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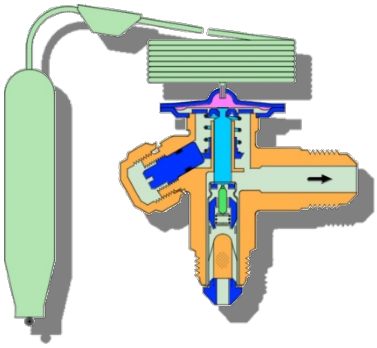
Setting TEV Superheat



This guide shows how to measure and adjust the superheat setting on thermostatic expansion valves. It is an important procedure because the correct superheat makes sure the performance of the evaporator is as good as possible whilst ensuring liquid refrigerant cannot return to the compressor and cause damage.

What is superheat?

When a refrigerant is superheated it is 100% gas at a higher temperature than the saturation (dew) temperature (the temperature at which it changes state, e.g. the evaporating temperature).

Evaporator superheat is the difference between the temperature of the refrigerant at the exit of the evaporator and the evaporating temperature:

Superheat = exit evaporator temperature – evaporating temperature (dew)

On most systems the superheat should be 5K:

- If the superheat is greater than 5K the evaporator is being starved of refrigerant and the cooling capacity and efficiency of the system is reduced;
- If the superheat is less than 5K there is a risk of liquid refrigerant leaving the evaporator and returning to the compressor, especially if the load reduces.

Note: 5K is 5^{O}C temperature difference.

The superheat achieved in the evaporator is also called useful superheat because it contributes (a small amount) to the cooling capacity. The refrigerant also superheats in the suction line between the evaporator outlet and the compressor. This is classed as non-useful because it does not contribute to the cooling and is actually detrimental – it reduces the efficiency of the system. That is why suction lines are always insulated.

Expansion valves are factory set, but not necessarily to the superheat you require, so it is important they are checked and adjusted during commissioning.

Tools required to measure and set superheat

To measure the superheat and adjust the expansion valve you will need:

- A gauge manifold set with accurate gauges;
- An accurate electronic thermometer with a suitable touch / contact probe;
- A refrigerant comparator;
- A screw driver if you need to adjust the superheat setting.

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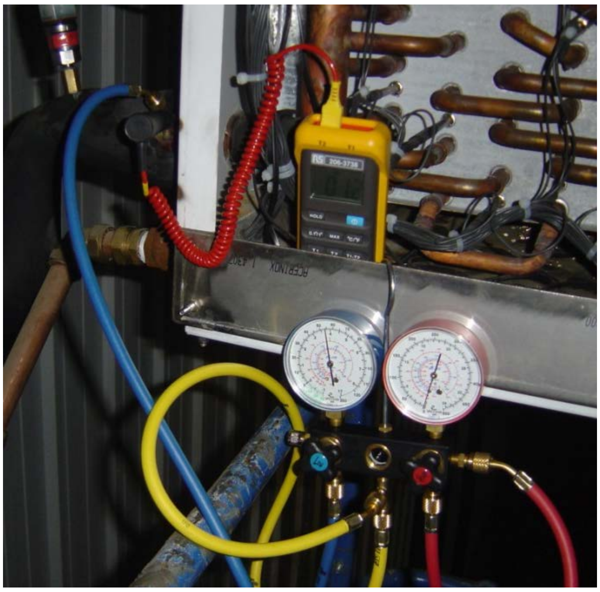
The photo shows an example where the low pressure gauge is connected to a Schrader valve on the outlet of the evaporator, and the temperature probe is measuring the temperature adjacent to this point.



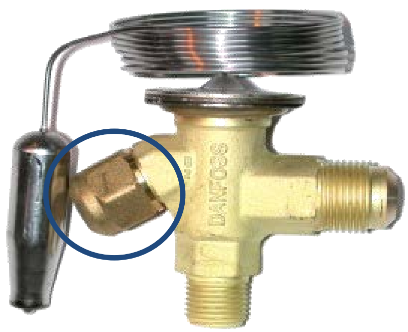
Procedure to measure and set superheat

The system must be running and be fully charged to measure and adjust the superheat accurately.

The procedure is as follows:

1.
   - Measure the temperature at the exit of the evaporator (T)
2.
   - Measure the evaporating pressure as close to the evaporator as possible
   - Work out evaporating temp (ET) from a comparator
3.
   - Calculate the superheat as follows: superheat = T – ET
4.
   - Adjust the TEV if necessary:
   - If the superheat is less than 5K the valve needs closing down
   - If the superheat is greater than 5K the valve needs opening up
5.
   - Wait a few minutes;
   - Repeat steps 1 to 5 until the superheat is 5K
6.
   - 15 minutes after the final adjustment, check the superheat

The adjustment screw in under the cap circled in the photo, right.



If the initial measurement shows the superheat is very low, make a small adjustment first, e.g. ¼ turn.   This is in case you turn the adjustment screw the wrong way, flooding liquid out of the evaporator and back to the compressor.

If the correct superheat cannot be achieved the orifice in the expansion valve should be changed:

- If you cannot reduce the superheat to 5K a larger orifice is needed;
- If you cannot increase the superheat to 5K a smaller orifice is needed.

You should discuss this with an applications engineer before changing the orifice size.

Example for R134a

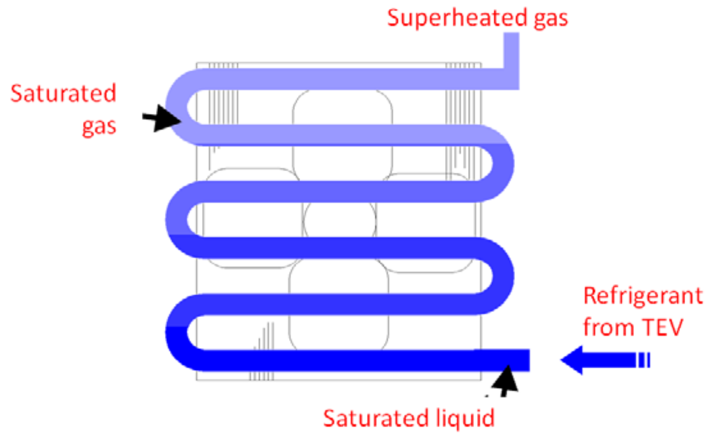
Evaporator exit temperature, 5°C
Evaporating pressure, 1.5 bar g
Evaporating temperature from a comparator, -4 °C
Superheat = 5 –(-4) = 9K

The TEV needs to be opened up to allow more liquid into the evaporator and achieve a superheat of 5K.

Setting superheat with zeotropic blends (R400 series refrigerants)

Zeotropic blends have temperature glide, i.e. the saturated liquid temperature is higher than the saturated gas temperature for the same pressure.   In an evaporator:

- When the refrigerant starts evaporating it is at the saturated liquid temperature (the bubble point);
- When it has totally evaporated, but not superheated, it is at the saturated gas temperature (the dew point).



The superheat is measured above the saturated gas temperature, and it should be 5K.

Example for R407C

Evaporator exit temperature, 7°C
Evaporating pressure, 4 bar g
Saturated gas (dew) temperature from a comparator, 3°C
Superheat, 7 – 3 = 4K.

The TEV needs closing down to reduce the amount of liquid entering the evaporator and achieve a superheat of 5K.

A superheat log

The table below can be used as a log to measure superheat and log the adjustments made:

	Initial check	After 1st adjustment	After 2nd adjustment	After 3rd adjustment	After 4th adjustment
Exit evaporator temperature, °C					
Evaporating pressure, bar g					
Evaporating temperature, °C					
Superheat, K Exit evap temp – evap temp					
Adjustment direction					
Number of turns					

With thanks to Danfoss for the photos used in this document.

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