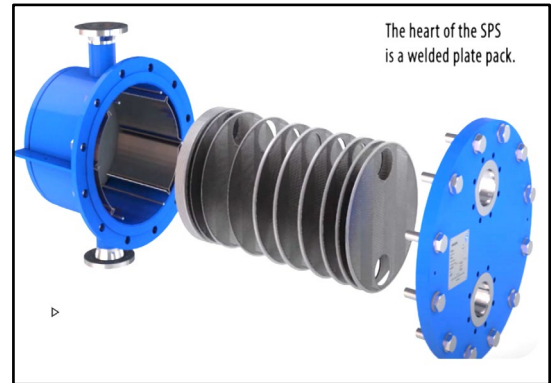




NH3-Heat pump 2-stage

Air-to-water NH3 heat pumps

If the outside air is to be used at low temperatures in winter, for example in Central Europe at -15°C , a 2-stage NH3 heat pump is recommended, i.e. with the natural refrigerant NH3 with a GWP = 0 (Global Warming Potential), preferably for a higher output with oil-free turbo compressors. Thanks to non-contact magnetic or gas bearings, lubricating oil is completely dispensed with. The flowing refrigerant serves as the lubricant, which prevents the oil from foaming and increases the efficiency in the heat exchangers due to the lack of oil films.



Alternatives to R717 (NH3)

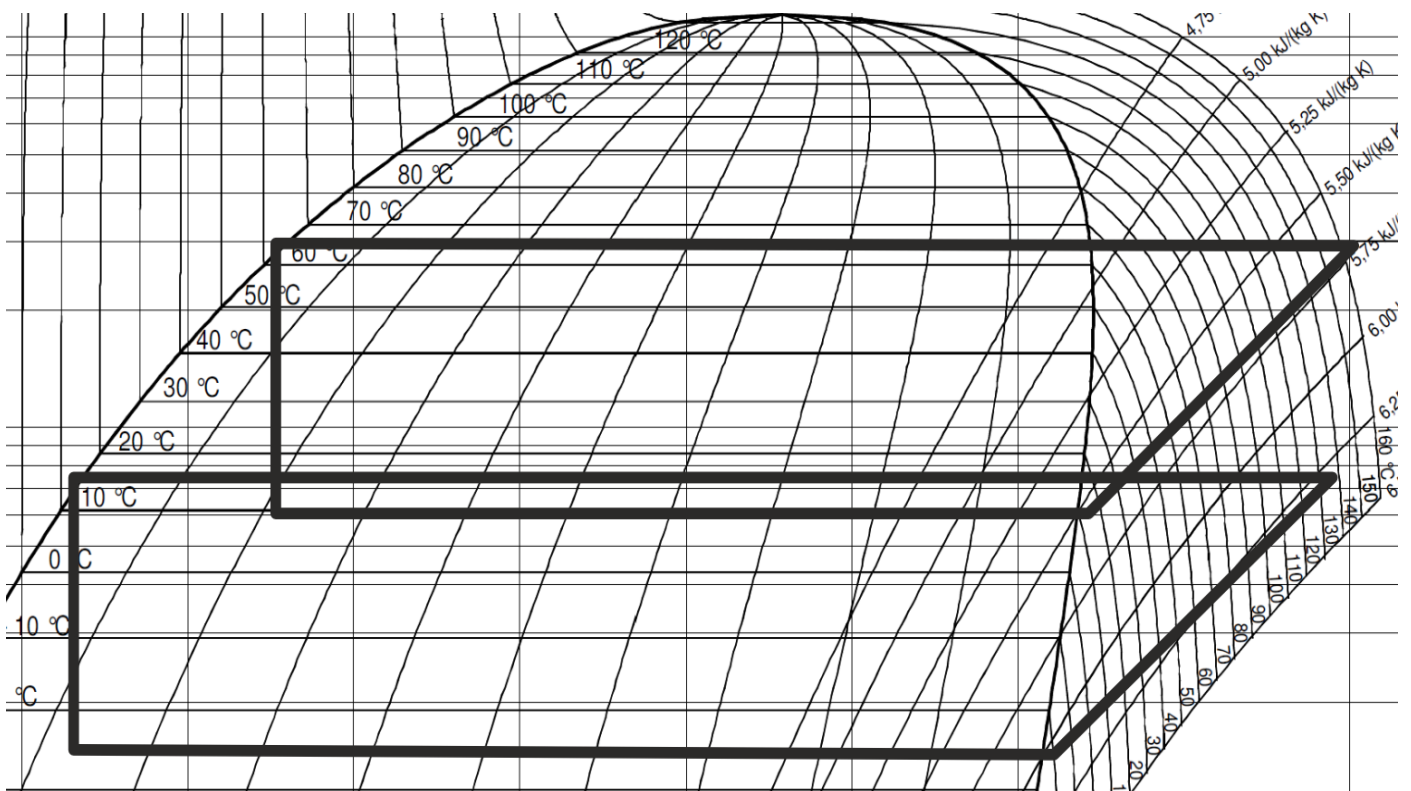
The flammable refrigerant R290 (Propane) is not used at high outputs for reasons of various strict regulations. In the second stage, the refrigerant R744 (CO2) raises supercritical pressures of up to 110 bar on the cooler, which makes the heat exchangers unnecessarily expensive.

Low Pressure Stage 1

For optimal regulation, 2 turbo compressors compress the NH3 refrigerant to a modest pressure and temperature level. The evaporator is a fin coil heat exchanger, that cools the outside air and must be defrosted periodically with hot gases via a second collector in winter, due to frost formation. If you wanted to defrost via the capillaries, it would take far too much time. Ideally, the condenser is a welded plate heat exchanger, which is connected to the high-pressure stage in a cascade connection.

High Pressure Level 2

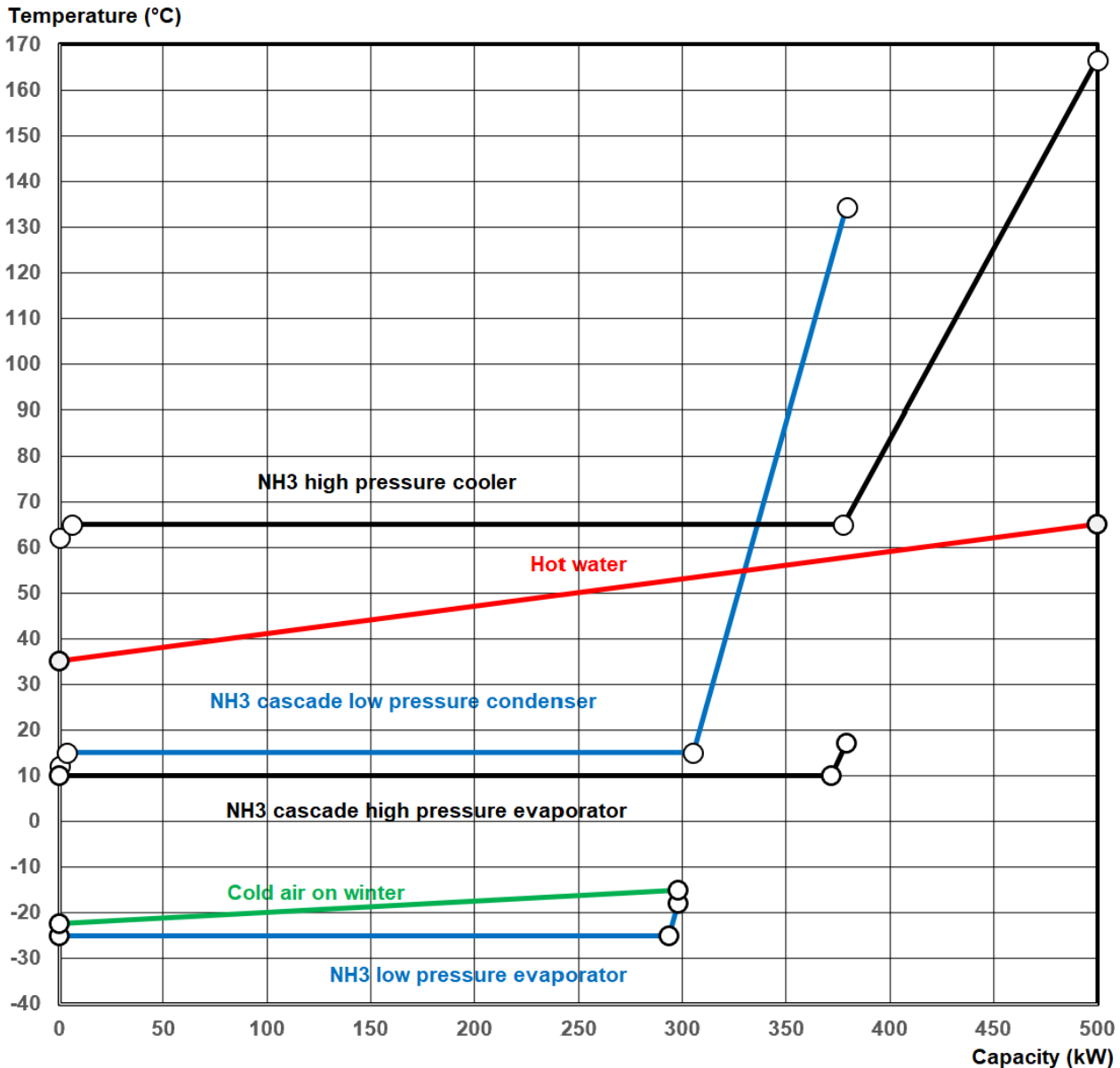
For optimal regulation, 2 turbo compressors compress the NH3 refrigerant to an acceptable pressure and temperature level. This results in a high usable heat of 65°C for hot and heating water. The condenser is ideally a welded plate heat exchanger. The evaporator is ideally a welded plate heat exchanger. Which is connected to the low-pressure stage in a cascade connection.



Example

Subsequently, an air-to-water NH3 heat pump was designed for hot and heating water of 65°C with a capacity of 500 kW. This temperature level is sufficient not only for underfloor heating, but also for heating systems with sufficiently large radiators.

Heat exchanger	Pressure bar	Mass flow kg/h	Temperature °C	Capacity kW
Hot water	1.000	14358.514	35 auf 65	500.000
NH3 high pressure cooler	29.492	1380.118	65.000	500.000
NH3 cascade low pressure condenser	7.286	899.795	15.000	379.204
NH3 cascade high pressure evaporator	6.151	1380.118	10.000	379.204
NH3 low pressure evaporator	1.514	899.795	-25.000	297.690
Cold air on winter		119278.084	-15 auf -22	297.690



Problem

Air-to-water heat pumps have to be defrosted periodically in winter at low outside temperatures, which requires a lot of equipment and noticeably reduces the availability of heat pump operation. This would not be the case with water-to-water heat pumps, which are operated via geothermal probes. The temperature of geothermal probes depends on the depth and the season. In the upper layers of the earth (up to approx. 15 m) it is constant all year round at about 10°C to 12°C. From a depth of 100 metres, the temperature rises by about 3°C per 100 meters due to the geothermal gradient.

Page 3 Software Changeover refrigerants: Injection evaporator, freezing capacity 6,544 kW
 Page 4-8 Software CAP: Defrosting via the second collector or via the capillaries
 Pages 9-13 Software COR: Reduced performance during the defrosting process



Capacity	kW	297.690	----- sensible:	249.699
Surface reserve	%	2.863	latent:	42.078
Present surface	m2	1652.264	frost:	6.544
Required surface	m2	1606.279		
k-coeff.	W/m2K	38.476		
Average temp. diff. (100.00 %)	K	4.817		

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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	-15.000	-22.466	20.000
Rel. humidity	%	100.000	100.000	40.000
Abs. humidity	g/kg	1.006	0.492	5.783
Density humid	kg/m3	1.366	1.407	1.200
Enthalpy humid	kJ/kg	-12.603	-21.391	34.801
Volume flow humid	m3/h	87391.154	84793.857	100000.000
Mass flow dry	kg/h	119278.084	119278.084	119278.084
Condensate flow	kg/h		61.253	
Surface temperature	°C	-22.525	-23.757	
Velocity	m/s	1.897	1.840	2.170
Pressure drop (dry 66 Pa)	Pa		69.660	

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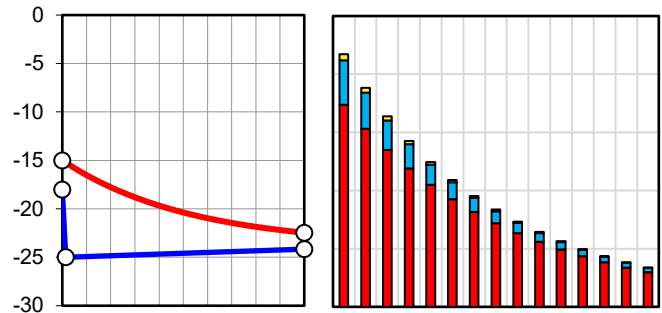
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Plant
Object
Position

R717 (NH3) Evaporation 1.514 bar (ff=0.00005 m2K/W)

Condensate"	°C	15.000
Condensate'	°C	15.000
Subcooling	°C	12.000
Evaporation"	°C	-25.000
Superheating	°C	-18.000
Mass flow	kg/h	899.795
Volume flow	m3/h	694.387
Velocity	m/s	13.934
Pressure drop Evaporation	K	0.835
Pressure drop Capillary	bar	4.880

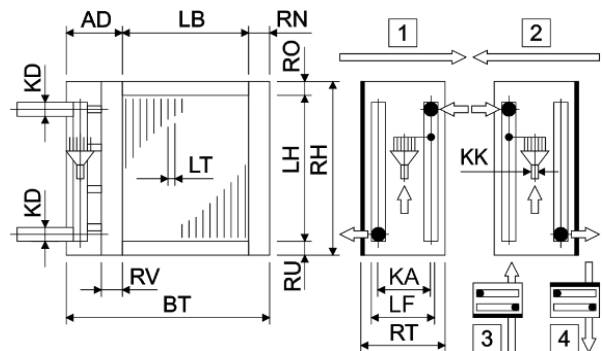
Part of steam on the inject point 12.64 %



Technical data

Tubes total	Piece	512
Tubes blank	Piece	2
Tube rows on the depth	Piece	8
Tube rows on the height	Piece	64
Tube coupling in series	Piece	6
Number of circuits (NC)	Piece	85
Volume	l	481
Weight	kg	1676
Cond. connection	KK	mm 42
Steam connection	KD	mm 168
Frame height	RH	mm 2640
Frame width	BT	mm 5328
Frame depth	RT	mm 440
Finned height	LH	mm 2560
Finned width	LB	mm 5000
Finned depth	LF	mm 277
Frame on top	RO	mm 40
Frame on bottom	RU	mm 40
Frame in front	RV	mm 30
Frame on back (~69mm)	RN	mm 69
Covering (~259mm)	AD	mm 259
Collector distance	KA	mm 243
Fin spacing	LT	mm 4.000
Fin thickness	LD	mm 0.200
Tube diameter	DA	mm 16.400
Tube thickness	S	mm 1.000
Tube interval on the height	S1	mm 40.000
Tube interval on the depth	S2	mm 34.641

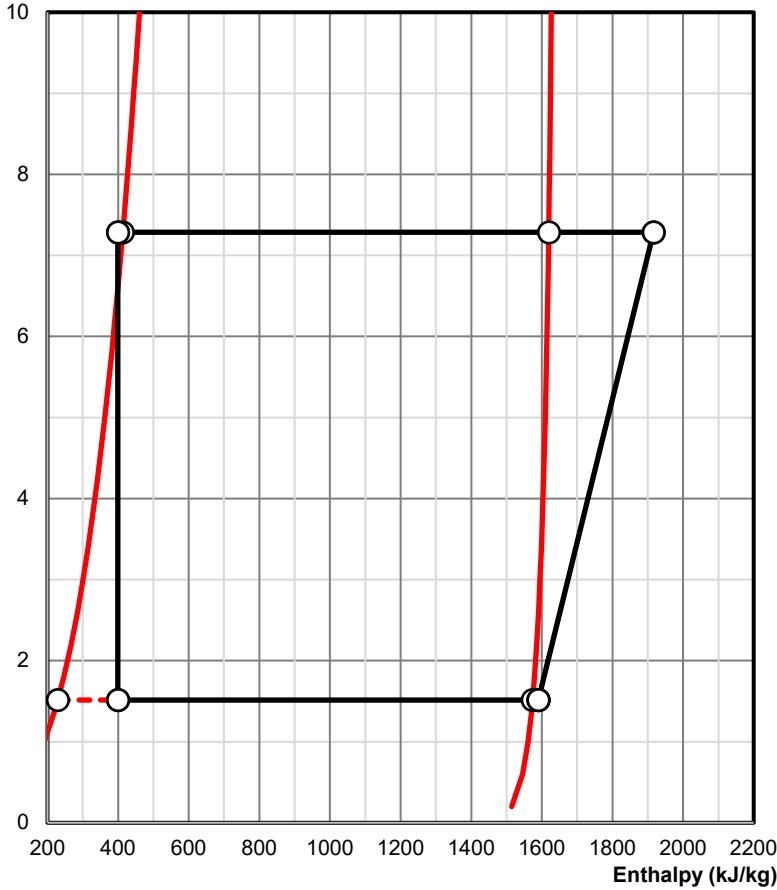
Capillary:	5.00 x 1.00 x 2760.00 mm
Tubes:	smooth AISI 304
Tubes:	staggered
Collectors:	AISI 304
Connections:	AISI 304
Fins:	ribbed Al
Frame:	2.0 mm AISI 304
Circulations:	1 Default
Protection:	without
Protection:	---
Air flow direction:	horizontal



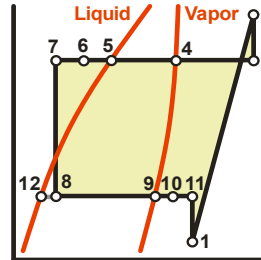
This requires 10 fans from Ziehl-Abegg, type FE80-AD.6N.V7.Y.
These models use bionically shaped blades modelled on the owl's wing and are used worldwide in mechanical engineering as well as in air-conditioning, refrigeration and ventilation technology.



Pressure (bar)



- 1 = Refrig. compressor
- 2 = Refrig. compressor
- 3 = Hot gas Condenser
- 4 =Condensation" (Vapor)
- 5 =Condensation' (Liquid)
- 6 = Subcooling Condenser
- 7 = Subcooling additional
- 8 = Evaporator Injection point
- 9 = Evaporator" (Vapor)
- 10 = Superheating Evaporator
- 11 = Superheating additional
- 12 =Evaporation' (Liquid)



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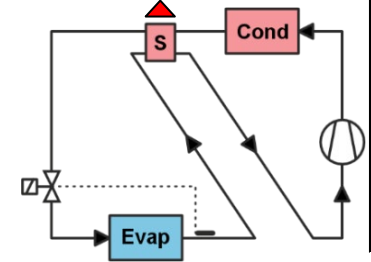
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Object
Position

Heat exchanger: No!



Refrig. compressor	bar	°C	kJ/kg	kW	kg/h	(n)	
1 = Refrig. compressor	1.514	-18.000	1590.190				
2 = Refrig. compressor	7.286	134.332	1916.321				
Difference			326.130	81.514	899.795		
Polytrophic exponent (n)						1.424	
Condenser	bar	°C	kJ/kg	kW	kg/h	COP	
3 = Hot gas Condenser	7.286	134.332	1916.321				
4 =Condensation" (Vapor)	7.286	15.000	1619.535				
5 =Condensation' (Liquid)	7.286	15.000	413.234				
6 = Subcooling Condenser	7.286	12.000	399.158				
Difference			1517.162	379.204	899.795	4.652	
Subcooling additional	bar	°C	kJ/kg	kW	kg/h		
6 = Subcooling Condenser	7.286	12.000	399.158				
7 = Subcooling additional	7.286	12.000	399.158				
Difference			0.000	0.000	899.795		
Evaporator	bar	°C	kJ/kg	kW	kg/h	COP	Flashgas
12 =Evaporation' (Liquid)	1.514	-25.000	229.186				
8 = Evaporator Injection point	1.514	-25.000	399.158				0.126
9 = Evaporator" (Vapor)	1.514	-25.000	1573.800				
10 = Evaporator Superheating	1.514	-18.000	1590.190				
Difference			1191.032	297.690	899.795	3.652	
Superheating additional	bar	°C	kJ/kg	kW	kg/h		
10 = Superheating Evaporator	1.514	-18.000	1590.190				
11 = Superheating additional	1.514	-18.000	1590.190				
Difference			0.000	0.000	899.795		
Pressure drop	bar	°C	kJ/kg				
2-3 = Pressure drop	0.000	0.000					
11-1 = Pressure drop	0.000	0.000					
Connections	ρ	\dot{V}	c max	di min	di eff	da eff	\emptyset eff
--	kg/m ³	m ³ /h	m/s	m	mm	mm	--
Condensation" (Vapor)	5.726	157.141	14.977	0.061	72.100	76.100	2 ½"
Condensation' (Liquid)	617.504	1.457	1.256	0.020	25.000	28.000	1"
Evaporation' (Liquid)	671.591	1.340	0.598	0.028	32.000	35.000	1 ¼"
Evaporation" (Vapor)	1.296	694.387	11.714	0.145	159.300	168.300	NW 150

Pressure drop capillaries

Software by www.zcs.ch



Number of circuits (NC)	Piece	85.000
Length	mm	2760.000
Outside diam.	mm	5.000
Thickness	mm	1.000
Inside diam.	mm	3.000
Roughness	mm	0.080
Mass flow	kg/h	899.795
Type of cooling oil	---	Oil ISO VG32
Part of cooling oil	%	0.500

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R717 (NH3) °C kJ/kg ---

Hot gas	thg	134.332	1916.321
Condensate	tc''	15.000	1619.535
Condensate	tc'	15.000	413.234
Subcooling	tsc	12.000	399.158
Evaporation	to'	-25.000	229.186
Evaporation	tox	-25.000	399.158
Evaporation	to''	-25.000	1573.800
Superheating	tsh	-18.000	1590.190
Flashgas	x		0.126

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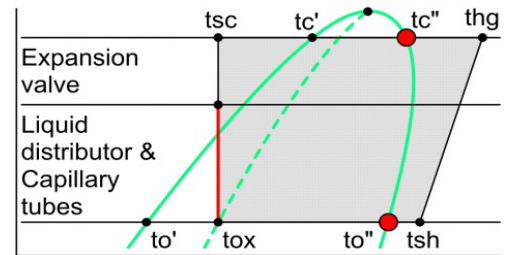
Plant
Object
Position

Pressure / Capacity bar kW

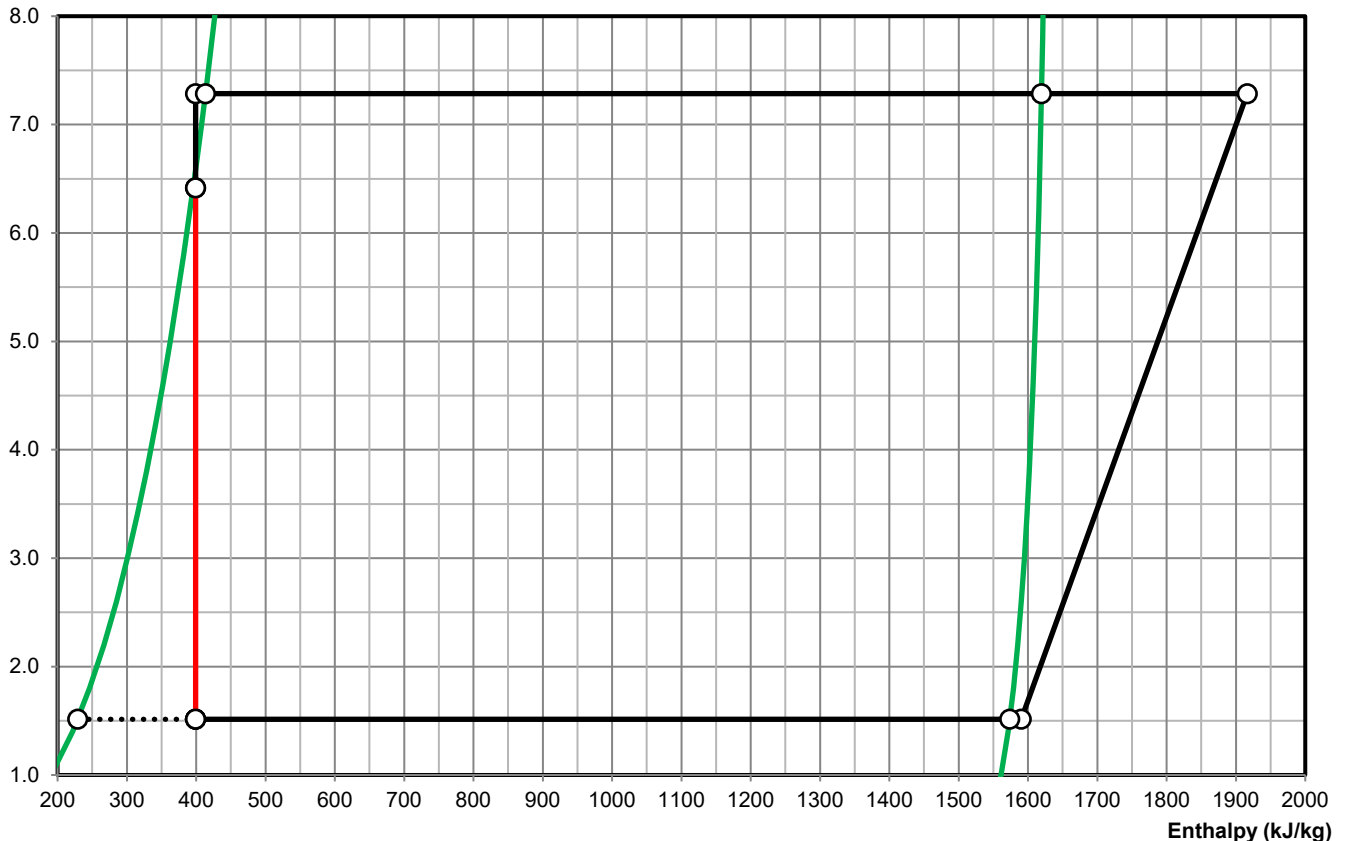
Condenser	pc	7.286	379.204
Evaporator	po	1.514	297.690
Refrig. compressor	---	5.772	81.514

Pressure drop bar %

Pressure drop expansion valve	0.868	15.042
Pressure drop capillaries	4.904	84.958
Total	5.772	100.000



Pressure (bar)





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Object
Position

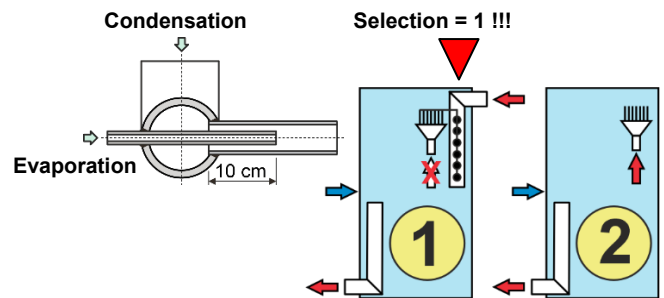
Number of circuits (NC)	Piece	85.000	
Length	mm	2760.000	
Outside diam.	mm	5.000	
Thickness	mm	1.000	
Inside diam.	mm	3.000	
Roughness	mm	0.080	
Mass flow	kg/h	899.795	(100.00%)
Type of cooling oil	---	Oil ISO VG32	
Part of cooling oil	%	0.500	

R717 (NH3)

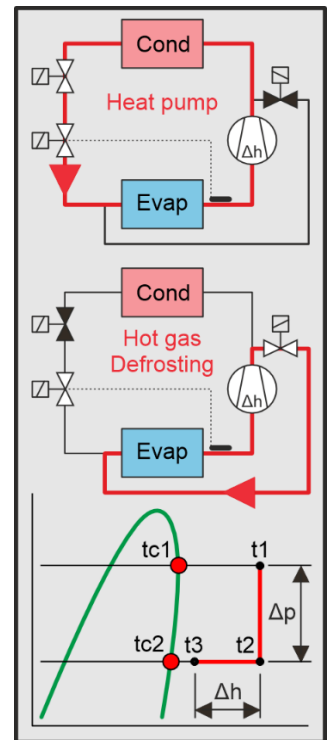
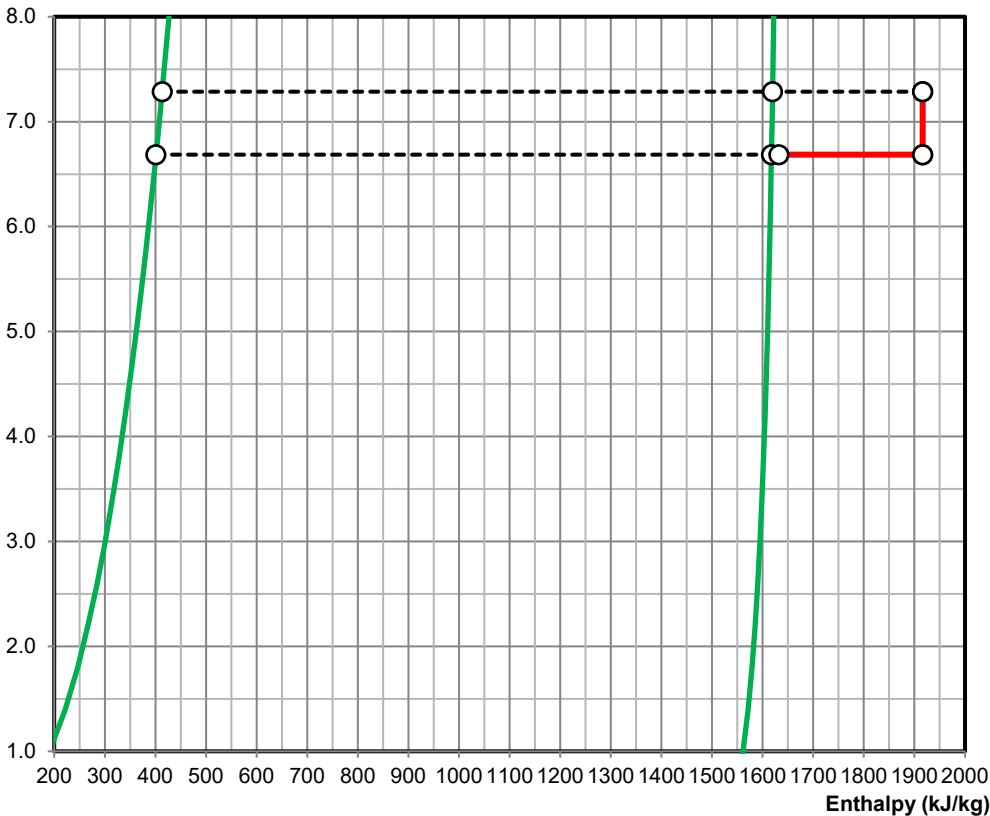
Hot gas	t1	°C	134.332
Hot gas	h1	kJ/kg	1916.321
Condensate"	tc1	°C	15.000
Pressure	p1	bar	7.286
Hot gas	t2	°C	133.634
Hot gas	h2	kJ/kg	1916.321
Condensate"	tc2	°C	12.438
Pressure	p2	bar	6.686
Refrig. compressor	Qc	kW	71.080
Hot gas	h3	kJ/kg	1631.935
Hot gas	t3	°C	17.582

Pressure drop valves, pipes	dp	bar	0.500
Pressure drop collectors	dp	bar	0.100
Pressure drop total	dp	bar	0.600

Frost capacity	kW	6.544
Defr. cycle	h	12.000
Frost energy	kWh	78.528
Defr. time	h	1.105
Defr. time	min	66.287



Pressure (bar)



Hot gas defrosting



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Object
Position

Number of circuits (NC)	Piece	85.000	
Length	mm	2760.000	
Outside diam.	mm	5.000	
Thickness	mm	1.000	
Inside diam.	mm	3.000	
Roughness	mm	0.080	
Mass flow	kg/h	449.897	(50.00%)
Type of cooling oil	---	Oil ISO VG32	
Part of cooling oil	%	0.500	

R717 (NH3)

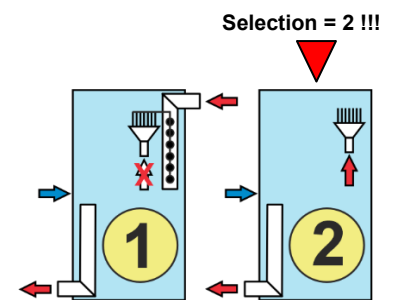
Hot gas	t1	°C	134.332
Hot gas	h1	kJ/kg	1916.321
Condensate"	tc1	°C	15.000
Pressure	p1	bar	7.286

Hot gas	t2	°C	130.000
Hot gas	h2	kJ/kg	1916.321
Condensate"	tc2	°C	-5.954
Pressure	p2	bar	3.418

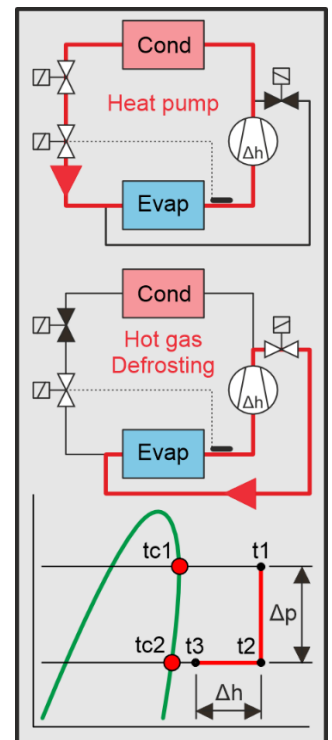
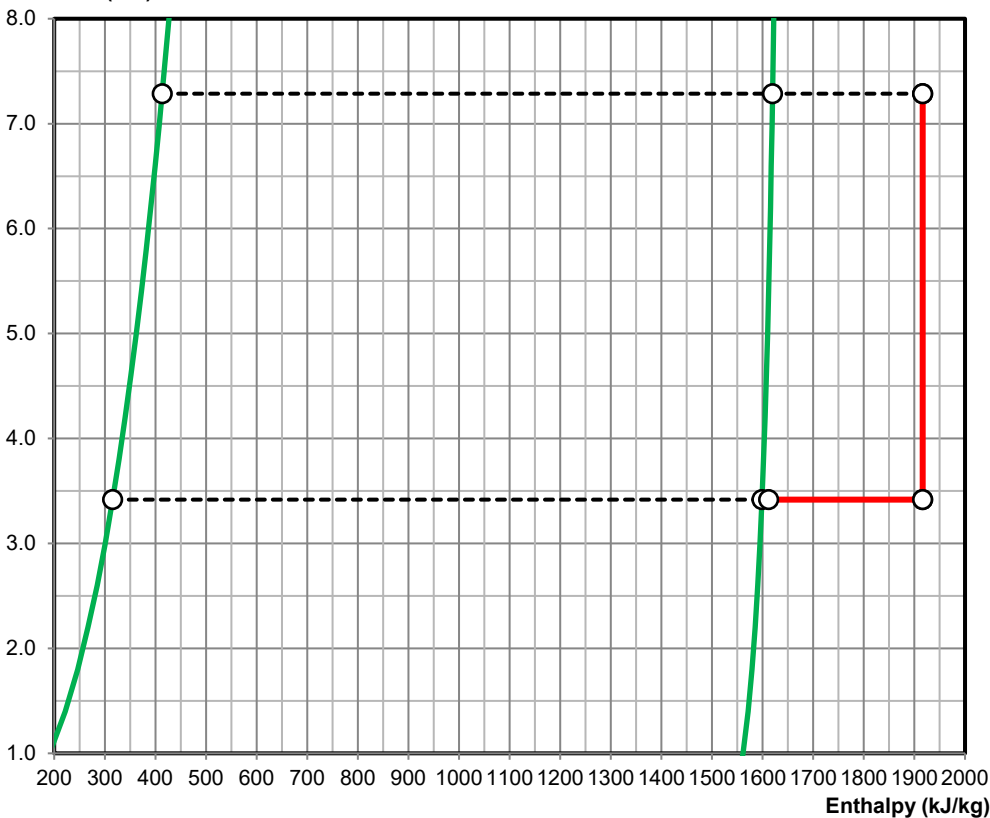
Refrig. compressor	Qc	kW	38.034	(46.66%)
Hot gas	h3	kJ/kg	1611.976	
Hot gas	t3	°C	-0.778	

Pressure drop valves, pipes	dp	bar	0.500
Pressure drop capillaries	dp	bar	3.368
Pressure drop total	dp	bar	3.868

Frost capacity	kW	6.544
Defr. cycle	h	12.000
Frost energy	kWh	78.528
Defr. time	h	2.065
Defr. time	min	123.879



Pressure (bar)



Hot gas defrosting

Evaporator

Number of circuits (NC)	Piece	85.00
Length	mm	2760.00
Outside diam.	mm	5.00
Thickness	mm	1.00
Inside diam.	mm	3.00
Roughness	mm	8.00E-02
Mass flow	kg/h	899.79
Type of cooling oil	---	Oil ISO VG32
Part of cooling oil	%	0.50

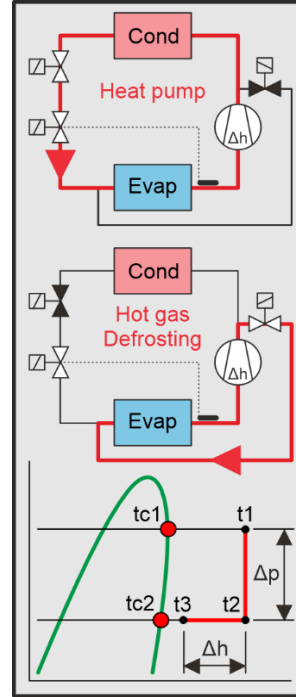
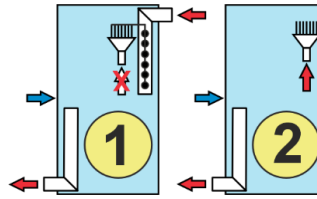
R717 (NH3)

Hot gas	thg	°C	134.332
Condensate	tc"	°C	15.000
Condensate	tc"	°C	15.000
Subcooling	tsc	°C	12.000
Evaporation	to'	°C	-25.000
Evaporation	tox	°C	-25.000
Evaporation	to"	°C	-25.000
Superheating	tsh	°C	-18.000
Flashgas	x	---	0.126

Pressure / Capacity	bar	kW	
Condenser	pc	7.286	379.204
Evaporator	Po	1.514	297.690
Refrig. compressor	---	5.772	81.514

Pressure drop	bar	%
Pressure drop expansion valve	0.868	15.042
Pressure drop capillaries	4.904	84.958
Total	5.772	100.000

Selection = 1 !!!



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Plant
Object
Position

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Selection = 1 !!!

Hot gas defrosting (Collector) Selection = 1 !!! Selection = 2 !!!

Refrig. compressor	---	kW	71.080	38.034
Pressure	p2	bar	6.686	3.418
Hot gas	t2	°C	133.634	130.000
Hot gas	t3	°C	17.582	-0.778
Condensate"	tc2	°C	12.438	-5.954
Pressure drop total	dp	bar	0.600	3.868
Frost capacity	---	kW	6.544	6.544
Defr. cycle	---	h	12.000	12.000
Frost energy	---	kWh	78.528	78.528
Defr. time	---	h	1.105	2.065
Availability	---	%	90.793	82.795

Changeover operation Selection = 1 !!! Selection = 2 !!!

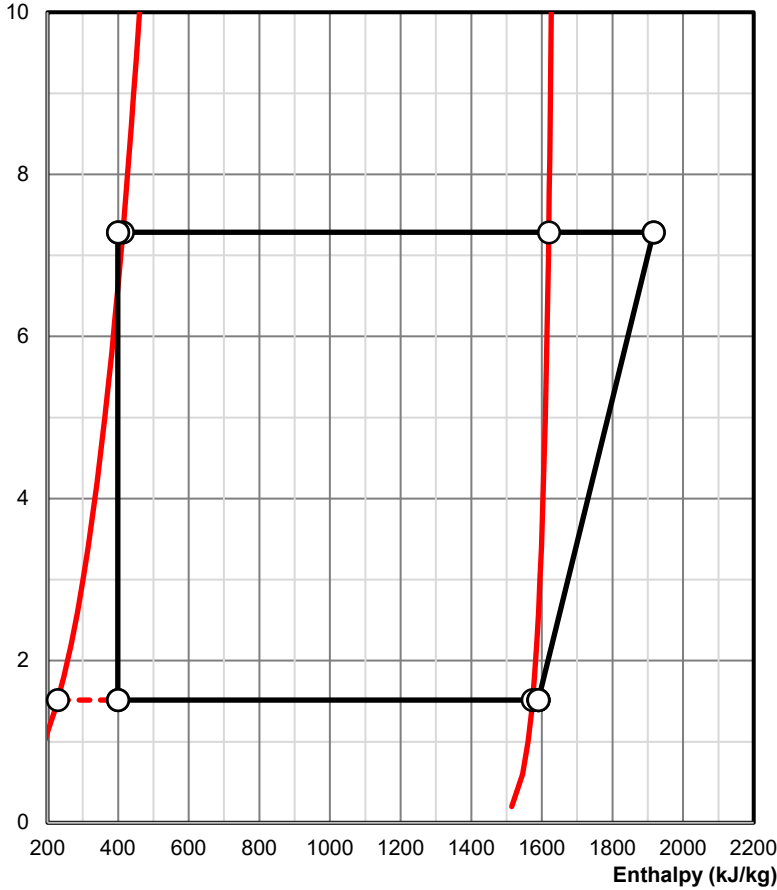
Condenser	---	kW	379.204	201.747
Evaporator	---	kW	297.690	160.990
Refrig. compressor	---	kW	81.514	40.757

Option 1: If the pressure drop in the capillaries is very high and defrosting with hot gases via the collector is desired, this is not a problem. If the condenser is expected to deliver a high capacity via the collector in changeover mode, this is also not a problem. Defrosting with hot gases via the collector takes little time, and the condenser can easily deliver its nominal capacity. Option 2: If the pressure drop in the capillaries is very high and defrosting with hot gases via the capillaries is desired, this is a problem. If the condenser is expected to deliver any capacity via the capillaries in changeover mode, this is also a problem. It is not surprising, if two highly negative consequences occur. Defrosting with hot gases via the capillaries takes far too long, and the condenser can only deliver a fraction of its nominal output.

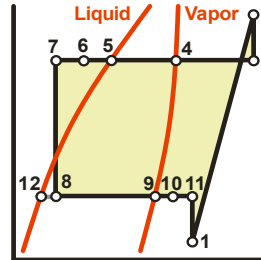




Pressure (bar)



- 1 = Refrig. compressor
- 2 = Refrig. compressor
- 3 = Hot gas Condenser
- 4 =Condensation" (Vapor)
- 5 =Condensation' (Liquid)
- 6 = Subcooling Condenser
- 7 = Subcooling additional
- 8 = Evaporator Injection point
- 9 = Evaporator" (Vapor)
- 10 = Superheating Evaporator
- 11 = Superheating additional
- 12 =Evaporation' (Liquid)



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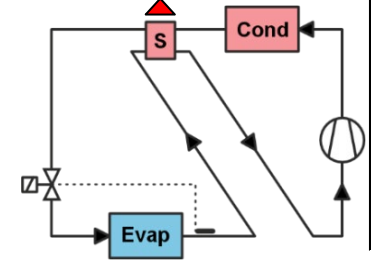
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Plant
Object
Position

Heat exchanger: No!



Refrig. compressor	bar	°C	kJ/kg	kW	kg/h	(n)	
1 = Refrig. compressor	1.514	-18.000	1590.190				
2 = Refrig. compressor	7.286	134.332	1916.321				
Difference			326.130	81.514	899.795		
Polytrophic exponent (n)						1.424	
Condenser	bar	°C	kJ/kg	kW	kg/h	COP	
3 = Hot gas Condenser	7.286	134.332	1916.321				
4 =Condensation" (Vapor)	7.286	15.000	1619.535				
5 =Condensation' (Liquid)	7.286	15.000	413.234				
6 = Subcooling Condenser	7.286	12.000	399.158				
Difference			1517.162	379.204	899.795	4.652	
Subcooling additional	bar	°C	kJ/kg	kW	kg/h		
6 = Subcooling Condenser	7.286	12.000	399.158				
7 = Subcooling additional	7.286	12.000	399.158				
Difference			0.000	0.000	899.795		
Evaporator	bar	°C	kJ/kg	kW	kg/h	COP	Flashgas
12 =Evaporation' (Liquid)	1.514	-25.000	229.186				
8 = Evaporator Injection point	1.514	-25.000	399.158				0.126
9 = Evaporator" (Vapor)	1.514	-25.000	1573.800				
10 = Evaporator Superheating	1.514	-18.000	1590.190				
Difference			1191.032	297.690	899.795	3.652	
Superheating additional	bar	°C	kJ/kg	kW	kg/h		
10 = Superheating Evaporator	1.514	-18.000	1590.190				
11 = Superheating additional	1.514	-18.000	1590.190				
Difference			0.000	0.000	899.795		
Pressure drop	bar	°C	kJ/kg				
2-3 = Pressure drop	0.000	0.000					
11-1 = Pressure drop	0.000	0.000					
Connections	ρ	\dot{V}	c max	di min	di eff	da eff	\emptyset eff
--	kg/m ³	m ³ /h	m/s	m	mm	mm	--
Condensation" (Vapor)	5.726	157.141	14.977	0.061	72.100	76.100	2 ½"
Condensation' (Liquid)	617.504	1.457	1.256	0.020	25.000	28.000	1"
Evaporation' (Liquid)	671.591	1.340	0.598	0.028	32.000	35.000	1 ¼"
Evaporation" (Vapor)	1.296	694.387	11.714	0.145	159.300	168.300	NW 150

Pressure drop capillaries

Software by www.zcs.ch



Number of circuits (NC)	Piece	85.000
Length	mm	2760.000
Outside diam.	mm	5.000
Thickness	mm	1.000
Inside diam.	mm	3.000
Roughness	mm	0.080
Mass flow	kg/h	899.795
Type of cooling oil	---	Oil ISO VG32
Part of cooling oil	%	0.500

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R717 (NH3) °C kJ/kg ---

Hot gas	thg	134.332	1916.321
Condensate	tc''	15.000	1619.535
Condensate	tc'	15.000	413.234
Subcooling	tsc	12.000	399.158
Evaporation	to'	-25.000	229.186
Evaporation	tox	-25.000	399.158
Evaporation	to''	-25.000	1573.800
Superheating	tsh	-18.000	1590.190
Flashgas	x		0.126

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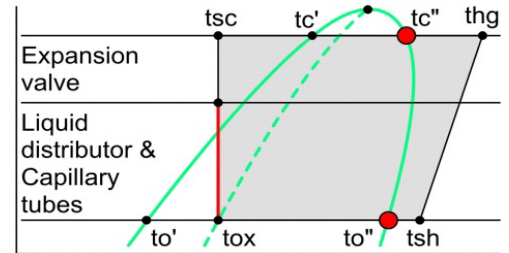
Plant
Object
Position

Pressure / Capacity bar kW

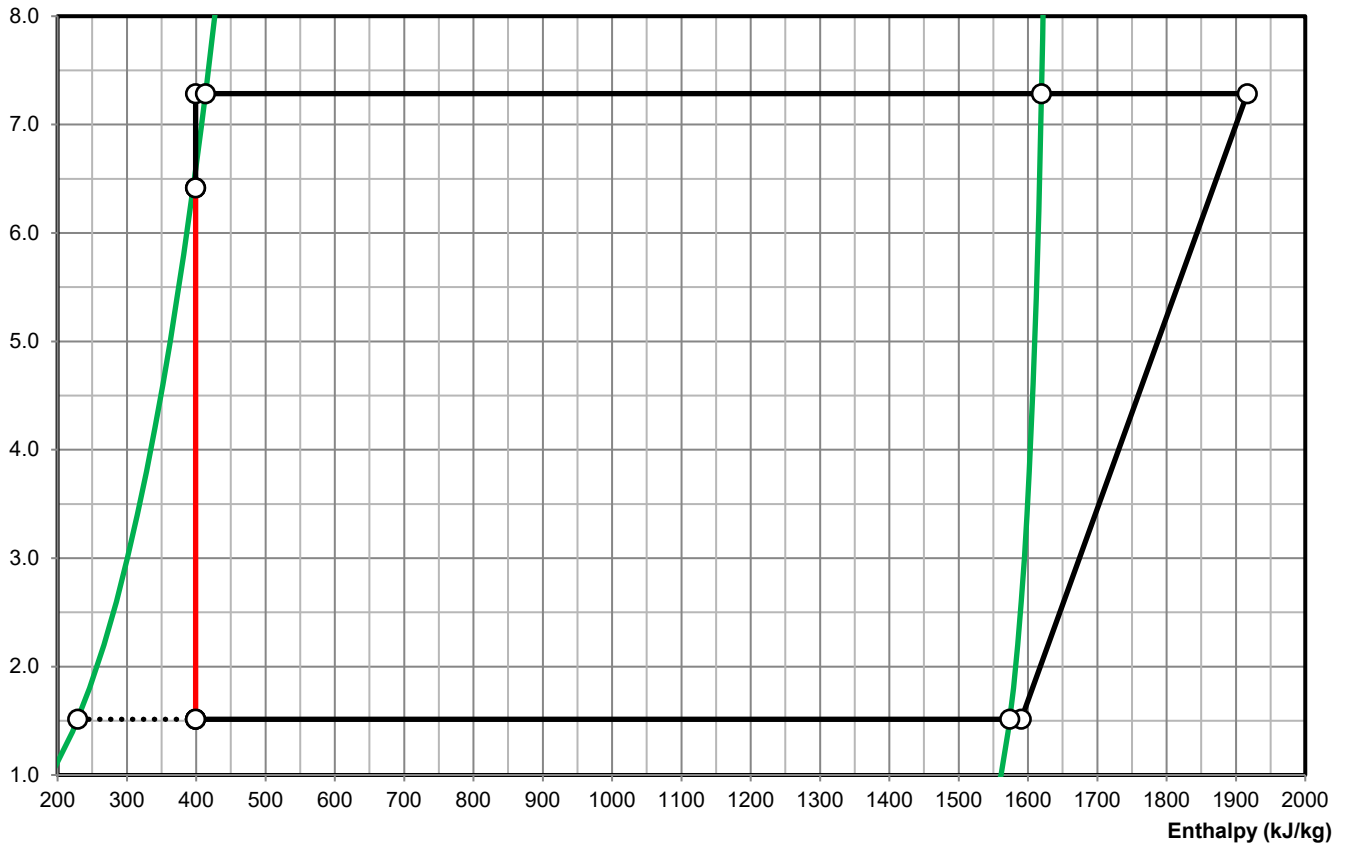
Condenser	pc	7.286	379.204
Evaporator	po	1.514	297.690
Refrig. compressor	---	5.772	81.514

Pressure drop bar %

Pressure drop expansion valve	0.868	15.042
Pressure drop capillaries	4.904	84.958
Total	5.772	100.000



Pressure (bar)





Number of circuits (NC)	Piece	85.000
Length	mm	2760.000
Outside diam.	mm	5.000
Thickness	mm	1.000
Inside diam.	mm	3.000
Roughness	mm	0.080
Mass flow	kg/h	899.795
Type of cooling oil	---	Oil ISO VG32
Part of cooling oil	%	0.500

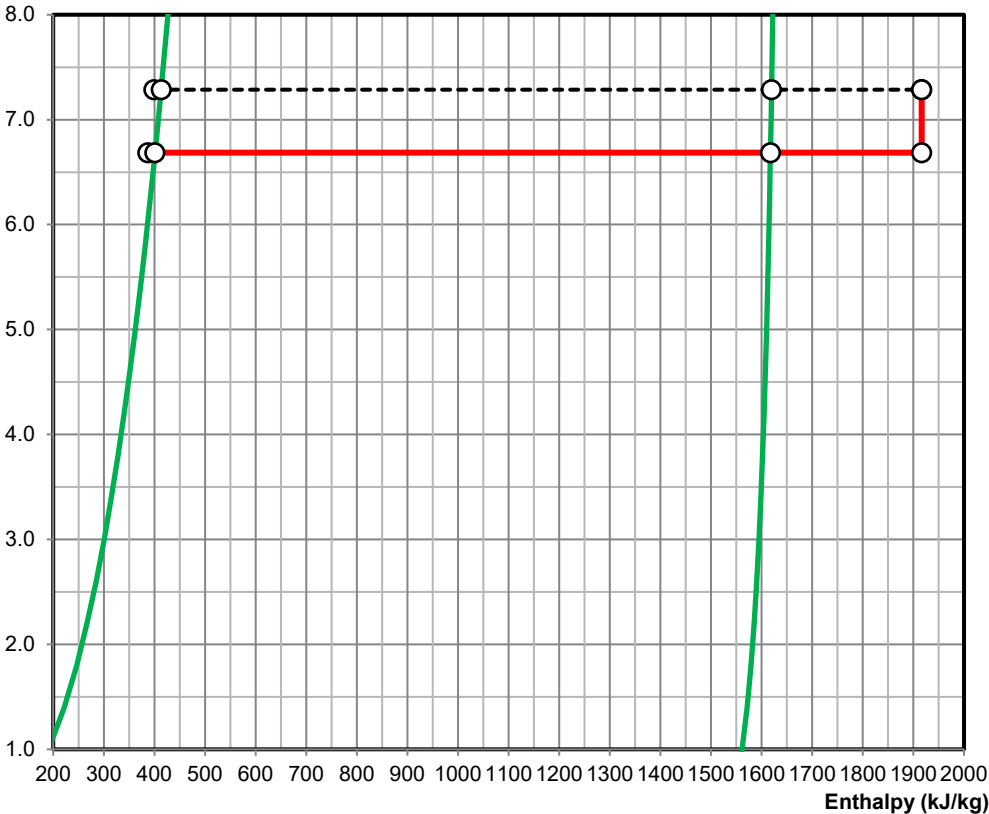
R717 (NH3)

Hot gas	t1	°C	134.332
Hot gas	h1	kJ/kg	1916.321
Condensate"	tc1	°C	15.000
Pressure	p1	bar	7.286
Hot gas	t2	°C	133.634
Hot gas	h2	kJ/kg	1916.321
Condensate"	tc2	°C	12.438
Pressure	p2	bar	6.686
Condensate'	tc3	°C	12.438
Subcooling	t3	°C	9.438
Subcooling	h3	kJ/kg	387.198
Condenser	Q	kW	382.193
Refrig. compressor	Q	kW	81.514
Evaporator	Q	kW	300.679

Pressure drop

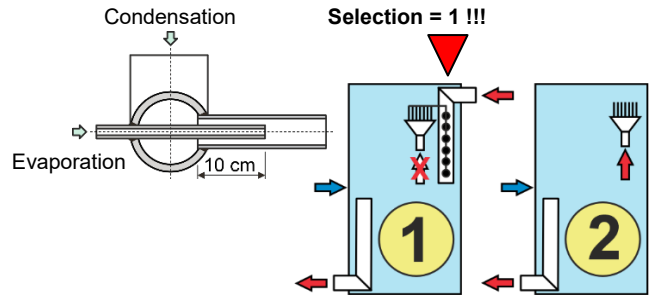
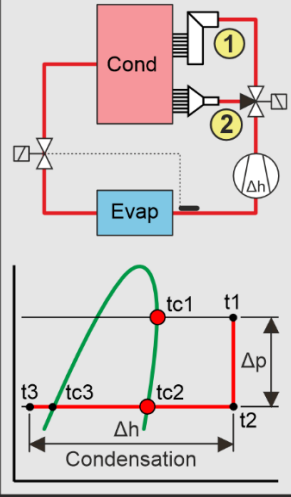
Pressure drop valves, pipes	dp	bar	0.500
Pressure drop collectors	dp	bar	0.100
Pressure drop total	dp	bar	0.600

Pressure (bar)



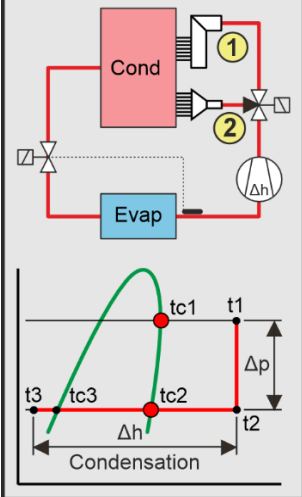
Changeover refrigerants

- ① Via 2nd collector
Large capacity
Small pressure drop
- ② Via capillaries
Small capacity
Large pressure drop



Changeover refrigerants

- ① Via 2nd collector
Large capacity
Small pressure drop
- ② Via capillaries
Small capacity
Large pressure drop



Hot gas defrosting

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Plant
Object
Position



Number of circuits (NC)	Piece	85.000
Length	mm	2760.000
Outside diam.	mm	5.000
Thickness	mm	1.000
Inside diam.	mm	3.000
Roughness	mm	0.080
Mass flow	kg/h	637.055
Type of cooling oil	---	Oil ISO VG32
Part of cooling oil	%	0.500

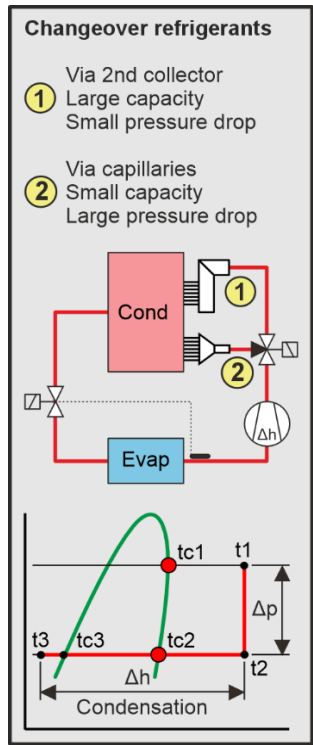
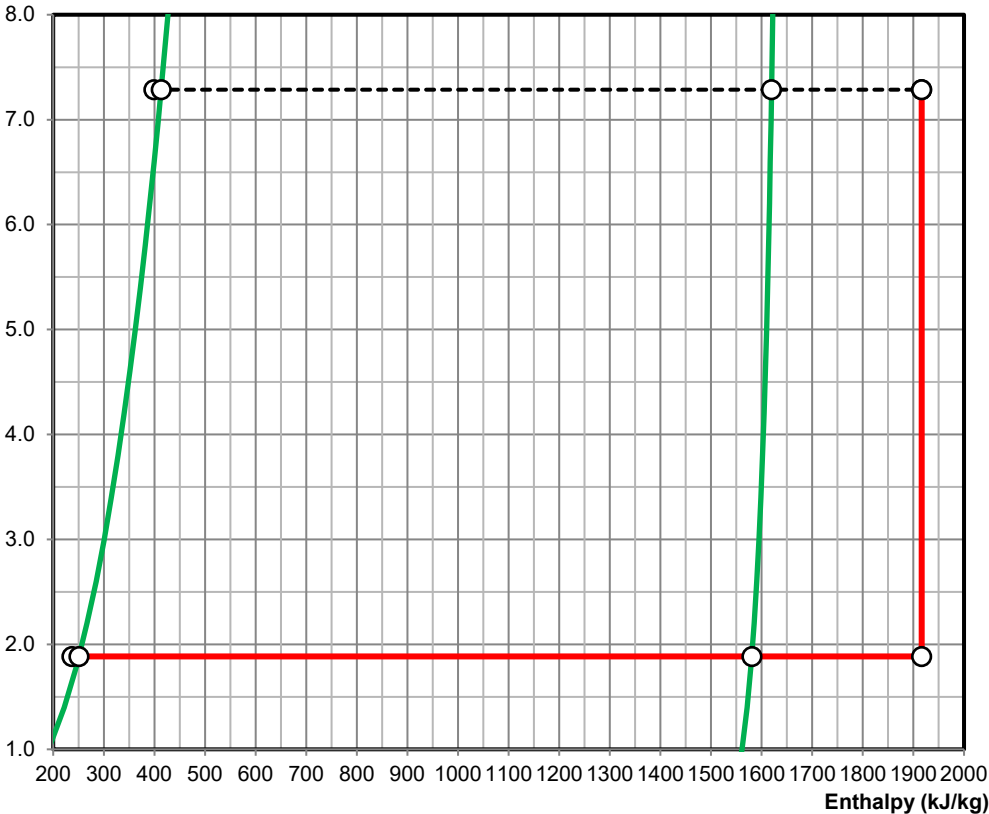
R717 (NH3)

Hot gas	t1	°C	134.332
Hot gas	h1	kJ/kg	1916.321
Condensate"	tc1	°C	15.000
Pressure	p1	bar	7.286
Hot gas	t2	°C	128.418
Hot gas	h2	kJ/kg	1916.321
Condensate"	tc2	°C	-20.176
Pressure	p2	bar	1.885
Condensate'	tc3	°C	-20.176
Subcooling	t3	°C	-23.176
Subcooling	h3	kJ/kg	236.963
Condenser	Q	kW	297.179
Refrig. compressor	Q	kW	57.712
Evaporator	Q	kW	239.467

Pressure drop

Pressure drop valves, pipes	dp	bar	0.500
Pressure drop capillaries	dp	bar	4.900
Pressure drop total	dp	bar	5.400

Pressure (bar)



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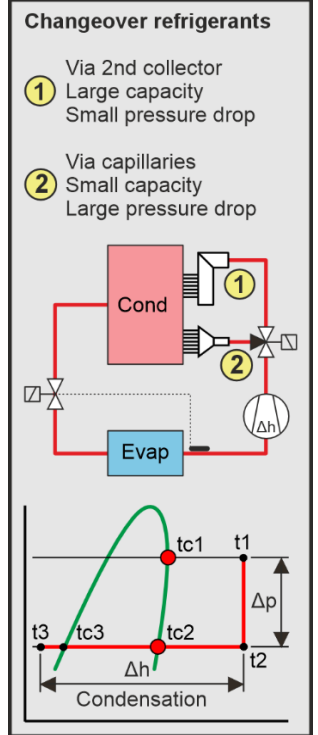
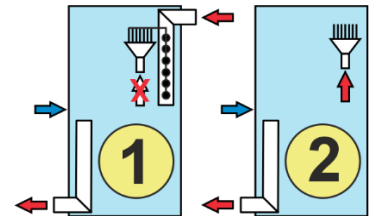
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Plant
Object
Position

Selection = 2 !!!



Hot gas defrosting

Evaporator

Number of circuits (NC)	Piece	85.00
Length	mm	2760.00
Outside diam.	mm	5.00
Thickness	mm	1.00
Inside diam.	mm	3.00
Roughness	mm	8.00E-02
Mass flow	kg/h	899.79
Type of cooling oil	---	Oil ISO VG32
Part of cooling oil	%	0.50

R717 (NH3)

Hot gas	thg	°C	134.332
Condensate	tc"	°C	15.000
Condensate	tc"	°C	15.000
Subcooling	tsc	°C	12.000
Evaporation	to'	°C	-25.000
Evaporation	tox	°C	-25.000
Evaporation	to"	°C	-25.000
Superheating	tsh	°C	-18.000
Flashgas	x	---	0.126

Pressure / Capacity	bar	kW	
Condenser	pc	7.286	379.204
Evaporator	po	1.514	297.690
Refrig. compressor	---	5.772	81.514

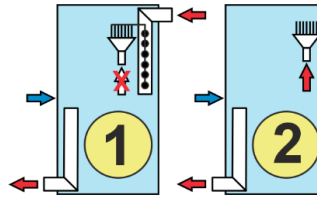
Pressure drop	bar	%
Pressure drop expansion valve	0.868	15.042
Pressure drop capillaries	4.904	84.958
Total	5.772	100.000

Condensation	Selection = 1 !!!	Selection = 2 !!!		
Refrig. compressor	---	kW	81.514	57.712
Pressure	p2	bar	6.686	1.885
Pressure drop total	dp	bar	0.600	5.400
Hot gas	t2	°C	133.634	128.418
Condensate"	tc2	°C	12.438	-20.176
Condensate'	tc3	°C	12.438	-20.176
Subcooling	t3	°C	9.438	-23.176

Changeover operation	Selection = 1 !!!	Selection = 2 !!!		
Condenser	---	kW	379.204	297.100
Evaporator	---	kW	297.690	239.388
Refrig. compressor	---	kW	81.514	57.712

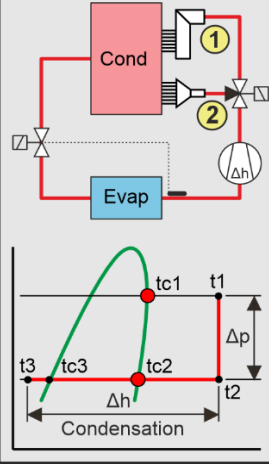
Option 1: If the pressure drop in the capillaries is very high and defrosting with hot gases via the collector is desired, this is not a problem. If the condenser is expected to deliver a high capacity via the collector in changeover mode, this is also not a problem. Defrosting with hot gases via the collector takes little time, and the condenser can easily deliver its nominal capacity. Option 2: If the pressure drop in the capillaries is very high and defrosting with hot gases via the capillaries is desired, this is a problem. If the condenser is expected to deliver any capacity via the capillaries in changeover mode, this is also a problem. It is not surprising, if two highly negative consequences occur. Defrosting with hot gases via the capillaries takes far too long, and the condenser can only deliver a fraction of its nominal output.

Selection = 1 !!!



Changeover refrigerants

- ① Via 2nd collector
Large capacity
Small pressure drop
- ② Via capillaries
Small capacity
Large pressure drop



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Plant
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Position

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Selection = 1 !!!

