Electrolux

Technical Support Europe

Repair instruction and handling for Isobutane (R600a) refrigerant.

Refrigerant Isobutane R600a

Isobutane is a colourless gas with a slight odour.

It is also known as cigarette lighter fuel and camping gas.

Customer service may only use isobutane as a coolant.

Technical data:

- Short form R600a
- Chemical formula $(CH_3)_2CH\text{-}CH_3$
- Boiling point at 1013 mbar: -11.7 °C
- Vapour pressure at 20 °C: 3.04 bar
- Explosion limits with air 1.3 % vol. to 8.5 % vol.

When handling isobutane the following safety precautions must be observed:

- Only engineers qualified in handling coolants and isobutane may carry out repairs on cooling systems.
- Naked flames and smoking strictly forbidden.
- Safety goggles and gloves must be worn.
- When entering the circulation system use pipe cutter.
- Make sure that the room is well ventilated.
- Isobutane is not collected with the recycling cartridges but released into the atmosphere via 5 m hose supplied. Make sure that outside are no naked flames.
- Smoking is not allowed when transporting isobutane in a service van.
- During transport and storage the aluminium containers are treated in the same way as spray cans (aerosol). They must be protected from temperatures in excess of 50 °C, for example direct sunlight in the service van. Also the containers should be protected with the cardboard tube and be stored securely in upright position.

When storage isobutane the following safety precautions must be observed:

- Isobutane-containers must not be exposed to heat in excess of 50 °C by sunlight or other heat sources.
- Isobutane-containers must not be stored in corridors or entrance areas, staircases and roofspaces.
- Isobutane packages must not be issued if they are leaky or show other damage which could have affect safety or function.
- Storage areas must comply with construction supervision laws.
- Storage areas must be sufficient ventilated, either naturally or artificially.
- Storage areas must be located such that they can be quickly and safety evacuated in case of an emergency.
- Storage areas must have a fire extinguisher filled with at least 6 kg located at each exit. Fire extinguishing equipment etc must be ready for use all the time.
- Storage together with pyrotechnical items is not permitted.

Repair instruction for Isobutane (R600a) refrigerant.

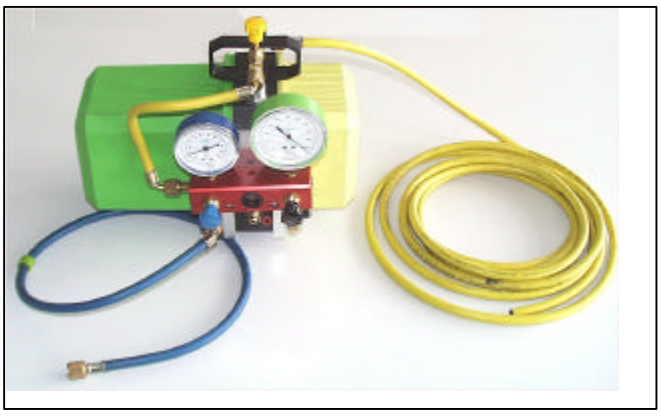
Due to the different pressure relationship of isobutane in comparison to R 12 or R134a a different repair technique must be used for isobutane.
During repair do not forget the safety precautions.

Evacuation and filling without exchange of the compressor.

1. Affix tapping valve to filling stud or suction hose.
2. Make connection to suction gauge.
3. Open tapping valve and watch suction gauge.
   Attention!
   The pressure for Isobutane is lower than for R 12 or R134a at the same temperature.
   If the compressor is cold it is possible that there is no overpressure, despite in fact that the system is filled correctly with Isobutane. (Isobutane is freely soluble in the motor oil!).
4. For further diagnosis switch on the compressor and watch the suction gauge.
   Attention!
   Normal suction pressure is between about –0.3 bar to –0.5 bar.
5. Isobutane is vented from the cooling system into the atmosphere.
6. Once the repair is complete switch on the compressor.
7. Switch on the vacuum pump (vent hose into atmosphere).
8. After 10 minutes switch off the compressor.
9. After 15 minutes switch off the vacuum pump.
10. By using the weighing system fill the system required amount of coolant.
    Attention!
    Use 5 % less Isobutane than it is stated on the rating plate.
    (The difference is caused by the soluble Isobutane which remains in the oil)
11. Carryout leakage, safety and function tests.

Evacuation and filling with exchange of the compressor.

The procedure is as outlined above, with the exception that the system is evacuated for 10 minutes before removing the compressor (this is to release the isobutane bound to the compressor oil). The exchanged compressor is returned to the depot for disposal of the waste oil.



Soldering instruction for appliances with combustible refrigerants

R600a (Isobutane) and R290 (Propane) are combustible and possibly explosive refrigerants.
Soldering the refrigeration circuit it must be sure that no combustible gas-air mixture is in the refrigeration circuit.
The refrigerant must removed from the circuit and the air (oxygen) must be pushed aside with nitrogen (inert gas).

Repair instruction with compressor exchange:

1. Affix tapping valve to filling stud or suction hose.
2. Make connection to the evacuation station.
3. Isobutane is vented from the cooling system into the atmosphere.
   (Make sure that outside are no naked flames.)
   Wait till the suction gauge displays 0 bar.
4. Switch on the vacuum pump for 10 minutes (vent hose into atmosphere).
5. Remove the compressor. Use the pipe cutter to loosen the compressor.
   Attention:
   It is rigorous forbidden to sold out the compressor.
   (This is caused by the soluble Isobutane which remains in the oil.)
6. Connect a snapping coupling at the pressure side and blow nitrogen (10 bar) through the circuit as long as no oil comes outside.
7. Now it is sure that no refrigerant is in the circuit and the compressor can be sold in.
8. Follow the instruction ”Evacuation and filling without exchange of the compressor”.

Repair instruction without compressor exchange:

9. Affix tapping valve to filling stud or suction hose.
10. Make connection to the evacuation station.
11. Isobutane is vented from the cooling system into the atmosphere.
    (Make sure that outside are no naked flames.)
    Wait till the suction gauge displays 0 bar.
12. Switch on the vacuum pump for 10 minutes during running compressor (vent hose into atmosphere).
13. Remove the dryer. Use the pipe cutter to loosen the dryer.
    Attention:
    It is rigorous forbidden to sold out the dryer.
    (The humidity in the dryer evaporates and can burst the pipes.)
14. Connect a snapping coupling at the sucking side and blow nitrogen (10 bar) through the circuit as long as no oil comes outside.
15. The defect component can be removed (condensator, evaporator) by using a pipe cutter.
16. The feeding pipe with valve, the needed spare part(s) and the pipes will be prepared for soldering.
17. After sold out the filling pipe of the compressor the feeding pipe without valve will be sold in.
18. From the feeding pipe nitrogen is blown through the circuit (very low pressure << 1 bar) and the parts can be sold in.
19. The last soldering (that is at the dryer) is without nitrogen. Using nitrogen during the last soldering produces bad connection (leakages).
20. Follow the instruction ”Evacuation and filling with exchange of the compressor”.

Weighing system for coolants

Isobutane (R600a) must not filled into charging stations. The circulation system is therefore with in isobutane by means of a weighing system. The weighing system consists of modified electronic scales, which all possible causes for interference have been eliminated. The weighing system is connected to the existing evacuation system via hose. When the evacuation process is complete, the coolant is filled into the system in its gaseous state. To speed the filling process, the compressor is switched on so that the gaseous coolant is sucked into the system. This system can also be used for R 12 and R134a.
Prior to filling, the coolant cartridge is placed onto the scales. The spiral hose is connected to the bottle valve. The connection between weighing system and evacuation station is made with a hose. During evacuation, the ball valve at the weighing system is opened so that the complete hose system is also evacuated. Next the ball valve is closed and the bottle valve is opened. On completion of the evacuation process , it is important that the vacuum meter is removed, as the coolant pressure is too high for the vacuum meter.
The filling process can now begin: The scales are switched on or, if already switched on, are set to ”0”; the ball valve is opened and the coolant flows into the system. Now the compressor is switched on. The scales are monitored during the filling process. Once the correct amount has been reached, the ball valve is closed. The hose connection between evacuation station and scales is only removed when the suction pressure shows 0 bar overpressure. The connection is first removed at the evacuation station (Schrader valve).
There exists a special tool for liquid fillings with this weighing system. You can filling liquid if the coolant quantity you need is bigger then 50 g.
Spare part numbers:

Weighing system (spare part no.) : 298 001 801
Tool (liquid filling, spare part no.) : 298 001 815

Attention:

If you fill gaseous the compressor has to run.
If you fill liquid the compressor has to stop.

Suction gauge

As this meter is used for measuring pressures, all already existing suction gauges may be used for isobutane repairs. The suction gauges of the evacuation station are fitted only with a pressure scale. For the boiling points of the different coolants , please refer to pressure tables for the coolant.
You should be in mind that the suction gauge displays overpressure whereas the pressure tables list the absolute pressure.

Example

2 bar overpressure (suction gauge) corresponds to 3 bar absolute pressure (pressure table). With a torr gauge you always measure the absolute pressure.

Temperature – Pressure chart for different refrigerants.

T [°C]	R12	R22	R134a	R600a
	absolute pressure [bar]	absolute pressure [bar]	absolute pressure [bar]	absolute pressure [bar]
-60	0.090	0.376	0.163	0.090
-55	0.120	0.497	0.223	0.122
-50	0.164	0.646	0.299	0.164
-45	0.216	0.830	0.396	0.216
-40	0.281	1.053	0.516	0.281
-35	0.362	1.321	0.666	0.362
-30	0.460	1.640	0.848	0.460
-25	0.578	2.016	1.067	0.578
-20	0.719	2.455	1.330	0.719
-15	0.885	2.964	1.642	0.885
-10	1.08070	3.550	2.008	1.081
-5	1.30770	4.219	2.435	1.308
0	1.56980	4.980	2.929	1.570
5	1.87030	5.839	3.497	1.870
10	2.21250	6.803	4.146	2.213
15	2.60010	7.882	4.883	2.600
20	3.0366	9.081	5.716	3.037
25	3.5254	10.410	6.651	3.525
30	4.0704	11.880	7.698	4.070
35	4.6750	13.500	8.865	4.675
40	5.3431	15.270	10.160	5.343
45	6.0784	17.210	11.592	6.078
50	6.8846	19.330	13.171	6.885
55	7.7657	21.640	14.907	7.766
60	8.7257	24.150	16.811	8.726
65	9.7686		18.894	9.769
70	10.8990		21.170	10.899
75	12.1210		23.651	12.121
80	13.439		26.353	13.439
85	14.859		29.292	14.856
90	16.387		32.487	16.387
95	18.028		35.958	18.028
100	19.791		39.728	19.791

Fault diagnosis of R600a appliances

The fault diagnosis of freezer and fridge appliances with the coolant R600a is different from the fault diagnosis of appliances with the coolant R134a.
The main difference depends on the boiling point which is –11.7 °C at 1013 mbar. So you have negative pressure at –25 °C (- 0.422 bar) which is the normal temperature of the coolant entering the evaporator.
With normal suction gauge it is a problem to measure this low pressure. You have to use a torr gauge. The torr gauge measures the absolute pressure and you should take care of this if you look at the pressure- temperature tables of coolants.

1.Step Compressor out of function

Connect the suction gauge with the pipe on the sucking side.

2.Step Compressor out of function

Suction gauge display:

Positive pressure (depends on the temperature).

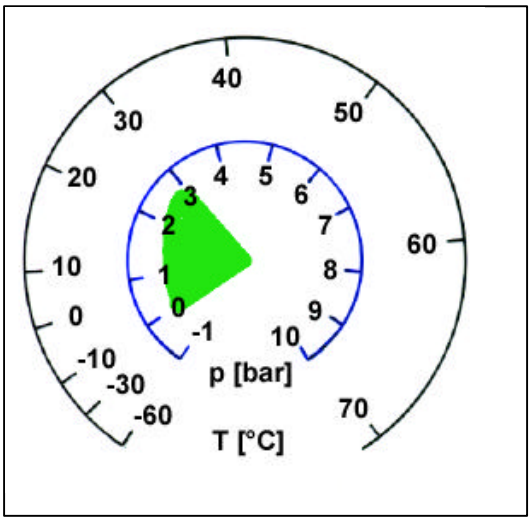
Diagnosis:

Coolant in the system.

Attention:

When the compressor is cold there can be a lot of coolant dissolved in the compressor oil. So you are measuring no overpressure. You can only recognise R600a in the system when the compressor is running.

The pressure of R600a is between 0 bar and 3 bar.

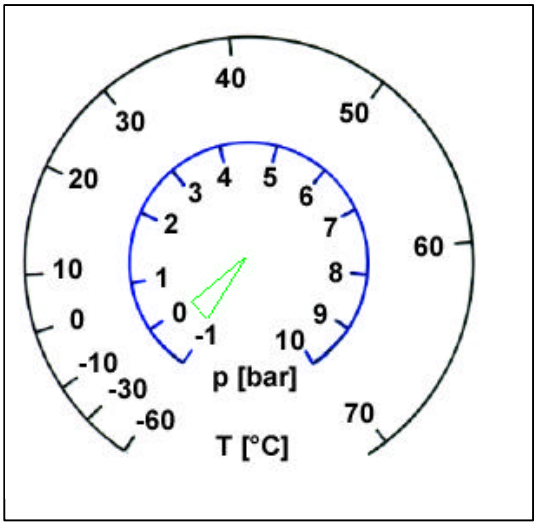


3. Step: Compressor is running.

The boiling point of the refrigerant R600a is –11.7 °C (1013 mbar). The normal pressure on the sucking side is lower than 0 bar. So it is useful to work with a torr gauge instead of a suction gauge. The torr gauge have to be adjusted to the atmosphere pressure (~1 bar).

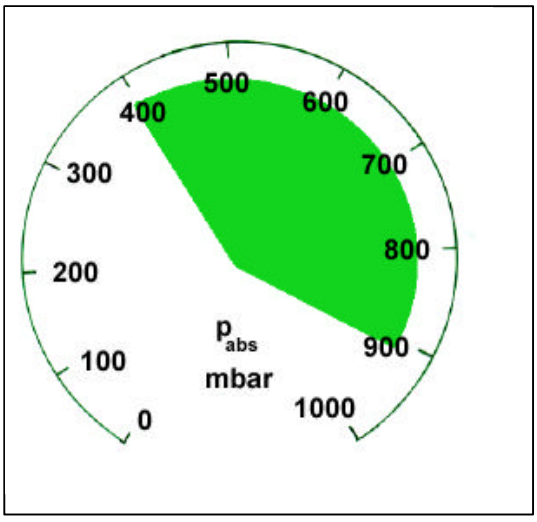
Displayed pressure using the suction gauge:

-0.1 bar - -0.6 bar



Displayed pressure using the torr gauge:

400 mbar - 900 mbar



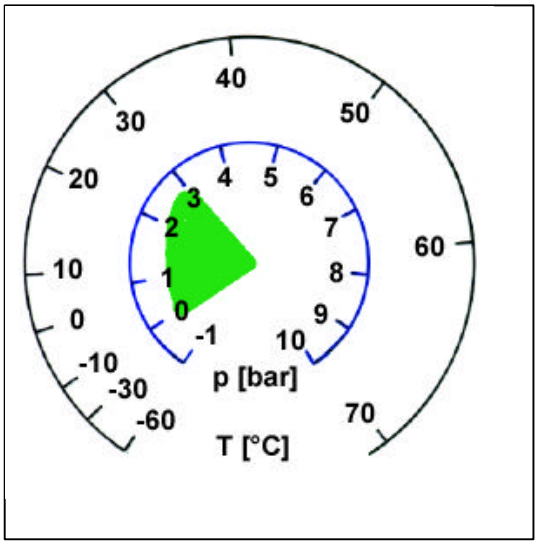
Diagnosis:

The refrigeration cycle is okay.

4. Step: Compressor is running.

Suction gauge display:
pressure > 0 bar. There is no vacuum.

Diagnosis:
The compressor is defect. (cooling point of view)

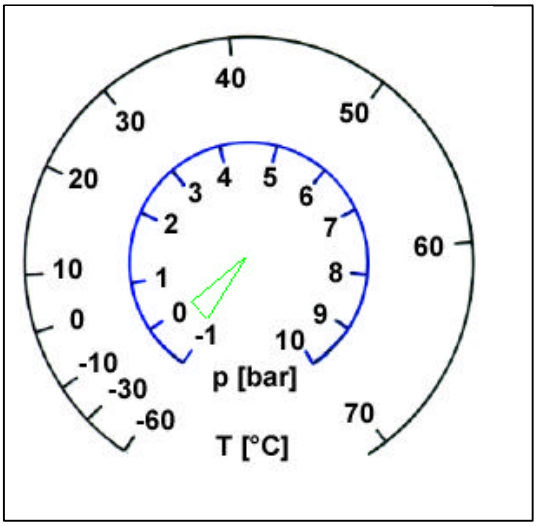


5. Step: Compressor is running.

Suction gauge display:
- 0.1bar - - 0.6bar

Diagnosis:
The refrigeration cycle is okay.

Attention:
When the sucking line is covered with hair frost there is a overfilling of the refrigeration cycle. It is not possible to measure unambiguous a overfilling even with the torr gauge.



6. Step: Compressor is running.

Suction gauge display:

pressure << 0 bar.
There is a big vacuum.

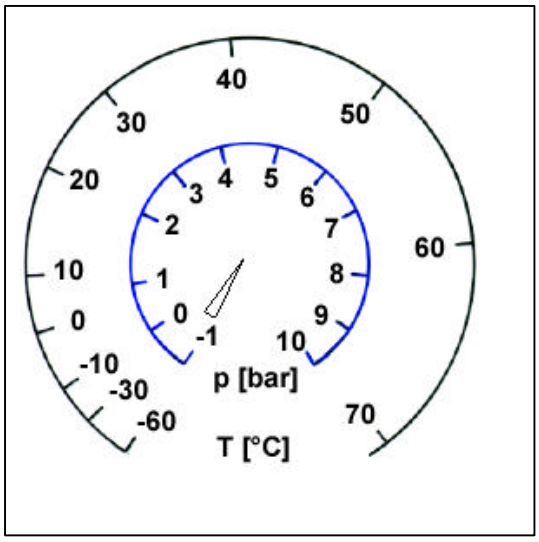
Diagnosis:

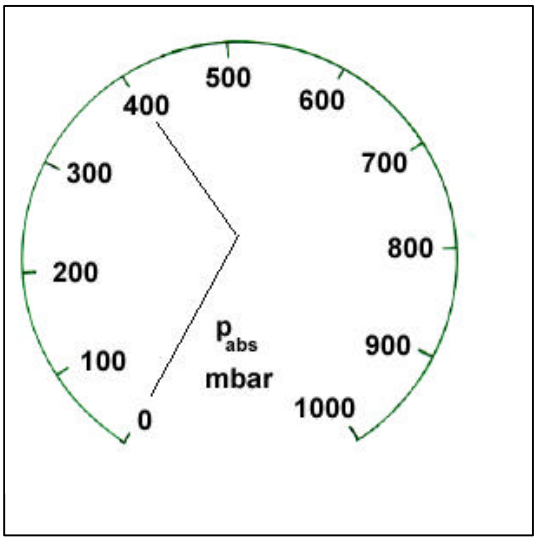
Either the refrigeration cycle is blocked or underfilled.

Filling the circuit with a bit of refrigerant (10 g):

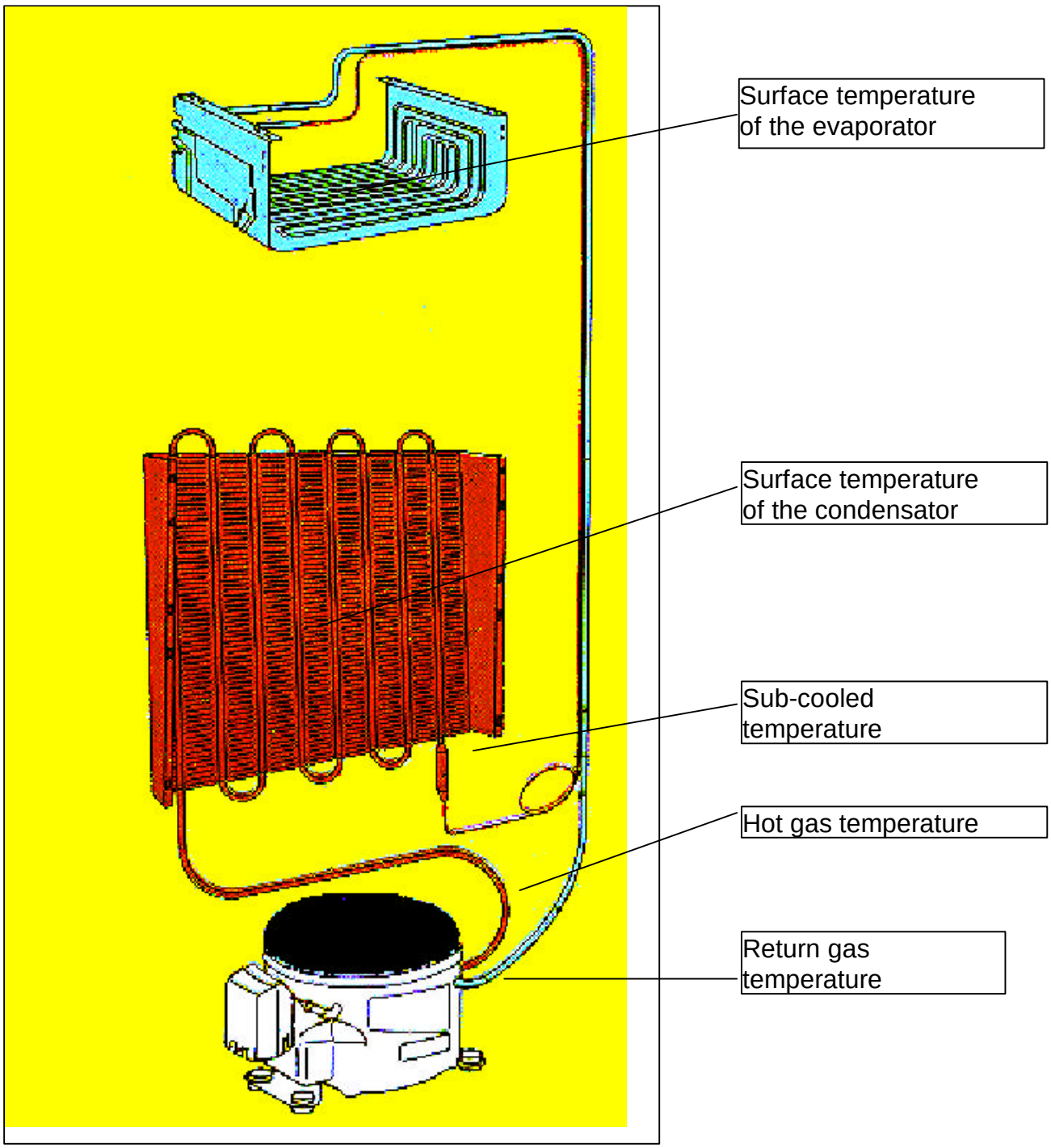
Blocked:
The system is blocked when after a short running time the same pressure as before filling is measured.

Underfilled System:
The system is underfilled when after a short running time a higher pressure as before filling is measured.
The cause of 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.





Temperatures in refrigeration circuit



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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.

Measuring the hot gas temperature:

The temperature should be measured near to the compressor.
Typical values for refrigerants of a faultless refrigeration circuit:

R12, R134a	between 50°C and 70 °C
R600a	between 40°C and 60 °C
R22	between 50°C and 80 °C

Is only the hot gas temperature significant higher the sucking gas cooling of the compressor is not enough. The compressor quarries to less refrigerant which can be caused by a leakage, partial blockade or air in the refrigeration circuit.

Measuring the sub-cooled temperature:

The temperature should be measured at the end of the condenser (near to the dryer). In comparison to the hot gas temperature it should be 10K – 15K colder. If the condenser is not cooled enough (bad air circulation, pollution of the condenser) the temperature increases as a consequence the pressure increases. Due to the high pressure the cooling power decreases (the compressor is faultless).

Fault diagnosis: