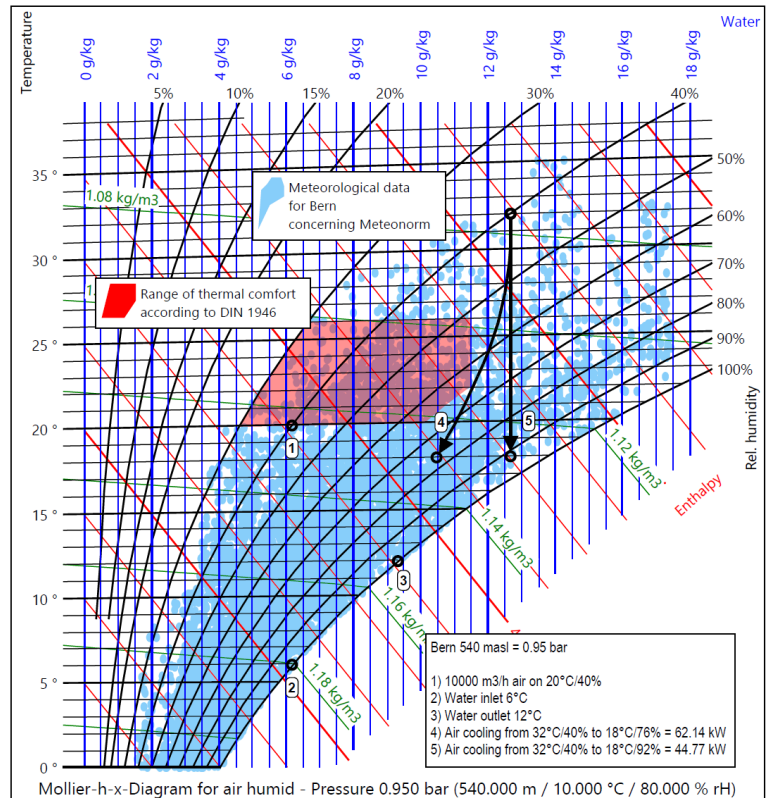




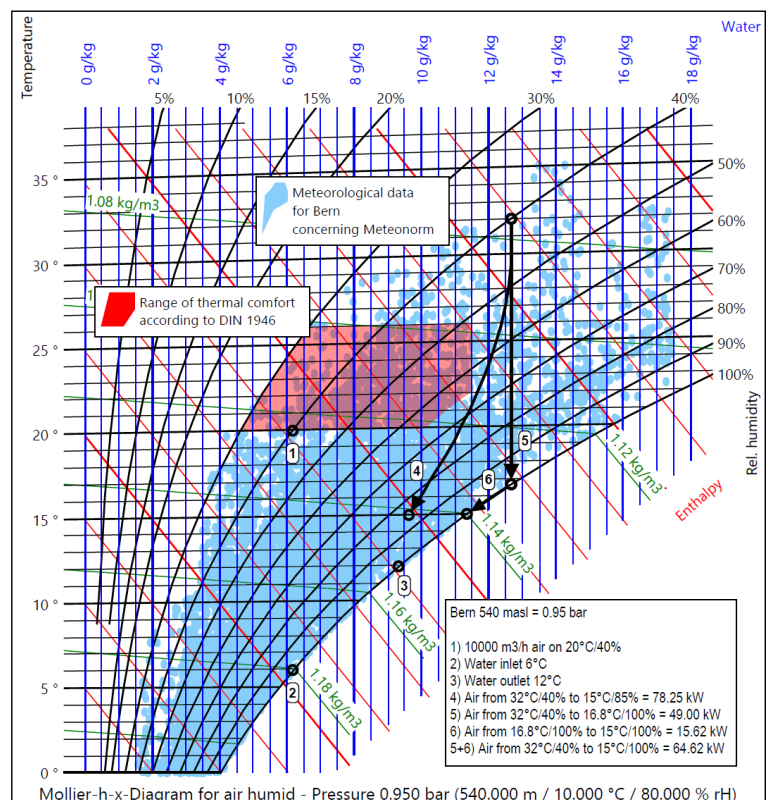
# Cooling of humid air

Why the so-called experts disagree about how the cooling curve must be calculated correctly and displayed in the Mollier-HX-Chart is an irrefutable fact, proven by countless offers from various manufacturers of fin coil heat exchangers. But it would be so easy to get to the bottom of the truth: Neutral measurements at TUEV Süd in Munich, with the aim of obtaining the type examination. What nonsense is offered can be seen below with two examples.

The nonsense starts with the fact, that 95% of the calculations are at sea level, although the location is known. The nonsense continues with the fact, that 95% of the air volume flow at the entrance or exit or God knows where is assumed, just not at 20°C/40%, as recommended in air conditioning technology (process 1). The nonsense continues with the fact, that certain incorrigible ignoramuses claim, that the cooling curve would run vertically downwards in the Mollier-HX-Chart and thus the capacity would only be 44.77 kW. Accordingly, a much too small fin coil heat exchanger is offered, which is of course also very cheap (process 5). The inlet and outlet of the cooling water (processes 2 and 3) are mapped on the relative humidity curve of 100%. We calculate the cooling curve in 15 sub-steps with regard to air direction in the counterflow (process 4), which results in a capacity of 62.14 kW. The capacity is higher by a factor of 1,388, which also applies to the price of the cooler = Quod erat demonstrandum.



And what does it look like, if cooling is required below the dew point? Then the nonsense continues with the fact, that certain incorrigible ignoramuses claim, that the cooling curve in the Mollier-HX-Chart would first go vertically down to the dew point (process 5) and then run on the curve of 100% relative humidity (process 6) and would thus result in a capacity of only 64.62 kW. Accordingly, a much too small fin coil heat exchanger is offered, which is of course also very cheap (processes 5 & 6). The inlet and outlet of the cooling water (processes 2 and 3) are mapped on the relative humidity curve of 100%. We calculate the cooling curve in 15 sub-steps with regard to air direction in the counterflow (process 4), which results in a capacity of 78.25 kW. The capacity is higher by a factor of 1,211, which also applies to the price of the cooler = Quod erat demonstrandum. What do you say in conclusion? Faith is good, control is better, neutral measurements at TUEV Süd in Munich are best.



**Cooler: 40/35/15-4R-28T-1195A-3.5PA-14C-Cu/Al/AISI304**

Capacity sensible	kW	44.578
Capacity latent	kW	18.786
Capacity frost	kW	0.000
Capacity total	kW	63.364
Surface reserve	%	3.823
Present surface	m <sup>2</sup>	98.932
Required surface	m <sup>2</sup>	95.289
k-coeff.	W/m <sup>2</sup> K	45.670
Average temp. diff. (92.97 %)	K	14.560

Company  
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Fax: xxxxxxxxxx  
E-Mail  
Homepage

Air humid		Inlet	Outlet	Definition
Fouling outside	m <sup>2</sup> K/W			5.000E-05
Height over sea level	m			540.000
Pressure	mbar			949.653
Temp.	°C	32.000	18.000	20.000
Rel. humidity	%	40.000	75.105	40.000
Abs. humidity	g/kg	12.667	10.302	6.174
Density humid	kg/m <sup>3</sup>	1.076	1.129	1.124
Enthalpy humid	kJ/kg	64.635	44.217	35.793
Volume flow humid	m <sup>3</sup> /h	10516.927	9997.048	10000.000
Mass flow dry	kg/h	11172.198	11172.198	11172.198
Condensate flow	kg/h		26.423	
Surface temperature	°C	16.440	8.664	
Velocity	m/s	2.183	2.075	2.075
Pressure drop dry	Pa		30.252	
Pressure drop wet	Pa		34.024	

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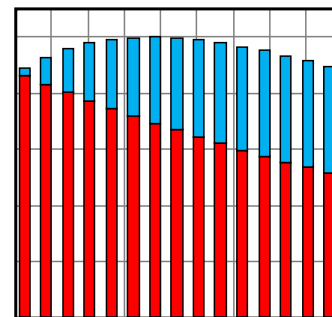
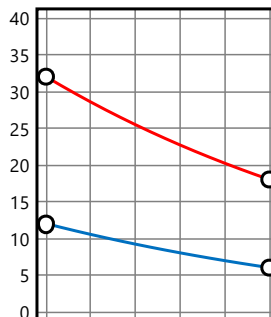
Plant  
Object  
Position

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**Water**

Fouling inside	m <sup>2</sup> K/W	5.000E-05
Temp. Inlet	°C	6.000
Temp. Outlet	°C	12.000
Temp. Selection	°C	8.190
Density	kg/m <sup>3</sup>	999.850
Spec. heat	kJ/kgK	4.196
Heat cond.	W/mK	0.577
Viscosity	Pas	1.378E-03
Volume flow	m <sup>3</sup> /h	9.062
Velocity	m/s	1.074
Pressure drop (Factor T/C)	---	3.336
Pressure drop	kPa	21.031

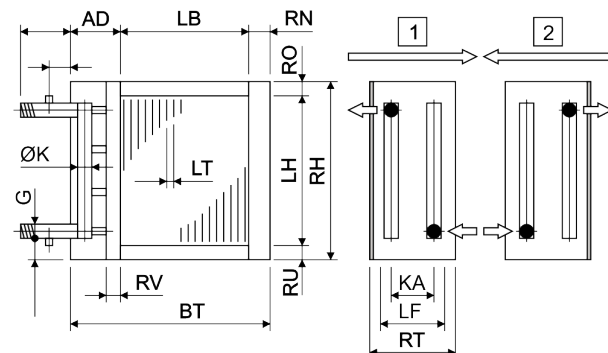
**Temperature (°C)**



**Technical data**

Tubes total	Piece	112
Tubes blank	Piece	0
Int. vent./drains	Piece	0
Tube rows on the depth	Piece	4
Tube rows on the height	Piece	28
Tube coupling in series	Piece	8
Number of circuits (NC)	Piece	14
Volume	l	31
Weight	kg	81
Connections	G ---	2"
Frame height	RH mm	1200
Frame width	BT mm	1400
Frame depth	RT mm	190
Finned height	LH mm	1120
Finned width	LB mm	1195
Finned depth	LF mm	140
Frame on top	RO mm	40
Frame on bottom	RU mm	40
Frame in front	RV mm	30
Frame on back	RN mm	65
Collector-Diameter	K mm	54
Collector covering	AD mm	140
Collector distance	KA mm	105
Fin spacing	LT mm	3.500
Fin thickness	LD mm	0.200
Tube diameter	DA mm	15.400
Tube diameter	da mm	15.400
Tube thickness	S mm	0.400
Tube interval on the height	S1 mm	40.000
Tube interval on the width	S2 mm	35.000

Tubes:	Cu
Tubes:	smooth
Tubes:	staggered
Tubes:	circular
Collectors:	Cu
Collectors:	1.23 m/s
Connections:	Rg7
Connections:	1.23 m/s
Fins:	Al
Fins:	smooth
Frame:	AISI304
Frame:	2.00 mm
Protection:	without
Protection:	---
Circulations:	1 default
Air flow direction:	horizontal



**Price net: EUR 1411.00**

**Cooler: 40/35/15-6R-28T-1195A-3.5PA-21C-Cu/Al/AISI304**

Capacity sensible	kW	54.060
Capacity latent	kW	24.195
Capacity frost	kW	0.000
Capacity total	kW	78.255
Surface reserve	%	9.853
Present surface	m <sup>2</sup>	148.398
Required surface	m <sup>2</sup>	135.088
k-coeff.	W/m <sup>2</sup> K	45.291
Average temp. diff. (92.85 %)	K	12.790

Company  
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Street  
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Phone: xxxxxxxxxx  
Fax: xxxxxxxxxx  
E-Mail  
Homepage

Air humid		Inlet	Outlet	Definition
Fouling outside	m <sup>2</sup> K/W			5.000E-05
Height over sea level	m			540.000
Pressure	mbar			949.653
Temp.	°C	32.000	15.000	20.000
Rel. humidity	%	40.000	84.939	40.000
Abs. humidity	g/kg	12.667	9.621	6.174
Density humid	kg/m <sup>3</sup>	1.076	1.141	1.124
Enthalpy humid	kJ/kg	64.635	39.419	35.793
Volume flow humid	m <sup>3</sup> /h	10516.927	9883.388	10000.000
Mass flow dry	kg/h	11172.198	11172.198	11172.198
Condensate flow	kg/h		34.030	
Surface temperature	°C	17.126	8.307	
Velocity	m/s	2.183	2.051	2.075
Pressure drop dry	Pa		44.809	
Pressure drop wet	Pa		50.719	

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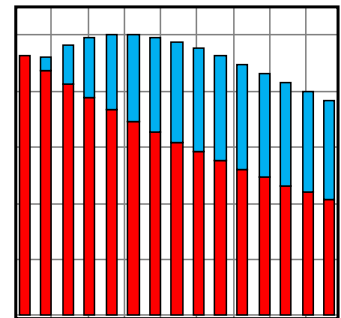
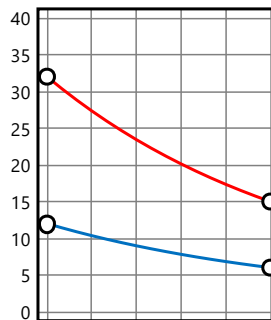
Plant  
Object  
Position

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**Wasser**

Fouling inside	m <sup>2</sup> K/W	5.000E-05
Temp. Inlet	°C	6.000
Temp. Outlet	°C	12.000
Temp. Selection	°C	8.190
Density	kg/m <sup>3</sup>	999.850
Spec. heat	kJ/kgK	4.196
Heat cond.	W/mK	0.577
Viscosity	Pas	1.378E-03
Volume flow	m <sup>3</sup> /h	11.192
Velocity	m/s	0.884
Pressure drop (Factor T/C)	---	6.233
Pressure drop	kPa	13.182

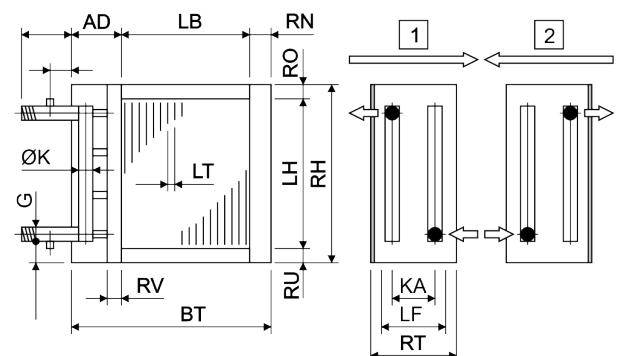
**Temperature (°C)**



**Technical data**

Tubes total	Piece	168
Tubes blank	Piece	0
Int. vent./drains	Piece	0
Tube rows on the depth	Piece	6
Tube rows on the height	Piece	28
Tube coupling in series	Piece	8
Number of circuits (NC)	Piece	21
Volume	l	48
Weight	kg	117
Connections	G ---	2 1/2"
Frame height	RH mm	1200
Frame width	BT mm	1400
Frame depth	RT mm	280
Finned height	LH mm	1120
Finned width	LB mm	1195
Finned depth	LF mm	210
Frame on top	RO mm	40
Frame on bottom	RU mm	40
Frame in front	RV mm	30
Frame on back	RN mm	65
Collector-Diameter	K mm	76
Collector covering	AD mm	140
Collector distance	KA mm	175
Fin spacing	LT mm	3.500
Fin thickness	LD mm	0.200
Tube diameter	DA mm	15.400
Tube diameter	da mm	15.400
Tube thickness	S mm	0.400
Tube interval on the height	S1 mm	40.000
Tube interval on the width	S2 mm	35.000

Tubes:	Cu
Tubes:	smooth
Tubes:	staggered
Tubes:	circular
Collectors:	Cu
Collectors:	0.76 m/s
Connections:	Rg7
Connections:	0.76 m/s
Fins:	Al
Fins:	smooth
Frame:	AISI304
Frame:	2.00 mm
Protection:	without
Protection:	---
Circulations:	1 default
Air flow direction:	horizontal



**Price net: EUR 2081.00**