In this article we will explain in a simplified way what is the role of the expansion valve in the refrigeration production cycle. We will also detail the differences between a thermostatic expansion valve and an electronic expansion valve. Firstly, it is important to understand the main principles and operations within the refrigeration production cycle.

A REMINDER ON COLD PRODUCTION

In the field of food processing, cold production is usually generated by a closed circuit fluid expansion system. The product is cooled down by cold air blown onto it rather than being placed directly in contact with the refrigerant (R404A, CO2, R134, glycol water, etc).

The refrigerant circulates in a closed circuit where it is successively compressed, condensed, decompressed and vaporized. As the fluid decompresses, its temperature and pressure is lowered. Accordingly, when hot air flows through the evaporator fins the air is cooled. The temperature inside the cabinet is therefore lowered as well as the products. The cycle starts again until the set temperature (which is programmed) is reached.

EXPANSION VALVE ROLE

The regulator has several purposes:
- Lower the pressure in the circuit
- Lower the temperature of the refrigerant by partially vaporizing it
- Manage the mass flow (=> quantity) of fluid reaching the evaporator

The regulator must transmit the optimal amount of refrigerant to the evaporator:
- If it transmits too little, the fluid immediately evaporates and the product will warm up, overheating occurs and the evaporator efficiency decreases.
- If too much is transmitted, the excess fluid which cannot be evaporated remains liquid and will be sucked in by the compressor. It may cause damages or breakages to the compressor as a result of the “excess liquid”.

VS

Compressor
Condenser
Evaporator

Cold air
Hot air
Pressure regulator

Refrigeration cycle
LP
HP
Differences between a thermostatic expansion valve and an electronic expansion valve

The fluid quantity to be transferred to the evaporator depends on the value of the overheating.

The overheating corresponds to the difference between the evaporation temperature and the compressor suction temperature.

\[ \text{Overheating} = \text{Evaporation } T^* - \text{compressor suction } T^* \]

To measure the overheating, the expansion valve is equipped with a local temperature sensor as well as a temperature and / or pressure sensor located at the Low pressure exit of the evaporator.

**Expansion Valves Models**

For our refrigeration applications, two technologies are used:

- **Thermostatic expansion valve**
- **Electronic expansion valve**
## Differences Between a Thermostatic Expansion Valve and an Electronic Expansion Valve

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<th>Type and Curve</th>
<th>Simplified Operation</th>
<th>Advantages</th>
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| **Thermostatic Expansion Valve** | Depending on the overheating value (orange curve), a valve opens or closes to supply the evaporator (blue line). Depending on the evaporator load, the difference between the stable overheating and the actual overheating is not the same. **For high and low loads, compressor performances are lower.** | • Low investment cost  
• Good reliability  
• Simple adjustment  
• Lower maintenance cost  

### Disadvantages
• Imprecise regulation  
• Limited accuracy for measuring overheating  
• More work required at lower ΔP when the condensation pressure is low.  
• Complicated multi-fluid adaptation and the regulator must be adjusted. |
| **Electronic Expansion Valve** | Depending on the refrigerant and the measured overheating, the controller calculates the opening and closing of the expansion valve. Depending on the evaporator load, the difference between the stable overheating and the actual overheating is regular. **Regardless of the evaporator load, the compressor performance is similar.** | • Extremely reliable  
• Optimizes overheating in the evaporator  
• Performs well at low Δp when working at low condensing pressures  
• Improves compressor performance  
• It can be attached to a controller that centralizes the control of all components of the refrigerant circuit and optimizes the operation of the entire system  
• Flexibility to adapt to different types of fluid by changing parameters  

### Disadvantages
• Higher cost than thermostatic expansion valve |
In summary, the thermostatic expansion valve is very reliable and offers a really added value.

For those who wish to optimize the refrigeration performance of their installation and create energy savings, the electronic expansion valve is the solution.

To offer a rewarding quality / price ratio, Hengel has chosen to equip certain models with thermostatic expansion valves and others with electronic regulators.

The latest models developed are performance-oriented with advanced technology and energy-savings, such as the RSE deep freezers, GS40-B blast-freezing cells and deep-freezing tunnels. They are equipped with electronic expansion valve as well as a stepper motor. It is in the transitional regimes (temperature changing) within blast-chilling or deep-freezing that the efficiency of the refrigeration process becomes interesting.

Sources:
Hengel