Meaningful energy recovery

We would like to point out, why the so-called experts disagree on how much energy recovery makes sense, we would like to point out, that EU regulations require a minimum temperature efficiency of 70% and a maximum air velocity of 2 m/s on the finneded inflow surface, which is complied with in Germany and Switzerland. In EU countries, such as France, Italy and Spain, the planning engineers don't care at all, which is why you can still find air handling units without energy recovery and far too high air speed, miserable mafiosi and constant beggars in Brussels!

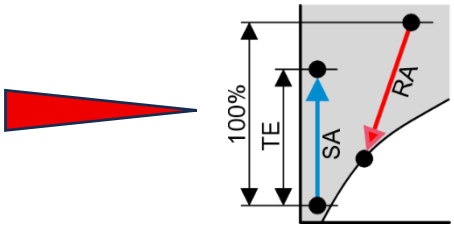
For calculations in this regard, we offer the downloadable **HES-Software**, which runs as a demo for 30 days without restrictions and calculates 40 different geometries in 1 second, including the optimal geometry of the company www.tps-imp.si, according to the motto: Maximum performance, minimum airside pressure loss.

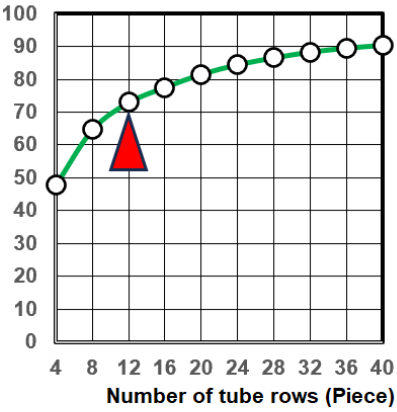
With this geometry, a temperature efficiency of 73% is achieved with 12 rows of tubes! Other geometries require more rows of tubes and therefore have to split them into 2 heat exchangers as a result of VDI 6022. The diagrams on the right show, that with more than 12 rows of tubes, the temperature efficiency increases only slightly and the COP (or ETV = electrothermal amplification factor) drops sharply. Companies like www.sew-kempen.de in Germany or www.konvekta.energy in Switzerland still advertise temperature efficiencies of up to 90%, which is really absolute bullshit!

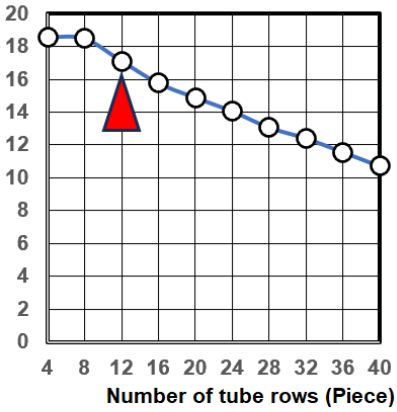
The diagrams on the right show, that with more than 12 rows of tubes, the prices of the heat exchangers and the payback period increase massively. This does not include the prices for more than 12 rows of tubes for the necessary splitting, which can be 10% to 20%. In addition, a distance of 500 mm must be maintained between the split heat exchangers. On the following pages you can find all the data on the finned heat exchangers with 12 rows of tubes.

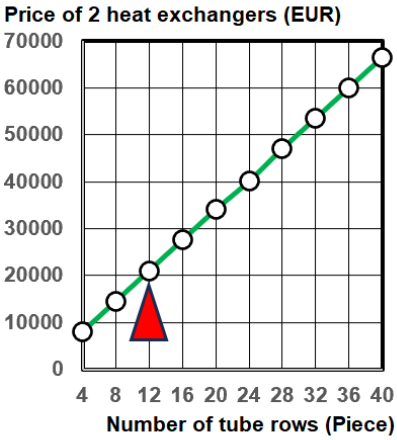
The diagrams on the right show, that with more than 12 rows of tubes, the airside pressure loss of the finned heat exchangers increases massively and triggers high operating costs. Additional packages of 4 rows of tubes cost the same, combined with a very small additional capacity for more than 3 packages of 4 rows of tubes = 12 rows of tubes in total.

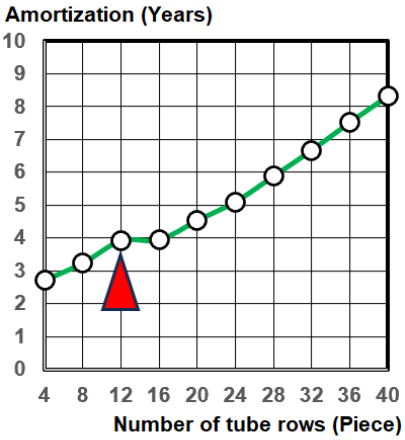
Pak. 1	**EUR 8'084**	**144.1 kW**	**56.1 EUR/kW**
Pak. 2	**EUR 6'487**	**50.2 kW**	**129.2 EUR/kW**
Pak. 3	**EUR 6'487**	**24.9 kW**	**260.5 EUR/kW**
Pak. 4	EUR 6'487	13.8 kW	470.1 EUR/kW
Pak. 5	EUR 6'487	12.0 kW	540.6 EUR/kW
Pak. 6	EUR 6'487	8.7 kW	745.6 EUR/kW
Pak. 7	EUR 6'487	6.3 kW	1'029.7 EUR/kW
Pak. 8	EUR 6'487	5.3 kW	1'224.0 EUR/kW
Pak. 9	EUR 6'487	3.6 kW	1'801.9 EUR/kW
Pak. 10	EUR 6'487	2.6 kW	2'495.0 EUR/kW

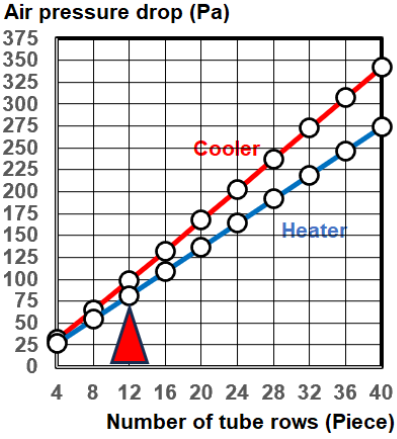


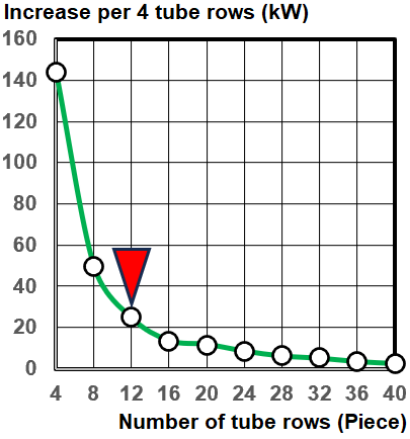












Hohe Rückwärmzahlen und Effizienz

Eine der wichtigsten Kenngrößen von Wärmetauschern und WRG-Systemen sind der Austauschgrad und die Rückwärmzahl. Der Gegenstrom-Schicht-Wärmetauscher (GSWT®) erzielt durch einen Gegenstromanteil von > 99 % Austauschgrade von 90 % und zwar gleichzeitig (!) für Fluid und Luft. Dass die Austauschgrade beiderseits hoch sind, ist wichtig für das Zusammenspiel in einem Kreislaufverbundsystem (KVS). Im KVS werden damit Rückwärmzahlen von bis zu 80 % unter Normbedingungen erreicht. Wärmetauscher und WRG-Systeme nur nach der Rückwärmzahl zu beurteilen, greift zu kurz. Die zweite wichtige Kenngröße ist die Effizienz. Die hohen Rückwärmzahlen in Verbindung mit der hohen Redundanz erlauben die multifunktionale Nutzung. Mit jeder weiteren Zusatzfunktion nimmt der Nutzen bei nahezu gleichbleibendem Aufwand zu – und damit die Effizienz. Mit der EN 13053:2012 wurde erstmals der Versuch unternommen, den Eigenaufwand des Systems mit zu berücksichtigen. Bei der Berechnung des energetischen Wirkungsgrades fehlt jedoch die genaue Vorgabe, was an elektrischem Aufwand zu berücksichtigen ist. Die Effizienzsteigerung durch Wegfall luftseitiger Erhitzer und Kühler findet offiziell keine Berücksichtigung. Da die Berechnung nur einen Betriebsfall berücksichtigt, bleibt die Betrachtung nach EN 13053 eine Momentaufnahme und ohne Nachweispflicht ein Muster ohne Wert.

Wesentlich informativer ist eine Betrachtung über das ganze Betriebsjahr. Rein auf die Wärme-/ Kälterückgewinnung bezogen liefert die GSWT®-Technologie eine Effizienz von etwa 1:20, mit der integrierten Nacherwärmung und Nachkühlung steigt diese auf 1:30, mit Freier Kühlung, Entfeuchtungskälterückgewinnung und Rückkühlung der Kältemaschine können bis zu 1:100 erreicht werden, d.h. mit 1 Teil Strom werden 100 Teile Wärme, Kälte und Rückkühlung erwirtschaftet – dafür steht die GSWT®-Technologie.

Konvekta Wärmeübertrager bestehen aus einer einzigartigen Konstruktion mit beidseitigen Sammelkollektoren. Damit wird ein Kreuzgegenstrom erreicht, welcher beinahe reinem Gegenstrom entspricht. Dadurch sind grosse Überschneidungen der Austrittstemperaturen der beiden Medien möglich.

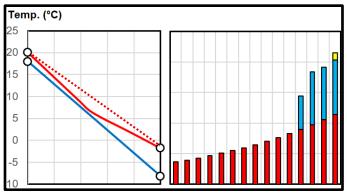
Konvekta ist weltweiter Technologieführer im Bereich Hochleistungs-Energierückgewinnung für Lüftungs- und Klimaanlagen.

Die Kreisläufverbundsysteme von Konvekta sind in der Lage, ausserordentlich effizient Energie – in Form von Kälte oder Wärme – der Abluft von Gebäuden zu entnehmen und der Zuluft wieder zuzuführen.

Dabei sind energetische Einsparungen alleine für die Erwärmung der Aussenluft bis über 95% realisierbar. In gleichem Masse gilt das selbstverständlich auch für Einsparungen an CO_2-Emissionen. Die hohe Effizienz wird durch die Verwendung unserer einsatzspezifischen Wärmeübertrager und unserer umfangreichen Optimierungs- und Regelungssoftware erreicht. Dies basierend auf der ausgereiften mathematischen Systemmodellierung von Konvekta nach dem Digital-Twin-Verfahren.

Coming back to absolutely lousy companies like www.sew-kempen.de in Germany or www.konvekta.energy in Switzerland, which advertise temperature efficiencies of up to 90%, which is really absolute bullshit, because they claim, that they achieve average logarithmic temperature differences of pure counterflow, so to speak, and therefore offer heat exchangers with an installation depth of up to 2,000 mm. In addition, www.sew-kempen.de builds it in one piece, in contrast to VDI 6022, and claims, that the whole thing can be separated layer by layer for cleaning purposes. Theoretically possible, practically impossible! Add to this the fact, that www.konvekta.energy can only produce fins of 60 mm à 2 rows of tubes, ergo has 20 packages with 40 bumper edges for 40 rows of tubes, any further comment regarding the possibility of cleaning is superfluous, although it claims, that top results can only be achieved with these antediluvian heat exchangers. If these miserable brain amputees Mafiosi would calculate their 40 rows of tubes in 20 packages of 2 rows of tubes each, in order to achieve a temperature efficiency of 90%, the whole monstrous hoax would be exposed and one would see, that on average only 50% of the average logarithmic temperature difference of the pure countercurrent can be achieved. How so? The humidity of the exhaust air plays the absolutely dominant role in this context. We calculate the whole thing in 4 heat exchangers of 10 rows of tubes of 15 cells each in the direction of the air, i.e. in a total of 60 packages, i.e. another factor of 3.00 more accurate. Pay particular attention to the temperature profile of the exhaust air cooler (red line), which really has absolutely nothing to do with pure counterflow (red dotted line). In this context, the mean logarithmic temperature difference can also be understood as the area between the red and the blue line.

Leistung	kW	271.641	------ sensibel:	205.349
Flächenreserve	%	2.353	latent:	63.918
Vorhandene Fläche	m2	4492.800	frost:	2.374
Erforderliche Fläche	m2	4389.513		
k-Wert	W/m2K	31.918	---------- ffi:	5.000E-05
Mittl. log. Temp. diff. (50.89 %)	K	1.939	ffa:	5.000E-05



Cooler: 33/29/12-40R-60T-2181A-2.5PA-30C-Cu/Al/AISI 304 — **Software by www.zcs.ch**

Capacity	kW	271.641	------ sensible:	205.349
Surface reserve	%	2.353	latent:	63.918
Present surface	m2	4492.800	frost:	2.374
Required surface	m2	4389.513		
k-coeff.	W/m2K	31.918	---------- ffi:	5.000E-05
Average temp. diff. (50.89 %)	K	1.939	ffa:	5.000E-05

LOGO

Company
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Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
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City, 5.6.2026
With the compliments of

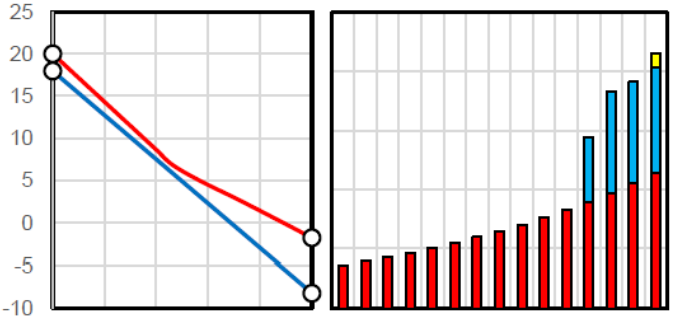
Representative
Direct dialing
xxxxxxxxxx

Plant
Object
Position

Air humid		Inlet	Outlet	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Temp.	°C	20.000	-1.778	20.000
Rel. humidity	%	40.000	99.931	40.000
Abs. humidity	g/kg	6.174	3.468	6.174
Density humid	kg/m3	1.124	1.216	1.124
Enthalpy humid	kJ/kg	35.793	6.871	35.793
Volume flow humid	m3/h	30000.000	27651.780	30000.000
Mass flow dry	kg/h	33516.594	33516.594	33516.594
Condensate flow	kg/h		90.688	
Surface temperature	°C	18.879	-4.056	
Velocity	m/s	1.910	1.761	1.910
Pressure drop (dry 312 Pa)	Pa		341.337	

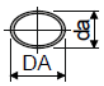
25 V% Et.glycol		
Temp. Inlet	°C	-8.190
Temp. Outlet	°C	17.970
Temp. Selection	°C	1.358
Density	kg/m3	1043.516
Spec. heat	kJ/kgK	3.683
Heat cond.	W/mK	0.450
Viscosity	Pas	3.310E-03
Volume flow	m3/h	9.726
Velocity	m/s	0.838
Reynolds	---	3089.345
Pressure drop (T/C = 122.933)	kPa	267.741

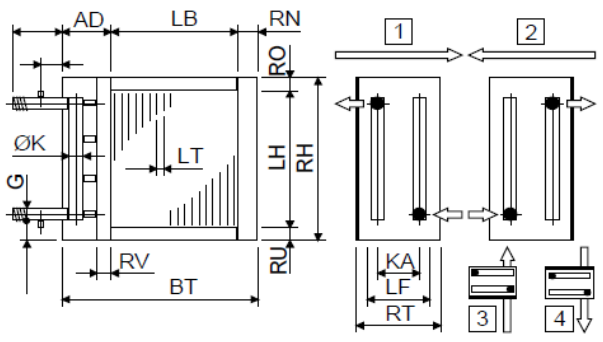
Temp. (°C)



Technical data

Tubes total		Piece	2400	Tubes:		Cu
Tubes blank		Piece	0	Tubes:		smooth
Int. vent./drains		Piece	19	Tubes:		staggered
Tube rows on the depth		Piece	40	Tubes:		circular
Tube rows on the height		Piece	60	Collectors:	0.66 m/s	Cu
Tube coupling in series		Piece	80	Connections:	0.66 m/s	Rg7
Number of circuits (NC)		Piece	30	Fins:		Al
Volume		l	608	Fins:		Wave structure
Weight		kg	2003	Circulations:	1	Default
Connections	G	---	2 ½"	Frame:	2.0 mm	AISI 304
Frame height	RH	mm	2080	Protection:		without
Frame width	BT	mm	2400	Protection:		---
Frame depth	RT	mm	1280	Air flow direction:		horizontal
Finned height	LH	mm	2000			
Finned width	LB	mm	2181			
Finned depth	LF	mm	1155			
Frame on top	RO	mm	40			
Frame on bottom	RU	mm	40			
Frame in front	RV	mm	30			
Frame on back (~53mm)	RN	mm	53			
Collector-Diameter	K	mm	76			
Covering (~166mm)	AD	mm	166			
Collector distance	KA	mm	1177			
Fin spacing	LT	mm	2.500			
Fin thickness	LD	mm	0.200			
Tube diameter	DA	mm	12.400	Delivery:		5-6 weeks
Tube diameter	da	mm	12.400	Validity:		12 weeks
Tube thickness	S	mm	0.350	Condit.:		net, prepaid address
Tube interval on the height	S1	mm	33.333	Payment:		30 days net
Tube interval on the depth	S2	mm	28.867	**Price net:**	**EUR**	**33219.00**





Now the same cooler of 40 tube rows was calculated in 10 packages of 4 tube rows, whereby 15 cells in the air direction were taken into account in each package, i.e. a calculation with a total of 150 cells.

Air humid		1	2	3	4	5	6	7	8	9	10	Total
Temp. Inlet	°C	20.00	17.09	14.60	12.47	10.65	9.08	7.73	6.56	5.67	4.54	20.00
Rel. humidity Inlet	%	40.00	47.97	56.24	64.57	72.81	80.84	88.57	95.97	99.46	99.99	40.00
Temp. Outlet	°C	17.09	14.60	12.47	10.65	9.08	7.73	6.56	5.67	4.54	2.57	2.57
Rel. humidity Outlet	%	47.97	56.24	64.57	72.81	80.84	88.57	95.97	99.46	99.99	100.00	100.00
Pressure drop	Pa	30.64	30.26	29.94	29.66	29.43	29.23	29.05	32.75	36.34	36.34	313.64

25 V% Et.glycol		1	2	3	4	5	6	7	8	9	10	Total
Temp. Inlet	°C	15.31	13.05	11.13	9.48	8.06	6.83	5.76	4.61	2.61	-0.81	-0.81
Temp. Outlet	°C	17.97	15.31	13.05	11.13	9.48	8.06	6.83	5.76	4.61	2.61	17.97
Pressure drop	kPa	28.94	26.15	26.52	26.83	27.14	27.36	27.59	27.89	28.27	29.01	275.68

Cooler		1	2	3	4	5	6	7	8	9	10	Total
Tubes blank	Piece	0	0	0	0	0	0	0	0	0	0	0
Int. vent./drains	Piece	1	1	1	1	1	1	1	1	1	1	10
Tube rows on the depth	Piece	4	4	4	4	4	4	4	4	4	4	40
Tube rows on the height	Piece	60	60	60	60	60	60	60	60	60	60	---
Number of circuits (NC)	Piece	30	30	30	30	30	30	30	30	30	30	---
Capacity sensible	kW	27.58	23.64	20.15	17.26	14.84	12.80	11.13	8.39	10.73	18.58	165.09
Capacity latent	kW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.65	10.04	16.97	30.65
Capacity frost	kW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capacity total	kW	27.58	23.64	20.15	17.26	14.84	12.80	11.13	12.04	20.77	35.55	195.75
Surface reserve	%	0.44	0.30	0.20	0.08	0.25	0.44	0.44	0.30	0.14	0.24	0.28
Present surface	m2	449.28	449.28	449.28	449.28	449.28	449.28	449.28	449.28	449.28	449.28	4492.80
Required surface	m2	447.29	447.92	448.39	448.92	448.18	447.30	447.32	447.94	448.67	448.19	4480.12
k-coeff.	W/m2K	35.24	34.45	33.72	33.06	32.46	31.90	31.41	32.54	33.35	32.02	33.01
Δtm-Effective	K	1.75	1.53	1.33	1.16	1.02	0.90	0.79	0.83	1.39	2.48	1.320

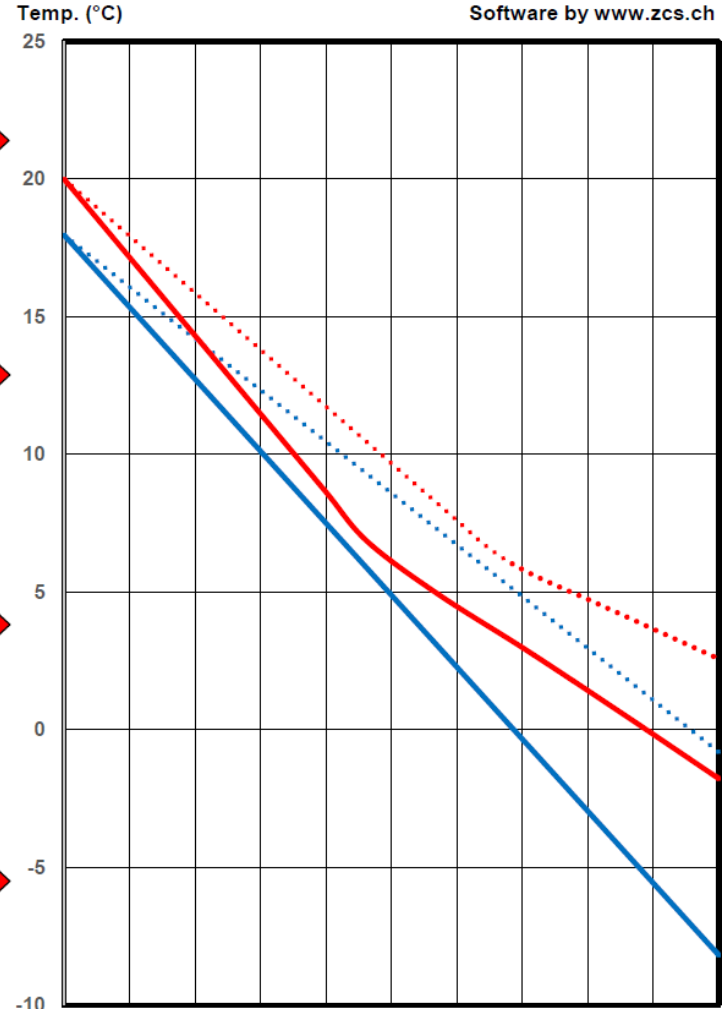
Cooler		1	2	3	4	5	6	7	8	9	10	Total
Δtm-Effective	K	1.75	1.53	1.33	1.16	1.02	0.90	0.79	0.83	1.39	2.48	1.32
Δtm-Countercurrent flow	K	1.90	1.66	1.44	1.25	1.10	0.96	0.85	0.92	1.45	2.59	2.65
Δtm-Effective	%	**91.96**	**92.32**	**92.57**	**92.80**	**93.03**	**93.25**	**93.42**	**89.36**	**95.47**	**95.73**	**49.81**

Cooler total ---		Target ——	Reached ·····	Diff. %
Capacity sensible	kW	205.35	165.09	**-19.60**
Capacity latent	kW	63.92	30.65	**-52.05**
Capacity frost	kW	2.37	0.00	**-100.00**
Capacity total	kW	271.64	195.75	**-27.94**
Δt-Air humid	K	21.78	17.43	**-19.97**
Δt-25 V% Et.glycol	K	26.16	18.78	**-28.20**

We first calculate the performance of a single air cooler, divided into 15 cells along the airflow direction, which yields the target values. Then we split the air cooler into 10 subunits, each subunit divided into 15 cells along the airflow direction, for a total of 150 cells along the airflow direction, which yields the actual values. This shows that the air cooler never reaches the required target values.

It's important to note, that in each of the 10 sub-units, over 90% of the airflow is achieved in a pure countercurrent flow. To conclude from this, that the entire air cooler would achieve the same, is pure wishful thinking, a complete illusion! On the contrary, one should be happy if 50% of pure countercurrent flow is achieved with humid air.

For highly dubious companies like www.sew.kempen.de and www.konvekta.energy, humidity conditions like those in the Sahara or on the moon, do not exist anywhere in the world. Only under such circumstances could one achieve a near-pure countercurrent. Instead of baseless claims, neutral measurements by TÜV South in Munich would be appropriate.

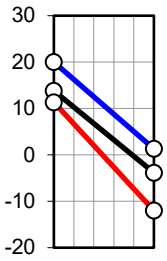


CC-System in winter		SA-He	RA-Co	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	72.950	58.462	
Capacity sensible	kW	219.186	176.712	
Capacity latent	kW	---	41.381	
Capacity frost	kW	---	1.092	
Capacity total	kW	219.186	219.186	
Surface reserve	%	0.121	0.367	
Present surface	m2	1347.840	1347.840	

SA-He		Inlet	Outlet	Definition
Temp.	°C	-12.000	11.344	20.000
Rel. humidity	%	90.000	14.448	40.000
Abs. humidity	g/kg	1.273	1.273	6.174
Volume flow humid	m3/h	26516.860	28887.091	30000.000
Velocity	m/s	1.689	1.840	1.910
Pressure drop	Pa		81.633	

RA-Co		Inlet	Outlet	Definition
Temp.	°C	20.000	1.292	20.000
Rel. humidity	%	40.000	99.696	40.000
Abs. humidity	g/kg	6.174	4.422	6.174
Volume flow humid	m3/h	30000.000	28007.271	30000.000
Velocity	m/s	1.910	1.784	1.910
Pressure drop wet	Pa		98.707	

25 V% Et.glycol			SA-He	RA-Co
Temp.	in	°C	13.810	-3.830
Temp.	out	°C	-3.830	13.810
Volume flow		m3/h	11.623	11.627
Velocity		m/s	1.251	1.252
Reynolds		---	5112.580	4983.535
Pressure drop		kPa	197.773	199.044



LOGO

Company
Branch
Street
Country / ZIP / City

Phone: xxxxxxxxxx
Fax: xxxxxxxxxx
E-Mail
Homepage

City, 24.5.2026
With the compliments of

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Direct dialing
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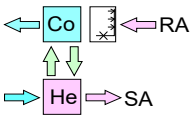
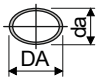
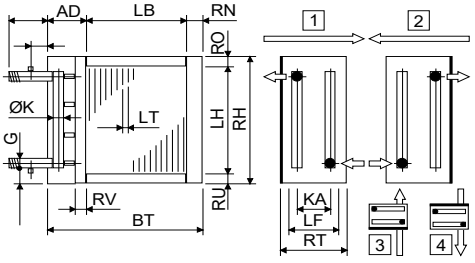
Bern
Inselspital
Bettenhaus



Software by www.zcs.ch

Technical data			SA-He	RA-Co		SA-He	RA-Co
Tubes total		Piece	720	720	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	60	60	Collectors:	Cu	Cu
Tube coupling in series		Piece	30	30	Collectors:	0.79 m/s	0.79 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	195	195	Connections:	0.79 m/s	0.79 m/s
Weight		kg	640	640	Fins:	Al	Al
Connections	G	---	2 ½"	2 ½"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2080	2080	Frame:	AISI 304	AISI 304
Frame width	BT	mm	2400	2400	Air flow direction:	horizontal	horizontal
Frame depth	RT	mm	470	470	Protection:	without	without
Finned height	LH	mm	2000	2000	Protection:	---	---
Finned width	LB	mm	2181	2181			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	40	40			
Frame on bottom	RU	mm	40	40			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	76	76			
Covering	AD	mm	166	166			
Collector distance	KA	mm	369	369			
Fin spacing	LT	mm	2.500	2.500			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400	Delivery:		5-6 weeks
Tube diameter	da	mm	12.400	12.400	Validity:		12 weeks
Tube thickness	S	mm	0.350	0.350	Condit.:		net, prepaid address
Tube interval on the height	S1	mm	33.333	33.333	Payment:		30 days net
Tube interval on the depth	S2	mm	28.867	28.867			





SA-He: 33/29/12-12R-60T-2181A-2.5PA-24C-Cu/Al/AISI 304 **SA-He:** **EUR** **10538.00**

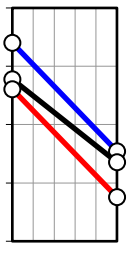
RA-Co: 33/29/12-12R-60T-2181A-2.5PA-24C-Cu/Al/AISI 304 **RA-Co:** **EUR** **10538.00**

CC-System in summer		RA-Hy	SA-Co	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	70.050	70.267	
Capacity sensible	kW	89.103	89.104	
Capacity latent	kW	0.000	0.000	
Capacity frost	kW	---	0.000	
Capacity total	kW	89.103	89.104	
Surface reserve	%	0.230	0.121	
Present surface	m2	1347.840	1347.840	

RA-Hy	Inlet	Outlet	Definition
Temp. (26.000)	°C	18.783	28.041	20.000
Rel. humidity (51.432)	%	100.000	57.276	40.000
Abs. humidity (11.500)	g/kg	14.501	14.501	6.174
Volume flow humid	m3/h	30271.446	31231.468	30000.000
Velocity	m/s	1.928	1.989	1.910
Pressure drop	Pa		93.951	

SA-Co	Inlet	Outlet	Definition
Temp.	°C	32.000	22.713	20.000
Rel. humidity	%	40.000	68.823	40.000
Abs. humidity	g/kg	12.667	12.667	6.174
Volume flow humid	m3/h	31550.781	30590.557	30000.000
Velocity	m/s	2.009	1.948	1.910
Pressure drop wet	Pa		95.267	

25 V% Et.glycol			RA-Hy	SA-Co
Temp.	in	°C	28.888	21.772
Temp.	out	°C	21.772	28.888
Volume flow		m3/h	11.623	11.626
Velocity		m/s	1.251	1.252
Reynolds		---	9279.112	9126.001
Pressure drop		kPa	172.878	173.611



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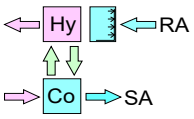

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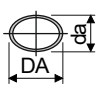
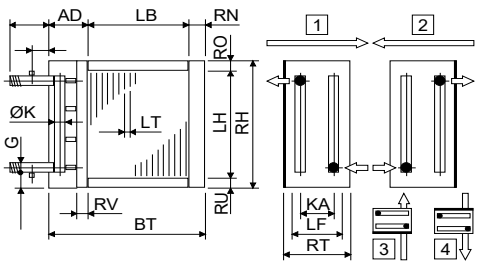
Technical data			RA-Hy	SA-Co		RA-Hy	SA-Co
Tubes total		Piece	720	720	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	60	60	Collectors:	Cu	Cu
Tube coupling in series		Piece	30	30	Collectors:	0.79 m/s	0.79 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	195	195	Connections:	0.79 m/s	0.79 m/s
Weight		kg	640	640	Fins:	Al	Al
Connections	G	---	2 ½"	2 ½"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2080	2080	Frame:	AISI 304	AISI 304
Frame width	BT	mm	2400	2400	Air flow direction:	horizontal	horizontal
Frame depth	RT	mm	470	470	Protection:	without	without
Finned height	LH	mm	2000	2000	Protection:	---	---
Finned width	LB	mm	2181	2181			
Finned depth	LF	mm	346	346			
Frame on top	RO	mm	40	40			
Frame on bottom	RU	mm	40	40			
Frame in front	RV	mm	30	30			
Frame on back	RN	mm	53	53			
Collector-Diameter	K	mm	76	76			
Covering	AD	mm	166	166			
Collector distance	KA	mm	369	369			
Fin spacing	LT	mm	2.500	2.500			
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400	Delivery:		5-6 weeks
Tube diameter	da	mm	12.400	12.400	Validity:		12 weeks
Tube thickness	S	mm	0.350	0.350	Condit.:		net, prepaid address
Tube interval on the height	S1	mm	33.333	33.333	Payment:		30 days net
Tube interval on the depth	S2	mm	28.867	28.867			





RA-Hy: 33/29/12-12R-60T-2181A-2.5PA-24C-Cu/Al/AISI 304 **RA-Hy: EUR 10538.00**

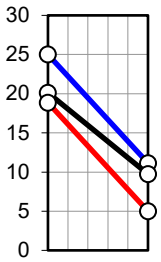
SA-Co: 33/29/12-12R-60T-2181A-2.5PA-24C-Cu/Al/AISI 304 **SA-Co: EUR 10538.00**

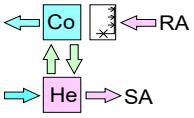
CC-System (DIN EN 308)		SA-He	RA-Co	Definition
Height over sea level	m			540.000
Pressure	hPa			949.653
Efficiency	%	69.300	69.285	
Capacity sensible	kW	129.875	129.874	
Capacity latent	kW	---	---	
Capacity frost	kW	---	---	
Capacity total	kW	129.875	129.874	
Surface reserve	%	0.104	0.083	
Present surface	m2	1347.840	1347.840	

SA-He		Inlet	Outlet	Definition
Temp.	°C	5.000	18.860	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m3/h	28185.284	29589.684	30000.000
Velocity	m/s	1.795	1.884	1.910
Pressure drop	Pa		86.375	

RA-Co		Inlet	Outlet	Definition
Temp.	°C	25.000	11.143	20.000
Rel. humidity	%	0.000	0.000	40.000
Abs. humidity	g/kg	0.000	0.000	6.174
Volume flow humid	m3/h	30211.836	28807.737	30000.000
Velocity	m/s	1.924	1.835	1.910
Pressure drop	Pa		88.891	

25 V% Et.glycol			SA-He	RA-Co
Temp.	in	°C	20.115	9.739
Temp.	out	°C	9.739	20.115
Volume flow		m3/h	11.660	11.664
Velocity		m/s	1.255	1.256
Reynolds		---	7090.030	6885.241
Pressure drop		kPa	184.907	186.278





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Technical data			SA-He	RA-Co		SA-He	RA-Co
Tubes total		Piece	720	720	Tubes:	Cu	Cu
Tubes blank		Piece	0	0	Tubes:	smooth	smooth
Int. vent./drains		Piece	5	5	Tubes:	staggered	staggered
Tube rows on the depth		Piece	12	12	Tubes:	circular	circular
Tube rows on the height		Piece	60	60	Collectors:	Cu	Cu
Tube coupling in series		Piece	30	30	Collectors:	0.79 m/s	0.79 m/s
Number of circuits (NC)		Piece	24	24	Connections:	Rg7	Rg7
Volume		l	195	195	Connections:	0.79 m/s	0.79 m/s
Weight		kg	640	640	Fins:	Al	Al
Connections	G	---	2 ½"	2 ½"	Fins:	Wave structure	Wave structure
Frame height	RH	mm	2080	2080	Frame:	AISI 304	AISI 304
Frame width	BT	mm	2400	2400	Air flow direction:	horizontal	horizontal
Frame depth	RT	mm	470	470	Protection:	without	without
Finned height	LH	mm	2000	2000	Protection:	---	---
Finned width	LB	mm	2181	2181			
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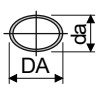
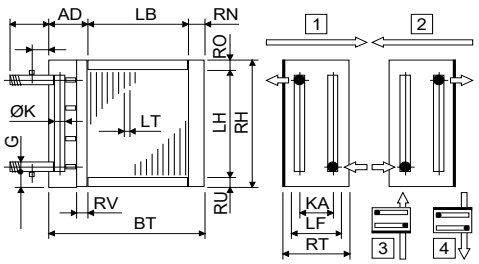
Fin thickness	LD	mm	0.200	0.200			
Tube diameter	DA	mm	12.400	12.400	Delivery:		5-6 weeks
Tube diameter	da	mm	12.400	12.400	Validity:		12 weeks
Tube thickness	S	mm	0.350	0.350	Condit.:		net, prepaid address
Tube interval on the height	S1	mm	33.333	33.333	Payment:		30 days net
Tube interval on the depth	S2	mm	28.867	28.867			





SA-He: 33/29/12-12R-60T-2181A-2.5PA-24C-Cu/Al/AISI 304 **SA-He:** **EUR** **10538.00**

RA-Co: 33/29/12-12R-60T-2181A-2.5PA-24C-Cu/Al/AISI 304 **RA-Co:** **EUR** **10538.00**

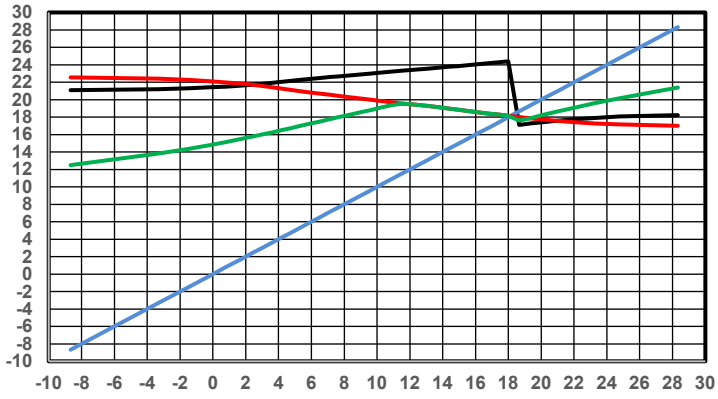
Energy recovery / Year (Service at 100% Air flow = 5310 Hours

No	Outside air		CCSB		Return air		Exhaust air		Efficiency	Capacity	Energy
	°C	%	°C	%	°C	%	°C	%	%	kW	MWh
1	-8.7	84.0	12.5	16.8	21.1	34.5	2.9	92.3	76.04	198.86	26.40
2	-3.3	78.4	13.8	23.0	21.2	35.0	5.6	87.2	76.04	161.25	21.41
3	-1.4	79.2	14.4	26.2	21.3	35.4	6.6	85.4	76.04	148.96	19.77
4	-0.2	78.5	14.8	28.0	21.4	35.9	7.3	84.2	76.04	141.46	18.78
5	0.8	76.3	15.2	28.8	21.5	36.3	7.9	83.3	76.04	135.09	17.93
6	1.6	79.2	15.5	31.1	21.6	36.7	8.4	82.7	76.04	130.33	17.30
7	2.4	77.1	15.8	31.4	21.7	37.2	8.9	82.1	76.04	125.98	16.72
8	3.0	77.3	16.0	32.4	21.8	37.6	9.3	81.7	76.04	122.48	16.26
9	3.6	76.2	16.3	32.7	21.9	38.1	9.7	81.3	76.04	119.29	15.84
10	4.2	75.3	16.5	33.1	22.0	38.5	10.1	81.1	76.04	116.38	15.45
11	4.7	75.9	16.7	34.2	22.2	39.0	10.4	80.8	76.04	113.45	15.06
12	5.3	73.8	17.0	34.0	22.3	39.4	10.8	80.5	76.04	110.52	14.67
13	5.9	75.2	17.2	35.6	22.4	39.9	11.2	79.9	76.04	107.17	14.23
14	6.5	72.4	17.5	35.2	22.5	40.3	11.7	79.3	76.04	103.69	13.76
15	7.1	73.7	17.7	36.7	22.6	40.7	12.0	78.9	76.04	100.66	13.36
16	7.7	72.1	18.0	36.7	22.7	41.2	12.4	78.3	76.04	97.66	12.96
17	8.3	73.0	18.3	38.2	22.8	41.6	12.9	77.4	76.04	94.09	12.49
18	9.0	73.9	18.5	39.8	22.9	42.1	13.4	76.4	76.04	90.53	12.02
19	9.6	73.3	18.8	40.5	23.0	42.5	13.9	75.3	76.04	86.97	11.54
20	10.3	71.7	19.1	40.6	23.1	43.0	14.3	74.4	76.04	83.72	11.11
21	10.9	72.5	19.4	42.1	23.2	43.4	14.8	73.5	76.04	80.36	10.67
22	11.5	68.9	19.6	41.0	23.3	43.9	15.3	72.4	76.04	76.07	10.10
23	12.3	68.7	19.4	42.2	23.4	44.3	15.8	71.1	76.04	67.75	8.99
24	13.1	69.7	19.3	44.2	23.5	44.7	16.4	69.8	76.04	59.11	7.85
25	13.7	67.7	19.1	44.0	23.6	45.2	16.8	68.8	76.04	51.54	6.84
26	14.3	69.5	19.0	46.2	23.8	45.6	17.3	68.0	76.04	44.75	5.94
27	14.9	71.2	18.9	48.5	23.9	46.1	17.7	67.1	76.04	37.34	4.96
28	15.5	71.6	18.7	49.8	24.0	46.5	18.2	66.4	76.04	30.47	4.04
29	16.1	71.0	18.6	50.5	24.1	47.0	18.6	65.6	76.04	23.33	3.10
30	16.7	67.3	18.4	49.0	24.2	47.4	19.1	64.7	76.04	16.06	2.13
31	17.4	64.6	18.3	48.2	24.3	47.9	19.5	63.9	76.04	8.76	1.16
32	18.0	64.9	18.1	49.5	24.4	48.3	20.0	63.1	76.04	1.41	0.19
33	18.6	63.9	17.6	68.3	17.1	100.0	18.2	93.6	76.04	10.14	1.35
34	19.3	64.2	17.9	70.2	17.3	100.0	18.7	91.6	76.04	13.95	1.85
35	20.1	64.5	18.3	72.5	17.4	100.0	19.3	89.1	68.78	17.76	2.36
36	21.0	60.2	18.7	69.7	17.6	100.0	19.9	86.3	68.80	22.61	3.00
37	22.0	62.1	19.1	74.5	17.7	100.0	20.7	83.4	68.76	28.09	3.73
38	23.2	60.1	19.6	75.1	17.9	100.0	21.5	79.9	68.74	34.91	4.63
39	24.8	56.4	20.2	74.7	18.1	100.0	22.7	75.3	68.74	44.25	5.87
40	28.3	50.1	21.4	75.6	18.2	100.0	25.2	65.6	68.70	66.51	8.83

Air (%)	Service (h/a)
100.00	3120
50.00	3120
25.00	2520
▼	▼
100.00	5310

EU: Energy recovery: Heat energy	MWh	383.05	EUR	22983.00	(60.00 EUR/MWh)
EU: Energy recovery: Cold energy	MWh	31.62	EUR	2530.00	(80.00 EUR/MWh)
EU: 2 Fan + Glycol pump	MWh	-27.98	EUR	-2798.00	(100.00 EUR/MWh)
EU: Energy recovery: Net useful ratio / Year	MWh	386.69	EUR	22715.00	(58.74 EUR/MWh)
EU: Need of energy total / Year	MWh	694.91	EUR	48468.83	(69.75 EUR/MWh)
EU: Net useful ratio / Year	%	55.65	%	46.87	TWG = 72.95%
CH: Guidelines from associations such as SIA and SWKI: TWG>70.00% & JNG>75.00% & ETV>15.00					JNG = 70.77%
					ETV = 17.11

Outside air (°C) Return air (°C) Supply air (°C)
Energy recovery (°C)



Station		Bern (CH)
Height over sea level	m	540.00
Pressure	hPa	949.65
Outside air	m3/h	30000.00
Return air	m3/h	30000.00
Adiabatic return air cooling	h/a	1062.00
Service at 100% Air flow	h/a	5310.00
Capital interest	%	1.00
Energy increase	%	1.00
Inflation	%	1.00
Support costs	%	5.00
Costs without CC-System	EUR	86000.00
Costs with CC-System	EUR	154000.00
Additional costs	EUR	68000.00
BEP (Break even point) after	Years	3.55

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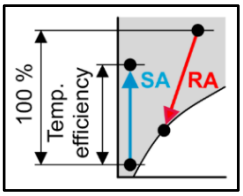

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