



Degassing refrigerators

Drill-head and Piercing-plier



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1. For what purpose do we have to degas a refrigerator?

A refrigerator has to be disposed as hazardous waste. The refrigerants inside a hazardous refrigerator are harmful for the environment (ozone depleting and greenhouse effect).

Most common refrigerants are; R12, R134a and R600a. The uncommon is the removal of NH₃.

Refrigerants are developed to dissolve very easily into the compressor oil. Therefore it is necessary to remove the oil as well as the refrigerant. Even after a long time the oil will contain refrigerants when it is not treated.

The law says:

- *All liquids that contribute to a contamination of separated fractions during, or after, the treatment process, shall be removed.*
- *All refrigerants shall be separated from oil.*
- *The amount of CFC, HCFC and HFC separated from cooling circuits shall be equal to, or higher than 90% of the expected amount of these substances.*
- *The mass-balance has to exceed than 98% in weight.*
- *The compressor oil with less than 0.2% total halogen content may be used for material recycling or in normal incinerators, provided national regulation permit this procedure.*
- *The compressor oil with more than 0.2% total halogen content shall be treated only in thermal processes for the safe destruction of "controlled substances"*
- *Compressors shall not be re-used.*

Treatment companies for cooling and freezing appliances shall use state of the art technology to reach the required targets and follow accepted environmental practices for the separation of controlled substances.

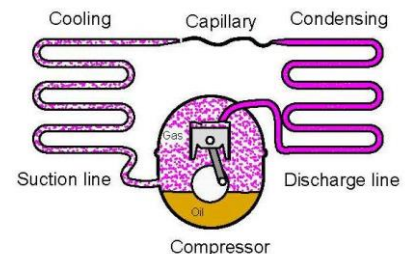
2. A few facts

- Refrigerators contain up to 300 grams refrigerant (CFC R12, HCFC R134a, HC ISO-Butane R600a)
- Refrigerators contain 250 grams oil average. Between 150 and 450 grams.
- CFC R12 has a Global Warming Potential that is 8100 times higher than carbon dioxide (CO₂).
- HCFC 134a the replacement of R12 has a GWP that is 1300 higher than carbon dioxide (CO₂).
- R600a is a highly combustible gas that has to be treated with great care in order to avoid explosions.
- Compressor oil contains up to 1/3 refrigerant by mass (up to 100 grams).
- Sorting out refrigerators based on type of gasses is not possible and will lead to damaging the cooling circuits and spillage of refrigerants.
- A leak cooling circuit (no pressure) contains up to 30 grams of harmful refrigerant (no pressure means atmospheric pressure ca 1 bar).
- A degassing machine must be able to degas none leaking as well as leaking fridges.

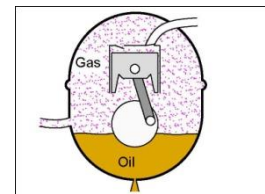
3. What is refrigerator degassing?

Degassing a refrigerator is the removal of oil and gas from the cooling system of a domestic refrigerator without spilling anything into the environment.

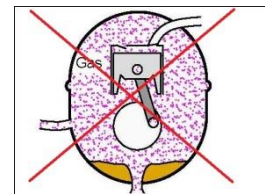
Inside the compressor and the pipework connected to the compressor a pressure of more than 6 bars is possible, depending on the ambient temperature and the type of gas. There are in general no draining valves at the cooling system of a domestic fridge. Therefore a connection to the pressurized system has to be made, before draining is possible. This connection has to be made without losing any gas during this operation. Also the aspect of inflammable gasses has to be considered.



A cooling circuit consists of oil and gas (refrigerant). It is very important to first drain the oil because the pressure of the gas will help pushing it out. This can only be done by making a hole at the lowest point of the oil.



The hole should be large enough to drain the oil as fast as possible but not so fast that the gas will break through the oil surface. In this case the pressure of the gas cannot be used to push the oil out. As a result of this oil will be left inside the compressor.



Once the gas is out and the system is vacuumed, it is not possible to get the oil out. Therefore it is important to drain underneath the oil to make sure all the oil will be drained. After the oil is drained the gas is evacuated until there is no pressure anymore in the compressor. No pressure means -1 bar relative to the ambient pressure.

Remark: A widely spread misunderstanding by suppliers of draining machines and also governmental agencies is the treatment of leaking refrigerators. They assume that when a refrigerator has no overpressure in his cooling circuit that there is no refrigerant present anymore.

When the system has no overpressure it means that there is still an absolute pressure of 1 bar. This means an amount of harmful refrigerant of 1 bar which is corresponding with up to 30 grams. Also the oil can contain large amounts of refrigerant. Therefore it is important to drain every refrigerator.

4. Ways of degassing

There are in general two ways of emptying the cooling system of a refrigerator; piercing pliers and drill head.

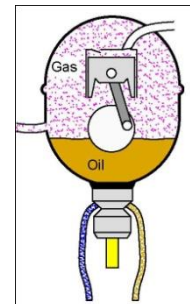
4.1. Drill-head

The drill head is especially designed to drain a refrigerator in order to recycle it. The position of drilling, the diameter of drill and the time of drilling are all outcomes of studies and experience. Draining is done by drilling a hole of 2.5 mm in the compressor. Leakage is prevented by a rubber seal which is placed by vacuum.

The refrigerator has to be placed on its back in order to drill the hole directly in the oil bath. Oil will be drained completely because the hole is at the lowest point. When a drill head is placed all circumstances are checked by a PLC in order to release the drill for drilling. During the draining cycle all pressures are controlled. Because of the place of drilling and the diameter of the hole a refrigerator can be drained within one minute.

4.1.1. Properties

- Very high recovery.
- Fast draining. One unit per minute per drill head
- Electronic control on the process.
- Indication of leak and non-leak amount
- No need to sort out leak refrigerators.
- Small operating area
- Constant amount of fridges coming trough
- According to ATEX and small ex-zone
- Easy to handle for unskilled operators



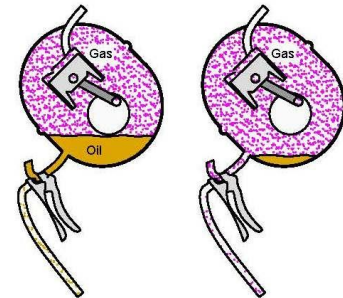
4.2. Piercing-pliers

Piercing pliers have a hollow needle and are placed on a copper pipe in order to punch through. Originally they are made to only degas a refrigerator and not for draining the oil. The needle has an opening of 1,5 mm where the oil should also go through. When the oil is warm enough it will flow through but when cold it will take more than 15 minutes to drain.



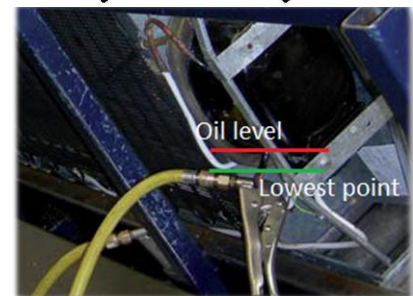
Bleeder tables are often used for collecting the rest of the oil when the compressor is taken off the refrigerator. During that procedure refrigerant will escape into the environment.

The refrigerator has to be placed in an angled position to make sure that as much as possible oil will be drained. When there is a steel pipe instead of a copper one the needle will break. After placing the piercing pliers there has to be a valve manually opened. When forgotten, the refrigerator will not be drained and is leak when the pliers is removed. Due to the place of piercing and the small hole in the needle recovery time is very long.



4.2.1. Properties

- Slow draining up to 15 minutes
- Bad recovery. Oil is only drained for 80%
- Needle is easy to break.
- Not all refrigerators have copper piping.
- Opening in needle is easy to block. Due to this there will be no recovery.
- No indication if needle has punctured pipe correctly.
- Much space required for logistics
- Long handling time
- Large ex-zone
- Not “state of the art” technology.



5. The degassing machine

A degassing machine has to control the draining devices (piercing-pliers or drill-heads). It has to collect the refrigerant, oil and air which is coming out of a refrigerator. After collection it has to separate the refrigerant from oil and the air from the refrigerant.

Refrigerants should be separated from oil until a level of rest halogen is reached of less than 0,2%.

Refrigerants should be separated from air in such a way that there is no contamination in the outgoing air.

Remark: Outgoing air should not be blown into stage 2 in order to dilute the amount of refrigerant in the air. Stage two has a large amount of nitrogen flow and there are installations where the outgoing air of stage one is diluted in stage two to fulfill the requirements.

Refrigerants should be liquefied and stored in a storage vessel. The pressure in the storage vessel should be controlled and regulated automatically. Also the level of filling should be controlled in order to guarantee safety.

Remark: The overpressure inside the storage vessel should be lead through the degassing machine in order to separate the refrigerant gasses from air. The overpressure should not be released by hand and should also not be released inside stage two.

The degassing machine should be able to handle leaking as well as non-leaking refrigerators. This means it should be able to handle air and therefore water in its system.

Leaking refrigerators contain up to 30 gram refrigerant.

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