



# Explanations of the AHH software (Mollier-HX-Chart)

Hello potential customer,

Since I have been working in the air conditioning industry, since 1970, and not in meteorology, I do not cover the fog area and fog isotherms.

More than 6,500 engineers worldwide work with the AHH software, including several universities, with interactive support for 8 languages.

In the AHH software, the entire theory can be **viewed and printed** under Regarding AHH.

Regarding the software prices, you should contact me by phone, to explain the downloadable price list under [www.zcs.ch](http://www.zcs.ch). Of course, the prices are unique.

The example on the right shows a heat recovery process with a temperature efficiency of 75% (black).

Of course, the cooling course could also be mapped into the extremely transient fog area (red).

However, multiple laboratory measurements at TUEV Süd in Munich have shown, that this is of no significance for the air conditioning industry and that the condensate collects in the drip tray below the heat exchanger.

At the bottom right, the data from the Mollier-HX-Chart can be seen, although the frost performance is not shown, as this is not treated according to Mollier. It is also not shown, how much the sensitive and latent benefit component is.

In the example chosen, part of the condensate will form frost at the heat exchanger and must be de-frosted regularly. According to Mollier, this performance component is also not covered.

If you are interested in all 3 capacity components, i.e. sensitive, latent and frost parts, you will not be able to avoid making a serious calculation of the heat exchangers.

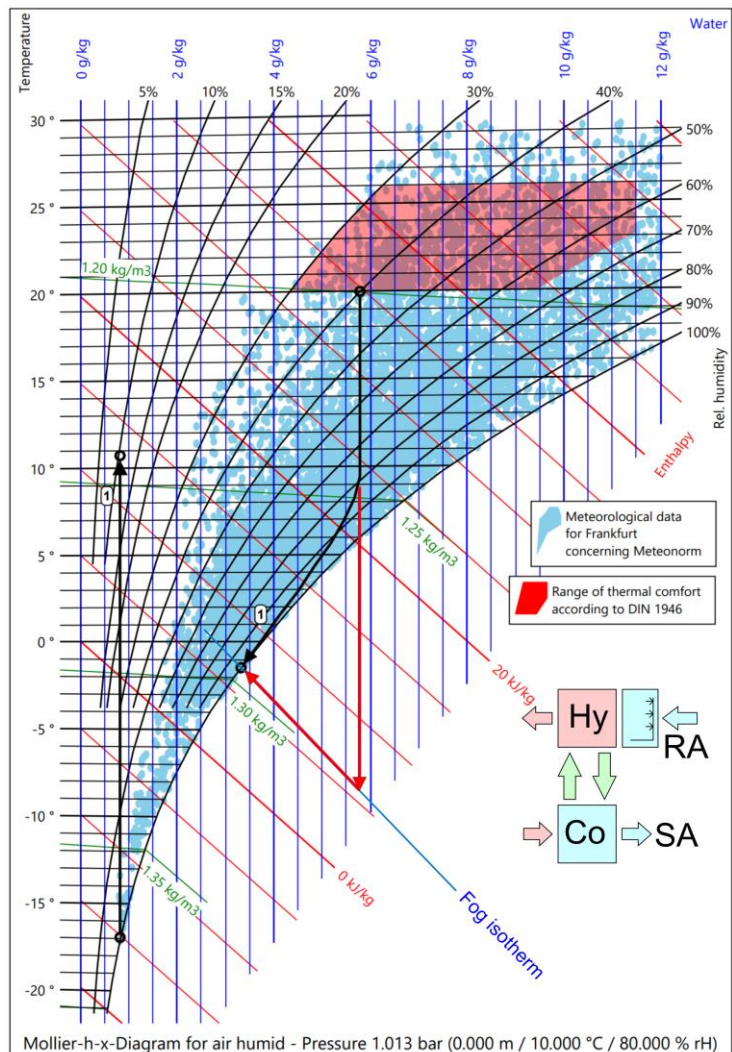
Why?

Because the Mollier-HX-chart does not take into account the air velocity, the heat exchanger geometry and the quality of the mist eliminator, or only partially.

You will therefore find a concrete calculation on the following pages.

Kind regards

Grad.-Eng. Marin Zeller TU, VDI



1) Heat recovery - Circuit connect-system - Surface relation hot/cold 1.000 - Partition of fins (2.5 - 3.5 mm)				
Efficiency temperature	%	75.000		
Efficiency hygroscopic	%	0.000		
Efficiency humid	%	0.000		
Capacity	kW	77.674		
Mean temp.diff.	K	12.116		
Coefficient	kW/K	6.411		
		Cold air In	Cold air Out	Hot air In
Temperature	°C	-17.000	10.750	20.000
Rel. humidity	%	100.000	10.511	40.000
Abs. humidity	g/kg	0.834	0.834	5.782
Density humid	kg/m³	1.377	1.243	1.200
Enthalpy humid	kJ/kg	-15.044	12.919	34.800
Volume flow humid	m³/h	7267.549	8054.844	8383.355
Massflow dry	kg/h	10000.000	10000.000	10000.000
Condensed water	kg/h		0.000	24.481
Surface temperature	°C			-7.223

Danger of FREEZING!

The effective capacities according to the following pages in a concrete calculation of the heat exchangers result in the following values:

Sensitive capacity 59,805 kW

Latent capacity 16,821 kW

Frost capacity 1,048 kW

Total capacity 77,674 kW

CC-System in winter		SA-He	RA-Co	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	75.000	57.461	
Capacity sensible	kW	77.674	59.805	
Capacity latent	kW	---	16.821	
Capacity frost	kW	---	1.048	
Capacity total	kW	77.674	77.674	
Surface reserve	%	1.947	1.810	
Present surface	m2	358.185	358.185	



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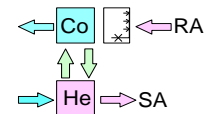
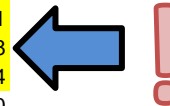
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SA-He ( ff = 0.00005 m2K/W )		Inlet	Outlet	Definition
Temp.	°C	-17.000	10.750	20.000
Rel. humidity	%	100.000	10.511	40.000
Abs. humidity	g/kg	0.834	0.834	5.784
Volume flow humid	m3/h	7267.906	8055.244	8383.770
Velocity	m/s	1.665	1.845	1.920
Pressure drop	Pa		102.240	

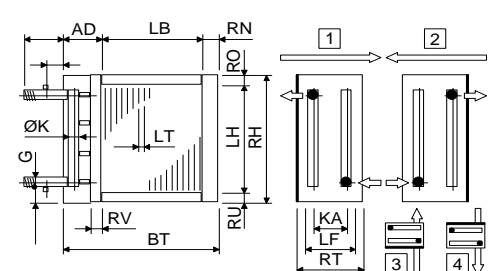
RA-Co ( ff = 0.00005 m2K/W )		Inlet	Outlet	Definition
Temp.	°C	20.000	-1.261	20.000
Rel. humidity	%	40.000	100.000	40.000
Abs. humidity	g/kg	5.784	3.398	5.784
Volume flow humid	m3/h	8383.770	7746.214	8383.770
Velocity	m/s	1.920	1.774	1.920
Pressure drop wet	Pa		121.246	

Temper -20 ( ff = 0.00005 / 0.00005 m2K/W )		SA-He	RA-Co	
Temp.	in °C	13.175	-7.000	
Temp.	out °C	-7.000	13.175	
Volume flow	m3/h	3.699	3.700	
Velocity	m/s	1.080	1.081	
Reynolds	---	4559.745	4462.361	
Pressure drop	kPa	185.135	186.186	



Software by www.zcs.ch

Technical data		SA-He	RA-Co	SA-He	RA-Co
Tubes total	Piece	504	504	Tubes:	Cu
Tubes blank	Piece	0	0	Tubes:	smooth
Int. vent./drains	Piece	6	6	Tubes:	staggered
Tube rows on the depth	Piece	14	14	Tubes:	circular
Tube rows on the height	Piece	36	36	Collectors:	Cu
Tube coupling in series	Piece	56	56	Collectors:	1.28 m/s
Number of circuits (NC)	Piece	9	9	Connections:	Rg7
Volume	l	68	68	Connections:	1.28 m/s
Weight	kg	216	216	Fins:	Al
Connections	G	1 1/4"	1 1/4"	Fins:	Wave structure
Frame height	RH	mm	1150	Frame:	AISI 304
Frame width	BT	mm	1300	Air flow direction:	horizontal
Frame depth	RT	mm	420	Protection:	without
Finned height	LH	mm	1080	Protection:	---
Finned width	LB	mm	1123		
Finned depth	LF	mm	364		
Frame on top	RO	mm	35		
Frame on bottom	RU	mm	35		
Frame in front	RV	mm	30		
Frame on back (~53/53mm)	RN	mm	53		
Collector-Diameter	K	mm	35		
Collector covering	AD	mm	124		
Collector distance	KA	mm	354		
Fin spacing	LT	mm	2.800		
Fin thickness	LD	mm	0.200		
Tube diameter	DA	mm	12.400		
Tube diameter	da	mm	12.400		
Tube thickness	S	mm	0.400		
Tube interval on the height	S1	mm	30.000		
Tube interval on the depth	S2	mm	25.981		
SA-He: 30/26/12-14R-36T-1123A-2.8PA-9C-Cu/Al/AISI 304				SA-He:	EUR 4256.00
RA-Co: 30/26/12-14R-36T-1123A-2.8PA-9C-Cu/Al/AISI 304				RA-Co:	EUR 4256.00



Delivery: 5-6 weeks  
Validity: 12 weeks  
Condit.: net, prepaid address  
Payment: 30 days net

**SA-He: 30/26/12-14R-36T-1123A-2.8PA-9C-Cu/Al/AISI 304**



Capacity	kW	77.674		
Surface reserve	%	1.947		
Present surface	m2	358.185		
Required surface	m2	351.345		
k-coeff.	W/m2K	44.117	----- ffi:	5.000E-05
Average temp. diff. ( 93.72 % )	K	5.011	ffa:	5.000E-05

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Air humid		Inlet	Outlet	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Temp.	°C	-17.000	10.750	20.000
Rel. humidity	%	100.000	10.511	40.000
Abs. humidity	g/kg	0.834	0.834	5.784
Density humid	kg/m3	1.377	1.242	1.200
Enthalpy humid	kJ/kg	-15.043	12.920	34.805
Volume flow humid	m3/h	7267.906	8055.244	8383.770
Mass flow dry	kg/h	10000.000	10000.000	10000.000
Velocity	m/s	1.665	1.845	1.920
Pressure drop	Pa		102.240	

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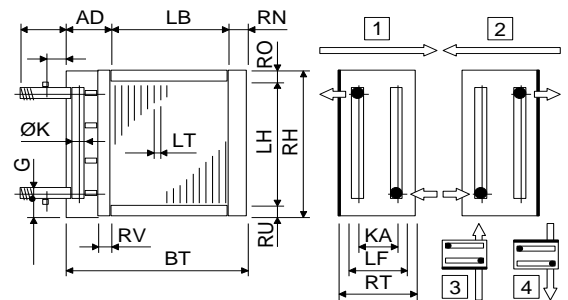
Plant  
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Temper -20 ( ff = 0.00005 / 0.00005 m2K/W )		Inlet	Outlet	Selection
Temp.	°C	13.175	-7.000	2.090
Density	kg/m3			1146.531
Spec. heat	kJ/kgK			3.268
Heat cond.	W/mK			0.484
Viscosity	Pas			3.151E-03
Volume flow	m3/h			3.699
Velocity	m/s			1.080
Pressure drop	kPa			185.135

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**Technical data**

Tubes total	Piece	504	Tubes:	Cu
Tubes blank	Piece	0	Tubes:	smooth
Int. vent./drains	Piece	6	Tubes:	staggered
Tube rows on the depth	Piece	14	Tubes:	circular
Tube rows on the height	Piece	36	Collectors:	1.28 m/s Cu
Tube coupling in series	Piece	56	Connections:	1.28 m/s Rg7
Number of circuits (NC)	Piece	9	Fins:	Al
Volume	l	68	Fins:	Wave structure
Weight	kg	216	Frame:	2.0 mm AISI 304
Connections	G ---	1 1/4"	Protection:	without
Frame height	RH mm	1150	Protection:	---
Frame width	BT mm	1300	Air flow direction:	horizontal
Frame depth	RT mm	420		
Finned height	LH mm	1080		
Finned width	LB mm	1123		
Finned depth	LF mm	364		
Frame on top	RO mm	35		
Frame on bottom	RU mm	35		
Frame in front	RV mm	30		
Frame on back (~53mm)	RN mm	53		
Collector-Diameter	K mm	35		
Collector covering	AD mm	124		
Collector distance	KA mm	354		
Fin spacing	LT mm	2.800		
Fin thickness	LD mm	0.200		
Tube diameter	DA mm	12.400	Delivery:	5-6 weeks
Tube diameter	da mm	12.400	Validity:	12 weeks
Tube thickness	S mm	0.400	Condit.:	net, prepaid address
Tube interval on the height	S1 mm	30.000	Payment:	30 days net
Tube interval on the depth	S2 mm	25.981	Price net:	EUR 4256.00



**RA-Co: 30/26/12-14R-36T-1123A-2.8PA-9C-Cu/Al/AISI 304**



Capacity	kW	77.674	----- sensible:	59.805
Surface reserve	%	1.810	latent:	16.821
Present surface	m2	358.185	frost:	1.048
Required surface	m2	351.816		
k-coeff.	W/m2K	47.804	----- ffi:	5.000E-05
Average temp. diff. ( 73.70 % )	K	4.618	ffa:	5.000E-05

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Air humid		Inlet	Outlet	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Temp.	°C	20.000	-1.261	20.000
Rel. humidity	%	40.000	100.000	40.000
Abs. humidity	g/kg	5.784	3.398	5.784
Density humid	kg/m3	1.200	1.295	1.200
Enthalpy humid	kJ/kg	34.805	7.219	34.805
Volume flow humid	m3/h	8383.770	7746.214	8383.770
<b>Mass flow dry</b>	<b>kg/h</b>	<b>10000.000</b>	<b>10000.000</b>	<b>10000.000</b>
Condensate flow	kg/h		23.865	
Velocity	m/s	1.920	1.774	1.920
Pressure drop dry	Pa		111.528	
Pressure drop wet	Pa		121.246	

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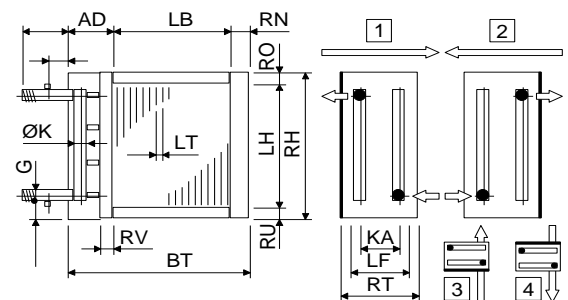
Temper -20 ( ff = 0.00005 / 0.00005 m2K/W )		Inlet	Outlet	Selection
Temp.	°C	-7.000	13.175	1.498
Density	kg/m3			1146.665
Spec. heat	kJ/kgK			3.267
Heat cond.	W/mK			0.483
Viscosity	Pas			3.221E-03
Volume flow	m3/h			3.700
Velocity	m/s			1.081
Pressure drop	kPa			186.186

Software by www.zcs.ch

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Tube interval on the height	S1 mm	30.000
Tube interval on the depth	S2 mm	25.981

Tubes: Cu  
Tubes: smooth  
Tubes: staggered  
Tubes: circular  
Collectors: 1.28 m/s Cu  
Connections: 1.28 m/s Rg7  
Fins: Al  
Fins: Wave structure  
Frame: 2.0 mm AISI 304  
Protection: without  
Protection: ---  
Air flow direction: horizontal



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