ENGINEERING
TOMORROW

Choosing the right component: **Thermostatic Expansion Valve** vs **Capillary Tube** in Glass Door Merchandisers

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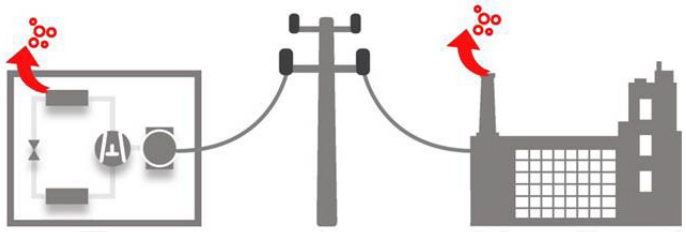
With a growing focus on reducing their enviromental footprint and reducing costs, manufacturers of Glass Door Merchandisers (GDMs) are looking for alternatives to optimize their equipment in order to save energy and improve the efficiency of the system.

Depending on the condition of the equipment and the environment, choosing the right component can bring significant advantages. This article analyzes two of the most common expansion devices: capillary tube and thermostatic expansion valve (TXV).

Up to 10%
reduction of energy consumption when using a thermostatic expansion valve instead of a capillary tube

A popular topic these days is how we can help reduce our impact on global warming. When considering this, it is important to remember the Total Equivalent Warming Impact (TEWI). The TEWI is the sum of both direct emissions and indirect emissions of greenhouse gases.

Direct emissions are caused by the particular refrigerant used and can be lowered simply by using a more environmentally friendly refrigerant, such as propane or CO_2. Indirect emissions come from the system's energy consumption which means there can be multiple ways to address this concern. While it is possible for some of us to replace our energy source with renewable energy, like solar or wind, others may not have that option. Instead, they will need to reduce their system's level of energy consumption by making the system more efficient.



Direct leakage (Direct impact) *CO_2 (Indirect impact)*

Direct and indirect emissions from refrigeration installations

Glass door merchandisers (GDMs) consume a lot of energy and there are many of them currently in operation, with numerous businesses owning multiple units. And while there have been steady improvements over the years, opportunities still remain to further improve their energy efficiency.

The alternatives

A simple way of reducing a GDM's energy consumption is to optimize the parts inside. While addressing issues like compressors, fans, lighting and insulation is important, do not forget to also look at the expansion device. GDMs often only use a simple capillary tube, a long pipe with a very small inner diameter which is used to restrict the flow of the refrigerant and therefore maintain the proper pressure within the system. The length and diameter of the pipe depend on the system capacity and have to be determined for new systems. This can be facilitated by using a program like DanCap™, but multiple tests will still need to be conducted to ensure optimization.

An alternative to using a capillary tube is to employ a thermostatic expansion valve (TXV). A TXV is a mechanical device that controls the refrigerant flow between the high and low pressure sides of the system. If operating conditions and the ambient environment are stable, an optimized capillary tube system may perform as well as a TXV. However, with varying conditions, such as during a pull-down or changing ambient conditions, the TXV has a strong advantage. TXVs are able to adapt the refrigerant mass flow to the changing demands on the system.

Capillary tube openings are fixed, but TXV openings adjust based on changing conditions. The ultimate goal of either device is to keep the evaporator as full as possible and to ensure that all refrigerant evaporates in order to prevent liquid refrigerant from entering the compressor suction port and causing damage. A charge inside the bulb placed at the outlet of the evaporator reacts to the temperature of the refrigerant which creates a pressure above the diaphragm in the valve. Under the diaphragm, the evaporating pressure and a spring create an opposing pressure. The bulb charge, along with the selected spring, are determined by the refrigerant used in the system.

Capillary Tube

TD 1 and TUB Thermostatic Expansion Valves

To better see the advantages of using a TXV compared with a capillary tube, let's take a look at both of them in action using an initial pull down (IPD) as an example. During an IPD, a capillary tube will restrict the flow of refrigerant. The refrigerant will bottle up in the condenser, which will increase the condensing pressure and, consequently, also increase the power consumption of the compressor. Due to the relatively low mass flow, the IPD will take a long time and the system will not be working very efficiently. However, under the same circumstances, the TXV will open and respond more quickly to adapt the flow to the higher load. The higher mass flow enables the evaporator to remove heat from the cooling compartment at a faster rate and will keep the condensing pressure low.

In a nutshell

As mentioned earlier, a system with a capillary tube may work as well as a TXV under ideal circumstances if the tube is optimized, but real-world systems do not work under static conditions. The condensing and/or evaporating conditions will vary with changing ambient temperatures and heat loads whenever the door is opened to remove or restock merchandise. In these common situations, the TXV will optimize the filling of the evaporator by controlling the system to an optimal superheat level. Measurements have shown up to 20% decrease in pull down time and up to 10% reduction in energy consumption when using a TXV instead of a capillary tube. That means the energy savings that result from using a TXV could offset the costs of installation in as little as six months, depending on the actual reduction of energy consumption and cost of energy.

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