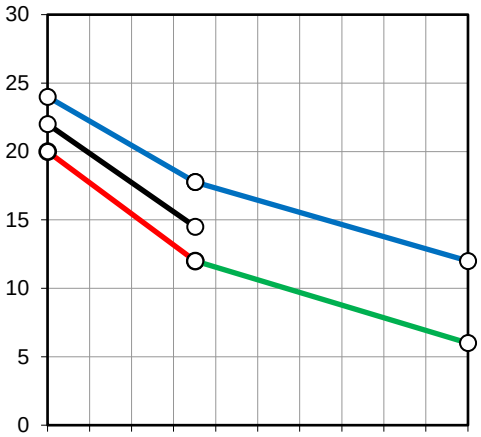
Dehumidifying		Co1	Co2	He	Co1+Co2
Capacity	kW	67.770	125.227	67.770	**192.997**
Surface reserve	%	2.259	3.599	2.680	
Present surface	m2	1148.963	514.746	1148.963	
Temp. in	°C	24.000	17.760	12.000	
Rel. humidity in	%	70.000	97.335	100.000	
Abs. humidity in	g/kg	13.060	12.370	8.727	
Temp. out	°C	17.760	12.000	20.000	
Rel. humidity out	%	97.335	100.000	60.070	
Abs. humidity out	g/kg	12.370	8.727	8.727	
Velocity	m/s	1.932	1.889	1.888	
Pressure drop	Pa	75.443	44.879	66.174	

Definition		
Height over sea level	m	0.000
Pressure	hPa	1013.250
Temp.	°C	20.000
Rel. humidity	%	40.000
Supply air	m3/h	25000.000

25 V% Et.glycol		
Temp. in	°C	14.500
Temp. out	°C	22.000
Volume flow	m3/h	8.408
Pressure drop total	kPa	278.958

Water		SA-Co2
Temp. in	°C	6.000
Temp. out	°C	12.000
Volume flow	m3/h	17.918
Pressure drop	kPa	38.636

Co1 = 35.115 % **Co2 = 64.885 %**



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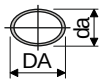
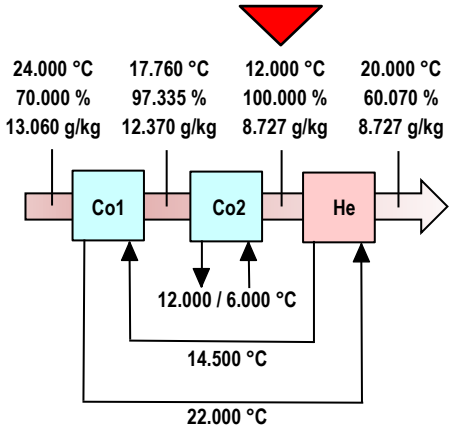
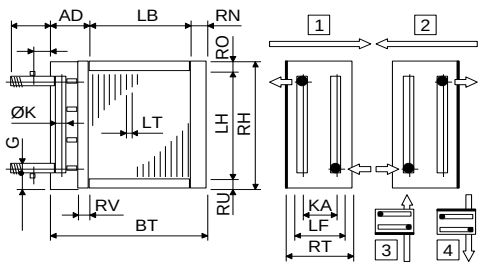
Technical data		Co1	Co2	He
Tubes blank	Piece	0	0	0
Int. vent./drains	Piece	5	0	5
Tube rows on the depth	Piece	12	6	12
Tube rows on the height	Piece	40	40	40
Number of circuits (NC)	Piece	20	40	20
Volume	l	144	82	144
Weight	kg	554	284	554
Connections	G	2"	2 ½"	2"
Frame height	RH	1480	1480	1480
Frame width	BT	2800	2800	2800
Frame depth	RT	480	280	480
Finned height	LH	1400	1400	1400
Finned width	LB	2604	2600	2604
Frame on top	RO	40	40	40
Frame on bottom	RU	40	40	40
Frame in front	RV	30	30	30
Frame on back (~53/53/53)	RN	53	53	53
Collector covering	AD	143	147	143
Fin spacing	LT	2.500	2.800	2.500
Fin thickness	LD	0.200	0.200	0.200
Tube diameter	DA	12.400	12.400	12.400
Tube diameter	da	12.400	12.400	12.400
Tube thickness	S	0.400	0.400	0.400
Tube interval on the height	S1	35.000	35.000	35.000
Tube interval on the depth	S2	35.000	35.000	35.000
Tubes	---	Cu	Cu	Cu
Tubes	---	smooth	smooth	smooth
Tubes	---	in line	in line	in line
Tubes	Type	circular	circular	circular
Collector	---	Cu	Cu	Cu
Connections	---	Rg7	Rg7	Rg7
Fins	---	Al	Al	Al
Fins	---	smooth	smooth	smooth
Frame	---	AISI 304	AISI 304	AISI 304
Protection	---	without	without	without
Protection	---	---	---	---
Price	**EUR**	**7568.00**	**4047.00**	**7568.00**



Wire mesh droplet eliminator (Demister)
Drop eliminator: Pressure drop > 100 Pa !!!





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

Economy: Dehumidifying		
Height over sea level	m	0.000
Pressure	hPa	1013.250
Temp.	°C	20.000
Rel. humidity	%	40.000

Definition
Supply air

Cold recovery		Dehumidifying
Efficiency	**%**	**35.115**
Capacity	kW	67.770

Cold recovery		Cooler
Present surface	m2	1148.963
Surface reserve	%	2.259
Temp. in	°C	24.000
Temp. out	°C	17.760
Volume flow humid	m3/h	25000.000
Pressure drop	Pa	75.443
Fan efficiency	---	0.700
Fan power	kW	0.748

Cold recovery		Heater
Present surface	m2	1148.963
Surface reserve	%	2.680
Temp. in	°C	12.000
Temp. out	°C	20.000
Volume flow humid	m3/h	25000.000
Pressure drop	Pa	66.174
Fan efficiency	---	0.700
Fan power	kW	0.656

Cooler: additional		Cooler
Present surface	m2	514.746
Surface reserve	%	3.599
Temp. in	°C	17.760
Temp. out	°C	12.000
Volume flow humid	m3/h	25000.000
Pressure drop	Pa	44.879
Fan efficiency	---	0.700
Fan power	kW	0.445

25 V% Et.glycol		Cold recovery
Volume flow	m3/h	8.408
Pressure drop Cold recovery	bar	1.396
Pressure drop Cold recovery	bar	1.394
Pressure drop Hydraulics	bar	2.000
Pressure drop Total	bar	4.790
Pump efficiency	---	0.800
Pump power	kW	1.398

Water		additional
Volume flow	m3/h	17.918
Pressure drop	bar	0.386
Pressure drop Hydraulics	bar	1.000
Pressure drop Total	bar	1.386
Pump efficiency	---	0.800
Pump power	kW	0.863

Economy		Dehumidifying
Gross useful ratio with CC-System	kW	67.770
Need of energy with CC-System	kW	4.111
Net useful ratio with CC-System	kW	63.659
Coefficient of performance (COP)	**---**	**16.485**

Economy		Dehumidifying
Volume flow humid Total	m3/h	25000.000
Need of energy with CC-System	kW	4.111
Specific Recovery Power (SRP)	**Ws/m3**	**591.975**

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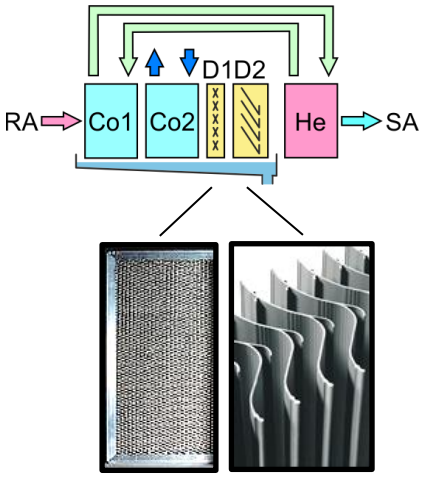
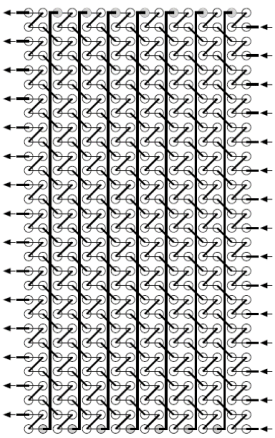
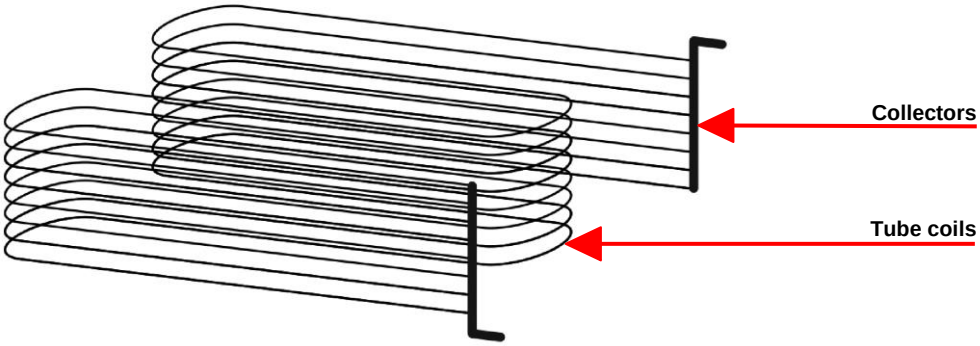


If there is a purely recirculating air operation and a lot of moisture has to be extracted from the air, part of the performance can take place via cold recovery. The rest, for example, has to be cooled with cold water from 6 to 12°C, which results in high operating costs.



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**

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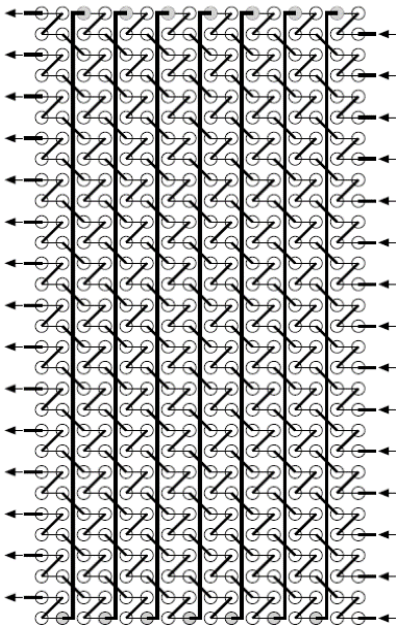
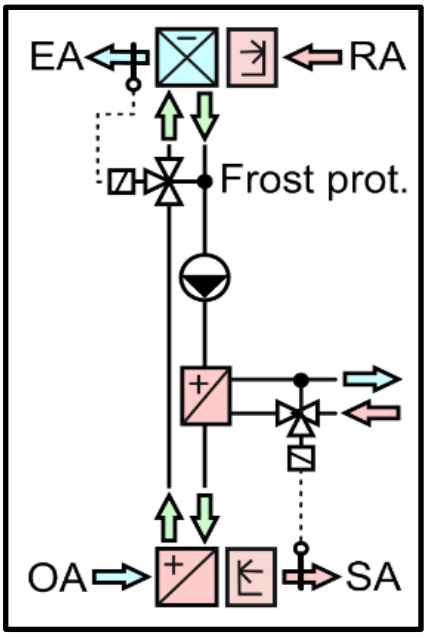
So if you really want to worry about optimal liquid distribution, turn to the air heater and air cooler, but certainly not to the heat exchangers in heat recovery! And yet there are absolute idiots who have applied for patents on an injection for heat recovery, i.e. exactly where it is totally superfluous.

www.maag.com

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.





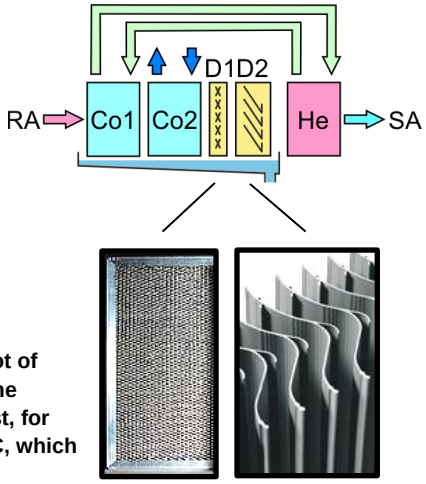
Dehumidifying

RA: Return air
SA: Supply air

Co1: Cold recovery - Cooler
He: Cold recovery - Heater

Co2: Cooler additional

D1: Wire mesh droplet eliminator (Demister)
D2: Drop eliminator: Pressure drop > 100 Pa !!!



If there is a purely recirculating air operation and a lot of moisture has to be extracted from the air, part of the performance can take place via cold recovery. The rest, for example, has to be cooled with cold water from 6 to 12°C, which results in high operating costs.

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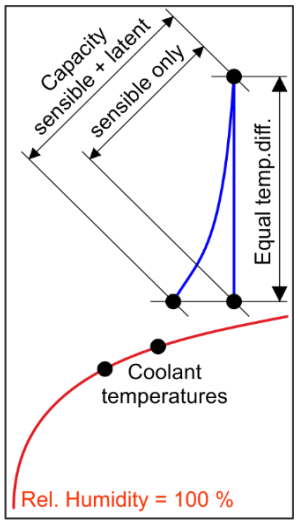
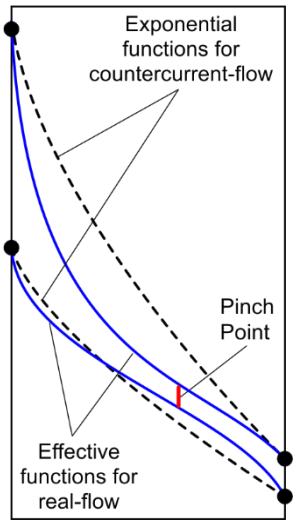
Both coolers must have smooth fins, which allow the condensate to drain away. The thickness of the lamellas should be at least 0,2 mm in order to generate large condensate droplets. These are combined into even larger droplets in the upstream demister and separated in the downstream droplet eliminator. Droplet eliminators must have a pressure loss of at least 100 Pa in order to ensure a high degree of fractional separation.

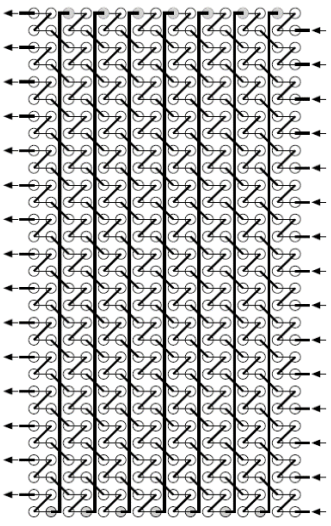
If this advice is not followed, you shouldn't be surprised if the air heater in the cold recovery does not reach the required air outlet temperature and the air outlet humidity is much too high. The main cause is the poor degree of condensate separation. Some of the condensate gets into the air heater, which is really not the point. Sisyphus sends his regards!

Counter-current flow in laminated heat exchangers only exists in the imagination of some producers who do not care whether the temperature efficiency of heat recovery systems is only 50 % instead of the promised 70 %! One hopes that it will not be measured. The correct procedure is described below and has been confirmed by measurements in the laboratory.

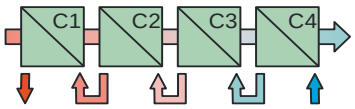
For humid air cooling, the opinions about the latent capacity deferred share far apart. Only those which calculated the cooling process with finite elements, can accurately determine, how the cooling process expires. For the humid air and the coolant, during the cooling process, Reynolds go down and Prandtl go up. That's reason the k-value go down. Once formed condensate however, the k-value go up. This can be done only by finite elements taken into account. The beautiful exponential temperature gradients in the chart right must be forgotten, just because at the beginning sensitive capacity exists only and at the end only, latent capacity can be removed. The temperature gradients deform. Since the temperature difference Δtm must understood as surface between the two temperature gradients, this reduced that extreme, well understood in counter-current-flow too! As pinch point means in the thermodynamic process technology the smallest temperature difference between the two media, whether this value between several heat exchangers or inside a heat exchanger occurs. Conclusion: Latent heat reduce the average temperature difference!







Definition		
Height over sea level	m	0.00
Pressure	hPa	1013.25
Temp.	°C	20.00
Rel. humidity	%	40.00
Air humid	m3/h	25000.00
25 V% Et.glycol	m3/h	8.41



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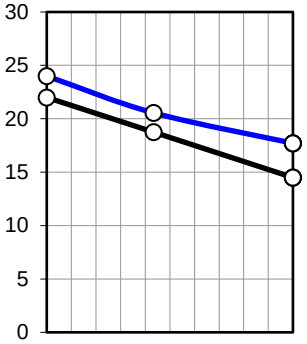
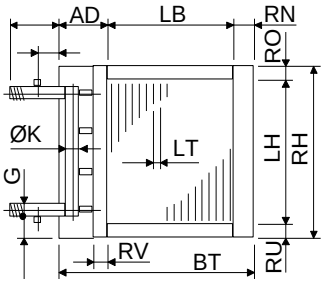
Air humid		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Temp. Inlet	°C	24.00	20.55	17.71	17.71
Rel. humidity Inlet	%	70.00	86.29	97.75	97.75
Temp. Outlet	°C	20.55	17.71	17.71	17.71
Rel. humidity Outlet	%	86.29	97.75	97.75	97.75
Pressure drop	Pa	37.33	43.68	0.00	0.00

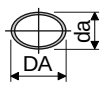
25 V% Et.glycol		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Temp. Inlet	°C	18.75	14.50	14.50	14.50
Temp. Outlet	°C	22.00	18.75	14.50	14.50
Pressure drop (103.47 %)	kPa	71.52	72.89	0.00	0.00

Heat exchanger		Cooler 1	Cooler 2	Cooler 3	Cooler 4
Capacity	kW	29.44	38.36	0.00	0.00
Surface reserve	%	0.22	0.48	0.00	0.00
Present surface	m2	612.10	612.10	0.00	0.00
Required surface	m2	610.74	609.19	0.00	0.00
k-coeff.	W/m2K	28.26	30.56	0.00	0.00
Average temp. diff.	K	1.71	2.06	0.00	0.00

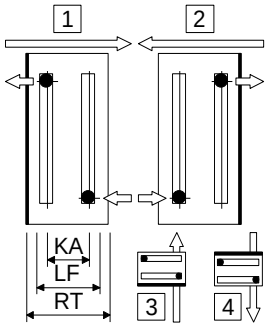


Tubes blank	Piece	0	0	0	0
Int. vent./drains	Piece	2	2	0	0
Tube rows on the depth	Piece	6	6	0	0
Tube rows on the height	Piece	40	40	0	0
Number of circuits (NC)	Piece	20	20	0	0
Volume	l	76	76	0	0
Weight	kg	303	303	0	0
Connections	G	2"	2"	0	0
Frame height	RH	1480	1480	0	0
Frame width	BT	2800	2800	0	0
Frame depth	RT	270	270	0	0
Finned height	LH	1400	1400	0	0
Finned width	LB	2604	2604	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	143	143	0	0



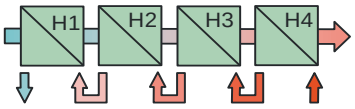


Tubes	Type	circular	circular	---	---
Tubes	DA / da	12.40 / 12.40	12.40 / 12.40	---	---
Tubes	S1 / S2	35.00 / 35.00	35.00 / 35.00	---	---
Tubes	---	in line	in line	---	---
Tubes	---	Cu	Cu	---	---
Tubes	---	smooth	smooth	---	---
Collector	---	Cu	Cu	---	---
Connections	---	Rg7	Rg7	---	---
Fins	LT / LD	2.34 / 0.20	2.34 / 0.20	---	---
Fins	---	Al	Al	---	---
Fins	---	smooth	smooth	---	---
Frame	---	AISI 304	AISI 304	---	---
Protection	---	without	without	---	---
Protection	---	---	---	---	---
Air flow direction	---	horizontal	horizontal	---	---



Cooler 1: 35/35/12-6R-40T-2604A-2.3PA-20C-Cu/Al/AISI 304	EUR	4114.00	Delivery:	5-6 weeks
Cooler 2: 35/35/12-6R-40T-2604A-2.3PA-20C-Cu/Al/AISI 304	EUR	4114.00	Validity:	12 weeks
Cooler 3: ---	EUR	0.00	Condit.:	net, prepaid address
Cooler 4: ---	EUR	0.00	Payment:	30 days net
Total	**EUR**	**8228.00**		

Definition		
Height over sea level	m	0.00
Pressure	hPa	1013.25
Temp.	°C	20.00
Rel. humidity	%	40.00
Air humid	m3/h	25000.00
25 V% Et.glycol	m3/h	8.41



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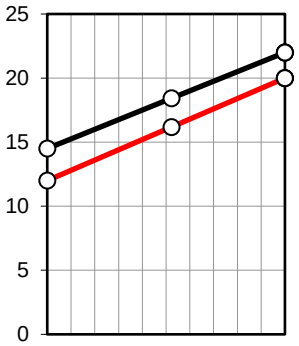
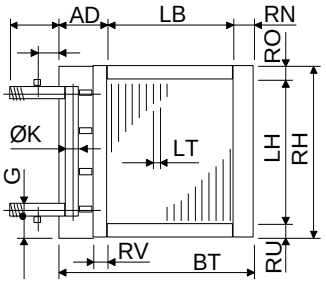
Air humid		Heater 1	Heater 2	Heater 3	Heater 4
Temp. Inlet	°C	12.00	16.18	20.00	20.00
Rel. humidity Inlet	%	100.00	76.30	60.07	60.07
Temp. Outlet	°C	16.18	20.00	20.00	20.00
Rel. humidity Outlet	%	76.30	60.07	60.07	60.07
Pressure drop (98.60 %)	Pa	32.31	32.93	0.00	0.00

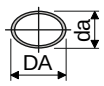
25 V% Et.glycol		Heater 1	Heater 2	Heater 3	Heater 4
Temp. Inlet	°C	18.43	22.00	22.00	22.00
Temp. Outlet	°C	14.50	18.43	22.00	22.00
Pressure drop (103.62 %)	kPa	72.92	71.47	0.00	0.00

Heat exchanger		Heater 1	Heater 2	Heater 3	Heater 4
Capacity	kW	35.44	32.33	0.00	0.00
Surface reserve	%	0.48	0.33	0.00	0.00
Present surface	m2	562.01	562.01	0.00	0.00
Required surface	m2	559.32	560.13	0.00	0.00
k-coeff.	W/m2K	28.15	28.73	0.00	0.00
Average temp. diff.	K	2.25	2.01	0.00	0.00

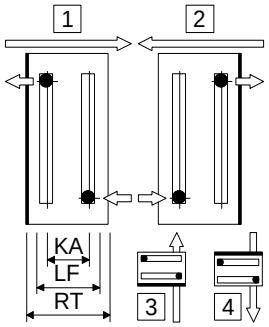


Tubes blank	Piece	0	0	0	0
Int. vent./drains	Piece	2	2	0	0
Tube rows on the depth	Piece	6	6	0	0
Tube rows on the height	Piece	40	40	0	0
Number of circuits (NC)	Piece	20	20	0	0
Volume	l	76	76	0	0
Weight	kg	289	289	0	0
Connections	G	2"	2"	0	0
Frame height	RH	1480	1480	0	0
Frame width	BT	2800	2800	0	0
Frame depth	RT	270	270	0	0
Finned height	LH	1400	1400	0	0
Finned width	LB	2604	2604	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	143	143	0	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	2.56 / 0.20	2.56 / 0.20	---	---
Fins	---	Al	Al	---	---
Fins	---	smooth	smooth	---	---
Frame	---	AISI 304	AISI 304	---	---
Protection	---	without	without	---	---
Protection	---	---	---	---	---
Air flow direction	---	horizontal	horizontal	---	---



Heater 1: 35/35/12-6R-40T-2604A-2.6PA-20C-Cu/Al/AISI 304	EUR	3997.00	Delivery:	5-6 weeks
Heater 2: 35/35/12-6R-40T-2604A-2.6PA-20C-Cu/Al/AISI 304	EUR	3997.00	Validity:	12 weeks
Heater 3: ---	EUR	0.00	Condit.:	net, prepaid address
Heater 4: ---	EUR	0.00	Payment:	30 days net
Total	**EUR**	**7994.00**		