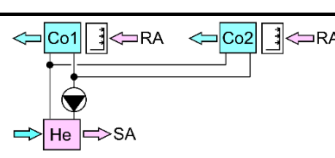


CC-System in winter			SA-He	RA-Co1	RA-Co2
Efficiency		%	72.569	55.000	53.514
Capacity		kW	115.694	62.820	52.874
Surface reserve		%	1.152	1.721	2.675
Present surface		m2	951.402	517.710	363.823
Air humid			SA-He	RA-Co1	RA-Co2
Temp.	in	°C	-13.000	20.000	22.000
Rel. humidity	in	%	90.000	40.000	50.000
Abs. humidity	in	g/kg	1.156	6.145	8.719
Temp.	out	°C	11.528	1.850	3.270
Rel. humidity	out	%	13.029	99.744	100.000
Abs. humidity	out	g/kg	1.156	4.584	5.086
Volume flow humid		m3/h	15000.000	9000.000	6000.000
Mass flow dry		kg/h	16840.689	10104.413	6736.276
Velocity		m/s	2.070	2.029	1.920
Pressure drop		Pa	98.537	102.736	129.999
30 V% Et.glycol			SA-He	RA-Co1	RA-Co2
Volume flow		m3/h	6.051	3.424	2.626
Temp.	in	°C	14.091	-4.100	-4.100
Temp.	out	°C	-4.100	13.400	15.100
Velocity		m/s	1.136	1.125	1.151
Pressure drop		kPa	196.879	195.055	196.214
Definition					
Height over sea level	m	500.000			
Pressure	hPa	954.276			
Temp.	°C	20.000			
Rel. humidity	%	40.000			
Abs. humidity	g/kg	6.145			
					
Technical data			SA-He	RA-Co1	RA-Co2
Tubes total	Piece		450	256	256
Tubes blank	Piece		2	0	4
Int. vent./drains	Piece		8	7	7
Tube rows on the depth	Piece		18	16	16
Tube rows on the height	Piece		25	16	16
Tube coupling in series	Piece		32	32	42
Number of circuits (NC)	Piece		14	8	6
Volume	l		119	65	46
Weight	kg		476	277	271
Connections	G	---	2"	1 1/2"	1 1/4"
Frame height	RH	mm	955	640	640
Frame width	BT	mm	2496	2384	1727
Frame depth	RT	mm	690	600	590
Finned height	LH	mm	875	560	560
Finned width	LB	mm	2300	2200	1550
Finned depth	LF	mm	630	560	560
Frame on top	RO	mm	40	40	40
Frame on bottom	RU	mm	40	40	40
Frame in front	RV	mm	30	30	30
Frame on back (~53/53/53)	RN	mm	53	53	53
Collector-Diameter	K	mm	54	42	35
Collector covering	AD	mm	143	131	124
Fin spacing	LT	mm	2.500	2.500	2.500
Fin thickness	LD	mm	0.200	0.200	0.350
Tube diameter	DA	mm	12.400	12.400	12.400
Tube diameter	da	mm	12.400	12.400	12.400
Tube thickness	S	mm	0.400	0.400	0.400
Tube interval on the height	S1	mm	35.000	35.000	35.000
Tube interval on the depth	S2	mm	35.000	35.000	35.000
Tubes	---		Cu / smooth	Cu / smooth	Cu / smooth
Tubes	---		in line	in line	in line
Tubes	---		circular	circular	circular
Collector / Connections	---		Cu / Rg7	Cu / Rg7	Cu / Rg7
Fins	---		Al	Al	Al
Fins	---		smooth	smooth	smooth
Frame	---		AISI 304	AISI 304	AISI 304
Protection	---		without	without	gold coated
Protection	---		---	---	4 µ vinyl
Price	EUR		6605.00	3879.00	4186.00



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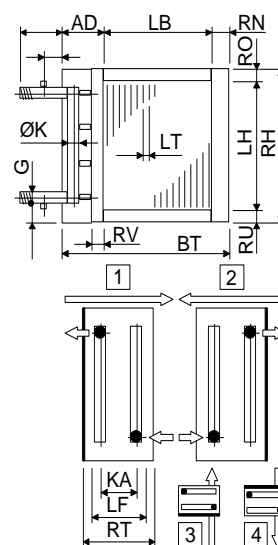
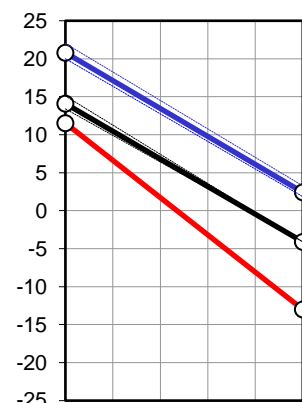
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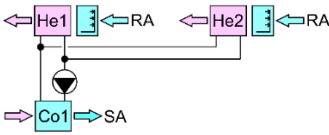
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Delivery: 5-6 weeks
Validity: 12 weeks
Condit.: prepaid address
Payment: 30 days net

total net: 14670.00

CC-System in summer			SA-Co	RA-He1	RA-He2
Efficiency		%	69.256	72.814	57.145
Capacity		kW	33.263	26.656	6.607
Surface reserve		%	0.006	0.090	0.091
Present surface		m2	951.402	517.710	363.823
Air humid			SA-Co	RA-He1	RA-He2
Temp.	in	°C	32.000	19.394	26.000
Rel. humidity	in	%	40.000	100.000	55.000
Abs. humidity	in	g/kg	12.608	15.005	12.256
Temp.	out	°C	25.099	28.573	29.429
Rel. humidity	out	%	59.647	57.688	45.041
Abs. humidity	out	g/kg	12.608	15.005	12.256
Volume flow humid		m3/h	15000.000	9000.000	6000.000
Mass flow dry		kg/h	16840.689	10104.413	6736.276
Velocity		m/s	2.070	2.029	1.920
Pressure drop		Pa	116.202	98.710	108.993
30 V% Et.glycol			SA-Co	RA-He1	RA-He2
Volume flow		m3/h	6.051	3.424	2.624
Temp.	in	°C	24.482	29.664	29.664
Temp.	out	°C	29.664	22.326	27.293
Velocity		m/s	1.136	1.125	1.149
Pressure drop		kPa	169.929	160.656	161.613
Definition					
Height over sea level	m	500.000			
Pressure	hPa	954.276			
Temp.	°C	20.000			
Rel. humidity	%	40.000			
Abs. humidity	g/kg	6.145			
					
Technical data			SA-Co	RA-He1	RA-He2
Tubes total	Piece		450	256	256
Tubes blank	Piece		2	0	4
Int. vent./drains	Piece		8	7	7
Tube rows on the depth	Piece		18	16	16
Tube rows on the height	Piece		25	16	16
Tube coupling in series	Piece		32	32	42
Number of circuits (NC)	Piece		14	8	6
Volume	l		119	65	46
Weight	kg		476	277	271
Connections	G	---	2"	1 1/2"	1 1/4"
Frame height	RH	mm	955	640	640
Frame width	BT	mm	2496	2384	1727
Frame depth	RT	mm	690	600	590
Finned height	LH	mm	875	560	560
Finned width	LB	mm	2300	2200	1550
Finned depth	LF	mm	630	560	560
Frame on top	RO	mm	40	40	40
Frame on bottom	RU	mm	40	40	40
Frame in front	RV	mm	30	30	30
Frame on back (~53/53/53)	RN	mm	53	53	53
Collector-Diameter	K	mm	54	42	35
Collector covering	AD	mm	143	131	124
Fin spacing	LT	mm	2.500	2.500	2.500
Fin thickness	LD	mm	0.200	0.200	0.350
Tube diameter	DA	mm	12.400	12.400	12.400
Tube diameter	da	mm	12.400	12.400	12.400
Tube thickness	S	mm	0.400	0.400	0.400
Tube interval on the height	S1	mm	35.000	35.000	35.000
Tube interval on the depth	S2	mm	35.000	35.000	35.000
Tubes	---	Cu / smooth	Cu / smooth	Cu / smooth	Cu / smooth
Tubes	---	in line	in line	in line	in line
Tubes	---	circular	circular	circular	circular
Collector / Connections	---	Cu / Rg7	Cu / Rg7	Cu / Rg7	Cu / Rg7
Fins	---	Al	Al	Al	Al
Fins	---	smooth	smooth	smooth	smooth
Frame	---	AISI 304	AISI 304	AISI 304	AISI 304
Protection	---	without	without	gold coated	gold coated
Protection	---	---	---	---	4 µ vinyl
Price	EUR		6605.00	3879.00	4186.00



Company
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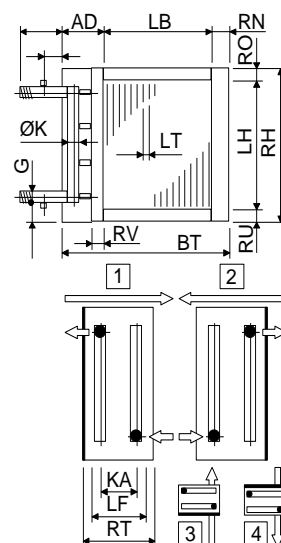
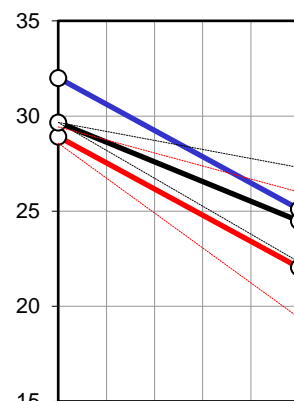
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Position

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

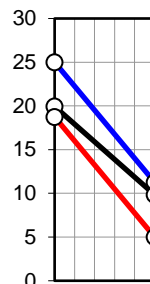
total net: 14670.00

CC-System (DIN EN 308)		SA-He	RA-Co	Definition
Height over sea level	m			500.000
Pressure	hPa			954.276
Efficiency	%	68.707	68.691	
Capacity	kW	64.698	64.697	
Surface reserve	%	0.093	0.097	
Present surface	m2	951.402	881.532	

SA-He		Inlet	Outlet	Definition
Temp.	°C	5.000	18.741	20.000
Rel. humidity	%	0.000	0.000	40.000
Volume flow humid	m3/h	14093.320	14789.542	15000.000
Velocity	m/s	1.945	2.041	2.070
Pressure drop	Pa		104.629	

RA-Co		Inlet	Outlet	Definition
Temp.	°C	25.000	11.262	20.000
Rel. humidity	%	0.000	0.000	40.000
Volume flow humid	m3/h	15106.644	14410.583	15000.000
Velocity	m/s	1.998	1.906	1.984
Pressure drop (dry 96 Pa)	Pa		96.031	

30 V% Et.glycol		SA-He	RA-Co
Temp.	in °C	19.933	9.838
Temp.	out °C	9.838	19.933
Volume flow	m3/h	6.069	6.077
Velocity	m/s	1.139	1.141
Reynolds	---	5444.811	5018.135
Pressure drop	kPa	183.163	176.423



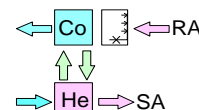
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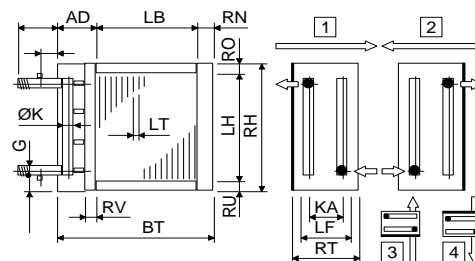
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Technical data		SA-He	RA-Co	SA-He	RA-Co
Tubes total	Piece	450	512	Tubes:	Cu
Tubes blank	Piece	2	8	Tubes:	smooth
Int. vent./drains	Piece	8	7	Tubes:	in line
Tube rows on the depth	Piece	18	16	Tubes:	circular
Tube rows on the height	Piece	25	32	Collectors:	Cu
Tube coupling in series	Piece	32	36	Connections:	Rg7
Number of circuits (NC)	Piece	14	14	Fins:	Al
Volume	l	119	113	Fins:	smooth
Weight	kg	476	509	Frame:	AISI 304
Connections	G	---	2"	Protection:	without
Frame height	RH	mm	1200	Protection:	---
Frame width	BT	mm	2496		
Frame depth	RT	mm	690		
Finned height	LH	mm	875		
Finned width	LB	mm	2300		
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	54		
Collector covering	AD	mm	143		
Collector distance	KA	mm	612		
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		



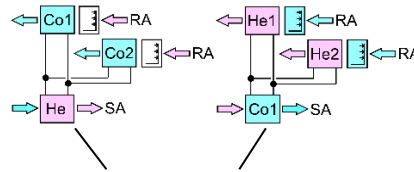
Delivery: 5-6 weeks
Validity: 12 weeks
Condit.: net, prepaid address
Payment: 30 days net

SA-He: 35/35/12-18R-25T-2300A-2.5PA-14C-Cu/Al/AISI 304
RA-Co1: 35/35/12-16R-32T-1875A-2.5PA-14C-Cu/Al/AISI 304

SA-He: EUR 6605.00
RA-Co: EUR 8065.00

Economy with CC-System

Base value	Definition
Height over sea level	m 500.000
Pressure	bar 954.276
Volume flow humid at	°C 20.000
Volume flow humid at	% 40.000



CC-System		Winter	Summer	DIN EN 308
Efficiency Supply air	%	72.569	69.256	68.707
Capacity	kW	115.694	33.263	64.698
Surface reserve	%	1.152	0.006	0.093
Present surface	m2	951.402	951.402	951.402

Supply air		Winter	Summer	DIN EN 308
Temp. in	°C	-13.000	32.000	5.000
Temp. out	°C	90.000	40.000	18.741
Volume flow humid	m3/h	15000.000	15000.000	15000.000
Pressure drop	Pa	98.537	116.202	104.629
Fan efficiency	---	0.700	0.700	0.700
Fan power	kW	0.587	0.692	0.623

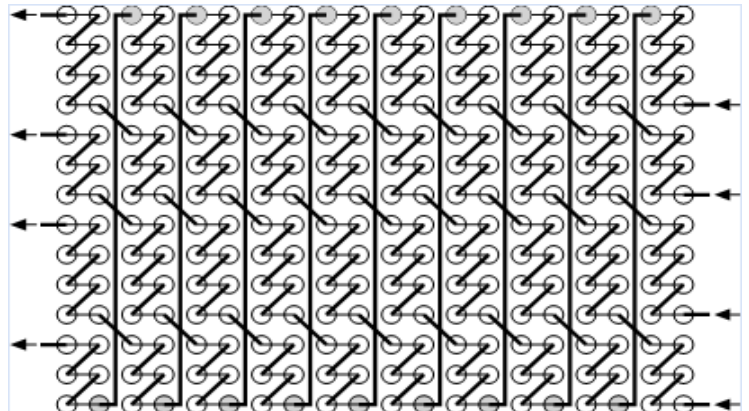
Return air		Winter	Summer	DIN EN 308
Temp. in	°C	20.800	22.036	25.000
Temp. out	°C	44.000	82.000	11.262
Volume flow humid	m3/h	15000.000	15000.000	15000.000
Pressure drop	Pa	113.641	102.824	96.031
Fan efficiency	---	0.700	0.700	0.700
Fan power	kW	0.676	0.612	0.572

30 V% Et.glycol		Winter	Summer	DIN EN 308
Volume flow	m3/h	6.051	6.047	6.069
Pressure drop Supply air	bar	1.969	1.699	1.832
Pressure drop Return air	bar	1.956	1.611	1.764
Pressure drop Hydraulics	bar	2.000	2.000	2.000
Pressure drop Total	bar	5.925	5.311	5.596
Pump efficiency	---	0.800	0.800	0.800
Pump power	kW	1.245	1.115	1.179

Economy		Winter	Summer	DIN EN 308
Gross useful ratio with CC-System	kW	115.694	33.263	64.698
Need of energy with CC-System	kW	2.508	2.419	2.374
Net useful ratio with CC-System	kW	113.186	30.845	62.324
Coefficient of performance (COP)	---	46.134	13.752	27.257

Economy		Winter	Summer	DIN EN 308
Volume flow humid Total	m3/h	30000.000	30000.000	30000.000
Need of energy with CC-System	kW	2.508	2.419	2.374
Specific Recovery Power (SRP)	Ws/m3	300.932	290.260	284.837

RA-He1: Adiabatic return air cooling = Yes
RA-He2: Adiabatic return air cooling = No



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

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

$$N = K + L + M$$

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

$$Q = E + I + P$$

$$R = A - Q$$

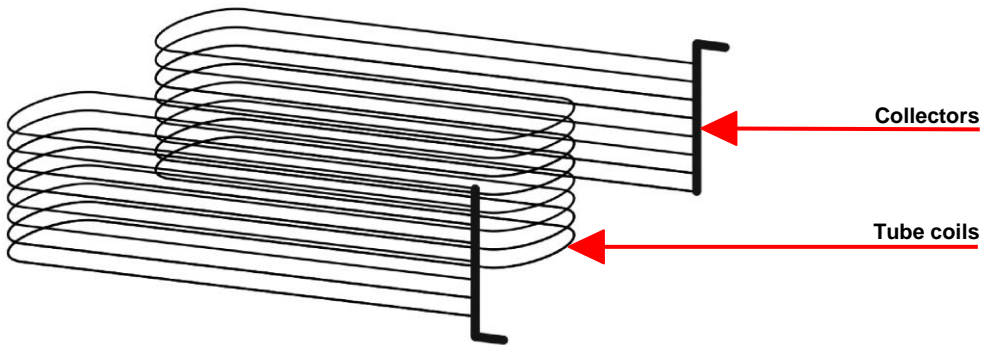
$$S = \frac{A}{Q}$$

$$T = B + F$$

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

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

