



Frost problems with Platte heat exchangers

As the majority of **plate heat exchanger** manufacturers say, this must be designed with a bypass on the side for the outside air in order to avoid permanent damage in winter when there is a risk of frost, which is why the usable width in the air conditioning unit must be adjusted accordingly. The fact that such a bypass is really of no use with regard to the risk of frost is shown below with different volume flow of fresh air via the bypass. This bypass must effectively guarantee the possibility of regulating the supply air temperature, otherwise the supply air temperatures will be too high in the transitional period.

Example Outside air 10'000 m³/h, -12 °C, 90 %
Exhaust air 10'000 m³/h, 20 °C, 40 %

Show page 3 Fresh air flow on the bypass 0.00 %
Frost mass flow 9.71 kg/h
Frost surface part 26.56 %
Heat recovery 72.84 kW

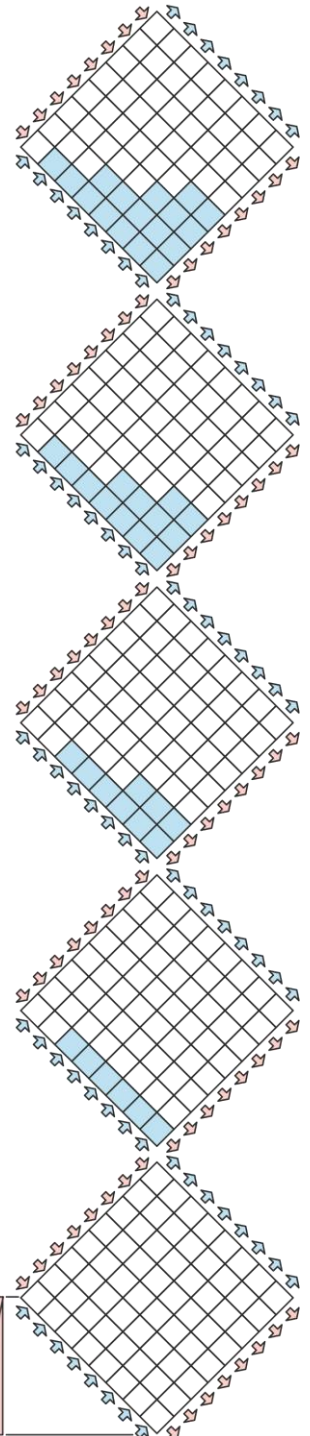
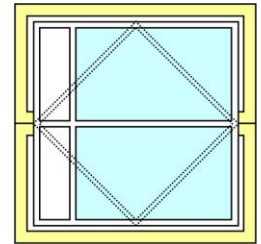
Show page 4 Fresh air flow on the bypass 25.00 %
Frost mass flow 7.08 kg/h
Frost surface part 20.31 %
Heat recovery 61.48 kW

Show page 5 Fresh air flow on the bypass 50.00 %
Frost mass flow 4.38 kg/h
Frost surface part 14.06 %
Heat recovery 46.60 kW

Show page 6 Fresh air flow on the bypass 75.00 %
Frost mass flow 2.48 kg/h
Frost surface part 9.38 %
Heat recovery 26.24 kW

Show page 7 Fresh air flow on the bypass 0.00 %
Frost mass flow 0.00 kg/h
Frost surface part 0.00 %
Air preheater 23.98 kW
Heat recovery 48.86 kW

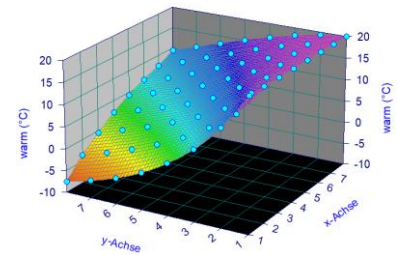
In order to protect the plate heat exchanger from the risk of frost, an air heater must be placed in front of it, which preheats it to an outside air temperature of -2.20 °C.



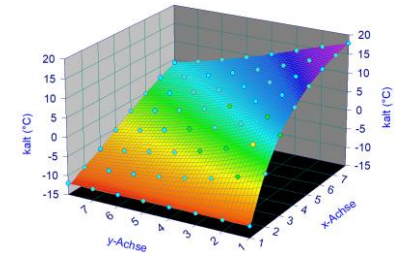
Now there are only two problems left to solve regarding the plate heat exchanger, which the manufacturers are only too happy to keep secret for marketing reasons.

On the one hand, the different outlet temperatures cause considerable regulation problems.

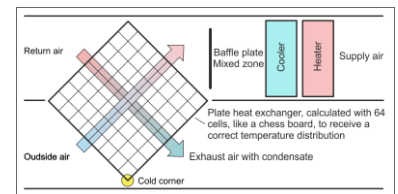
In the exhaust air, this leads to frost problems with the lowest outlet temperature in the cold corner.



In the supply air, with the different outlet temperatures of up to 14 K, this leads to considerable control problems in the subsequent heat exchangers.



This can only be remedied by a mixing zone before the after cooler and after heater can even be stably regulated.



Secondly, plate heat exchangers are advertised for up to 100,000 m3/h, which of course is absolute bullshit.

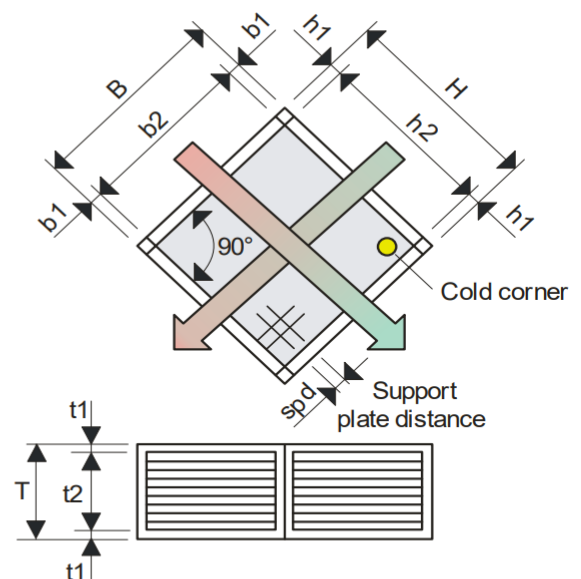
The diagonal overall depth and height of the plate heat exchanger alone is 5.12 m. In addition, there is the absolutely necessary mixing zone of 2.00 m. So you have to reckon with a total overall depth of 7.12 m. In comparison, with a rotor heat exchanger, or even better with a circuit connect system (CC-System), you need less than 1.00 m. You can therefore not only compare the prices for the different heat recovery systems, no!, you must also include the additional costs for the air conditioning units and the technical room used.

Technical data **Danger of freezing! Frost flow 98.12 kg/h - Surface 26.56 %** Software by www.zcs.ch

Cold corner - Surface temperature	°C	-8.557
Cold air - Outlet - Min.	°C	4.521
Cold air - Outlet - Max.	°C	16.165
Hot air - Outlet - Min.	°C	-5.498
Hot air - Outlet - Max.	°C	7.893

Standard plate-HE

Plate-Material	---	Al
Box-Material	---	AISI 304
Box-Thickness	mm	1.000
Weight	kg	2372.431
Support plate distance	spd	mm 100.000
Width	b1	mm 10.000
Width	b2	mm 3600.000
Box-Width	B	mm 3620.000
Altitude	h1	mm 10.000
Altitude	h2	mm 3600.000
Box-Altitude	H	mm 3620.000
Depth	t1	mm 10.000
Depth	t2	mm 3284.600
Box-Depth	T	mm 3304.600
Number of splits per side	n	Piece 161
Split width on cold air side	sk	mm 10.000
Split width on hot air side	sw	mm 10.000
Plate thickness	ld	mm 0.200



Delivery:	5-6 weeks
Validity:	12 weeks
Condit.:	net, prepaid address
Payment:	30 days net
Price net:	EUR 31458.00

Standard plate-HE: B1220 -H1220 -T986		Cold air	Hot air	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	68.135	55.221	
Capacity sensible	kW	72.843	59.389	
Capacity latent	kW		12.556	
Capacity frost	kW		0.899	
Fouling factor	m2K/W	5.000E-05	5.000E-05	
Present surface	m2			344.571
k-coeff.	W/m2K			24.154
Average temp. diff. (72.06 %)	K			8.752



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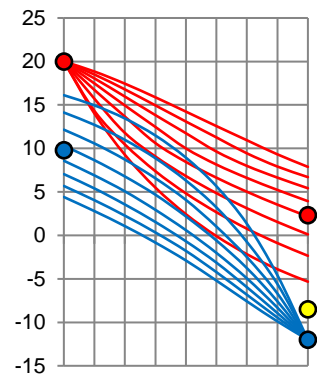
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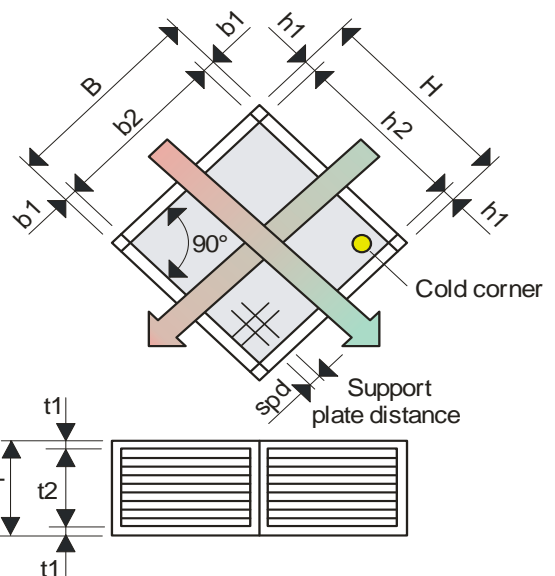
Cold air	Inlet	Outlet	Definition	
Temp.	°C	-12.000	9.803	20.000
Rel. humidity	%	90.000	16.006	40.000
Abs. humidity	g/kg	1.193	1.193	5.784
Density humid	kg/m3	1.350	1.246	1.200
Enthalpy humid	kJ/kg	-9.116	12.869	34.805
Volume flow humid	m3/h	8843.323	9581.616	10000.000
Mass flow dry	kg/h	11927.808	11927.808	11927.808
Velocity	m/s	4.636	5.023	
Pressure drop	Pa		176.086	

Hot air	Inlet	Outlet	Definition	
Temp.	°C	20.000	2.329	20.000
Rel. humidity	%	40.000	95.852	40.000
Abs. humidity	g/kg	5.784	4.291	5.784
Density humid	kg/m3	1.200	1.278	1.200
Enthalpy humid	kJ/kg	34.805	13.091	34.805
Volume flow humid	m3/h	10000.000	9374.888	10000.000
Mass flow dry	kg/h	11927.808	11927.808	11927.808
Surface temperature	°C	10.850	-0.914	
Condensate flow	kg/h		17.814	
Velocity	m/s	5.242	4.914	
Pressure drop (dry 186 Pa)	Pa		198.053	



Technical data Danger of freezing! Frost flow 9.71 kg/h - Surface 26.56 % Software by www.zcs.ch

Cold corner - Surface temperature	°C	-8.520
Cold air - Outlet - Min.	°C	4.411
Cold air - Outlet - Max.	°C	16.120
Hot air - Outlet - Min.	°C	-5.325
Hot air - Outlet - Max.	°C	7.879



Standard plate-HE

Plate-Material	---	Al	
Box-Material	---	AISI 304	
Box-Thickness	mm	1.000	
Weight	kg	195.534	
Support plate distance	spd	mm	100.000
Width	b1	mm	10.000
Width	b2	mm	1200.000
Box-Width	B	mm	1220.000
Altitude	h1	mm	10.000
Altitude	h2	mm	1200.000
Box-Altitude	H	mm	1220.000
Depth	t1	mm	10.000
Depth	t2	mm	966.200
Box-Depth	T	mm	986.200
Number of splits per side	n	Piece	115
Split width on cold air side	sk	mm	4.000
Split width on hot air side	sw	mm	4.000
Plate thickness	ld	mm	0.200

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Price net: EUR 2545.00

Standard plate-HE: B1220 -H1220 -T986		Cold air	Hot air	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	76.675	48.123	
Capacity sensible	kW	61.482	51.797	
Capacity latent	kW		9.031	
Capacity frost	kW		0.655	
Fouling factor	m2K/W	5.000E-05	5.000E-05	
Present surface	m2			344.571
k-coeff.	W/m2K			21.799
Average temp. diff. (71.61 %)	K			8.185



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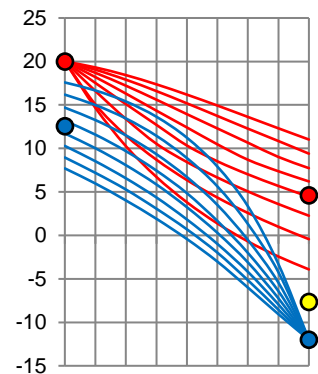
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Cold air	Inlet	Outlet	Definition
Temp.	°C	-12.000	12.536 20.000
Rel. humidity	%	90.000	13.359 40.000
Abs. humidity	g/kg	1.193	1.193 5.784
Density humid	kg/m3	1.350	1.234 1.200
Enthalpy humid	kJ/kg	-9.116	15.626 34.805
Volume flow humid	m3/h	6632.493	7255.620 7500.000
Mass flow dry	kg/h	8945.856	8945.856 8945.856
Velocity	m/s	3.477	3.803
Pressure drop	Pa		104.694

Hot air	Inlet	Outlet	Definition
Temp.	°C	20.000	4.601 20.000
Rel. humidity	%	40.000	89.623 40.000
Abs. humidity	g/kg	5.784	4.710 5.784
Density humid	kg/m3	1.200	1.267 1.200
Enthalpy humid	kJ/kg	34.805	16.446 34.805
Volume flow humid	m3/h	10000.000	9458.502 10000.000
Mass flow dry	kg/h	11927.808	11927.808 11927.808
Surface temperature	°C	12.207	1.341
Condensate flow	kg/h		12.813
Velocity	m/s	5.242	4.958
Pressure drop (dry 187 Pa)	Pa		197.014

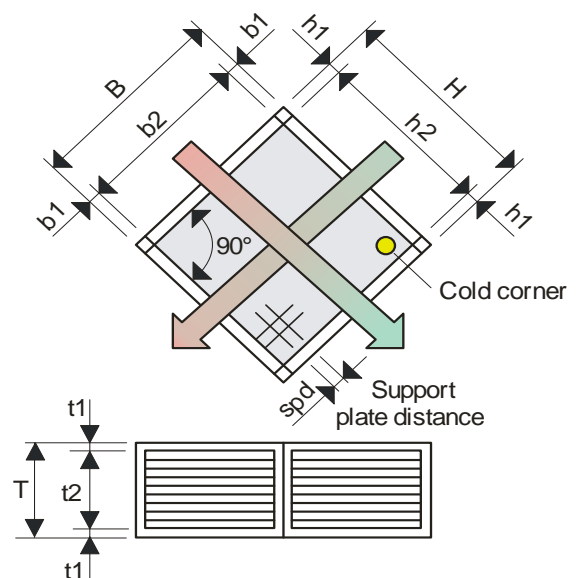


Technical data Danger of freezing! Frost flow 7.08 kg/h - Surface 20.31 % Software by www.zcs.ch

Cold corner - Surface temperature	°C	-7.663
Cold air - Outlet - Min.	°C	7.704
Cold air - Outlet - Max.	°C	17.587
Hot air - Outlet - Min.	°C	-3.914
Hot air - Outlet - Max.	°C	11.020

Standard plate-HE

Plate-Material	---	Al
Box-Material	---	AISI 304
Box-Thickness	mm	1.000
Weight	kg	195.534
Support plate distance	spd	mm 100.000
Width	b1	mm 10.000
Width	b2	mm 1200.000
Box-Width	B	mm 1220.000
Altitude	h1	mm 10.000
Altitude	h2	mm 1200.000
Box-Altitude	H	mm 1220.000
Depth	t1	mm 10.000
Depth	t2	mm 966.200
Box-Depth	T	mm 986.200
Number of splits per side	n	Piece 115
Split width on cold air side	sk	mm 4.000
Split width on hot air side	sw	mm 4.000
Plate thickness	ld	mm 0.200



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Standard plate-HE: B1220 -H1220 -T986		Cold air	Hot air	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	87.175	37.604	
Capacity sensible	kW	46.603	40.506	
Capacity latent	kW		5.691	
Capacity frost	kW		0.406	
Fouling factor	m2K/W	5.000E-05	5.000E-05	
Present surface	m2			344.571
k-coeff.	W/m2K			18.863
Average temp. diff. (71.51 %)	K			7.170



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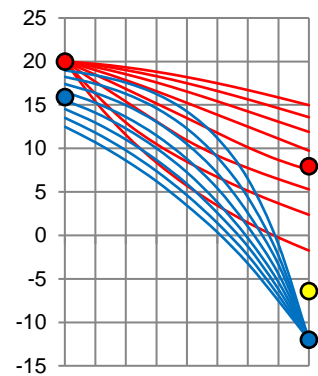
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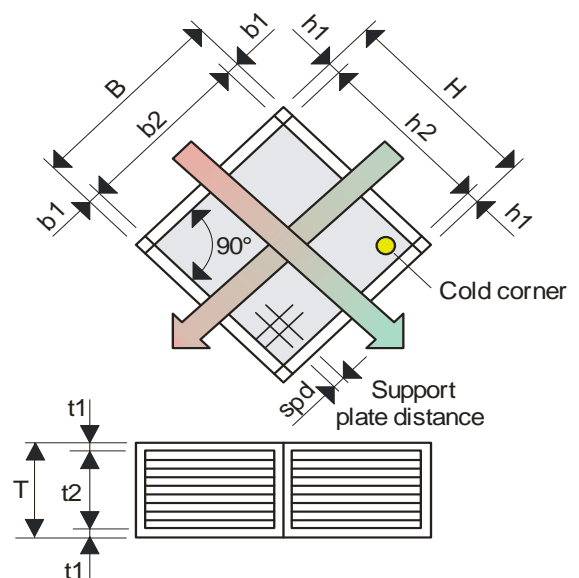
Cold air	Inlet	Outlet	Definition	
Temp.	°C	-12.000	15.896	20.000
Rel. humidity	%	90.000	10.753	40.000
Abs. humidity	g/kg	1.193	1.193	5.784
Density humid	kg/m3	1.350	1.220	1.200
Enthalpy humid	kJ/kg	-9.116	19.015	34.805
Volume flow humid	m3/h	4421.662	4893.964	5000.000
Mass flow dry	kg/h	5963.904	5963.904	5963.904
Velocity	m/s	2.318	2.565	
Pressure drop	Pa		50.746	

Hot air	Inlet	Outlet	Definition	
Temp.	°C	20.000	7.967	20.000
Rel. humidity	%	40.000	77.051	40.000
Abs. humidity	g/kg	5.784	5.107	5.784
Density humid	kg/m3	1.200	1.252	1.200
Enthalpy humid	kJ/kg	34.805	20.862	34.805
Volume flow humid	m3/h	10000.000	9579.193	10000.000
Mass flow dry	kg/h	11927.808	11927.808	11927.808
Surface temperature	°C	13.843	4.685	
Condensate flow	kg/h		8.075	
Velocity	m/s	5.242	5.021	
Pressure drop (dry 188 Pa)	Pa		196.513	



Technical data Danger of freezing! Frost flow 4.39 kg/h - Surface 14.06 % Software by www.zcs.ch

Cold corner - Surface temperature	°C	-6.399
Cold air - Outlet - Min.	°C	12.493
Cold air - Outlet - Max.	°C	18.970
Hot air - Outlet - Min.	°C	-1.744
Hot air - Outlet - Max.	°C	14.973



Standard plate-HE

Plate-Material	---	Al	
Box-Material	---	AISI 304	
Box-Thickness	mm	1.000	
Weight	kg	195.534	
Support plate distance	spd	mm	100.000
Width	b1	mm	10.000
Width	b2	mm	1200.000
Box-Width	B	mm	1220.000
Altitude	h1	mm	10.000
Altitude	h2	mm	1200.000
Box-Altitude	H	mm	1220.000
Depth	t1	mm	10.000
Depth	t2	mm	966.200
Box-Depth	T	mm	986.200
Number of splits per side	n	Piece	115
Split width on cold air side	sk	mm	4.000
Split width on hot air side	sw	mm	4.000
Plate thickness	ld	mm	0.200

Delivery: 5-6 weeks
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Price net: EUR 2545.00

Standard plate-HE: B1220 -H1220 -T986		Cold air	Hot air	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	98.144	21.362	
Capacity sensible	kW	26.235	23.026	
Capacity latent	kW		2.979	
Capacity frost	kW		0.230	
Fouling factor	m2K/W	5.000E-05	5.000E-05	
Present surface	m2			344.571
k-coeff.	W/m2K			16.609
Average temp. diff. (69.90 %)	K			4.584



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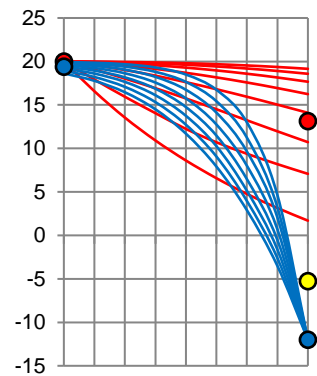
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Cold air		Inlet	Outlet	Definition
Temp.	°C	-12.000	19.406	20.000
Rel. humidity	%	90.000	8.623	40.000
Abs. humidity	g/kg	1.193	1.193	5.784
Density humid	kg/m3	1.350	1.205	1.200
Enthalpy humid	kJ/kg	-9.116	22.556	34.805
Volume flow humid	m3/h	2210.831	2476.696	2500.000
Mass flow dry	kg/h	2981.952	2981.952	2981.952
Velocity	m/s	1.159	1.298	
Pressure drop	Pa		17.739	

Hot air		Inlet	Outlet	Definition
Temp.	°C	20.000	13.164	20.000
Rel. humidity	%	40.000	57.960	40.000
Abs. humidity	g/kg	5.784	5.430	5.784
Density humid	kg/m3	1.200	1.229	1.200
Enthalpy humid	kJ/kg	34.805	26.956	34.805
Volume flow humid	m3/h	10000.000	9761.309	10000.000
Mass flow dry	kg/h	11927.808	11927.808	11927.808
Surface temperature	°C	15.644	9.964	
Condensate flow	kg/h		4.226	
Velocity	m/s	5.242	5.117	
Pressure drop (dry 190 Pa)	Pa		197.953	

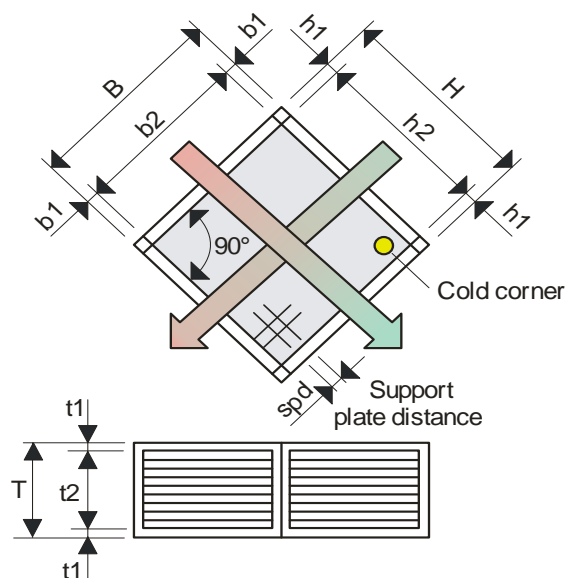


Technical data Danger of freezing! Frost flow 2.48 kg/h - Surface 9.38 % Software by www.zcs.ch

Cold corner - Surface temperature	°C	-5.283
Cold air - Outlet - Min.	°C	18.632
Cold air - Outlet - Max.	°C	19.932
Hot air - Outlet - Min.	°C	1.694
Hot air - Outlet - Max.	°C	19.153

Standard plate-HE

Plate-Material	---	Al
Box-Material	---	AISI 304
Box-Thickness	mm	1.000
Weight	kg	195.534
Support plate distance	spd	mm 100.000
Width	b1	mm 10.000
Width	b2	mm 1200.000
Box-Width	B	mm 1220.000
Altitude	h1	mm 10.000
Altitude	h2	mm 1200.000
Box-Altitude	H	mm 1220.000
Depth	t1	mm 10.000
Depth	t2	mm 966.200
Box-Depth	T	mm 986.200
Number of splits per side	n	Piece 115
Split width on cold air side	sk	mm 4.000
Split width on hot air side	sw	mm 4.000
Plate thickness	ld	mm 0.200



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Standard plate-HE: B1220 -H1220 -T986 Cold air Hot air Definition

Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	65.674	60.116	
Capacity sensible	kW	48.861	44.940	
Capacity latent	kW		3.921	
Capacity frost	kW		0.000	
Fouling factor	m2K/W	5.000E-05	5.000E-05	
Present surface	m2			344.571
k-coeff.	W/m2K			23.862
Average temp. diff. (72.28 %)	K			5.943



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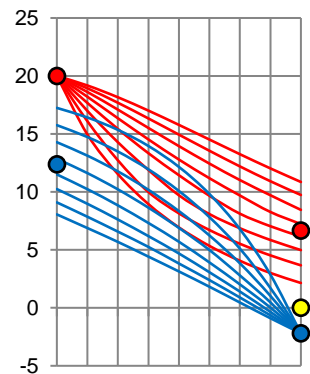
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Cold air Inlet Outlet Definition

Temp.	°C	-2.200	12.380	20.000
Rel. humidity	%	90.000	31.847	40.000
Abs. humidity	g/kg	2.823	2.823	5.784
Density humid	kg/m3	1.300	1.234	1.200
Enthalpy humid	kJ/kg	4.833	19.580	34.805
Volume flow humid	m3/h	9199.151	9694.133	10000.000
Mass flow dry	kg/h	11927.808	11927.808	11927.808
Velocity	m/s	4.822	5.082	
Pressure drop	Pa		181.323	

Hot air Inlet Outlet Definition

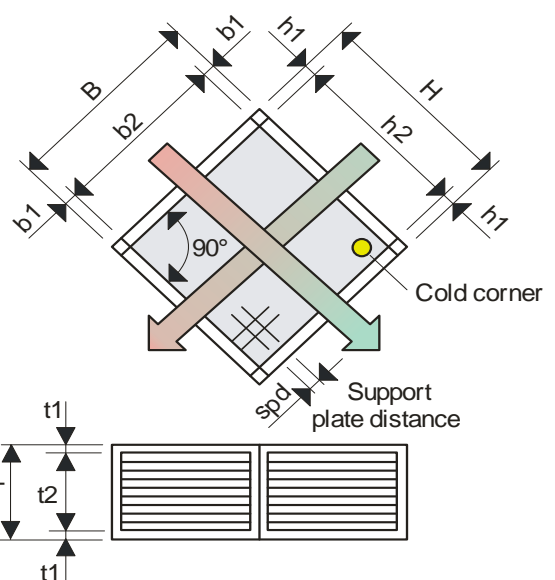
Temp.	°C	20.000	6.654	20.000
Rel. humidity	%	40.000	87.712	40.000
Abs. humidity	g/kg	5.784	5.318	5.784
Density humid	kg/m3	1.200	1.257	1.200
Enthalpy humid	kJ/kg	34.805	20.058	34.805
Volume flow humid	m3/h	10000.000	9537.673	10000.000
Mass flow dry	kg/h	11927.808	11927.808	11927.808
Surface temperature	°C	13.481	4.577	
Condensate flow	kg/h		5.563	
Velocity	m/s	5.242	5.000	
Pressure drop (dry 188 Pa)	Pa		192.987	



Technical data

Software by www.zcs.ch

Cold corner - Surface temperature	°C	0.013
Cold air - Outlet - Min.	°C	8.058
Cold air - Outlet - Max.	°C	17.245
Hot air - Outlet - Min.	°C	2.143
Hot air - Outlet - Max.	°C	10.857



Standard plate-HE

Plate-Material	---	Al
Box-Material	---	AISI 304
Box-Thickness	mm	1.000
Weight	kg	195.534
Support plate distance	spd	mm 100.000
Width	b1	mm 10.000
Width	b2	mm 1200.000
Box-Width	B	mm 1220.000
Altitude	h1	mm 10.000
Altitude	h2	mm 1200.000
Box-Altitude	H	mm 1220.000
Depth	t1	mm 10.000
Depth	t2	mm 966.200
Box-Depth	T	mm 986.200
Number of splits per side	n	Piece 115
Split width on cold air side	sk	mm 4.000
Split width on hot air side	sw	mm 4.000
Plate thickness	ld	mm 0.200

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