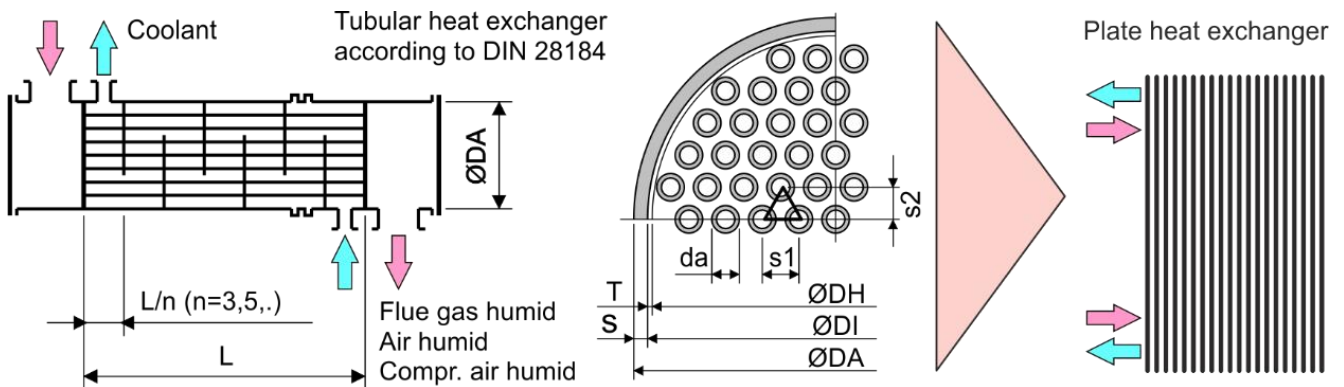


Tubular heat exchanger According to DIN 28184

The share of tubular heat exchangers has continuously decreased since 1970 and has been replaced by soldered, welded and screwed plate heat exchangers, such as those manufactured by www.alfalaval.com and www.swep.net, primarily for price reasons.

A few applications have remained where special tubular heat exchangers with removable inspection covers are still used. In this way, the inside of the tubes can be cleaned with special brushes without having to remove the connection lines. This involves humid flue gases, humid polluted air and humid polluted compressed air.

Depending on the size of the differences in longitudinal expansion of the shell and the tubes as a function of the temperature differences, axial expansion joints must be installed in the shell, otherwise leaks may occur as a result of cracks in the two tube plates.



With regard to software, we have always focused on finned heat exchangers in a wide variety of heat recovery systems in air conditioning units.

However, because we have repeatedly received requests for software for calculating such tubular heat exchangers, this area is now also available in terms of software, programmed in Excel and available as a protected or unprotected version. The latter offers the advantage that customer-specific extensions can be built in.

Page 2: Calculation example with humid flue gases.

Page 3: Calculation example with humid polluted air.

Page 4: Calculation example with humid polluted compressed air.

Page 5: Shell diameter and tube dimensions.

Tubular heat exchanger : Ø 1000 x 6000 (842 x Ø 25 x 1.00)

Capacity total	kW	1444.506
Capacity sensible	kW	1116.755
Capacity latent	kW	327.751
Surface reserve	%	9.072
Present surface	m2	396.783
Required surface	m2	363.781
k-coeff.	W/m2K	93.50
Average temp. diff. (60.592 %)	K	42.47



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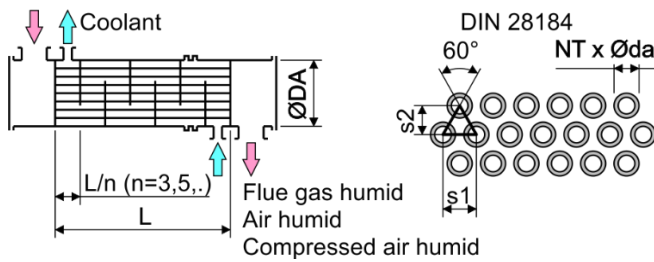
Plant
Object
Position

Software by www.zcs.ch

Flue gas humid (ffi = 0.100 m2K/kW)		Inlet	Outlet	Average
Pressure	bar	1.000		
Temp.	°C	250.000	80.000	165.000
Rel. humidity	%	0.800	62.745	4.467
Abs. humidity	g/kg	291.082	261.567	285.355
Density humid	kg/m3	0.586	0.876	0.701
Enthalpy humid	kJ/kg	1120.187	773.506	968.771
Volume flow humid	m3/h	33069.309	21602.080	27522.727
Mass flow dry	kg/h	15000.000	15000.000	15000.000
Condensate flow	kg/h		442.725	
Velocity	m/s	26.258	17.153	21.854
Pressure drop wet	kPa		2.037	

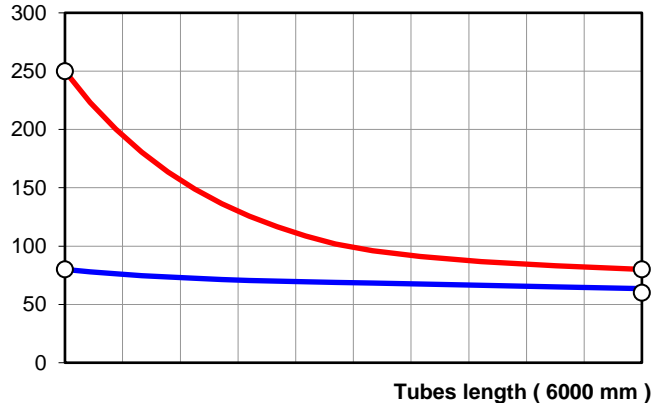
Water (ffa = 0.100 m2K/kW)		Inlet	Outlet	Average
Temp.	°C	60.000	80.000	70.000
Density	kg/m3			977.762
Spec. heat	kJ/kgK			4.190
Heat cond.	W/mK			0.663
Viscosity	Pas			4.041E-04
Volume flow	m3/h			63.466
Velocity	m/s			0.315
Pressure drop	kPa			23.298

Technical data



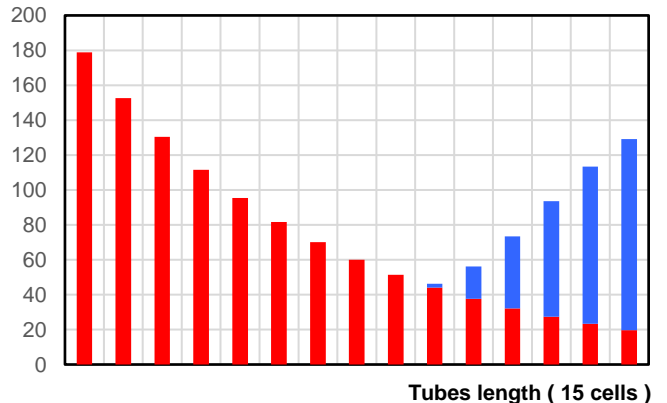
Tubes total	NT	Piece	842.000
Tubes length	L	mm	6000.000
Tube diameter	da	mm	25.000
Tube thickness	s	mm	1.000
Tube interval on the height	s2	mm	27.713
Tube interval on the depth	s1	mm	32.000
Number of chambers	n	Piece	25.000
Chamber width	L/n	mm	235.240
Flue gas humid: Connections		---	NW 700
Water: Connections		---	NW 150
Shell diameter	ØDA	mm	1000.000
Length total		mm	7700.000
Weight empty total		kg	5300.000
Material		---	AISI 316
Price		EUR	103000.000

Temp. (°C)



Capacity sensible (kW)

Capacity latent (kW)



Tubular heat exchanger : Ø 1100 x 12000 (1024 x Ø 25 x 1.00)

Capacity total	kW	296.812
Capacity sensible	kW	260.455
Capacity latent	kW	36.358
Surface reserve	%	0.619
Present surface	m2	965.097
Required surface	m2	959.165
k-coeff.	W/m2K	41.70
Average temp. diff. (53.183 %)	K	7.42



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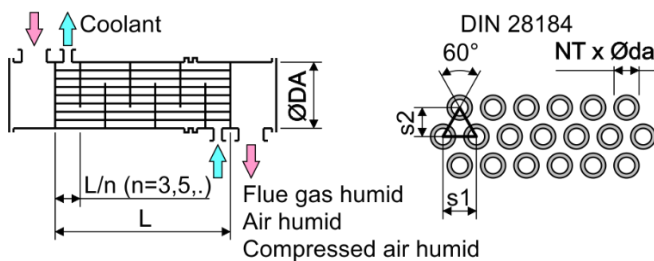
Plant
Object
Position

Software by www.zcs.ch

Air humid (ffi = 0.100 m2K/kW)		Inlet	Outlet	Average
Pressure	bar	1.000		
Temp.	°C	80.000	20.000	50.000
Rel. humidity	%	6.000	98.871	23.048
Abs. humidity	g/kg	18.123	14.692	18.123
Density humid	kg/m3	0.976	1.178	1.066
Enthalpy humid	kJ/kg	128.641	57.406	97.344
Volume flow humid	m3/h	15651.785	12923.015	14322.208
Mass flow dry	kg/h	15000.000	15000.000	15000.000
Condensate flow	kg/h		51.466	
Velocity	m/s	10.219	8.438	9.351
Pressure drop wet	kPa		1.005	

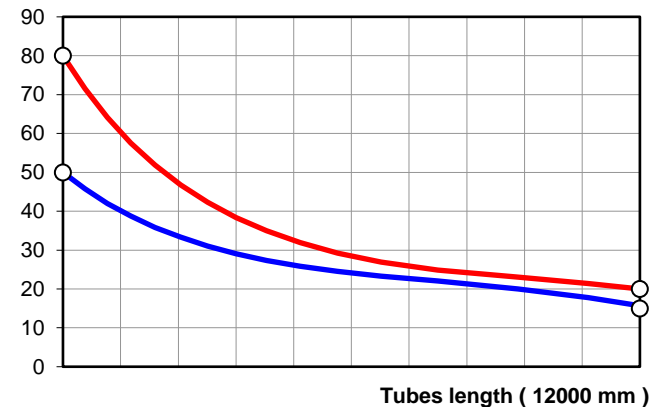
Water (ffa = 0.100 m2K/kW)		Inlet	Outlet	Average
Temp.	°C	15.000	50.000	32.500
Density	kg/m3			994.863
Spec. heat	kJ/kgK			4.177
Heat cond.	W/mK			0.619
Viscosity	Pas			7.567E-04
Volume flow	m3/h			7.347
Velocity	m/s			0.035
Pressure drop	kPa			0.943

Technical data

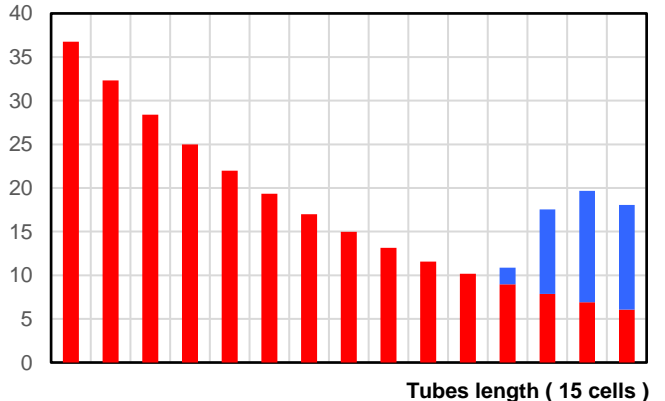


Tubes total	NT	Piece	1024.000
Tubes length	L	mm	12000.000
Tube diameter	da	mm	25.000
Tube thickness	s	mm	1.000
Tube interval on the height	s2	mm	27.713
Tube interval on the depth	s1	mm	32.000
Number of chambers	n	Piece	53.000
Chamber width	L/n	mm	222.585
Air humid: Connections		---	NW 500
Water: Connections		---	2"
Shell diameter	ØDA	mm	1100.000
Length total		mm	13300.000
Weight empty total		kg	11700.000
Material		---	AISI 316
Price		EUR	229000.000

Temp. (°C)



Capacity sensible (kW)
Capacity latent (kW)



Tubular heat exchanger : Ø 813 x 8000 (550 x Ø 25 x 1.00)

Capacity total	kW	667.914
Capacity sensible	kW	519.285
Capacity latent	kW	148.629
Surface reserve	%	2.075
Present surface	m2	345.575
Required surface	m2	338.549
k-coeff.	W/m2K	68.76
Average temp. diff. (80.358 %)	K	28.69



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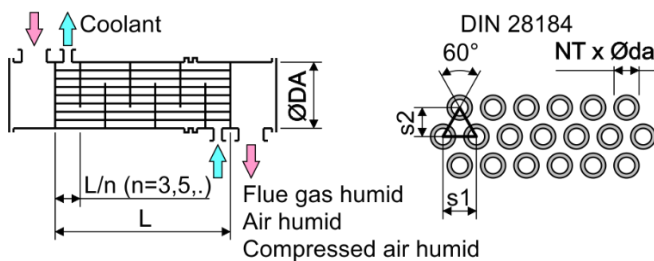
Plant
Object
Position

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Compressed air humid (ffi = 0.100 m2K/kW)		Inlet	Outlet	Average
Pressure	bar	7.000		
Temp.	°C	150.000	30.000	90.000
Rel. humidity	%	4.000	100.000	19.054
Abs. humidity	g/kg	17.452	3.782	12.065
Density humid	kg/m3	5.702	8.024	6.666
Enthalpy humid	kJ/kg	200.163	39.864	122.930
Volume flow humid	m3/h	2676.355	1876.418	2277.530
Mass flow dry	kg/h	15000.000	15000.000	15000.000
Condensate flow	kg/h		205.051	
Velocity	m/s	3.253	2.281	2.769
Pressure drop wet	kPa		0.356	

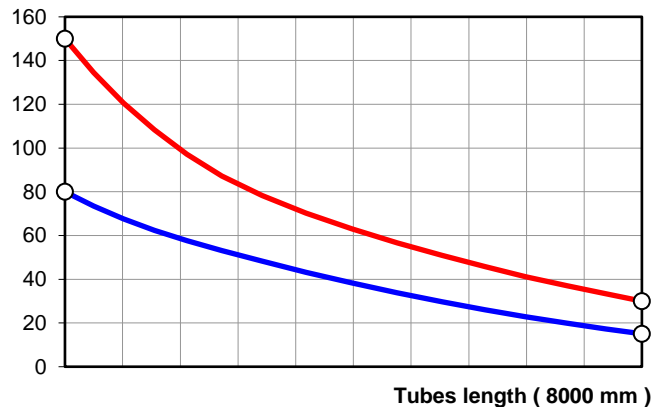
Water (ffa = 0.100 m2K/kW)		Inlet	Outlet	Average
Temp.	°C	15.000	80.000	47.500
Density	kg/m3			989.137
Spec. heat	kJ/kgK			4.179
Heat cond.	W/mK			0.641
Viscosity	Pas			5.706E-04
Volume flow	m3/h			8.950
Velocity	m/s			0.074
Pressure drop	kPa			2.314

Technical data

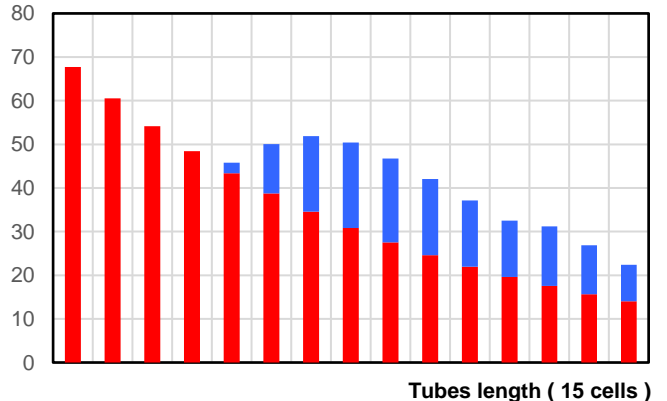


Tubes total	NT	Piece	550.000
Tubes length	L	mm	8000.000
Tube diameter	da	mm	25.000
Tube thickness	s	mm	1.000
Tube interval on the height	s2	mm	27.713
Tube interval on the depth	s1	mm	32.000
Number of chambers	n	Piece	47.000
Chamber width	L/n	mm	166.277
Compressed air humid: Connections		---	NW 250
Water: Connections		---	2"
Shell diameter	ØDA	mm	813.000
Length total		mm	8800.000
Weight empty total		kg	4500.000
Material		---	AISI 316
Price		EUR	88000.000

Temp. (°C)



Capacity sensible (kW)
Capacity latent (kW)



Tubular heat exchanger				9	ØD	ØDA	S	ØDI	ØDH	T	NT
Tube diameter	da	mm	25.00	1	250	273.00	3.00	267.00	253.67	6.66	57
Tube interval on the depth	s1	mm	32.00	2	300	323.90	4.00	315.90	304.26	5.82	82
				3	350	355.60	4.00	347.60	334.32	6.64	99
				4	400	406.40	4.00	398.40	384.57	6.92	131
				5	450	457.00	4.00	449.00	435.51	6.75	168
				6	500	508.00	5.00	498.00	486.91	5.54	210
				7	600	610.00	5.00	600.00	588.72	5.64	307
				8	700	711.00	5.00	701.00	686.13	7.43	417
				9	800	813.00	5.00	803.00	787.99	7.51	550
				10	900	900.00	6.00	888.00	874.89	6.55	678
				11	1000	1000.00	6.00	988.00	974.98	6.51	842
				12	1100	1100.00	6.00	1088.00	1075.20	6.40	1024
				13	1200	1200.00	6.00	1188.00	1175.04	6.48	1223
Tube diameter	da	mm	20.00	15	200	219.10	3.00	213.10	200.61	6.24	54
Tube interval on the depth	s1	mm	26.00	16	250	273.00	3.00	267.00	253.17	6.92	86
				17	300	323.90	4.00	315.90	304.00	5.95	124
				18	350	355.60	4.00	347.60	334.36	6.62	150
				19	400	406.40	4.00	398.40	385.11	6.64	199
				20	450	457.00	4.00	449.00	435.09	6.95	254
				21	500	508.00	5.00	498.00	486.06	5.97	317
				22	600	610.00	5.00	600.00	588.06	5.97	464
				23	700	711.00	5.00	701.00	685.77	7.62	631
				24	800	813.00	5.00	803.00	787.93	7.54	833
				25	900	900.00	6.00	888.00	874.88	6.56	1027
				26	1000	1000.00	6.00	988.00	974.80	6.60	1275
Tube diameter	da	mm	16.00	28	150	168.30	3.00	162.30	151.17	5.57	47
Tube interval on the depth	s1	mm	21.00	29	200	219.10	3.00	213.10	200.89	6.11	83
				30	250	273.00	3.00	267.00	253.34	6.83	132
				31	300	323.90	4.00	315.90	303.94	5.98	190
				32	350	355.60	4.00	347.60	334.40	6.60	230
				33	400	406.40	4.00	398.40	384.45	6.97	304
				34	450	457.00	4.00	449.00	435.45	6.77	390
				35	500	508.00	5.00	498.00	486.10	5.95	486
				36	600	610.00	5.00	600.00	588.37	5.82	712
				37	700	711.00	5.00	701.00	686.03	7.48	968
Tube diameter	da	mm	30.00	39	1100	1100.00	6.00	1088.00	1075.08	6.46	726
Tube interval on the depth	s1	mm	38.00	40	1200	1200.00	6.00	1188.00	1174.85	6.57	867



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