

# COLD

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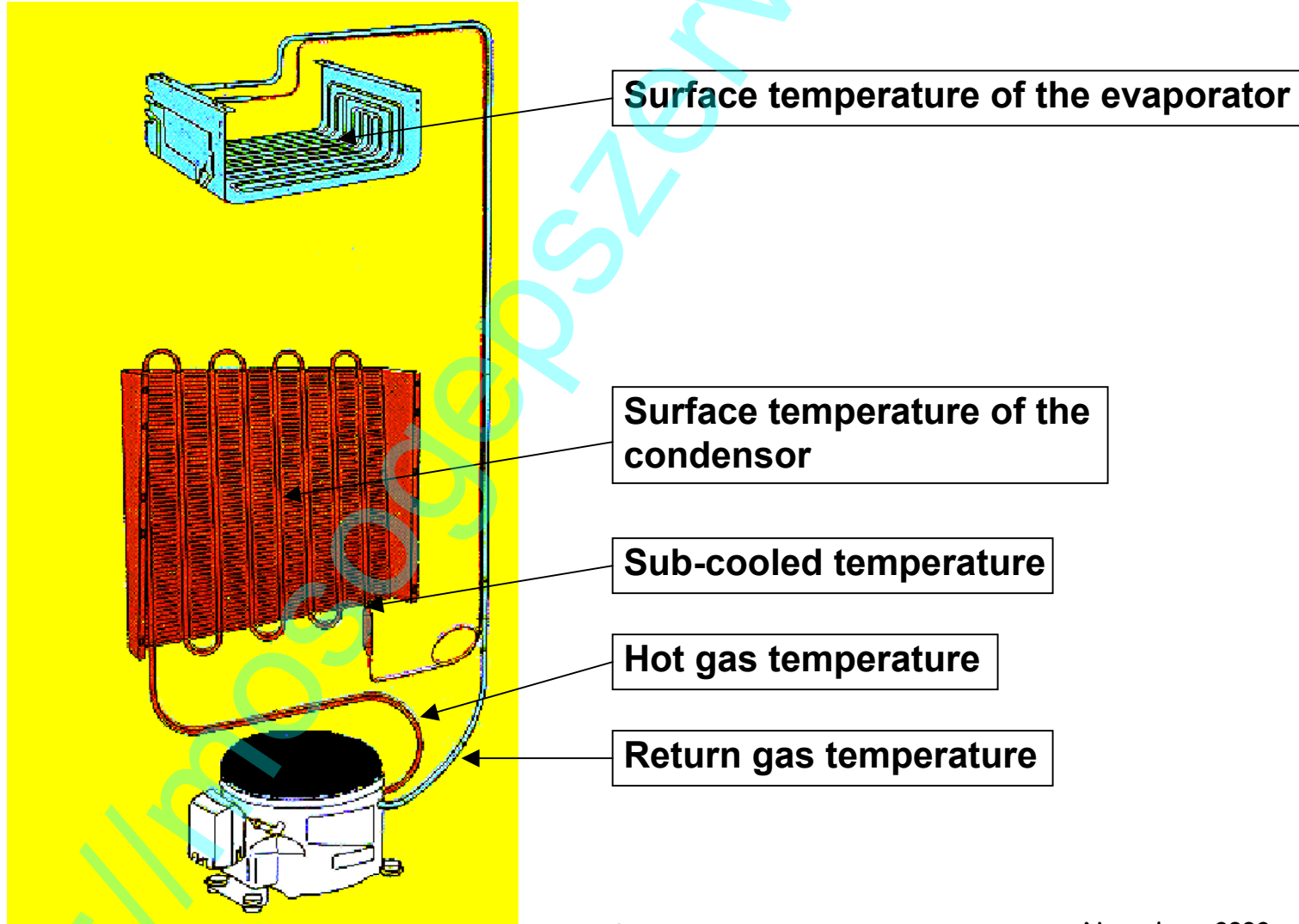
## Basic Training Course III

# COLD

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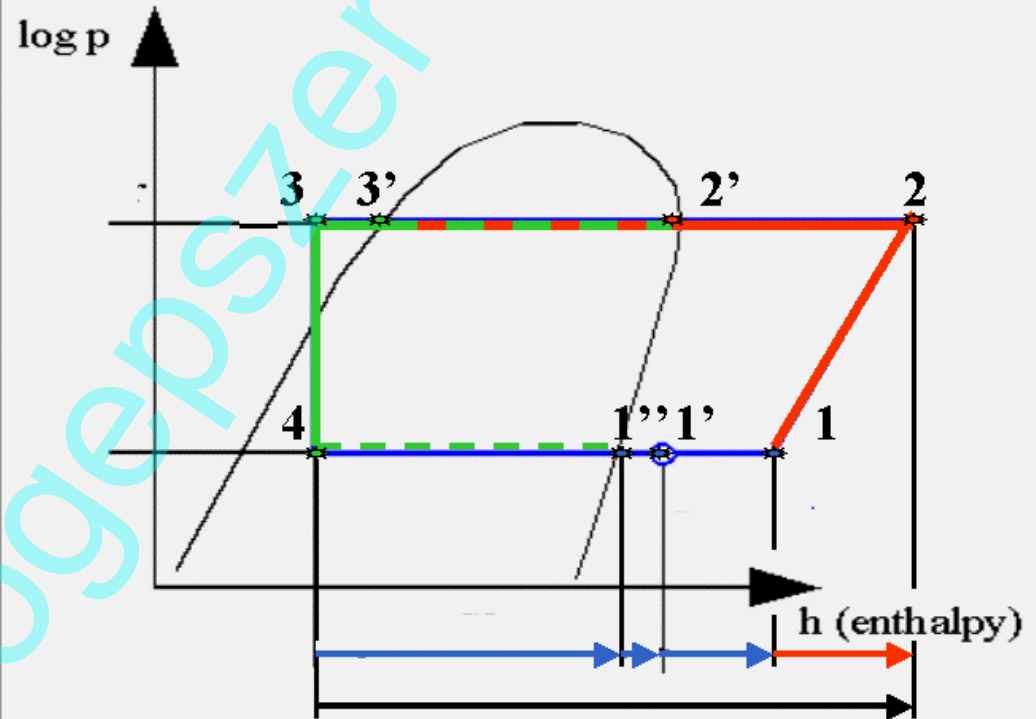
## Measuring Temperature and Pressure for diagnosis

# Temperatures in refrigeration circuit



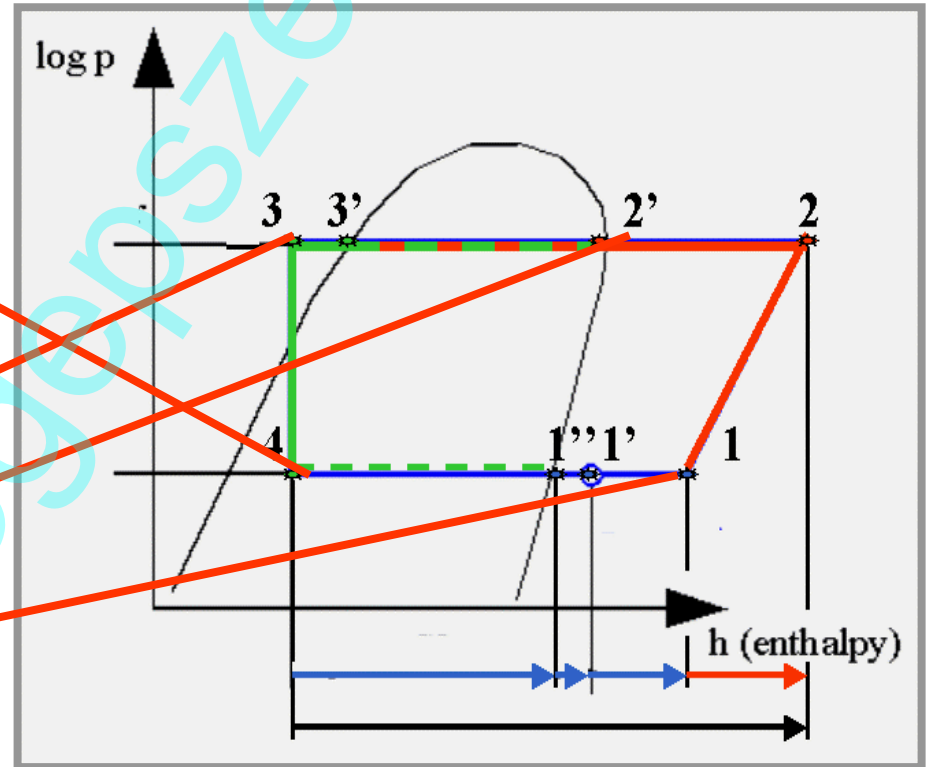
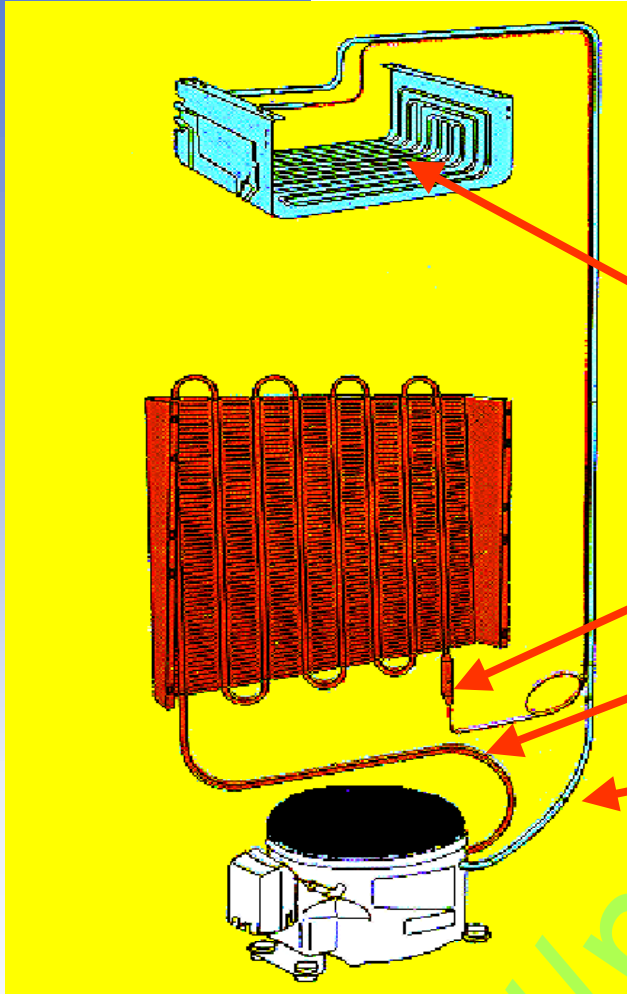
# h log p Diagram

- 2 - 2' = Super heating
- 2' - 3' = Condensing
- 3' - 3 = Subcooling
- 3 - 4 = Expansions Device
- 4 - 1' = Evaporating
- 1'' - 1' = Suction pipe inside Fridge
- 1' - 1 = Suction pipe outside Fridge
- 1 - 2 = Compress power
  
- 4 - 1 = Refrigerating capacity  $Q_0$
- 2 - 3 = Condenser capacity



1	Suction tube	20°C	4 - 1''	Evaporating t	-25°C
2	Discharge tube	110°C	1'' - 1'	Fridge/Freezer t	5°C/-18°C
2' - 3'	Condensing t	55°C	1' - 1	Super heating	20°C
3' - 3	Subcooling	32°C			

# Temperatures in refrigeration circuit



# Temperatures in refrigeration circuit

- **Measuring the return gas temperature:**

**In the sucking pipe there should be vapour gas. The temperature is normally a bit warmer than the room temperature.**

**When the sucking line is covered with hair frost or humidity there is a overfilling of the refrigeration cycle.**

# Temperatures in refrigeration circuit

- **Measuring the hot gas temperature:**
- **R12, R134a    50 °C - 70 °C**
- **R600a            40 °C - 60 °C**

**Is only the hot gas temperature significant higher the sucking gas cooling of the compressor is not enough.**

**The compressor carries to less refrigerant which can be caused by a leakage, partial blockade or air in the refrigeration circle.**

# Temperatures in refrigeration circuit

- **Measuring the sub-cooled temperature:**

**In comparison to the hot gas temperature it should be 10 K - 15 K colder.**

**If the condensor is not cooled enough (bad air circulation, pollution) the temperature increases as a consequence the pressure increases.**



**The cooling power decreases**



# Fault diagnosis

- Average store temperature
- Enough air circulation
- Frost on evaporator (or measure it)
- Return gas temperature
- Hot gas temperature
- Sub-cooled temperature
  
- Everything okay?

Yes      End of diagnosis.

No      Open refrigeration circuit

# Fault diagnosis R600a

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- **The following instruction is based to the refrigerant R600a.**
- **Regarding to the different steam - pressure values you can transfer R600a instruction to the other refrigerants.**

# Fault diagnosis R600a

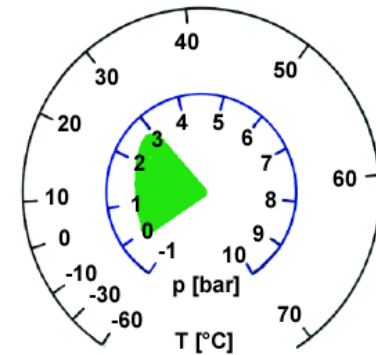
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- **1.Step (compressor out of function)**

**Connect the suction gauge with the pipe of the sucking side.**

# Fault diagnosis R600a

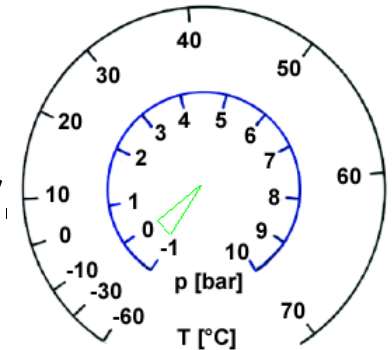
- **2.Step (compressor out of function)**
- **Suction gauge displays positive pressure.**
- **Diagnosis:  
Coolant in the system.**
- **Attention:  
When the compressor is cold there can be a lot of coolant dissolved in the compressor oil.**



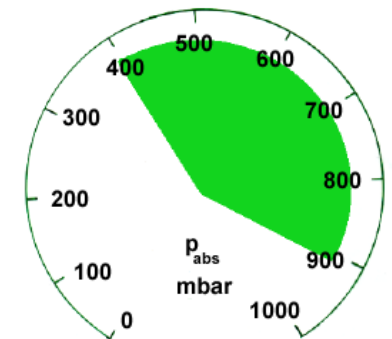
# Fault diagnosis R600a

- 3.Step (compressor is running)

- The normal pressure on the sucking side is lower than 0 bar



- Suction gauge:  
-0,1 to -0,6 bar  
Torr gauge:  
400 to 900 mbar

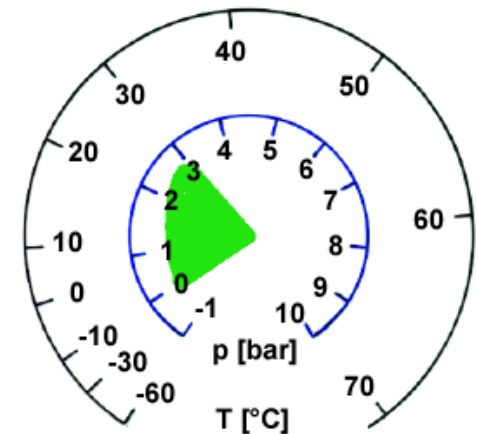


- Diagnosis:

**The refrigeration cycle is okay.**

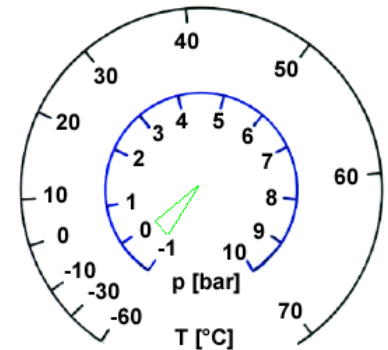
# Fault diagnosis R600a

- 4.Step (compressor is running)
- The suction gauge displays pressure  $> 0$  bar.
- Diagnosis:  
The compressor is defect.



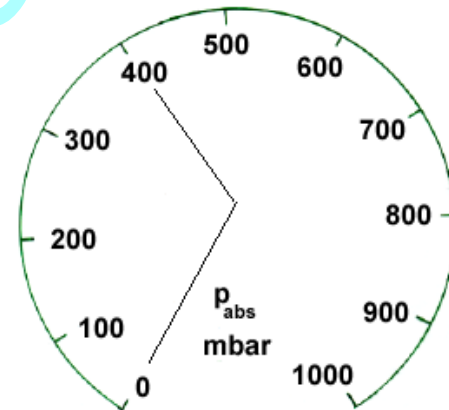
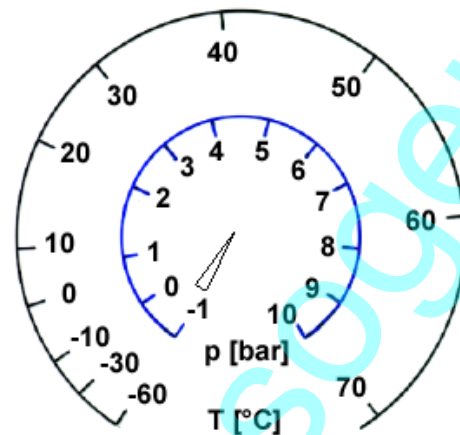
# Fault diagnosis R600a

- **5.Step (compressor is running)**
- **The suction gauge displays -0,1 to -0,6 bar.**
- **Diagnosis:**  
**The refrigeration cycle is okay.**
- **Attention:**  
**Even with the torr gauge it is not possible to detect a overfilling.**



# Fault diagnosis R600a

- 6.Step (compressor is running)
- The suction gauge displays  $\ll 0$  bar.



- **Diagnosis:**  
Either the refrigeration cycle is blocked or underfilled.



# Fault diagnosis R600a

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- **Filling the circuit with a bit of refrigerant (10 g).**
- **Blocked system:**
- **The system is blocked when after a short running time the same pressure is measured as before filling.**

# Fault diagnosis R600a

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- **Filling the circuit with a bit of refrigerant (10 g).**
- **Underfilled system:**
- **The system is underfilled when after a short running time a higher pressure is measured as before filling.**

# Fault diagnosis R600a

- **Underfilled system:**

**The cause of a underfilling is mostly a leakage.**

**Use Leak Tester Search to find the leakage.**

- **On the pressure side the compressor must run.**

- **On the sucking side the compressor must not run.**

# Fault diagnosis

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**Consider that  
R12 and R134a  
Refrigerant  
displays other pressure and  
temperature values**

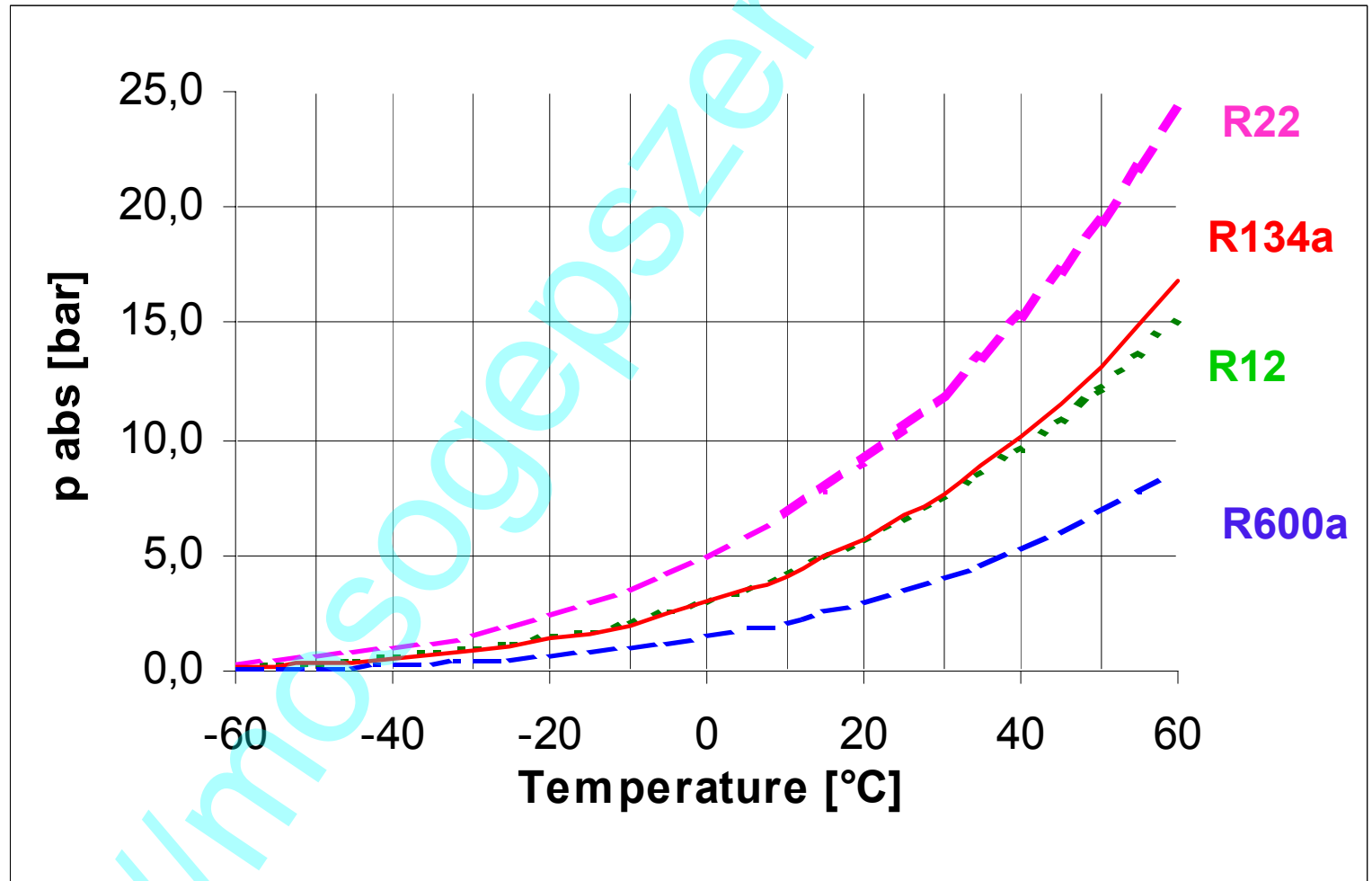
# Refrigerant

## vapour pressure tables

Temperature t [°C]	absolute pressure pabs [bar]			
	R12	R22	R134a	R600a
-60	0,226	0,376	0,163	0,08957
-55	0,300	0,497	0,223	0,12201
-50	0,392	0,646	0,299	0,16356
-45	0,505	0,830	0,396	0,21604
-40	0,642	1,053	0,516	0,28144
-35	0,807	1,321	0,666	0,36196
-30	1,000	1,640	0,848	0,45998
-25	1,237	2,016	1,067	0,57807
-20	1,510	2,455	1,330	0,71894
-15	1,827	2,964	1,642	0,88548
-10	2,193	3,550	2,008	1,0807
-5	2,612	4,219	2,435	1,3077
0	3,089	4,980	2,929	1,5698
5	3,629	5,839	3,497	1,8703
10	4,238	6,803	4,146	2,2125
15	4,921	7,882	4,883	2,6001
20	5,682	9,081	5,716	3,0366
25	6,529	10,41	6,651	3,5254
30	7,465	11,88	7,698	4,0704
35	8,498	13,50	8,865	4,6750
40	9,634	15,27	10,16	5,3431
45	10,88	17,21	11,59	6,0784
50	12,24	19,33	13,17	6,8846
55	13,72	21,64	14,91	7,7657
60	15,33	24,15	16,81	8,7257

# Refrigerant

## vapour pressure diagrams



# Refrigerant Properties

Refrigerant	R12	R134a	R600a
Evaporating point	- 30 °C	- 26 °C	- 12 °C
Condensing 55°C P <sub>abs</sub>	13.72 bar	14.91 bar	7.77 bar
Enthalpy by Evap.	166 KJ/Kg	215 KJ/Kg	367 KJ/Kg
Evap. Enthalpy 32/-25°C	122 KJ/Kg	156 KJ/Kg	274 KJ/Kg
Density of Vapour-25°C	7.69 Kg/m <sup>3</sup>	5.56 Kg/m <sup>3</sup>	1.67 Kg/m <sup>3</sup>
Evap. Pressure-25°C P <sub>abs</sub>	1.24 bar	1.07bar	0.56bar
Volume of Vapour -25°C	130 dm <sup>3</sup> /Kg	180 dm <sup>3</sup> /Kg	600 dm <sup>3</sup> /Kg

# Fault diagnosis

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## Status of the cooling circuit by

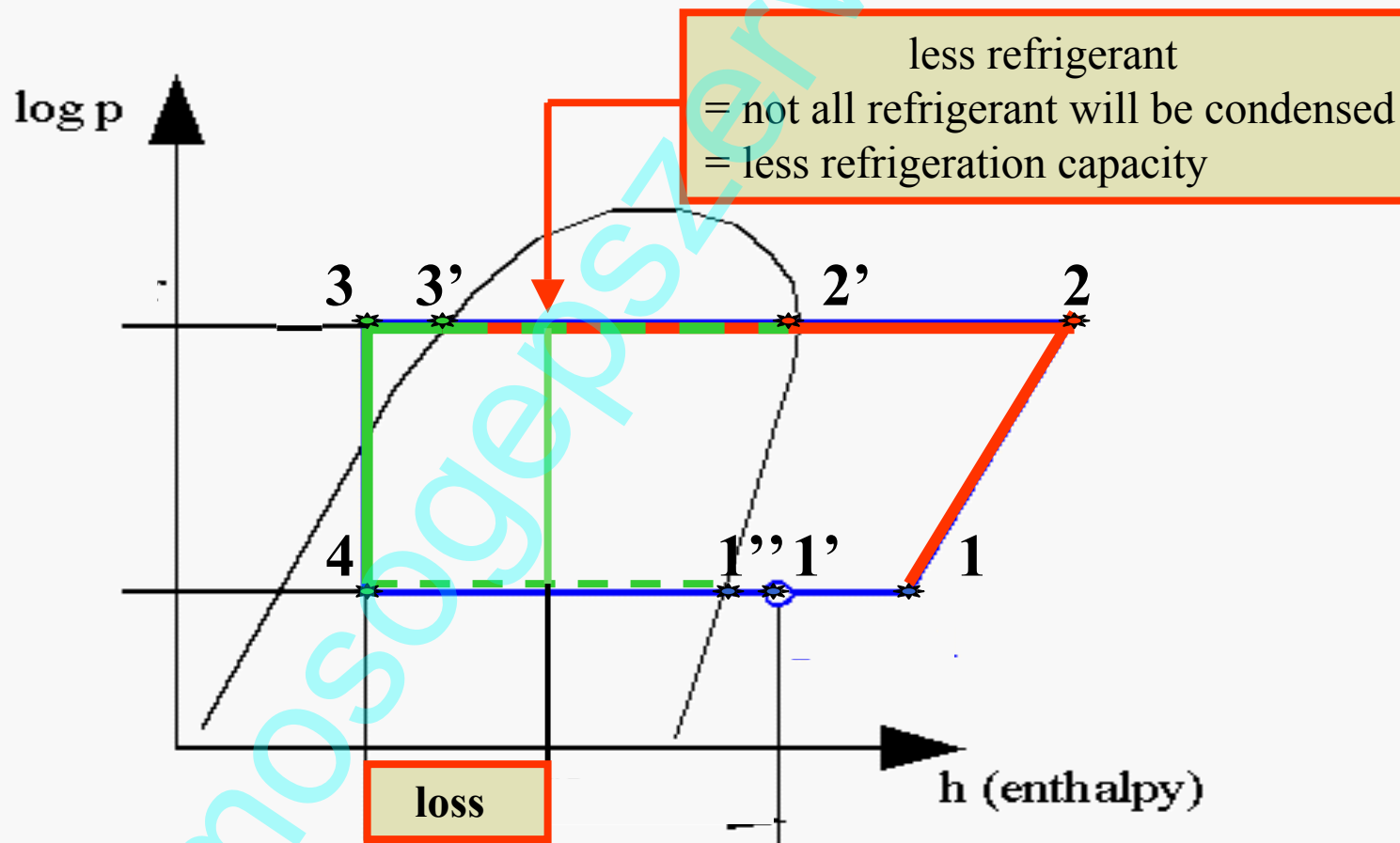
Less Refrigerant

Air in refrigeration circuit

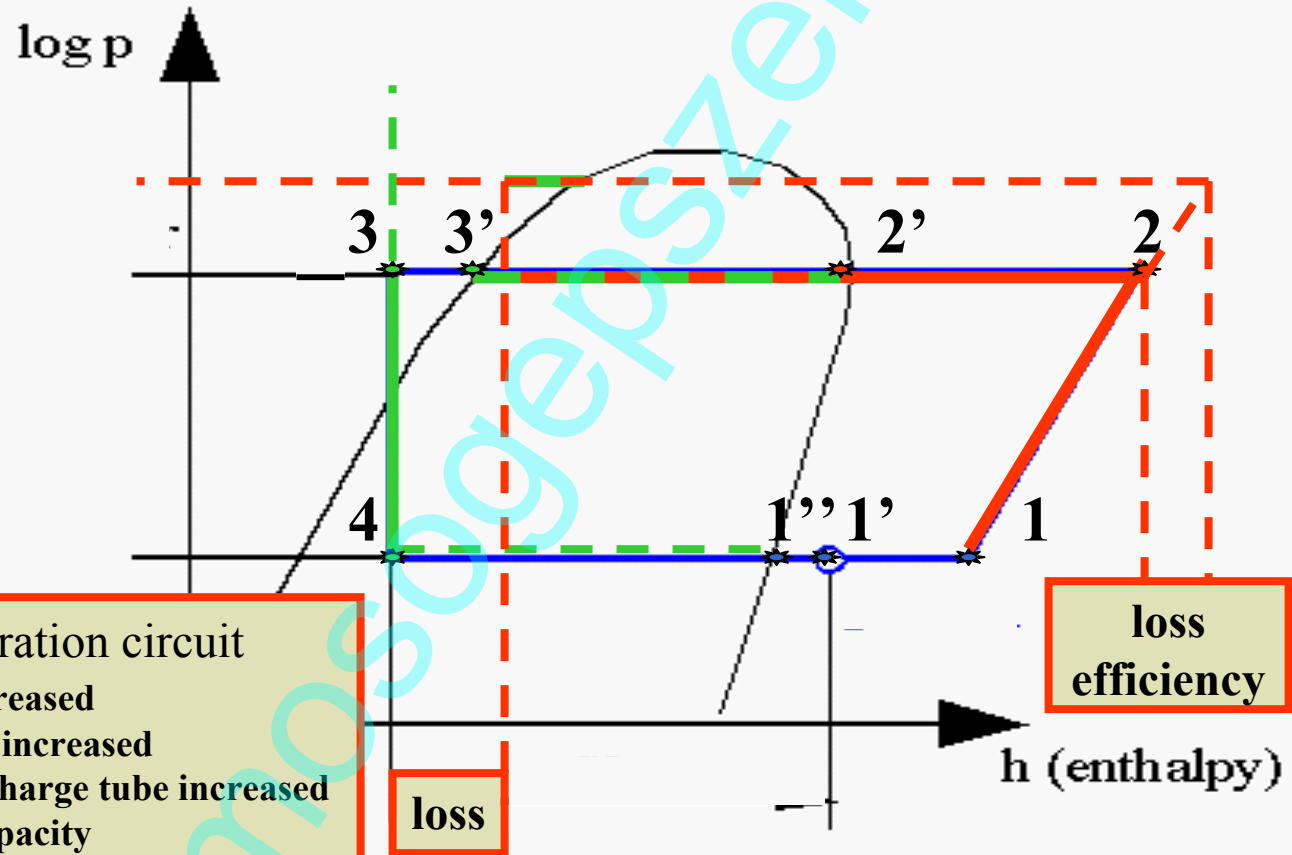
Fault condenser ventilation



# Less Refrigerant



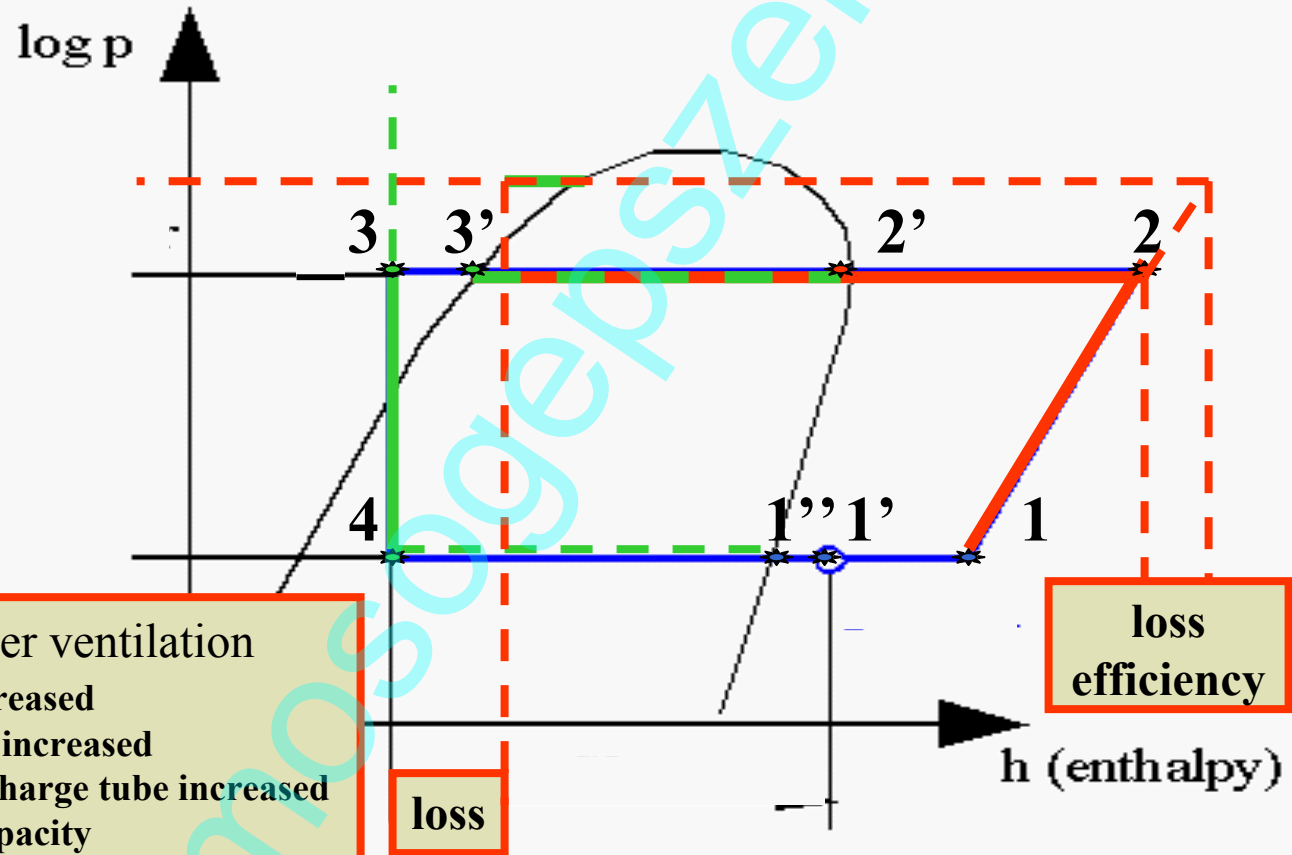
# Air in refrigeration circuit



## Air in refrigeration circuit

- = pressure will be increased
- = power consumption increased
- = temperature on discharge tube increased
- = less refrigeration capacity
- = lifetime decreased

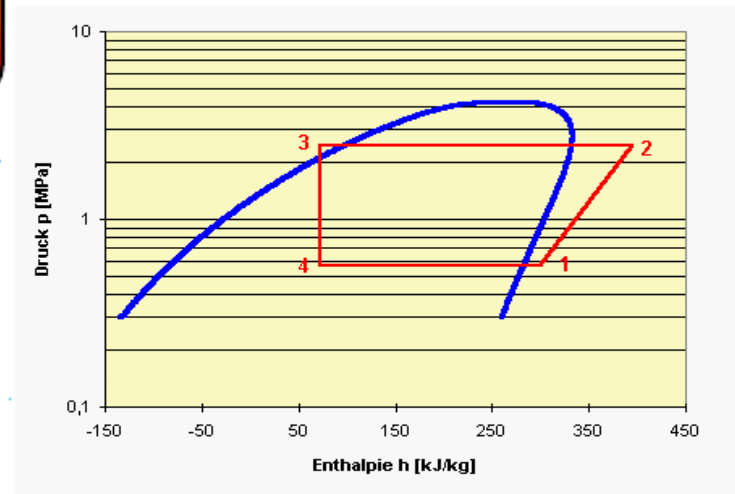
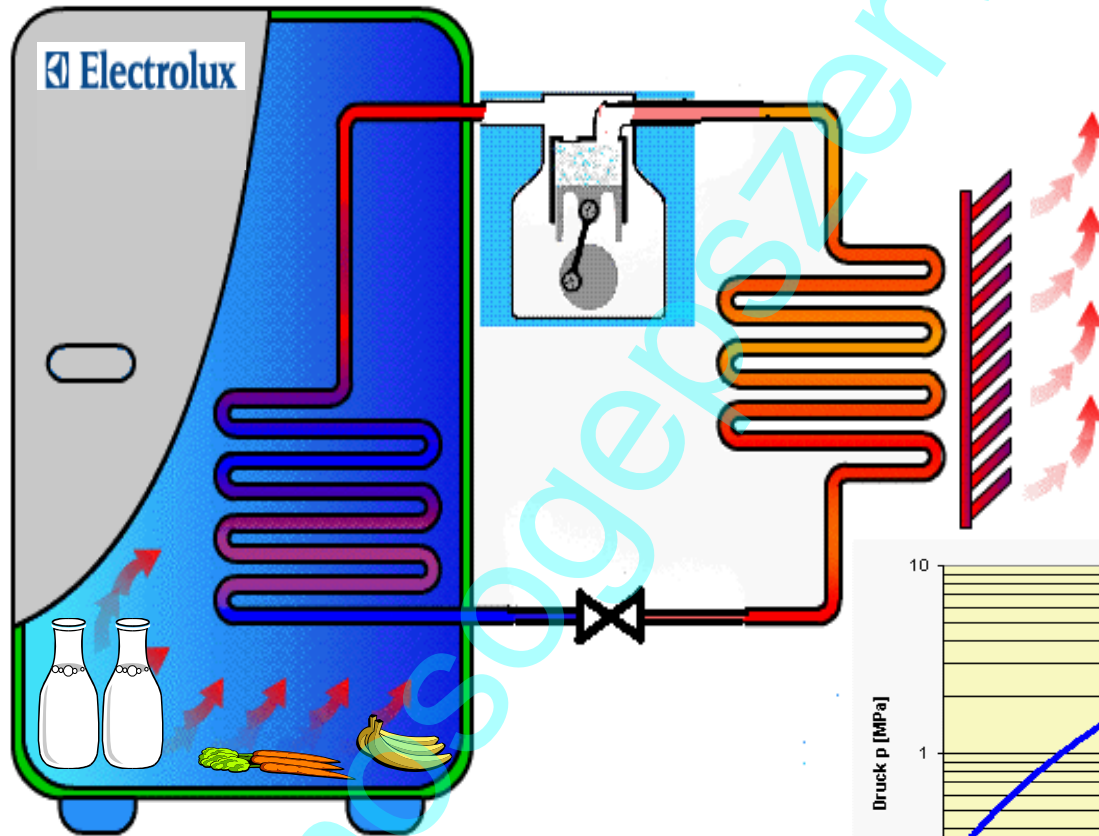
# Fault condenser ventilation

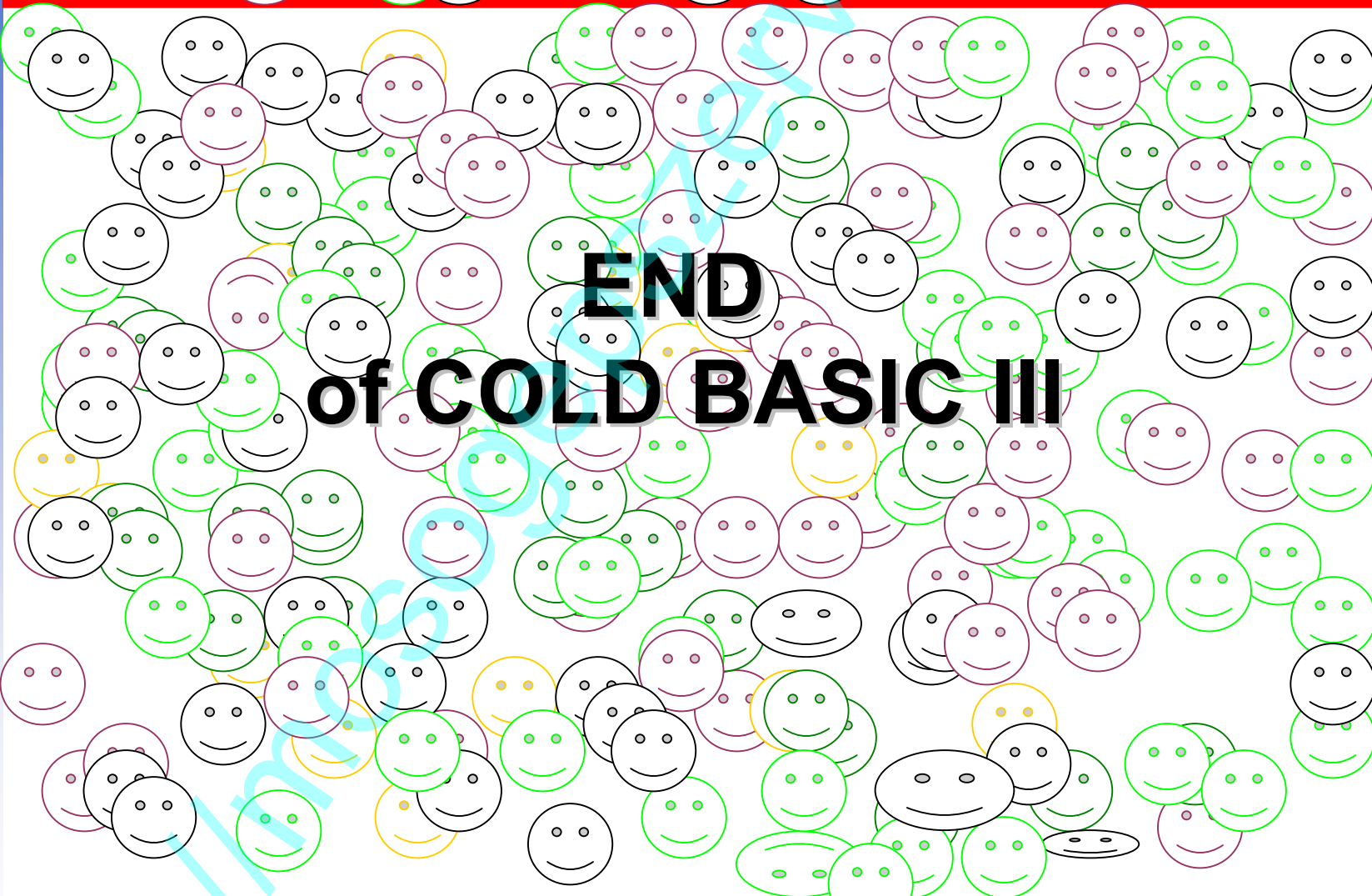


## Fault condenser ventilation

- = pressure will be increased
- = power consumption increased
- = temperature on discharge tube increased
- = less refrigeration capacity
- = lifetime decreased

# Refrigeration Circuit





# END of COLD BASIC III