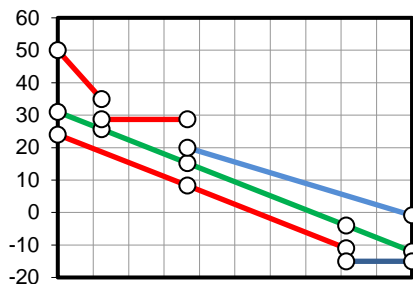


CC-System in winter		SA-He	RA-Co	Pt1	Pt2	Pt3
Height over sea level	m	0.000				
Pressure	hPa	1013.250				
Capacity total	%	100.000	77.344	22.704	29.515	15.844
Capacity total	kW	292.453	226.196	66.398	86.318	46.337
Capacity sensible	kW		175.209			
Capacity latent	kW		47.853			
Capacity frost	kW		3.134			
Surface reserve	%	0.324	0.046			
Present surface	m2	1588.428	1588.428			

25 V% Et.glycol		SA-He	RA-Co
Temp. in	°C	31.000	-12.013
Temp. out	°C	-4.000	15.284
Volume flow	m3/h	7.788	7.788
Velocity	m/s	1.023	1.023
Reynolds	---	5503.277	2853.274
Pressure drop	kPa	169.670	201.634



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Position

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Country / ZIP / City

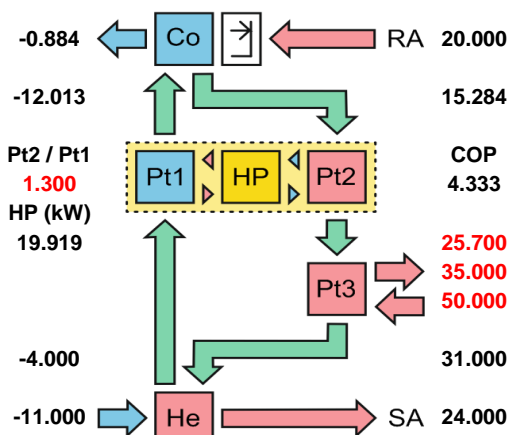
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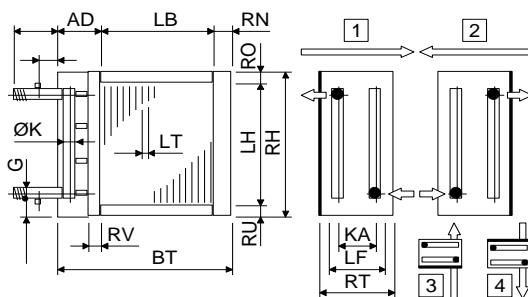
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SA-He		Inlet	Outlet	Definition
Temp.	°C	-11.000	24.000	20.000
Rel. humidity	%	90.000	7.134	40.000
Abs. humidity	g/kg	1.306	1.306	5.784
Volume flow humid	m3/h	22196.994	25160.432	25000.000
Velocity	m/s	1.835	2.080	
Pressure drop	Pa		105.623	

RA-Co		Inlet	Outlet	Definition
Temp.	°C	20.000	-0.884	20.000
Rel. humidity	%	40.000	100.000	40.000
Abs. humidity	g/kg	5.784	3.507	5.784
Volume flow humid	m3/h	25000.000	23134.920	25000.000
Velocity	m/s	2.067	1.913	
Pressure drop (dry 117 Pa)	Pa		126.616	



Technical data		SA-He	RA-Co	SA-He	RA-Co
Tubes total	Piece	720	720	Tubes:	Cu
Tubes blank	Piece	0	0	Tubes:	smooth
Int. vent./drains	Piece	8	8	Tubes:	in line
Tube rows on the depth	Piece	18	18	Tubes:	circular
Tube rows on the height	Piece	40	40	Collectors:	Cu
Tube coupling in series	Piece	36	36	Connections:	Rg7
Number of circuits (NC)	Piece	20	20	Finns:	Al
Volume	l	204	204	Finns:	smooth
Weight	kg	698	698	Frame:	AlMg3
Connections	G	2 1/2"	2 1/2"	Protection:	without
Frame height	RH	mm	1480	Protection:	---
Frame width	BT	mm	2619	Air flow direction:	horizontal
Frame depth	RT	mm	740		
Finned height	LH	mm	1400		
Finned width	LB	mm	2400		
Finned depth	LF	mm	630		
Frame on top	RO	mm	40		
Frame on bottom	RU	mm	40		
Frame in front	RV	mm	30		
Frame on back (~53/53mm)	RN	mm	53		
Collector-Diameter	K	mm	76		
Collector covering	AD	mm	166		
Collector distance	KA	mm	634		
Fin spacing	LT	mm	2.500		
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	35.000		
Tube interval on the depth	S2	mm	35.000		



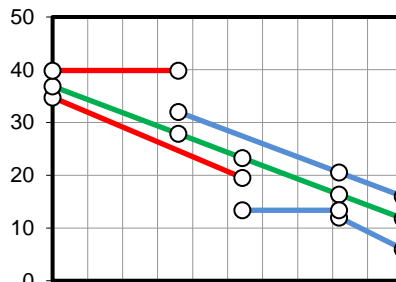
Delivery: 5-6 weeks
Validity: 12 weeks
Condit.: net, prepaid address
Payment: 30 days net

SA-He: 35/35/12-18R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3
RA-Co: 35/35/12-18R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3

SA-He: EUR 10213.00
RA-Co: EUR 10213.00

CC-System in summer		RA-Hy	SA-Co	Pt1	Pt2	Pt3
Height over sea level	m	0.000				
Pressure	hPa	1013.250				
Capacity total	%	84.620	100.000	55.958	43.044	28.293
Capacity total	kW	130.466	154.179	86.275	66.366	43.622
Capacity sensible	kW		136.146			
Capacity latent	kW		18.033			
Capacity frost	kW		0.000			
Surface reserve	%	0.057	0.343			
Present surface	m2	1588.428	1588.428			

25 V% Et.glycol		RA-Hy	SA-Co
Temp. in	°C	36.861	11.815
Temp. out	°C	23.272	27.875
Volume flow	m3/h	8.928	8.941
Velocity	m/s	1.173	1.175
Reynolds	---	7510.455	6673.610
Pressure drop	kPa	207.894	214.263



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Plant
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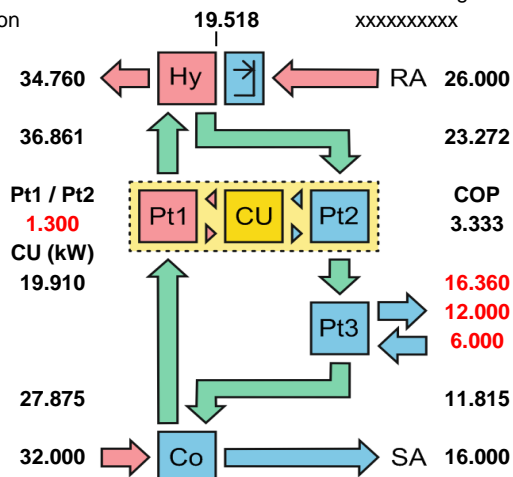
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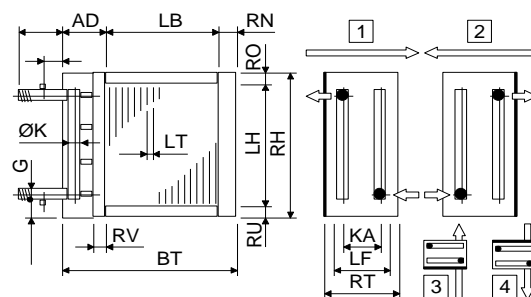
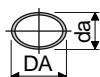
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RA-Hy		Inlet	Outlet	Definition
Temp. (26.000)	°C	19.518	34.760	20.000
Rel. humidity (55.000)	%	100.000	40.964	40.000
Abs. humidity (11.529)	g/kg	14.224	14.224	5.784
Volume flow humid	m3/h	25294.279	26611.548	25000.000
Velocity	m/s	2.091	2.200	
Pressure drop (dry 119 Pa)	Pa		119.173	
Moistening temperature	°C	15.000		

SA-Co		Inlet	Outlet	Definition
Temp.	°C	32.000	16.000	20.000
Rel. humidity	%	40.000	97.042	40.000
Abs. humidity	g/kg	11.860	11.010	5.784
Volume flow humid	m3/h	26275.113	24864.072	25000.000
Velocity	m/s	2.172	2.056	
Pressure drop (dry 119 Pa)	Pa		124.416	



Technical data		RA-Hy	SA-Co	RA-Hy	SA-Co
Tubes total	Piece	720	720	Tubes:	Cu
Tubes blank	Piece	0	0	Tubes:	smooth
Int. vent./drains	Piece	8	8	Tubes:	in line
Tube rows on the depth	Piece	18	18	Tubes:	circular
Tube rows on the height	Piece	40	40	Collectors:	Cu
Tube coupling in series	Piece	36	36	Connections:	Rg7
Number of circuits (NC)	Piece	20	20	Fins:	Al
Volume	l	204	204	Fins:	smooth
Weight	kg	698	698	Frame:	AlMg3
Connections	G	2 1/2"	2 1/2"	Protection:	without
Frame height	RH	mm	1480	Protection:	---
Frame width	BT	mm	2619	Air flow direction:	horizontal
Frame depth	RT	mm	740		
Finned height	LH	mm	1400		
Finned width	LB	mm	2400		
Finned depth	LF	mm	630		
Frame on top	RO	mm	40		
Frame on bottom	RU	mm	40		
Frame in front	RV	mm	30		
Frame on back (~53/53mm)	RN	mm	53		
Collector-Diameter	K	mm	76		
Collector covering	AD	mm	166		
Collector distance	KA	mm	634		
Fin spacing	LT	mm	2.500		
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	35.000		
Tube interval on the depth	S2	mm	35.000		



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

RA-Hy: 35/35/12-18R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3
SA-Co: 35/35/12-18R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3

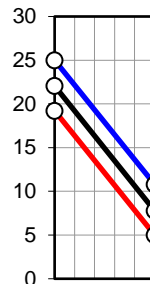
RA-Hy: EUR 10213.00
SA-Co: EUR 10213.00

CC-System (DIN EN 308)		SA-He	RA-Co	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Efficiency	%	71.070	71.056	
Capacity	kW	118.501	118.500	
Surface reserve	%	0.098	0.085	
Present surface	m2	1588.428	1588.428	

SA-He		Inlet	Outlet	Definition
Temp.	°C	5.000	19.214	20.000
Rel. humidity	%	0.000	0.000	40.000
Volume flow humid	m3/h	23502.367	24703.346	25000.000
Velocity	m/s	1.943	2.042	
Pressure drop	Pa		107.806	

RA-Co		Inlet	Outlet	Definition
Temp.	°C	25.000	10.789	20.000
Rel. humidity	%	0.000	0.000	40.000
Volume flow humid	m3/h	25192.212	23991.483	25000.000
Velocity	m/s	2.083	1.983	
Pressure drop (dry 111 Pa)	Pa		110.816	

25 V% Et.glycol		SA-He	RA-Co
Temp.	in °C	22.058	7.772
Temp.	out °C	7.772	22.058
Volume flow	m3/h	7.727	7.738
Velocity	m/s	1.015	1.017
Reynolds	---	5684.761	5079.539
Pressure drop	kPa	165.766	170.638



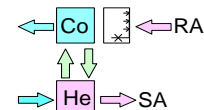
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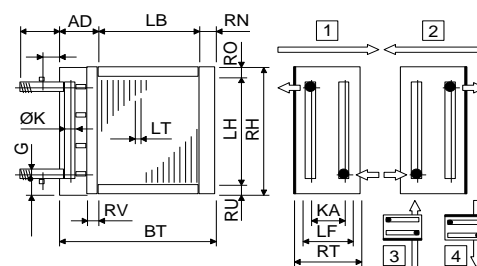
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Technical data		SA-He	RA-Co	SA-He	RA-Co
Tubes total	Piece	720	720	Tubes:	Cu
Tubes blank	Piece	0	0	Tubes:	smooth
Int. vent./drains	Piece	8	8	Tubes:	in line
Tube rows on the depth	Piece	18	18	Tubes:	circular
Tube rows on the height	Piece	40	40	Collectors:	Cu
Tube coupling in series	Piece	36	36	Connections:	Rg7
Number of circuits (NC)	Piece	20	20	Fins:	Al
Volume	l	204	204	Fins:	smooth
Weight	kg	698	698	Frame:	AlMg3
Connections	G	2 1/2"	2 1/2"	Protection:	without
Frame height	RH mm	1480	1480	Protection:	---
Frame width	BT mm	2619	2619	Air flow direction:	horizontal
Frame depth	RT mm	740	740		
Finned height	LH mm	1400	1400		
Finned width	LB mm	2400	2400		
Finned depth	LF mm	630	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	634	634		
Fin spacing	LT mm	2.500	2.500		
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		



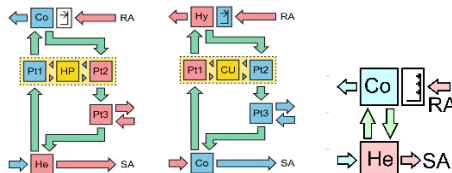
Delivery: 5-6 weeks
Validity: 12 weeks
Condit.: net, prepaid address
Payment: 30 days net

SA-He: 35/35/12-18R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3
RA-Co: 35/35/12-18R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3

SA-He: EUR 10213.00
RA-Co: EUR 10213.00

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	%	---	---	71.070
Capacity	kW	292.453	154.179	118.501
Surface reserve	%	0.324	0.343	0.098
Present surface	m2	1588.428	1588.428	1588.428

Supply air		Winter	Summer	DIN EN 308
Temp. in	°C	-11.000	32.000	5.000
Temp. out	°C	24.000	16.000	19.214
Volume flow humid	m3/h	25000.000	25000.000	25000.000
Pressure drop	Pa	105.623	124.416	107.806
Fan efficiency	---	0.700	0.700	0.700
Fan power	kW	1.048	1.234	1.070

Return air		Winter	Summer	DIN EN 308
Temp. in	°C	20.000	19.518	25.000
Temp. out	°C	-0.884	34.760	10.789
Volume flow humid	m3/h	25000.000	25000.000	25000.000
Pressure drop	Pa	126.616	119.173	110.816
Fan efficiency	---	0.700	0.700	0.700
Fan power	kW	1.256	1.182	1.099

25 V% Et.glycol		Winter	Summer	DIN EN 308
Volume flow	m3/h	7.788	8.941	7.727
Pressure drop Supply air	bar	1.697	2.143	1.658
Pressure drop Return air	bar	2.016	2.079	1.706
Pressure drop Hydraulics	bar	2.000	2.000	2.000
Pressure drop Total	bar	5.713	6.222	5.364
Pump efficiency	---	0.800	0.800	0.800
Pump power	kW	1.545	1.931	1.439

Refrig. compressor		Winter	Summer	DIN EN 308
Condenser - Evaporator	kW	19.919	19.910	19.919
Efficiency	---	0.800	0.800	0.800
Refrig. compressor	kW	24.899	24.887	24.899

Economy		Winter	Summer	DIN EN 308
Gross useful ratio with CC-System	kW	292.453	154.179	118.501
Need of energy with CC-System	kW	28.748	29.235	28.507
Net useful ratio with CC-System	kW	263.704	124.944	89.994
Coefficient of performance (COP)	---	10.173	5.274	4.157

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	28.748	29.235	28.507
Specific Recovery Power (SRP)	Ws/m3	2069.864	2104.931	2052.525



Nonsense !!!

Adiabatic return air cooling



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

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

$$N = K + L + M$$

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

$$X = \frac{V}{W}$$

$$Q = E + I + P$$

$$R = A - Q$$

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

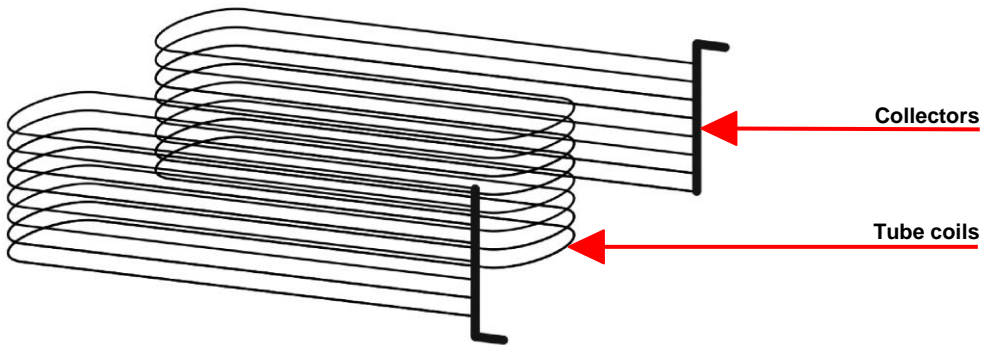
$$T = B + F$$

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

Normally, this value is less than 300 Ws/m3, but in this system more than 8 times what sufficiently says about this system. However, the holder of www.apess.de believes that its 2-stage heat recovery system is optimum among the many different systems. We refer to this system as CCSN Split and appear with the frost protection bypass where the biggest problem is to locate. In addition, you can read at www.apess.de, you can reach 100 % heat recovery with this patented 2-stage system, which reminds of the hair-raising nonsense one perpetuum Mobiles à la Daniel Düsentrrieb. If one believes that some patent attorney has exhibited such a corneal patent, which is easily challenged in court, so it has something good: the patent attorney has Heinz-Dieter Hombücher, the owner of Apess, money, which one only welcomes you can.

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.

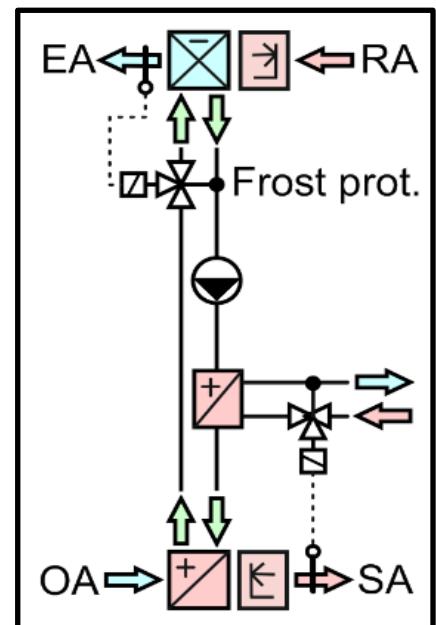
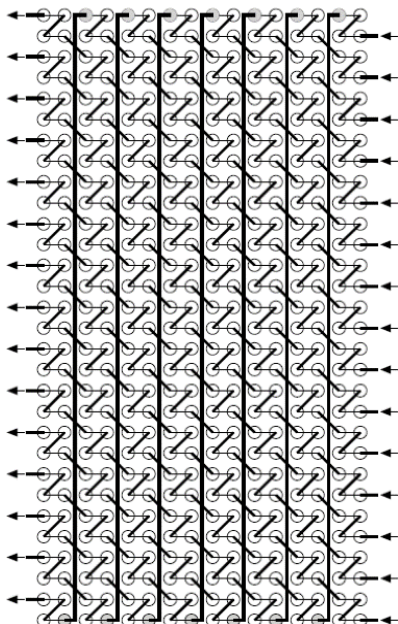


Typical applications			Heater	Cooler	CC-System
Pressure drop total	---	kPa	10.000	40.000	200.000
Coil pressure drop	T	kPa	6.500	33.000	193.000
Pressure drop collectors	C	kPa	3.500	7.000	7.000
Pressure ratio	T/C	---	1.857	4.714	27.571

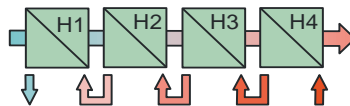
So if you really want to worry about optimal liquid distribution, turn to the air heater and air cooler, but certainly not to the heat exchangers in heat recovery! And yet there are absolute idiots who have applied for patents on an injection for heat recovery, i.e. exactly where it is totally superfluous.

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	7.788



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Air humid		Heater 1	Heater 2	Heater 3	Heater 4
Temp. Inlet	°C	-11.000	7.500	24.050	24.050
Rel. humidity Inlet	%	90.000	20.468	7.113	7.113
Temp. Outlet	°C	7.500	24.050	24.050	24.050
Rel. humidity Outlet	%	20.468	7.113	7.113	7.113
Pressure drop	Pa	57.648	49.942	0.000	0.000

25 V% Et.glycol		Heater 1	Heater 2	Heater 3	Heater 4
Temp. Inlet	°C	14.602	31.050	31.050	31.050
Temp. Outlet	°C	-4.000	14.602	31.050	31.050
Pressure drop	kPa	100.349	72.136	0.000	0.000

Heat exchanger		Heater 1	Heater 2	Heater 3	Heater 4
Capacity	kW	154.547	138.323	0.000	0.000
Surface reserve	%	0.197	0.042	0.000	0.000
Present surface	m2	892.724	714.179	0.000	0.000
Required surface	m2	890.970	713.879	0.000	0.000
k-coeff.	W/m2K	25.692	28.999	0.000	0.000
Average temp. diff.	K	6.751	6.682	0.000	0.000

Tubes blank	Piece	0	0	0	0
Int. vent./drains	Piece	4	3	0	0
Tube rows on the depth	Piece	10	8	0	0
Tube rows on the height	Piece	40	40	0	0
Number of circuits (NC)	Piece	20	20	0	0
Volume	l	119	98	0	0
Weight	kg	401	325	0	0
Connections	G	2 ½"	2 ½"	0	0
Frame height	RH	1480	1480	0	0
Frame width	BT	2619	2619	0	0
Frame depth	RT	460	390	0	0
Finned height	LH	1400	1400	0	0
Finned width	LB	2400	2400	0	0
Frame on top	RO	40	40	0	0
Frame on bottom	RU	40	40	0	0
Frame in front	RV	30	30	0	0
Frame on back (~53/53/0/0)	RN	53	53	0	0
Collector covering	AD	166	166	0	0
Fin spacing	LT	2.470	2.470	0.000	0.000
Fin thickness	LD	0.200	0.200	0.000	0.000
Tube diameter	DA	12.400	12.400	0.000	0.000
Tube thickness	S	0.400	0.400	0.000	0.000
Tube interval on the height	S1	35.000	35.000	0.000	0.000
Tube interval on the depth	S2	35.000	35.000	0.000	0.000

Tubes	Cu	Cu	---	---
Tubes	smooth	smooth	---	---
Collector	Cu	Cu	---	---
Connections	Rg7	Rg7	---	---
Fins	Al	Al	---	---
Fins	smooth	smooth	---	---
Frame	AlMg3	AlMg3	---	---
Protection	without	without	---	---
Protection	---	---	---	---

Heater 1: 35/35/12-10R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3

Heater 2: 35/35/12-8R-40T-2400A-2.5PA-20C-Cu/Al/AlMg3

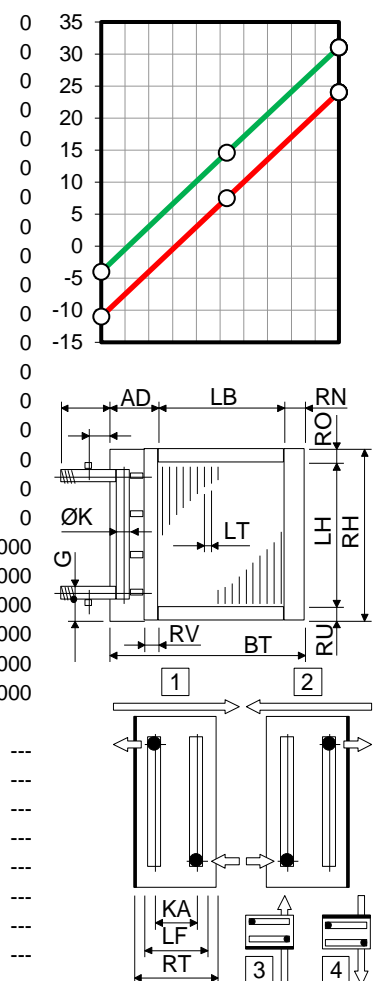
Heater 3: ---

Heater 4: ---

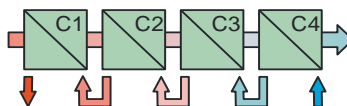
Total

EUR 5939.00
EUR 4862.00
EUR 0.00
EUR 0.00
EUR 10801.00

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	7.788



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

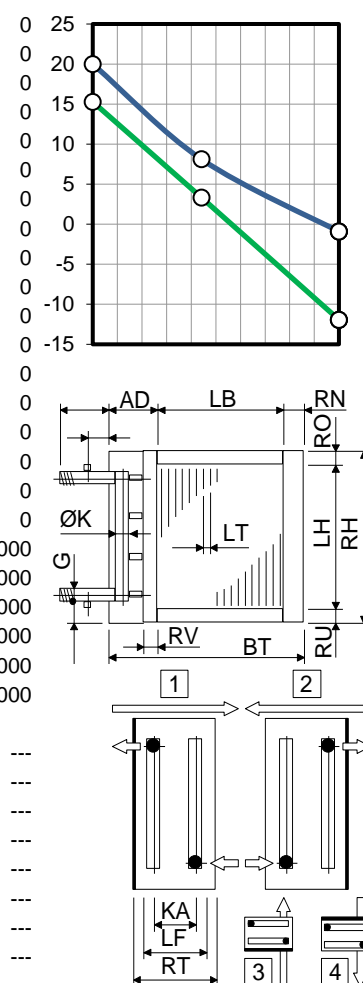
Air humid		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Temp. Inlet	°C	20.000	8.100	-0.915	-0.915
Rel. humidity Inlet	%	40.000	86.386	100.000	100.000
Temp. Outlet	°C	8.100	-0.915	-0.915	-0.915
Rel. humidity Outlet	%	86.386	100.000	100.000	100.000
Pressure drop	Pa	58.357	56.205	0.000	0.000

25 V% Et.glycol		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Temp. Inlet	°C	3.312	-11.929	-11.929	-11.929
Temp. Outlet	°C	15.284	3.312	-11.929	-11.929
Pressure drop	kPa	98.176	88.741	0.000	0.000

Heat exchanger		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Capacity	kW	100.266	126.439	0.000	0.000
Surface reserve	%	0.032	0.250	0.000	0.000
Present surface	m2	825.702	660.562	0.000	0.000
Required surface	m2	825.441	658.916	0.000	0.000
k-coeff.	W/m2K	27.665	27.276	0.000	0.000
Average temp. diff.	K	4.391	7.035	0.000	0.000

Tubes blank	Piece	0	0	0
Int. vent./drains	Piece	4	3	0
Tube rows on the depth	Piece	10	8	0
Tube rows on the height	Piece	40	40	0
Number of circuits (NC)	Piece	20	20	0
Volume	l	119	98	0
Weight	kg	383	311	0
Connections	G	2 1/2"	2 1/2"	0
Frame height	RH	1480	1480	0
Frame width	BT	2619	2619	0
Frame depth	RT	460	390	0
Finned height	LH	1400	1400	0
Finned width	LB	2400	2400	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
Fin spacing	LT	2.680	2.680	0.000
Fin thickness	LD	0.200	0.200	0.000
Tube diameter	DA	12.400	12.400	0.000
Tube thickness	S	0.400	0.400	0.000
Tube interval on the height	S1	35.000	35.000	0.000
Tube interval on the depth	S2	35.000	35.000	0.000

Tubes	Cu	Cu	---	---
Tubes	smooth	smooth	---	---
Collector	Cu	Cu	---	---
Connections	Rg7	Rg7	---	---
Fins	Al	Al	---	---
Fins	smooth	smooth	---	---
Frame	AlMg3	AlMg3	---	---
Protection	without	without	---	---
Protection	---	---	---	---



Cooler 1: 35/35/12-10R-40T-2400A-2.7PA-20C-Cu/Al/AlMg3

EUR 5783.00

Delivery: 5-6 weeks

Cooler 2: 35/35/12-8R-40T-2400A-2.7PA-20C-Cu/Al/AlMg3

EUR 4737.00

Validity: 12 weeks

Cooler 3: ---

EUR 0.00

Condit.: net, prepaid address

Cooler 4: ---

EUR 0.00

Payment: 30 days net

Total

EUR 10520.00