaco® dry coolers are equipped with a control cabinet. This control cabinet is mounted on the dry cooler and contains all the parts required for autonomous regulation. Control cabinets are equipped with heating, ventilation and lighting. Colour RAL 7032, protection class IP65. Design in accordance with the Low Voltage Installation Ordinance (NIV).

### **Regulation**

Control components are integrated in the control cabinet. Messages from/to external devices are exchanged via potential-free contacts.

A BUS interface for integrating the dry coolers into the building management system is available as hardware.

### **Wiring**

Electrical components (e.g. fan, pump, valves) are wired to the control cabinet in a CE-compliant manner and are ready for operation.

### **Commissioning**

The re-cooling systems are commissioned at the factory. Adjustment and parameter setting is done on site as soon as the system is connected to the re-cooling/refrigeration network and is electrically connected. Water levels and switching times are adjusted and set on site.

### **Transport**

The re-cooling systems are transported in one piece. If this is not possible for various reasons (height, width), the fans may have to be dismantled for transport and then reassembled and reconnected on site.

### **Assembly**

The systems are mounted using a mobile crane or building crane. The dry coolers are levelled at the installation site. Vibration-reducing plates (e.g. Mafund plates) are used for structure-borne sound-absorbing installation.

## Water quality – make-up and circulating water

Mountair Hybaco® dry coolers can be operated with different quality of water. Rainwater, fully demineralised water - treated by reverse osmosis - or fully softened water can be used for wetting hybrid dry coolers. Each type of water supply has its advantages.

### General requirements

PH value: 6.0 – 7.5  
 Clear and colourless  
 Without sediment and odourless

Raw water in Switzerland has a hardness of 15 - 20 °fH (urban regions such as the centre of Zurich and regions bordering the lake such as Kreuzlingen), 25 - 30 °fH (agglomerations such as Schlieren) and 35 °fH (Swiss Plateau).

The water hardness in the Jura is extreme at up to 45 °fH.

	Water hardness	Conductance value
At lakeside, City	15.0 °fH / 8.0 °dH	± 300 µs/cm
Agglomerations	25.0 °fH / 14.0 °dH	± 500 µs/cm
Plateau	35.0 °fH / 19.0 °dH	± 700 µs/cm
Jura	45.0 °fH / 25.0 °dH	± 900 µs/cm

**Rainwater** has the great advantage of being available for free. It is similar to demineralised water and a similar thickening can be expected (5-10 times). The disadvantage is that a large collection tank is required to provide sufficient water. In the event of acid rain (pH value < 5.5), care must be taken to ensure that the total pH value of the water collected in the tank stabilises at a value > 6.0 (mixture with raw water).

Hardness	< 3.0 °fH / < 2.0 °dH
Chlorides	< 10 mg/l
Sulphate	< 20 mg/l
Conductance value	< 30 µs/cm

**Demineralised water (reverse osmosis)** has the great advantage of low thickening/low sludging (10-12 times). The cleaning effort is reduced and the cleanliness of the heat exchanger fins is increased. Demineralised water is largely free of salts and other organic substances. On the other hand, providing demineralised water results in increased costs.

Hardness	0.0 °fH / 0.0 °dH
Chlorides	< 2 mg/l
Sulphate	< 3 mg/l
Conductance value	< 30 µs/cm

**Fully softened water** is cheaper to provide. The total salt content and the conductivity of softened water correspond to those of raw water. Calcium and magnesium ions are substituted during water softening. This reduces calcification (deposition of calcium carbonate). Lower thickening/sludging must be expected (3-4 times).

Hardness	0.0 °fH / 0.0 °dH
Chlorides	< 20 mg/l
Sulphate	< 50 mg/l
Conductance value	By region 300 – 700 µs/cm

**The limit values for the circulating water** are set according to the quality of the fresh water. The following limit values must not be exceeded.

	Rain water/ Demineralised	water Fully softened
Hardness	< 7.5 °fH / < 4.0 °dH	< 7.5 °fH / < 4.0 °dH
Chlorides	< 20 mg/l	< 60 mg/l
Sulphate	< 30 mg/l	< 150 mg/l
Conductance value	< 400 µs/cm	< 1800 µs/cm

**Example of softened water:** Münsterlingen site (Münsterlingen Cantonal Hospital facilities). Water hardness approx. 16 °fH. This corresponds approximately to a conductance value of 300-350 µs/cm. If this raw water is now softened, we obtain fresh water (for wetting the hybrid dry cooler) of 0 °fH and an unchanged conductance value of 300-350 µs/cm. If a thickening of 3 is assumed, the blowdown conductance is set at around 1000 µs/cm. This procedure can also be applied to other locations.

### Additional information on water quality

Mountair Hybaco® dry coolers are equipped with water filters by default to filter out dirt and other growth-promoting impurities. Water trays are fitted with protective covers to protect them from dirt (ingress) and UV radiation from the sun (germ growth).

Additional dosing agents (Varidos, Nalco Stabrex, Genodos, etc.) can be used to combat biological microbial growth. The necessity for this should be checked according to the situation. Mountair Hybaco® dry coolers can be operated reliably without additional chemical dosing agents.

There are alternative, chemical-free options for disinfection. UV sterilisation systems, for example, can be implemented both in the water trays and in the piping system.

## References



2023

### Aarau Cantonal Hospital

- Hybrid dry cooler with 1310 kW re-cooling capacity (38/29 °C)



2023

### Sigma House (Hotel Savoy)

- Hybrid dry cooler with 1310 kW re-cooling capacity (38/29 °C)



2023

### Laboratory Südstrasse, Schlieren

- Hybrid dry cooler with 1310 kW re-cooling capacity (38/29 °C)



2021

### ZHAW, Wädenswil

- Hybrid dry cooler with 1310 kW re-cooling capacity (38/29 °C)



2021

### Morgines, Geneve

- 2 hybrid dry coolers with an output of 600 kW each
- "half V-shape"
- Suction on one side (facade) and blowing out upwards
- Complete with regulation, touch panel



2021

### Ivoclar Vivadent, Schaan

- Machine operation: 2 × 1000 kW, free cooling operation: 2 × 800 kW Expansion with 4th cooling unit
- Consisting of 1 x hybrid dry cooler (800/1000 kW), 1 × hydraulic master module and 1 × HFO cooling machine (800 kW)
- Incl. complete cooling control (Beckhoff)



2020

**CUORE, Blaufahnenstrasse**

- 2 units of monobloc drycooler
- System 1: 22,000 m<sup>3</sup>/h, 250 kW recooling capacity, Humidos low-pressure humidifier 337 kg/h
- System 2: 3400 m<sup>3</sup>/h, 36 kW recooling capacity, Humidos low-pressure humidifier 49 kg/h



2020

**WWZ Choller, data centre, Zug**

- Ventilation - monoblocks with run-around coil system. Plate heat exchanger, rotary heat exchanger, humidifier
- Data centre - Cooling wall modules



2019

**Hilti, new office building, Schaan**

- 2 × supply air-exhaust air
- 2 × exhaust air humidification 87,500 m<sup>3</sup>/h
- 1 × supply air humidification 8300 m<sup>3</sup>/h
- 2 × pumping station 50 - 1000 kg/h



2019

**Grabs Hospital, Grabs St. Gallen**

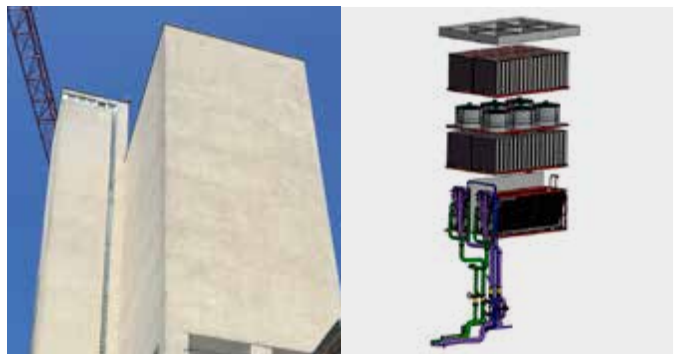
- 2 systems with Q = 880 kW each



2019

**Sterile Processing Department (SPD) for devices used in medical procedures, Schlieren**

- Dry cooler, V-shape, 870 kW



2019

**ETH, ML - Hybrid cooling tower, Zurich**

- Hybrid recooling tower with an output of 2 x 2280 kW each
- 2 × around 370,000 m<sup>3</sup>/h air flow rate



2018

**Artificial ice rink, Sissach**

- V-shape, Q = 660 kW 34/28 °C at Tf = 18 °C



2018

**SBB construction site D, Zurich**

- 1 × V-shape with Q = 1400 kW



2018

**University Plattenstrasse**

- 1 × T2 roof unit with Hybaco, Q = 200 kW
- Air volume supply air = exhaust air = 17,000 m³/h
- Heat recovery pump station, 5.4 m³/h with plate heat exchanger heating and cooling



2017

**FHNW, Muttenz**

- 2 × 1490 kW
- Interconnected system with a total of 31 ventilation units
- Total air volume around 340,000 m³/h
- Hydraulic station 118 m²/h with redundancy pump
- Master-slave with heat recovery controller, 3 floor boxes, 31 field boxes



2017

**Sika, Limmat**

- 1 × 610 kW



2017

**Bethanien Hospital, Zurich**

- Special version T2 hybrid dry cooler
- 1 × 460 kW



2016

**Commercial building on Schiffbauplatz, Zurich**

- 2 × 580 kW



2016

**Maison Davidoff, Basel**

- 2 × 175 kW



2016

**Biozentrum University department, Basel**

- 2 × 3000 kW



2015

**Fontana Cantonal Hospital, Chur**

- Conversion - T2 dry cooler in the building
- 1 × 380 kW



2015

**Omega AG, Biel**

- Dry cooler, H-design, V = 90,000 m<sup>3</sup>/h, Q = 800 kW
- 2 × Supply air monobloc production with 21,000 m<sup>3</sup>/h
- 2 × pumping station (10 - 300 kg/h)



2015

**Hilti IC (Innovation Centre), Schaan**

- 1 × 2400 kW





2015

**CSS Insurance Agency, Lucerne**

- 1 × monobloc with 50,000 m<sup>3</sup>/h and up to 600 kg/h humidification
- 1 × pumping station (30 - 600 kg/h)



2014

**Quickline data centre, Münchenstein**

- Machine operation: 3 × 750 kW
- Free cooling mode: 3 × 620 kW



2014

**Cantonal Hospital Thurgau, Münsterlingen**

- 2 × 1200 kW



2014

**ewz Zurich, Cooling - Wagi 15, Zurich**

- 2 × 1550 kW
- 1 × 1550 kW (extension)



2014

**Hotel Säntispark, Abtwil**

- Special T2 architecture
- Hybrid dry cooler 520 kW



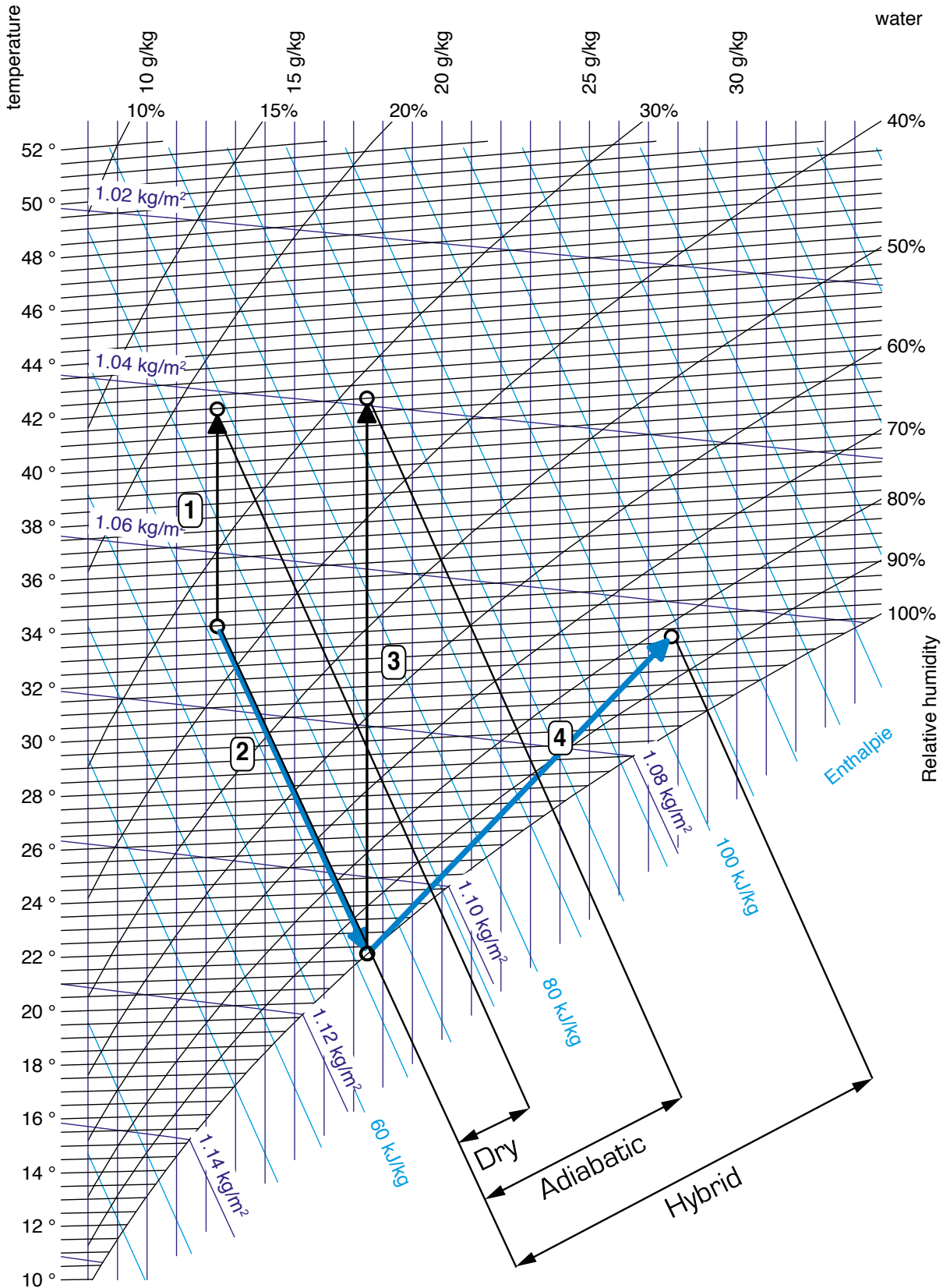
2004

**Roche Kaiseraugst, Kaiseraugst**

- 1st stage: 3 × 2200 kW
- 2nd stage: 3 × 2200 kW
- 6 × pumping station (10 - 300 kg/h)
- 11 × ventilation units with high-pressure atomiser Humidos
- 10 × adiabatic exhaust air humidification
- 1 × Supply air humidifier

# Mollier h-x diagram

Mollier-h-x diagram for damp air / pressure 0.960 bar (450.000 m / 10.000 °C / 80.000 % r. F.)



- 1 Dry recooling
- 2 Adiabatic cooling of the air on the wet bulb temperature
- 3 Dry recooling after adiabatic humidification
- 4 Hybrid recooling

# Request for quotation

Mountair HYBACO® Hybrid Recooler	Date
Company	Deadline
Contact person	
E-mail	Telephone

## Project name

Project address
-----------------

## TECHNICAL DATA

Height above sea level	m a.s.l.	Accessories	<input type="checkbox"/> Transport
Capacity per HYBACO®	kW		<input type="checkbox"/> Unloading
Number of plants			<input type="checkbox"/> Installation
Recooling medium	% [glycol concentration]		<input type="checkbox"/> Mobile crane: give height at which to be installed and layout
Recooling medium	<input type="checkbox"/> Ethylene glycol <input type="checkbox"/> Propylene glycol		
Recooling temperature	Flow °C Return °C		
Sound power per HYBACO®	dB(A)	Plant options	<input type="checkbox"/> Air partitioning dampers
Sound pressure level at 10 m distance	dB(A)		<input type="checkbox"/> Roller shutters
Hydraulic pressure loss	kPa		<input type="checkbox"/> UV disinfection
Operating/test pressure	bar		<input type="checkbox"/> Dosing stati
Installation area max.	Length mm Width mm		
Plant height maximum	Height mm		
Wetting water	<input type="checkbox"/> softened (0° fH) <input type="checkbox"/> desalinated		

AIR CONDITIONS	SUMMER/PEAK LOAD	2nd OPERATION/FREECOOLING
Outside air: temperature	°C	
Outside air: relative humidity	%	
Wet bulb temperature	°C	
Dry switchover point	°C	



**Mountair AG**  
**Lufotechnischer Apparatebau**  
Sonnenwiesenstrasse 11  
8280 Kreuzlingen

T +41 71 686 64 64  
F +41 71 686 64 76

**Mountair AG, Basel**  
Florenzstrasse 9  
4142 Münchenstein

T +41 61 841 09 74  
F +41 61 841 09 75

**Mountair AG, Suisse Romande**  
Route de Saint Julien, 275  
1258 Perly

T +41 22 771 58 36

[info@mountair.com](mailto:info@mountair.com)  
[www.mountair.com](http://www.mountair.com)

