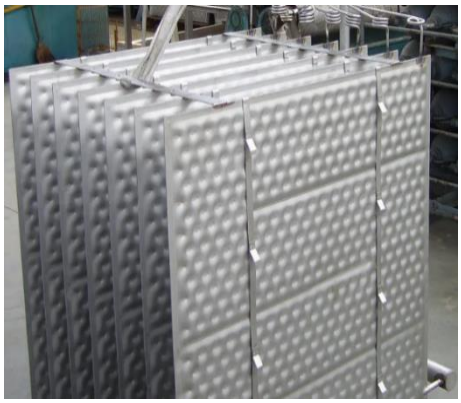
Pillow plate heat exchanger

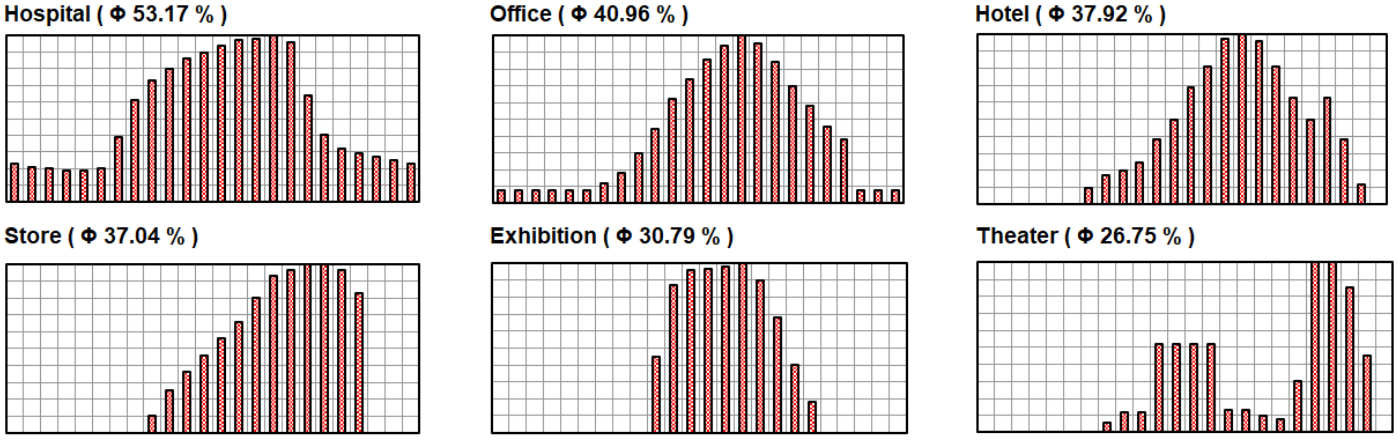
Heat recovery from gases
The picture on the right shows a pillow plate heat exchanger, which can cool any gases with harmful vapors and condense out the harmful vapors. It not only contributes to a healthy environment, but also to the reduction of heat demand by means of heat recovery via the liquid intermediate carrier medium. We believe, that this is one of the most important applications for this type of heat exchanger, which is why we have developed the appropriate software for it, see an example on page 2.

Falling film coolers have very high heat transfer coefficients
The picture on the right shows a pillow plate heat exchanger, which stands in a box. Water is distributed from above to the plates as a falling film and runs downwards with increasing speed as a result of gravity. In this process, the water is cooled from about 10°C to 0.5°C, which is called ice water. The water is cooled with a refrigerant in pump circulation mode, with an evaporation temperature of 0°C to prevent the cushion plates from freezing. For example, water of 6/12°C can be produced via a heat exchanger. We have developed the appropriate software for this, see an example on page 3.

Ice storage systems reduce peak demand
The picture on the right shows a pillow plate heat exchanger, which stands in a cubic well-insulated water tank. Ice is continuously formed on the outside of the pillow plates, which is thawed again in times of peak demand. A refrigerant circulates in the pillow plates in injection evaporation mode. Due to the chiller with a high COP (Coefficient of performance), this is more economical than with a brine, which is why we have developed the appropriate software for this, see an example on page 4.



Typical power requirement over 24 hours with information on the average power requirement



Plates-Cooler: B4000 - H1000 -T1000

Capacity	kW	375.372	------ sensible:	358.531
Surface reserve	%	3.738	latent:	16.840
Present surface	m2	421.556	frost:	0.000
Required surface	m2	406.366		
k-coeff.	W/m2K	23.519	---------- ffi:	1.000E-04
Average temp. diff. (89.67%)	K	39.276	ffa:	1.000E-04

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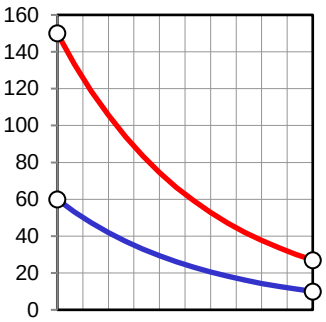
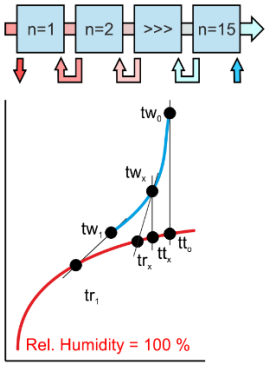
Software by www.zcs.ch

Air with 0.05 Benzene / 0.95 Water		Inlet	Outlet	Average
Pressure	bar	1.000		
Temp.	°C	150.000	27.000	88.500
Rel. humidity	%	0.500	51.636	3.464
Abs. humidity	g/kg	17.901	15.641	17.901
Density humid	kg/m3	0.818	1.154	0.957
Enthalpy humid	kJ/kg	200.587	65.453	135.271
Volume flow humid	m3/h	12449.213	8798.952	10638.982
Mass flow dry	kg/h	10000.000	10000.000	10000.000
Condensate flow	kg/h		22.601	
Surface temperature	°C	67.853	11.483	
Velocity	m/s	3.458	2.444	2.955
Pressure drop (dry 128 Pa)	Pa		129.570	

25 V% Et.glycol		
Temp. in	°C	10.000
Temp. out	°C	60.000
Density	kg/m3	1031.678
Spec. heat	kJ/kgK	3.770
Heat cond.	W/mK	0.491
Viscosity	Pas	1.305E-03
Volume flow	m3/h	6.949
Number of passages	Piece	1
Velocity	m/s	0.013
Pressure drop	kPa	6.837



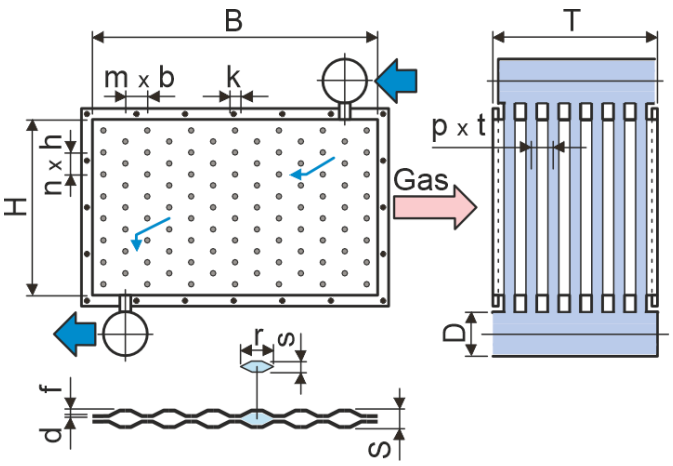


Technical data

Software by www.zcs.ch

Plates	---	---	AISI 316
Frame	---	---	AISI 316
Connections	---	---	AISI 316
Collector-Diameter	D	mm	48.3
Volume		l	612
Weight		kg	1904
Number in height	n	Piece	50
Division in height	h	mm	20.000
Plate in height	H	mm	1000.000
Number in width	m	Piece	200
Division in width	b	mm	20.000
Plate in width	B	mm	4000.000
Number in depth	p	Piece	50
Division in depth	t	mm	20.000
Plate in depth	T	mm	1000.000
Plate wall thickness	d	mm	0.500
Plate height embossing	f	mm	2.500
Welding diameter	k	mm	2.500
Number of welds	---	Piece	9851.000
Plate height	S	mm	6.000
Average channel width	r	mm	18.287
Channel height	s	mm	5.000
Channel length	---	mm	5000.000
Hydr. diameter	dh	mm	6.326
Channel cross section	---	mm2	60.956
Number of channels / Plate	---	Piece	50.000
Channel cross section / Plate	---	m2	0.003
Number of plates	---	Piece	50.000
Channel cross section total	---	m2	0.152

The flow pattern of the cooling medium is a cross-countercurrent. There is cross-current at the inlet and outlet. If the plate width is very large and the plate height is very small, the proportion of countercurrent increases.



Delivery:		5-6 weeks
Validity:		12 weeks
Condit.:		net, prepaid address
Payment:		30 days net
Price net:	**EUR**	**29266.00**

Plates-RC evaporator: B1000 - H1920 -T1000

Capacity		kW	1000.000
Surface reserve		%	4.555
Present surface		m2	194.337
Required surface		m2	185.869
k-coeff.		W/m2K	1712.151
Average temp. diff.		K	3.142

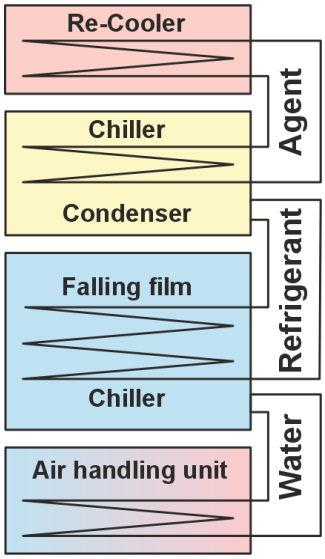
Water (Fouling outside = 0.0001 m2K/W)

Temp. in		°C	10.000
Temp. out		°C	0.500
Average		°C	5.250
Density		kg/m3	999.975
Spec. heat		kJ/kgK	4.203
Heat cond.		W/mK	0.571
Viscosity		Pas	1.507E-03
Volume flow		m3/h	90.174
Velocity		m/s	1.242
Pressure drop		kPa	0.000

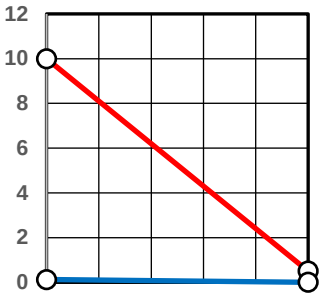
R744 (CO2) (Fouling inside = 0.0001 m2K/W)

Pressure		bar	34.851
Temp. in		°C	0.126
Temp. out		°C	0.000
Pump circulation factor	n	---	3.000
Mass flow		kg/h	47025.520
Volume flow in		m3/h	50.713
Volume flow out		m3/h	194.334
Velocity in		m/s	0.541
Velocity out		m/s	2.072
Pressure drop Evaporation		K	0.126

Example



Temp. (°C)



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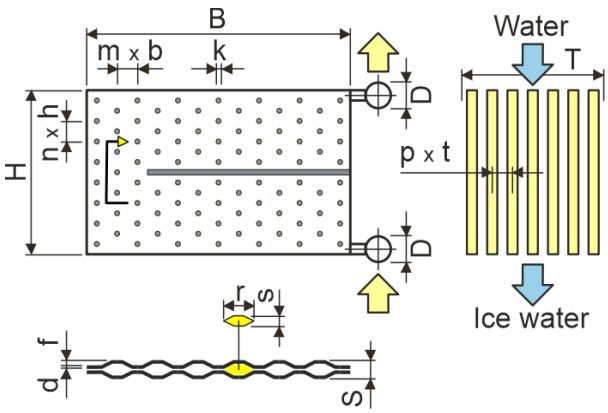
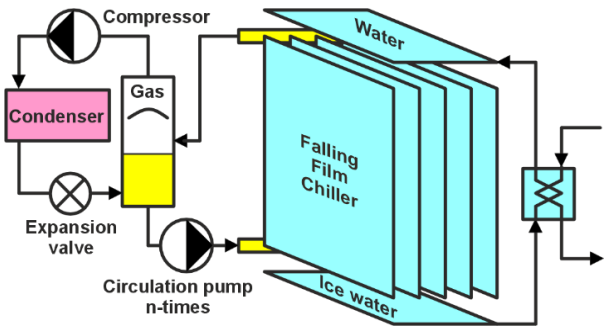
Plant
Object
Position

Technical data

Software by www.zcs.ch

Plates	---	---	AISI 316
Connections	---	---	AISI 316
Collector-Diameter	D	mm	168.3
Volume		l	309
Weight		kg	813
Number of passages	---	Piece	12
Water film thickness	---	mm	1.000
Air gap width	---	mm	12.000
Number in height	n	Piece	48
Division in height	h	mm	40.000
Plate in height	H	mm	1920.000
Number in width	m	Piece	25
Division in width	b	mm	40.000
Plate in width	B	mm	1000.000
Number in depth	p	Piece	50
Division in depth	t	mm	20.000
Plate in depth	T	mm	1000.000
Plate wall thickness	d	mm	0.500
Plate height embossing	f	mm	2.500
Welding diameter	k	mm	2.500
Number of welds	---	Piece	953.000
Plate height	S	mm	6.000
Average channel width	r	mm	39.074
Channel height	s	mm	5.000
Channel length	---	mm	1160.000
Hydr. diameter	dh	mm	6.587
Channel cross section	---	mm2	130.246
Number of channels / Plate	---	Piece	4.000
Channel cross section / Plate	---	m2	5.210E-04
Number of plates	---	Piece	50.000
Channel cross section total	---	m2	2.605E-02





Delivery:		5-6 weeks
Validity:		12 weeks
Condit.:		net, prepaid address
Payment:		30 days net
Price net:	**EUR**	**14273.00**

Plates-DX evaporator: B6000 - H1920 -T2000

Capacity	kW	200.000
Surface reserve	%	11.612
Present surface	m2	466.408
Required surface	m2	417.884
k-coeff.	W/m2K	42.245
Average temp. diff.	K	11.329

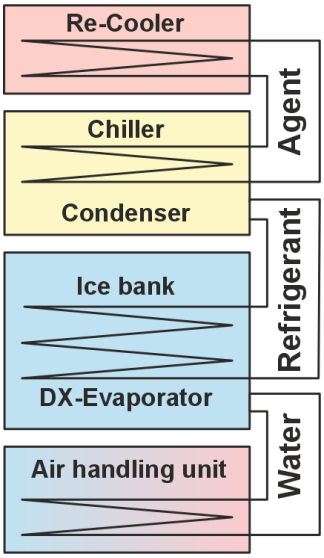
Water (Fouling outside = 0.0001 m2K/W)

Temp. in	°C	12.000
Temp. out	°C	6.000
Average	°C	9.000
Density	kg/m3	999.794
Spec. heat	kJ/kgK	4.194
Heat cond.	W/mK	0.578
Viscosity	Pas	1.345E-03
Volume flow	m3/h	28.616
Velocity	m/s	0.003
Pressure drop	kPa	18.832

R744 (CO2) (Fouling inside = 0.0001 m2K/W)

Pressure	bar	32.164
Condensate"	°C	25.000
Condensate'	°C	25.000
Subcooling	°C	22.000
Evaporation"	°C	-3.000
Superheating	°C	4.000
Mass flow	kg/h	3935.400
Volume flow	m3/h	44.319
Pressure drop Evaporation	K	0.448
Capillary: 20xØ8x1x1300 mm	bar	0.851

Example



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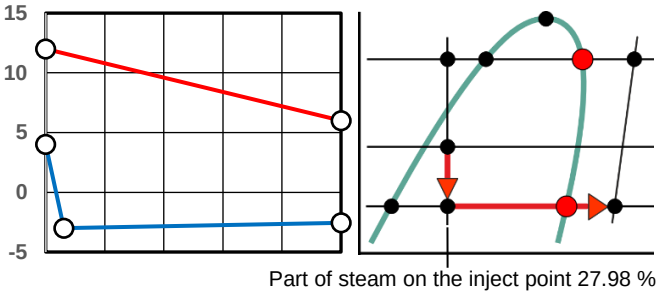
Plant
Object
Position

Temp. (°C)

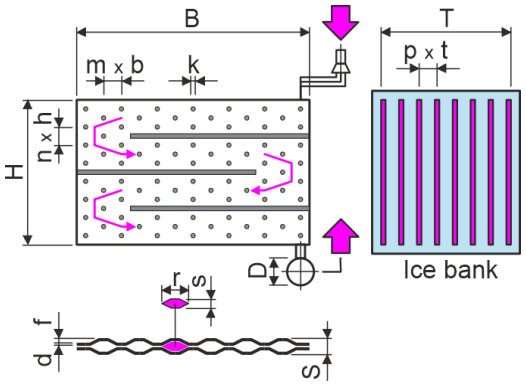


Part of steam on the inject point 27.98 %

Technical data

Software by www.zcs.ch

Plates	---	---	AISI 316
Connections	---	---	AISI 316
Collector-Diameter	D	mm	76.1
Volume		l	548
Weight		kg	1835
Number of passages	---	Piece	16
Ice layer thickness	---	mm	37.000
Water gap width	---	mm	20.000
Number in height	n	Piece	48
Division in height	h	mm	40.000
Plate in height	H	mm	1920.000
Number in width	m	Piece	150
Division in width	b	mm	40.000
Plate in width	B	mm	6000.000
Number in depth	p	Piece	20
Division in depth	t	mm	100.000
Plate in depth	T	mm	2000.000
Plate wall thickness	d	mm	0.500
Plate height embossing	f	mm	2.500
Welding diameter	k	mm	2.500
Number of welds	---	Piece	4888.000
Plate height	S	mm	6.000
Average channel width	r	mm	39.074
Channel height	s	mm	5.000
Channel length	---	mm	6120.000
Hydr. diameter	dh	mm	6.587
Channel cross section	---	mm2	130.246
Number of channels / Plate	---	Piece	3.000
Channel cross section / Plate	---	m2	3.907E-04
Number of plates	---	Piece	20.000
Channel cross section total	---	m2	7.815E-03



Ice-bank-Altitude	m	2.200
Ice-bank-Width	m	6.200
Ice-bank-Depth	m	2.200
Ice-bank-Total	m3	30.008
Plate volume	m3	1.382
Water volume	m3	11.576
Ice volume	m3	17.050
Ice density	kg/m3	1000.000
Ice mass	kg	17049.600
Melting enthalpy	MJ/kg	0.333
Melting energy	MJ	5679.222
Power requirement	kW	50.000
Defr. time	Hours	31.551

Delivery:	5-6 weeks
Validity:	12 weeks
Condit.:	net, prepaid address
Payment:	30 days net
Price without Ice-bank:	**EUR 34033.00**