

CC-System in summer		SA-Co1	SA-Co2	SA-He	RA-Hy
Capacity	kW	129.839	183.009	67.508	62.331
Surface reserve	%	2.343	2.496	3.380	2.810
Present surface	m ²	1601.665	535.049	533.888	1163.439
Temp. in (26.000)	°C	32.000	17.200	8.000	19.518
Rel. humidity in (55.000)	%	40.000	95.336	100.000	100.000
Abs. humidity in (11.529)	g/kg	11.860	11.684	6.660	14.224
Temp. out	°C	17.200	8.000	16.000	26.801
Rel. humidity out	%	95.336	100.000	59.106	64.456
Abs. humidity out	g/kg	11.684	6.660	6.660	14.224
Velocity	m/s	2.102	2.050	1.997	2.100
Pressure drop	Pa	117.401	94.638	36.471	90.841
Moistening temperature	°C				15.000

Definition

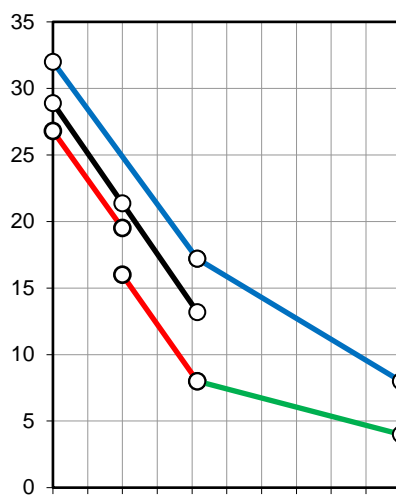
Height over sea level	m	0.000
Pressure	hPa	1013.250
Temp.	°C	20.000
Rel. humidity	%	40.000
Supply air	m ³ /h	25000.000
Return air	m ³ /h	25000.000

25 V% Et.glycol

Temp. in	°C	13.200
Temp. out	°C	28.900
Volume flow	m ³ /h	7.698
Pressure drop total	kPa	167.563

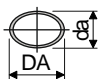
Water

Temp. in	°C	4.000
Temp. out	°C	8.000
Volume flow	m ³ /h	39.185
Pressure drop	kPa	47.481



Technical data

		SA-Co1	SA-Co2	SA-He	RA-Hy
Tubes blank	Piece	8	0	4	8
Int. vent./drains	Piece	8	0	2	8
Tube rows on the depth	Piece	18	8	6	18
Tube rows on the height	Piece	44	39	44	44
Number of circuits (NC)	Piece	28	39	26	28
Volume	l	200	164	72	200
Weight	kg	696	308	242	579
Connections	G	2"	4"	2"	2"
Frame height	RH	1620	1620	1620	1620
Frame width	BT	2396	2396	2396	2396
Frame depth	RT	690	380	270	690
Finned height	LH	1540	1560	1540	1540
Finned width	LB	2200	2128	2200	2200
Frame on top	RO	40	30	40	40
Frame on bottom	RU	40	30	40	40
Frame in front	RV	30	30	30	30
Frame on back (~53/69/53/53)	RN	53	69	53	53
Collector covering	AD	143	199	143	143
Fin spacing	LT	2.500	3.100	2.500	3.500
Fin thickness	LD	0.200	0.200	0.200	0.200
Tube diameter	DA	12.400	16.400	12.400	12.400
Tube diameter	da	12.400	16.400	12.400	12.400
Tube thickness	S	0.400	0.400	0.400	0.400
Tube interval on the height	S1	35.000	40.000	35.000	35.000
Tube interval on the depth	S2	35.000	34.641	35.000	35.000
Tubes	---	Cu	Cu	Cu	Cu
Tubes	---	smooth	smooth	smooth	smooth
Tubes	---	in line	staggered	in line	in line
Tubes	Type	circular	circular	circular	circular
Collector	---	Cu	Cu	Cu	Cu
Connections	---	Rg7	Rg7	Rg7	Rg7
Fins	---	Al	Al	Al	Al
Fins	---	smooth	smooth	smooth	smooth
Frame	---	AlMg3	AlMg3	AlMg3	AlMg3
Protection	---	without	without	without	without
Protection	---	---	---	---	---
Price	EUR	10277.00	4988.00	3710.00	9250.00



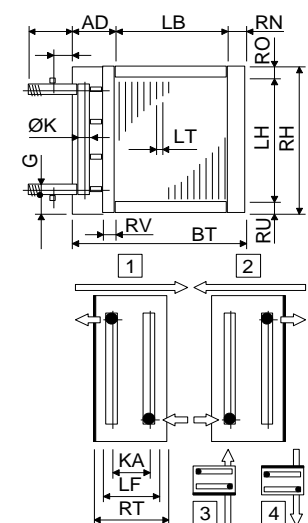
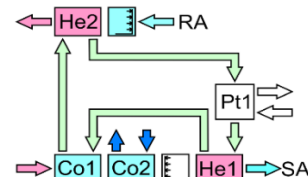
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Object
Position



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

CC-System in winter		SA-He1	SA-Co	SA-He2	RA-Co
Capacity	kW	244.218		146.201	139.115
Surface reserve	%	0.385		0.141	0.313
Present surface	m ²	1601.665	535.049	533.888	1163.439
Temp. in	°C	-11.000		6.658	20.000
Rel. humidity in	%	90.000		100.000	40.000
Abs. humidity in	g/kg	1.306		6.072	5.784
Temp. out	°C	18.230		24.000	4.840
Rel. humidity out	%	10.158		32.905	97.909
Abs. humidity out	g/kg	1.306		6.072	5.236
Velocity	m/s	1.921	1.921	2.018	1.996
Pressure drop	Pa	102.816	71.225	37.006	88.349



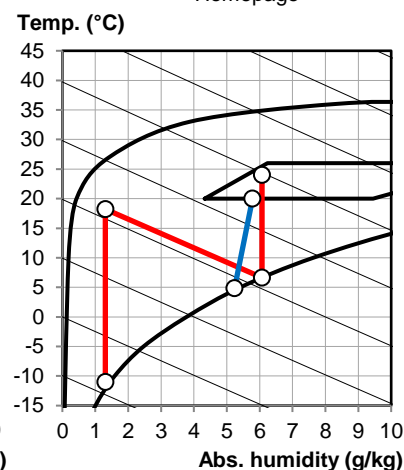
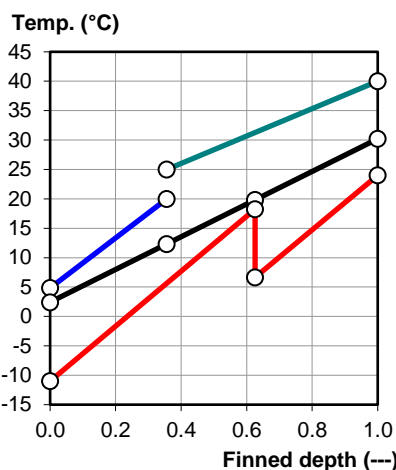
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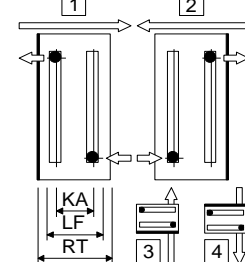
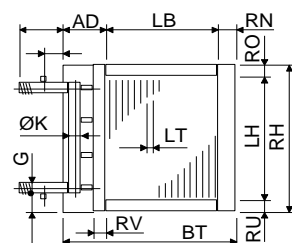
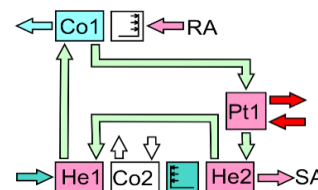
Definition		
Height over sea level	m	0.000
Pressure	hPa	1013.250
Temp.	°C	20.000
Rel. humidity	%	40.000
Supply air	m ³ /h	25000.000
Return air	m ³ /h	25000.000

25 V% Et.glycol		
Temp. in	°C	30.207
Temp. out	°C	2.433
Volume flow	m ³ /h	13.087
Pressure drop total	kPa	452.826

Water		
Temp. in	°C	
Temp. out	°C	
Volume flow	m ³ /h	
Pressure drop	kPa	



Technical data		SA-He1	SA-Co	SA-He2	RA-Co	Software by www.zcs.ch	
Tubes blank	Piece	8	0	4	8	Standard plate-HE	kW 251.305
Int. vent./drains	Piece	8	0	2	8	in	°C 40.000
Tube rows on the depth	Piece	18	8	6	18	out	°C 25.000
Tube rows on the height	Piece	44	39	44	44	in	°C 12.329
Number of circuits (NC)	Piece	28	39	26	28	out	°C 30.207
Volume	l	200	164	72	200		
Weight	kg	696	308	242	579		
Connections	G	2"	4"	2"	2"		
Frame height	RH	1620	1620	1620	1620		
Frame width	BT	2396	2396	2396	2396		
Frame depth	RT	690	380	270	690		
Finned height	LH	1540	1560	1540	1540		
Finned width	LB	2200	2128	2200	2200		
Frame on top	RO	40	30	40	40		
Frame on bottom	RU	40	30	40	40		
Frame in front	RV	30	30	30	30		
Frame on back (~53/69/53/53)	RN	53	69	53	53		
Collector covering	AD	143	199	143	143		
Fin spacing	LT	2.500	3.100	2.500	3.500		
Fin thickness	LD	0.200	0.200	0.200	0.200		
Tube diameter	DA	12.400	16.400	12.400	12.400		
Tube diameter	da	12.400	16.400	12.400	12.400		
Tube thickness	S	0.400	0.400	0.400	0.400		
Tube interval on the height	S1	35.000	40.000	35.000	35.000		
Tube interval on the depth	S2	35.000	34.641	35.000	35.000		
Tubes	---	Cu	Cu	Cu	Cu		
Tubes	---	smooth	smooth	smooth	smooth		
Tubes	---	in line	staggered	in line	in line		
Tubes	Type	circular	circular	circular	circular		
Collector	---	Cu	Cu	Cu	Cu		
Connections	---	Rg7	Rg7	Rg7	Rg7		
Fins	---	Al	Al	Al	Al		
Fins	---	smooth	smooth	smooth	smooth		
Frame	---	AlMg3	AlMg3	AlMg3	AlMg3	Delivery:	5-6 weeks
Protection	---	without	without	without	without	Validity:	12 weeks
Protection	---	---	---	---	---	Condit.:	net, prepaid address
Price	EUR	10277.00	4988.00	3710.00	9250.00	Payment:	30 days net

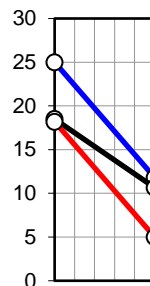


CC-System (DIN EN 308)		SA-He	RA-Co	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	65.980	65.964	
Capacity	kW	110.012	110.011	
Surface reserve	%	0.153	-0.717	
Present surface	m2	2135.553	1163.439	

SA-He		Inlet	Outlet	Definition
Temp.	°C	5.000	18.196	20.000
Rel. humidity	%	0.000	0.000	40.000
Volume flow humid	m3/h	23502.367	24617.327	25000.000
Velocity	m/s	1.927	2.018	
Pressure drop	Pa		141.352	

RA-Co		Inlet	Outlet	Definition
Temp.	°C	25.000	11.807	20.000
Rel. humidity	%	0.000	0.000	40.000
Volume flow humid	m3/h	25192.212	24077.521	25000.000
Velocity	m/s	2.065	1.974	
Pressure drop (dry 86 Pa)	Pa		86.172	

25 V% Et.glycol		SA-He	RA-Co
Temp.	in °C	18.498	10.652
Temp.	out °C	10.652	18.498
Volume flow	m3/h	13.064	13.075
Velocity	m/s	1.226	1.227
Reynolds	---	6799.910	6395.640
Pressure drop	kPa	217.038	172.096



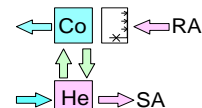
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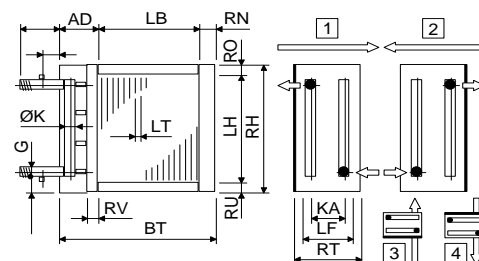
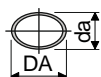
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Software by www.zcs.ch

Technical data		SA-He	RA-Co	SA-He	RA-Co
Tubes total	Piece	1056	792	Tubes:	Cu Cu
Tubes blank	Piece	48	8	Tubes:	smooth smooth
Int. vent./drains	Piece	11	8	Tubes:	in line in line
Tube rows on the depth	Piece	24	18	Tubes:	circular circular
Tube rows on the height	Piece	44	44	Collectors:	Cu Cu
Tube coupling in series	Piece	36	28	Connections:	Rg7 Rg7
Number of circuits (NC)	Piece	28	28	Fins:	Al Al
Volume	l	272	207	Fins:	smooth smooth
Weight	kg	932	588	Frame:	AlMg3 AlMg3
Connections	G	2 1/2"	2 1/2"	Protection:	without without
Frame height	RH mm	1620	1620	Protection:	--- ---
Frame width	BT mm	2419	2419	Air flow direction:	horizontal horizontal
Frame depth	RT mm	950	740		
Finned height	LH mm	1540	1540		
Finned width	LB mm	2200	2200		
Finned depth	LF mm	840	630		
Frame on top	RO mm	40	40		
Frame on bottom	RU mm	40	40		
Frame in front	RV mm	30	30		
Frame on back (~53/53mm)	RN mm	53	53		
Collector-Diameter	K mm	76	76		
Collector covering	AD mm	166	166		
Collector distance	KA mm	844	634		
Fin spacing	LT mm	2.500	3.500		
Fin thickness	LD mm	0.200	0.200		
Tube diameter	DA mm	12.400	12.400		
Tube diameter	da mm	12.400	12.400		
Tube thickness	S mm	0.400	0.400		
Tube interval on the height	S1 mm	35.000	35.000		
Tube interval on the depth	S2 mm	35.000	35.000		



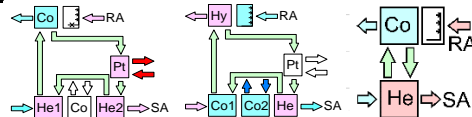
Delivery: 5-6 weeks
Validity: 12 weeks
Condit.: net, prepaid address
Payment: 30 days net

SA-He: 35/35/12-24R-44T-2200A-2.5PA-28C-Cu/Al/AlMg3
RA-Co: 35/35/12-18R-44T-2200A-3.5PA-28C-Cu/Al/AlMg3

SA-He: EUR 13987.00
RA-Co: EUR 9429.00

Economy with CC-System

Base value	Definition
Height over sea level	m 0.000
Pressure	bar 1.013
Volume flow humid at	°C 20.000
Volume flow humid at	% 40.000



CC-System		Winter	Summer	DIN EN 308
Efficiency Supply air	%	---	---	65.980
Capacity	kW	390.419	197.346	110.012
Surface reserve	%	0.526	5.723	0.153
Present surface	m2	2135.553	2135.553	2135.553

Supply air		Winter	Summer	DIN EN 308
Temp. in	°C	-11.000	32.000	5.000
Temp. out	°C	24.000	16.000	18.196
Volume flow humid	m3/h	25000.000	25000.000	25000.000
Pressure drop	Pa	211.048	248.509	141.352
Fan efficiency	---	0.700	0.700	0.700
Fan power	kW	2.094	2.465	1.402

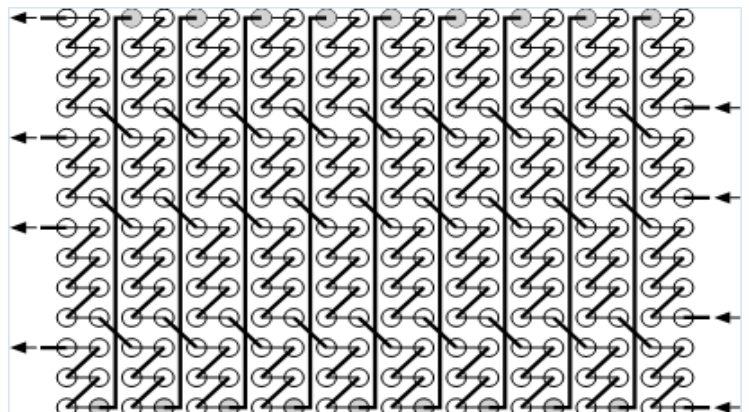
Return air		Winter	Summer	DIN EN 308
Temp. in	°C	20.000	19.518	25.000
Temp. out	°C	4.840	26.801	11.807
Volume flow humid	m3/h	25000.000	25000.000	25000.000
Pressure drop	Pa	88.349	90.841	86.172
Fan efficiency	---	0.700	0.700	0.700
Fan power	kW	0.876	0.901	0.855

25 V% Et.glycol		Winter	Summer	DIN EN 308
Volume flow	m3/h	13.087	7.698	13.064
Pressure drop Supply air	bar	2.597	0.992	2.170
Pressure drop Return air	bar	1.932	0.684	1.721
Pressure drop Hydraulics	bar	2.000	2.000	2.000
Pressure drop Total	bar	6.528	3.676	5.891
Pump efficiency	---	0.800	0.800	0.800
Pump power	kW	2.967	0.983	2.672

Economy		Winter	Summer	DIN EN 308
Gross useful ratio with CC-System	kW	---	---	110.012
Need of energy with CC-System	kW	5.937	4.349	4.930
Net useful ratio with CC-System	kW	---	---	105.082
Coefficient of performance (COP)	---	---	---	22.317

Economy		Winter	Summer	DIN EN 308
Volume flow humid Total	m3/h	50000.000	50000.000	50000.000
Need of energy with CC-System	kW	5.937	4.349	4.930
Specific Recovery Power (SRP)	Ws/m3	427.450	313.135	354.932

Adiabatic return air cooling



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$$E = \frac{B * C}{D * 3600 * 1000}$$

$$I = \frac{F * G}{H * 3600 * 1000}$$

$$N = K + L + M$$

$$P = \frac{J * N * 100000}{O * 3600 * 1000}$$

$$Q = E + I + P$$

$$R = A - Q$$

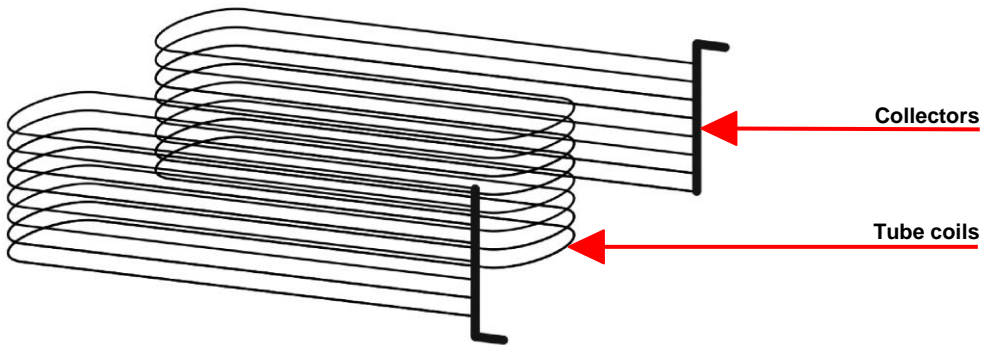
$$S = \frac{A}{Q}$$

$$T = B + F$$

$$U = \frac{Q * 3600 * 1000}{T}$$

Optimal pressure drop distribution on the tube coils and the collectors

With the optimal pressure drop distribution on the tube coils and the collectors, it is important that all tube coils receive the same amount of liquid. This is the only way to achieve optimum performance of the heat exchanger. This can only be achieved if the pressure drop in the tube coils is significantly higher than in the collectors. So it's about the pressure ratio (T/C), see below.

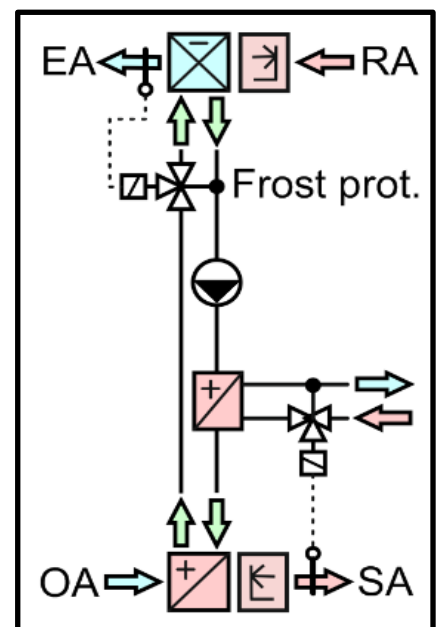
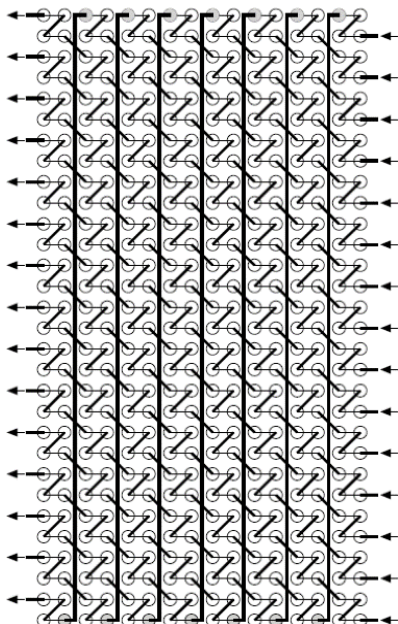


Typical applications			Heater	Cooler	CC-System
Pressure drop total	---	kPa	10.000	40.000	200.000
Coil pressure drop	T	kPa	6.500	33.000	193.000
Pressure drop collectors	C	kPa	3.500	7.000	7.000
Pressure ratio	T/C	---	1.857	4.714	27.571

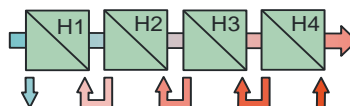
So if you really want to worry about optimal liquid distribution, turn to the air heater and air cooler, but certainly not to the heat exchangers in heat recovery! And yet there are absolute idiots who have applied for patents on an injection for heat recovery, i.e. exactly where it is totally superfluous.

An optimal CC-System must therefore have a pressure drop of 2 bar per heat exchanger in order to achieve maximum performance. In addition, there is the hydraulic system with a further 2 bar pressure drop. In total, a pressure drop of 6 bar is up for debate, which is not a problem when choosing the right pump. Idiots choose centrifugal pumps with a non-linear characteristic. Those familiar with the subject choose gear pumps from www.maag.com with absolutely linear characteristics. This means, for example, that when the speed is reduced to 50 %, the flow rate is exactly 50 %, so regulation is very easy.

www.maag.com



Definition		
Height over sea level	m	0.000
Pressure	hPa	1013.250
Temp.	°C	20.000
Rel. humidity	%	40.000
Air humid	m3/h	25000.000
25 V% Et.glycol	m3/h	13.113



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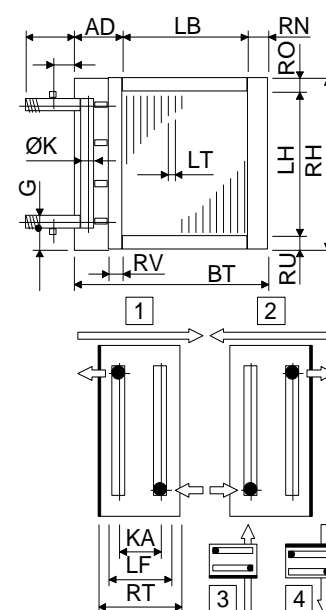
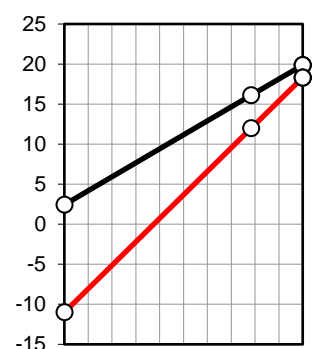
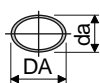
Air humid		Heater 1	Heater 2	Heater 3	Heater 4
Temp. Inlet	°C	-11.000	12.000	18.325	18.325
Rel. humidity Inlet	%	90.000	15.147	10.097	10.097
Temp. Outlet	°C	12.000	18.325	18.325	18.325
Rel. humidity Outlet	%	15.147	10.097	10.097	10.097
Pressure drop	Pa	56.742	48.559	0.000	0.000

25 V% Et.glycol		Heater 1	Heater 2	Heater 3	Heater 4
Temp. Inlet	°C	16.120	19.863	19.863	19.863
Temp. Outlet	°C	2.433	16.120	19.863	19.863
Pressure drop	kPa	108.788	69.261	0.000	0.000

Heat exchanger		Heater 1	Heater 2	Heater 3	Heater 4
Capacity	kW	192.150	52.862	0.000	0.000
Surface reserve	%	0.208	0.188	0.000	0.000
Present surface	m2	889.814	711.851	0.000	0.000
Required surface	m2	887.970	710.517	0.000	0.000
k-coeff.	W/m2K	28.379	29.407	0.000	0.000
Average temp. diff.	K	7.625	2.530	0.000	0.000

Tubes blank	Piece	8	4	0
Int. vent./drains	Piece	4	3	0
Tube rows on the depth	Piece	10	8	0
Tube rows on the height	Piece	44	44	0
Number of circuits (NC)	Piece	27	29	0
Volume	l	122	100	0
Weight	kg	403	327	0
Connections	G	2 1/2"	2 1/2"	0
Frame height	RH	1620	1620	0
Frame width	BT	2419	2419	0
Frame depth	RT	460	390	0
Finned height	LH	1540	1540	0
Finned width	LB	2200	2200	0
Frame on top	RO	40	40	0
Frame on bottom	RU	40	40	0
Frame in front	RV	30	30	0
Frame on back (~53/53/0/0)	RN	53	53	0
Collector covering	AD	166	166	0

Tubes	Type	circular	circular	---
Tubes	DA / da	12.40 / 12.40	12.40 / 12.40	---
Tubes	S1 / S2	35.00 / 35.00	35.00 / 35.00	---
Tubes	---	in line	in line	---
Tubes	---	Cu	Cu	---
Tubes	---	smooth	smooth	---
Collector	---	Cu	Cu	---
Connections	---	Rg7	Rg7	---
Fins	LT / LD	2.50 / 0.20	2.50 / 0.20	---
Fins	---	Al	Al	---
Fins	---	smooth	smooth	---
Frame	---	AlMg3	AlMg3	---
Protection	---	without	without	---
Protection	---	---	---	---
Air flow direction	---	horizontal	horizontal	---



Heater 1: 35/35/12-10R-44T-2200A-2.5PA-27C-Cu/Al/AlMg3

Heater 2: 35/35/12-8R-44T-2200A-2.5PA-29C-Cu/Al/AlMg3

Heater 3: ---

Heater 4: ---

Total

EUR 6076.00

EUR 4994.00

EUR 0.00

EUR 0.00

EUR 11070.00

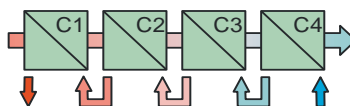
Delivery: 5-6 weeks

Validity: 12 weeks

Condit.: net, prepaid address

Payment: 30 days net

Definition		
Height over sea level	m	0.000
Pressure	hPa	1013.250
Temp.	°C	20.000
Rel. humidity	%	40.000
Air humid	m3/h	25000.000
25 V% Et.glycol	m3/h	13.147



Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 9.4.2021
With the compliments of

Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

software by www.zcs.ch

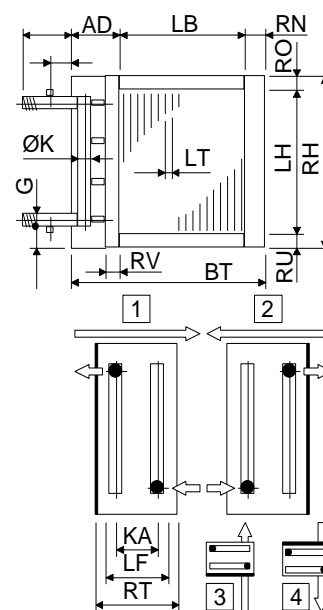
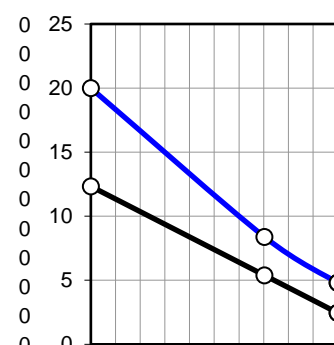
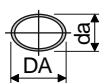
Air humid		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Temp. Inlet	°C	20.000	8.390	4.815	4.815
Rel. humidity Inlet	%	40.000	84.706	98.261	98.261
Temp. Outlet	°C	8.390	4.815	4.815	4.815
Rel. humidity Outlet	%	84.706	98.261	98.261	98.261
Pressure drop	Pa	48.750	42.401	0.000	0.000

25 V% Et.glycol		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Temp. Inlet	°C	5.390	2.451	2.451	2.451
Temp. Outlet	°C	12.329	5.390	2.451	2.451
Pressure drop	kPa	109.949	76.106	0.000	0.000

Heat exchanger		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Capacity	kW	97.823	41.299	0.000	0.000
Surface reserve	%	0.231	0.195	0.000	0.000
Present surface	m2	658.777	527.021	0.000	0.000
Required surface	m2	657.257	525.995	0.000	0.000
k-coeff.	V/m2K	31.135	32.150	0.000	0.000
Average temp. diff.	K	4.780	2.442	0.000	0.000

Tubes blank	Piece	8	4	0
Int. vent./drains	Piece	4	3	0
Tube rows on the depth	Piece	10	8	0
Tube rows on the height	Piece	44	44	0
Number of circuits (NC)	Piece	27	29	0
Volume	l	122	100	0
Weight	kg	341	278	0
Connections	G	2 ½"	2 ½"	0
Frame height	RH	1620	1620	0
Frame width	BT	2419	2419	0
Frame depth	RT	460	390	0
Finned height	LH	1540	1540	0
Finned width	LB	2200	2200	0
Frame on top	RO	40	40	0
Frame on bottom	RU	40	40	0
Frame in front	RV	30	30	0
Frame on back (~53/53/0/0)	RN	53	53	0
Collector covering	AD	166	166	0

Tubes	Type	circular	circular	---
Tubes	DA / da	12.40 / 12.40	12.40 / 12.40	---
Tubes	S1 / S2	35.00 / 35.00	35.00 / 35.00	---
Tubes	---	in line	in line	---
Tubes	---	Cu	Cu	---
Tubes	---	smooth	smooth	---
Collector	---	Cu	Cu	---
Connections	---	Rg7	Rg7	---
Fins	LT / LD	3.43 / 0.20	3.43 / 0.20	---
Fins	---	Al	Al	---
Fins	---	smooth	smooth	---
Frame	---	AlMg3	AlMg3	---
Protection	---	without	without	---
Protection	---	---	---	---
Air flow direction	---	horizontal	horizontal	---



Cooler 1: 35/35/12-10R-44T-2200A-3.4PA-27C-Cu/Al/AlMg3

Cooler 2: 35/35/12-8R-44T-2200A-3.4PA-29C-Cu/Al/AlMg3

Cooler 3: ---

Cooler 4: ---

Total

EUR 5536.00

EUR 4562.00

EUR 0.00

EUR 0.00

EUR 10098.00

Delivery: 5-6 weeks

Validity: 12 weeks

Condit.: net, prepaid address

Payment: 30 days net