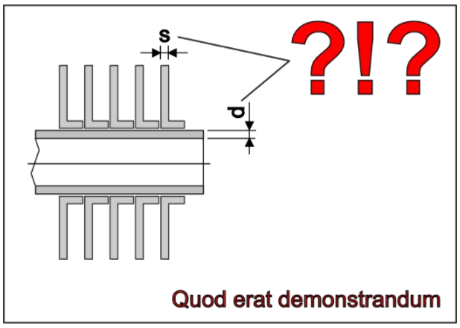
Heat exchanger reserve

Incorrect offer check

If you leave the decision to the purchasing department, without including the technology, you will most likely opt for the lowest price offer and thus expose yourself to the risk, that the heat exchanger will not achieve the required performance.

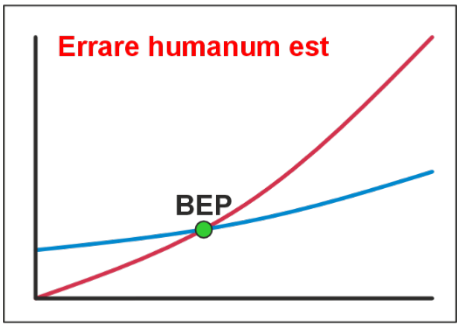
Incorrect exterior surface check

If you only compare the exterior surface of the heat exchanger, without checking the tube wall thickness and fin thickness, you run the risk, that the heat exchanger will not achieve the required performance.



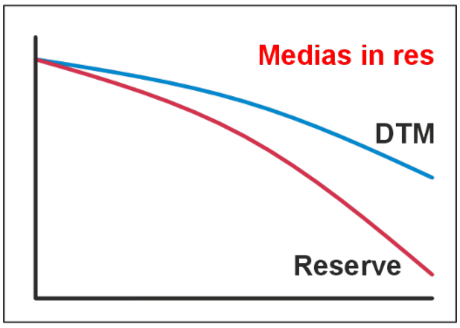
Insufficient pressure drop check

If you do not compare the internal and external pressure drops, you can save on investment costs, but you will have higher operating costs. Only an amortization calculation can show that the total costs are greater within a short time.



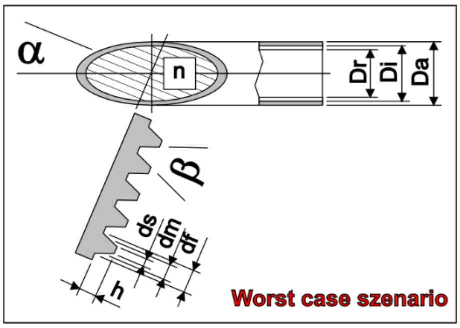
Surface reserve versus power reserve

A designated surface reserve has nothing to do with a power reserve, but always looks good in terms of design. The mean logarithmic temperature difference plays a significant role here. The smaller this value is, the faster you will run out of power reserve.



Fouling not taken into account

In the case of a refrigerant condenser with inner grooved tubes, for example, the performance decreases drastically within a short time, which can have various causes. There is no built-in oil separator, which is why there is far too much refrigerant oil in circulation. Refrigerant oil is deposited in the inner grooved tubes, turning the inner grooved tubes into smooth tubes. Refrigerant mixtures, so-called blends, lose their good thermodynamic properties, because the mechanical stress in the compressor is too great, which leads to a loss of performance.



Example 1 on the surface reserve of a cooler with a large temp. difference

Cooler: 40/35/15-6R-36T-1953A-2.5PA-36C-Cu/Al/AISI 304			Software by www.zcs.ch	
Capacity	kW	259.983	------ sensible:	149.553
Surface reserve	%	10.295	latent:	110.429
Present surface	m2	429.978	frost:	0.000
Required surface	m2	389.843		
k-coeff.	W/m2K	41.961		
Average temp. diff. (94.91 %)	K	15.893		

Air humid (ff = 0.00005 m2K/W)		Inlet	Outlet	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Temp.	°C	38.000	16.000	20.000
Rel. humidity	%	40.000	89.656	40.000
Abs. humidity	g/kg	16.638	10.155	5.783
Density humid	kg/m3	1.123	1.213	1.200
Enthalpy humid	kJ/kg	81.028	41.794	34.801
Volume flow humid	m3/h	21595.026	19864.504	20000.000
Mass flow dry	kg/h	23855.617	23855.617	23855.617
Condensate flow	kg/h		154.649	
Surface temperature	°C	19.756	9.158	
Velocity	m/s	2.133	1.962	1.975
Pressure drop (dry 68 Pa)	Pa		81.358	

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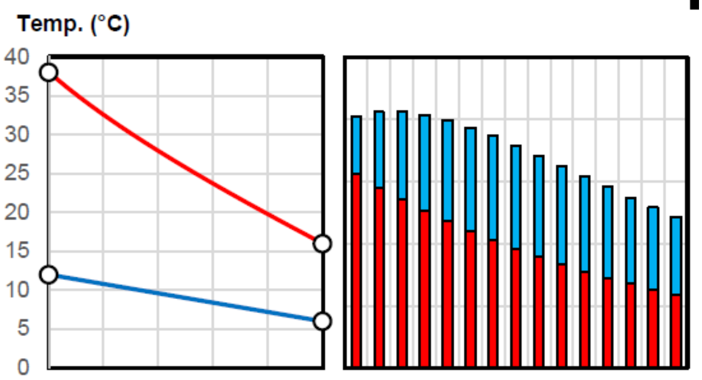
Position

Water (ff = 0.00005 m2K/W)		
Temp. Inlet	°C	6.000
Temp. Outlet	°C	12.000
Temp. Selection	°C	8.190
Density	kg/m3	999.850
Spec. heat	kJ/kgK	4.196
Heat cond.	W/mK	0.577
Viscosity	Pas	1.378E-03
Volume flow	m3/h	37.182
Velocity	m/s	1.714
Reynolds	---	18157.099
Pressure drop (T/C = 7.435)	kPa	46.432

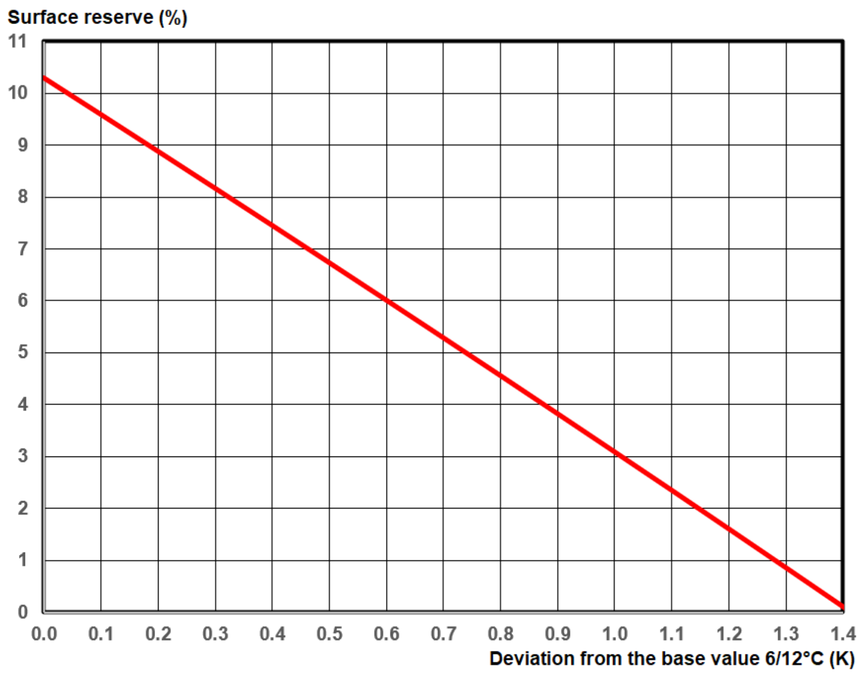


This heat exchanger has a surface reserve of **10,295%** with a large temperature difference of **15,893K**.

Now the question arises as to, what will happen, when the cold water of 6/12°C is a bit warmer due to regulation.

According to the diagram on the right, with a deviation of 1.4 K, the surface reserve is reduced to 0.1%, which corresponds to a cold water temperature of 7.4/13.4°C.

So, you have a certain certainty, that the cooler will still deliver the required capacity even with minor temperature fluctuations.



Example 2 on the surface reserve of a cooler with a small temp. difference

Cooler: 40/35/15-12R-36T-1953A-2.5PA-12C-Cu/Al/AISI 304			Software by www.zcs.ch	
Capacity	kW	128.809	------ sensible:	111.028
Surface reserve	%	10.295	latent:	17.780
Present surface	m2	859.957	frost:	0.000
Required surface	m2	779.687		
k-coeff.	W/m2K	31.790		
Average temp. diff. (83.58 %)	K	5.197		

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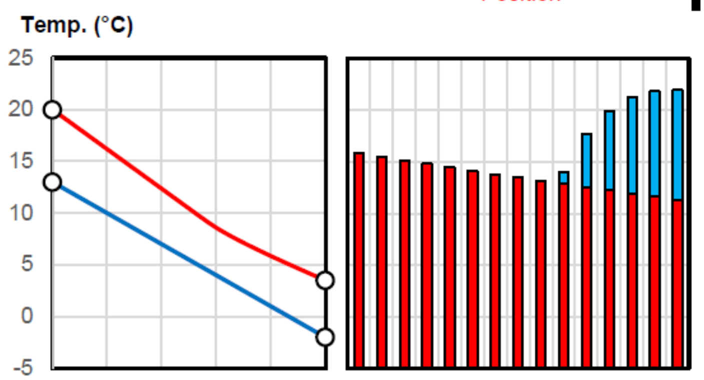
Air humid (ff = 0.00005 m2K/W)		Inlet	Outlet	Definition
Height over sea level	m			0.000
Pressure	hPa			1013.250
Temp.	°C	20.000	3.496	20.000
Rel. humidity	%	40.000	97.167	40.000
Abs. humidity	g/kg	5.783	4.725	5.783
Density humid	kg/m3	1.200	1.272	1.200
Enthalpy humid	kJ/kg	34.801	15.362	34.801
Volume flow humid	m3/h	20000.000	18842.238	20000.000
Mass flow dry	kg/h	23855.617	23855.617	23855.617
Condensate flow	kg/h		25.227	
Surface temperature	°C	15.224	0.154	
Velocity	m/s	1.975	1.861	1.975
Pressure drop (dry 111 Pa)	Pa		116.619	

25 V% Et.glycol (ff = 0.00005 m2K/W)		
Temp. Inlet	°C	-2.000
Temp. Outlet	°C	13.000
Temp. Selection	°C	3.475
Density	kg/m3	1042.934
Spec. heat	kJ/kgK	3.689
Heat cond.	W/mK	0.453
Viscosity	Pas	3.076E-03
Volume flow	m3/h	8.036
Velocity	m/s	1.111
Reynolds	---	5500.642
Pressure drop (T/C = 23.325)	kPa	142.946



This heat exchanger has a surface reserve of **10.295%** with a temperature difference of **5.197K**.

Now the question arises as to, what will happen, when the glycol-water mixture of -2/13°C is a bit warmer due to regulation.

According to the diagram opposite, **with a deviation of 0.47K, the area reserve is reduced to 0.0%,** which corresponds to a temperature of -1.53.0/13.47°C of the glycol-water mixture.

There is **no certainty** that the cooler will still deliver the required capacity with the slightest temperature fluctuations.

Quod erat demonstrandum!