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Subcooling Explained

Understanding the principle of "Subcooling" is important because subcooling the liquid refrigerant before it enters the expansion valve increases the system refrigeration capacity and prevents flash gas from forming ahead of the expansion valve. The Bulletin below explains how subcooling is achieved in practice.

Subcooling – what is it and why is it so important?

In a refrigeration system, there should be subcooled liquid refrigerant in the liquid line between the receiver and the expansion valve. The liquid from the receiver will be at the condensing temperature – well above ambient temperature. It will therefore cool down – subcool – as it travels along the liquid line. This will happen naturally, as shown in Figure 1 where the outside temperature is 20°C and the refrigerant condenses at 35°C. Although the shop temperature is warmer than ambient, the refrigerant sub cools by 8°C.

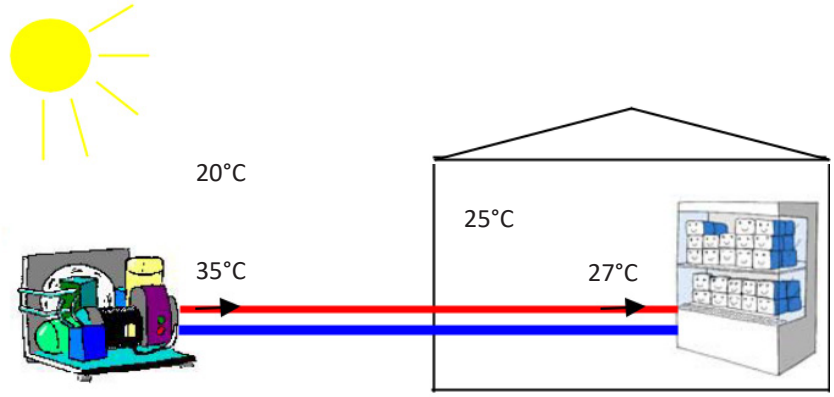

Figure 1

However, in the next diagram (Figures 2) the refrigerant has not subcooled because it's colder outside, resulting in a condensing temperature lower than the shop temperature.

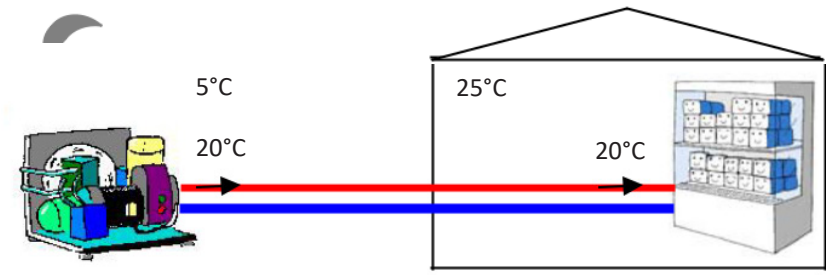

Figure 2

The refrigerant that enters the expansion valve must be full bore subcooled liquid to get maximum efficiency out of the valve and the evaporator. The low pressure liquid being fed by the expansion valve into the evaporator absorbs heat as it evaporates, if the refrigerant at the valve entry is saturated i.e. a mixture of gas and liquid (as in the diagram above) the gas does no useful job in the evaporator.

Bubbles in the liquid line sight glass?

If the refrigerant into the expansion device is not subcooled, the system will have to work harder and longer to achieve the correct storage temperature. This is the case if you see bubbles (flash gas) in the liquid line sight glass.

Just because you don't have bubbles in your sight glass doesn't mean you have subcooled liquid at the inlet to your expansion valve! Measure it using your gauge, thermometer and comparator.

Achieving subcooling

Condensed refrigerant can be subcooled in any of the following ways:

- Through a condenser incorporating a subcooling section. However in air-cooled condensers this effect is minimal.
- By installing internal heat exchangers providing subcooling and suction gas superheating at the same time.
- By installing external heat exchangers thus making it possible to achieve subcooling by means of an external cooling system. In this way heat extracted by the subcooling process is either delivered to a secondary cooling agent (water, air, brine) or another refrigeration system operating at a lower temperature.
- By installing the receiver or the piping outdoors.

Efficiency

Remember – for maximum efficiency liquid subcooling should be as high as possible. If the liquid line passes through an area of high ambient temperature, or if the liquid refrigerant is subcooled, e.g. by an economiser, it should be insulated.

Subcooling and the refrigeration cycle

SES Fundamentals 3 covered using the Pressure Enthalpy Chart for calculating subcooling in the refrigeration cycle.

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