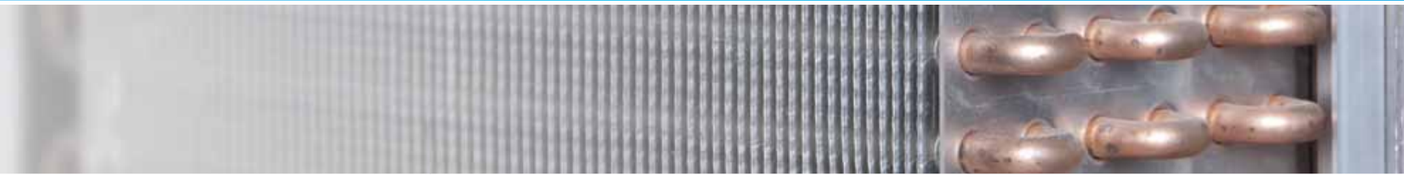
Basic knowledge

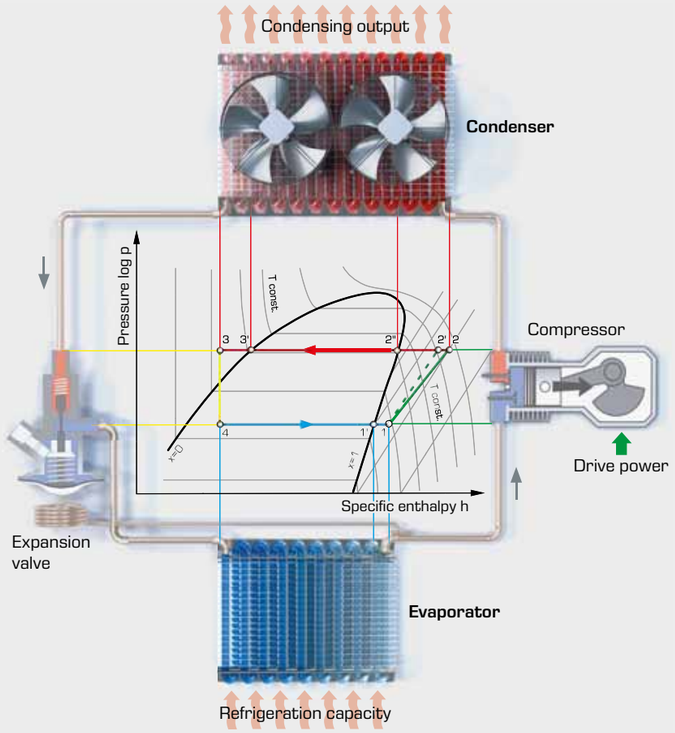
Heat exchangers in refrigeration used as evaporator / condenser



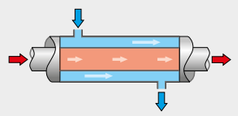
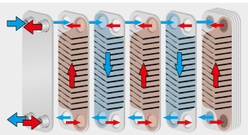
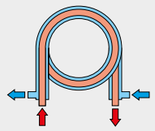
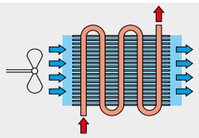
In principle heat exchangers have the purpose to transfer heat from a flowing substance to another flowing substance of a lower original temperature. The substances are gaseous or liquid.

Important for the heat transfer is the temperature difference of the two media as a driving gradient. Dependent on the flow direction (e.g. counterflow, parallel flow) the progression of the temperature difference along the path can be different.

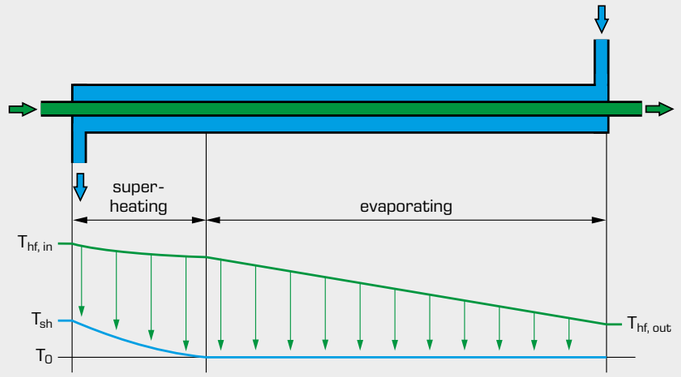
In refrigeration engineering, heat exchangers are equally used as **evaporators** and as **condensers**. In both applications, the refrigerant undergoes a phase transition.



Overview of different heat exchanger types

Type		Application
Tubular heat exchanger	 	■ internal heat exchanger for supercooling the refrigerant
Plate heat exchanger	 	■ evaporator ■ oil cooler
Coaxial coil heat exchanger	 	■ water-cooled condenser ■ water-heated evaporator
Finned tube heat exchanger	 	■ air-cooled condenser ■ air cooling evaporator

Heat transfer in the evaporator



Energy processes in the evaporator (counterflow)

T_0	evaporation temperature, refrigerant
$T_{hf, in}$	inlet temperature, hot medium
$T_{hf, out}$	outlet temperature, hot medium
T_{sh}	superheating temperature, refrigerant

refrigerant, heating fluid

The energy processes in an evaporator can be assigned to two different areas.

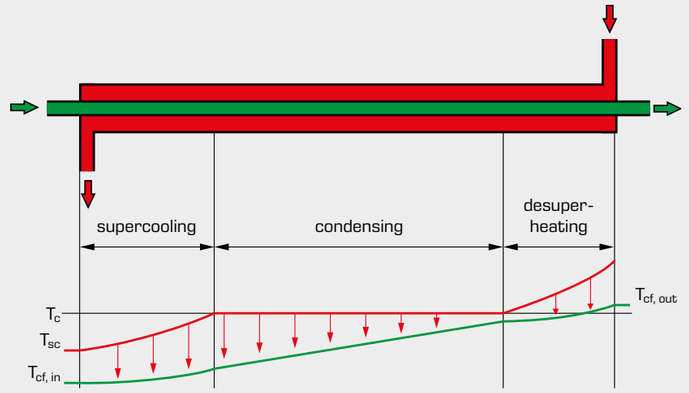
1. Evaporating

The refrigerant absorbs the heat from the medium and evaporates. The temperature of the refrigerant remains constant despite heat absorption. The absorbed energy is used for the phase change.

2. Superheating

The already completely evaporated refrigerant continues to absorb heat and is heated up in the process. Superheated refrigerant steam is found at the outlet. This operating superheat determines the degree of utilisation of the evaporator and can be adjusted via the expansion valve.

Heat transfer in the condenser



Energy processes in the condenser (counterflow)

T_c	condensation temperature
T_{sc}	supercooling temperature, refrigerant
$T_{cf, in}$	inlet temperature, cold medium
$T_{cf, out}$	outlet temperature, cold medium

refrigerant, cooling fluid

The energy processes in a properly designed condenser can be assigned to three different areas.

1. Desuperheating

The superheated, vaporous refrigerant is cooled from the superheating temperature to the condensation temperature (desuperheated).

2. Condensing

The refrigerant continuously releases heat to the cooling fluid and condenses at a constant pressure and constant temperature.

3. Supercooling

The already fully condensed refrigerant continues to release heat to the cooling fluid. The liquid refrigerant is cooled below the condensation temperature.