Refrigeration Service Today

TXV Installation & Troubleshooting

Proper thermostatic expansion valve (TXV) function is key to a variety of system deficiencies. Here's a look at installation and service tips that will make a diagnostic go smoother.

A thermostatic expansion valve (TXV) is built up around a thermostatic element separated from the valve body by a diaphragm. Its purpose is to regulate the rate at which refrigerant flows into the evaporator.

TXVs can contain one of three different types of charge:

- universal charge
- Maximum operating pressure (MOP) charge.
- MOP charge with ballast (standard for Danfoss expansion valves with MOP).

Expansion valves with Universal charge are used in most refrigeration system swhere there is no pressure limitation requirement and where the bulb can be located armer than the element or at high evaporating temperature/ evaporating pressure.

Expansion valves with MOP charge are typically used on factory-made units where suction pressure limitation on starting is required such as in the transport sector and in air conditioning systems. All expansion valves with MOP have a very small charge in the bulb. This means that the valve or the element must be located warmer than the bulb. If it's not, charge can migrate from the bulb to the element and prevent the expansion valve from functioning.

Expansion valves with MOP ballast charges are used mainly in refrigeration systems with "high dynamic" evaporators, such as in air conditioning systems and plate heat exchangers with high heat transfer.

Installation Procedures

The expansion valve must be installed in the liquid line, ahead of the evaporator, with bulb fastened to the suction line as close to the evaporator as possible. If there's external pressure equalization, the equalizing line must be connected to the suction line immediately after the bulb. **(Figure 1)**

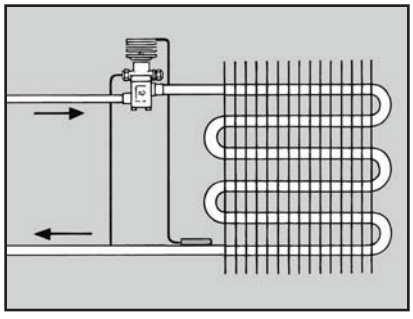

Fig. 1 The expansion valve must be installed in the liquid line.

The bulb is best mounted on a horizontal suction line tube and in a position corresponding to between 1 o'clock and 4 o'clock. The location depends on the outside diameter of the tube. **(Figure 2)** Note:The bulb must never be located at the bottom of the suction line due to the possibility of oil laying in the bottom of the pipe causing false signals.

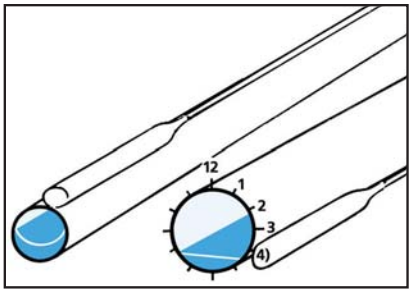

Fig. 2 The bulb is best mounted on a horizontal suction line tube and in a position corresponding to between 1 o'clock and 4 o'clock.

The bulb must be able to sense the temperature of the superheated suction vapour and must therefore not be located in a position that will expose it to extraneous heat/cold.

The bulb must not be installed after a heat exchanger. In this position it will give false signals to the expansion valve (**Figure 4**). Additionally, the bulb must not be installed close to components of large mass, as this also will give rise to false signals to the expansion valve.

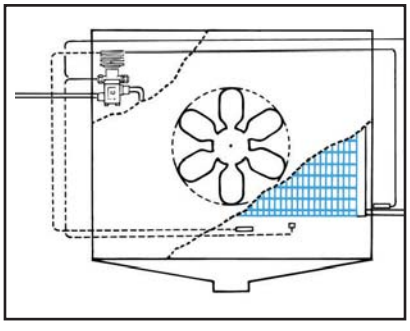

Fig. 3 If the bulb is exposed to a warm air current, insulation of the bulb is recommended.

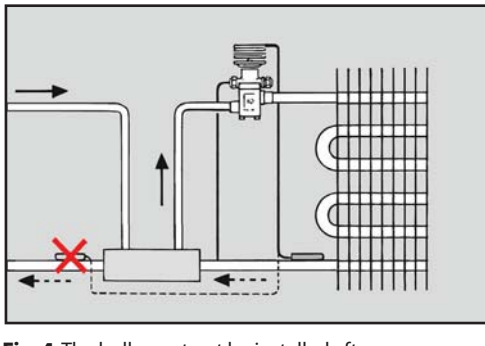

Fig. 4 The bulb must not be installed after a heat exchanger. The X indicates the wrong placement area.

TXV Troubleshooting

SYMPTOMS & POSSIBLE CAUSES	REMEDY
Room temperature too high, with high superheat:	
Pressure drop across evaporator too high.	Replace expansion valve with valve having external pressure equalization. Reset superheat on expansion valve if necessary.
Lack of subcooling ahead of expansion valve.	Check refrigerant subcooling ahead of expansion valve. Establish greater subcooling.
Pressure drop across expansion valve less than the pressure drop the valve is sized for.	Check pressure drop across expansion valve. Try replacement with larger orifice assembly and/or valve. Reset superheat on expansion valve if necessary.
Bulb located after a heat exchanger or too close to large valves, flanges, etc.	Check bulb location. Locate bulb away from large valves, flanges, etc.
Expansion valve blocked with ice, wax or other impurities.	Clean ice, wax or other impurities from the valve. Check sight glass for colour change (green means too much moisture). Replace filter drier if fitted. Check oil in the refrigeration system. Has the oil been changed or replenished? Has the compressor been replaced? Clean the filter.
Expansion valve too small.	Check refrigeration system capacity and compare with expansion valve capacity. Replace with larger valve or orifice. Reset superheat on expansion valve.
Charge lost from expansion valve.	Check expansion valve for loss of charge. Replace expansion valve. Reset superheat on expansion valve.
Charge migration in expansion valve.	Check whether expansion valve charge is correct. Identify and remove cause of charge migration. Reset superheat on expansion valve if necessary.
Room temperature too high, with low superheat:	
Expansion valve bulb not in good contact with suction line.	Ensure that bulb is secured on suction line. Insulate bulb if necessary.
Evaporator completely or partly iced up.	De-ice evaporator if necessary.
Refrigeration system hunts:	
Expansion valve superheat set at too small a value.	Reset superheat on expansion valve.
Expansion valve capacity too high.	Replace expansion valve or orifice with smaller size. Reset super heat on expansion valve if necessary.
Refrigeration system hunts at too high a room temperature:	
Expansion valve bulb location inappropriate, e.g. on collection tube, riser after oil lock, or near large valves, flanges or similar.	Check bulb location. Locate bulb so that it receives a reliable signal. Ensure that bulb is secured on suction line. Set superheat on expansion valve if necessary.
Suction pressure too high:	
Liquid flow. Expansion valve too large. Expansion valve setting incorrect.	Check refrigeration system capacity and compare with expansion valve capacity. Replace with larger valve or orifice. Reset superheat on expansion valve.
Charge lost from expansion valve.	Check expansion valve for loss of charge. Replace expansion valve. Reset superheat on expansion valve.
Charge migration in expansion valve.	Increase superheat on expansion valve. Check expansion valve capacity in relation to evaporator duty. Replace expansion valve or orifice with smaller size. Reset superheat on expansion valve if necessary.
Suction pressure too low:	
Pressure drop across evaporator too high.	Replace expansion valve with valve having external pressure equalization. Reset superheat on expansion valve if necessary.
Lack of subcooling ahead of expansion valve.	Check refrigerant subcooling ahead of expansion valve. Establish greater subcooling.
Evaporator superheat too high.	Check superheat. Reset superheat on expansion valve.
Pressure drop across expansion valve less than pressure drop valve is sized for.	Check pressure drop across expansion valve. Replace with larger orifice assembly and/or valve if necessary.
Bulb located too cold, e.g. in cold air flow or near large valves, flanges, etc.	Check bulb location. Insulate bulb if necessary. Locate bulb away from large valves, flanges, etc.
Expansion valve too small.	Check refrigeration system capacity and compare with expansion valve capacity. Replace with larger valve or orifice. Reset superheat on expansion valve.
Expansion valve blocked with ice, wax or other impurities.	Clean ice, wax and other impurities from valve. Check sight glass for colour change (yellow means too much moisture). Replace filter drier if fitted. Check oil in the refrigeration system. Has the oil been changed or replenished? Has the compressor been replaced? Clean the filter.
Charge lost from expansion valve.	Check expansion valve for loss of charge. Replace expansion valve. Reset superheat on expansion valve.
Charge migration in expansion valve.	Check charge in expansion valve. Reset superheat on expansion valve if necessary.
Evaporator wholly or partly iced up.	De-ice evaporator if necessary.
Liquid hammer in compressor:	
Expansion valve capacity too large.	Replace expansion valve or orifice with smaller size. Reset superheat on expansion valve if necessary.
Superheat on expansion valve set too low.	Increase superheat on expansion valve.
Expansion valve bulb not in good contact with suction line.	Ensure that bulb is secured on suction line. Insulate bulb if necessary.
Bulb located too warm or near large valves, flanges, etc.	Check bulb location on suction line. Move bulb to better position.

As previously mentioned, the bulb must be installed to the horizontal part of the suction line immediately after the evaporator. It must not be installed to a collection tube or a riser after an oil pocket. The expansion valve bulb must always be installed ahead of any liquid lock.

— Information courtesy Danfoss

How the TXV Controls Superheat

The thermostatic expansion valve (TXV) is a precision device designed to regulate the rate at which liquid refrigerant flows into the evaporator. This controlled flow is necessary to prevent the return of liquid refrigerant to the compressor.

The TXV separates the high pressure and low-pressure sides of a refrigeration or air conditioning system. Liquid refrigerant enters the valve under high pressure, but its pressure is reduced when the TXV limits the amount of refrigerant entering the evaporator.

Remember: the TXV controls only one thing: the rate of flow of liquid refrigerant into the evaporator. The TXV is not designed to control air temperature, head pressure, capacity, suction pressure, or humidity. Attempts to use the TXV to control any of these system variables will lead to poor system performance and possible compressor failure.

The TXV responds to the temperature of refrigerant gas as it leaves the evaporator. This temperature is detected by the sensing bulb, which is located near the evaporator outlet. The TXV also responds to the refrigerant pressure within the evaporator, which is transmitted to the TXV by an equalizer line. By responding to these variables, the TXV maintains a predetermined superheat within the evaporator. This is how the TXV keeps the system in balance and operating properly. To understand how this works, we must have a clear understanding of superheat.

Superheat is the difference between two temperatures:

• **the saturation temperature** of the refrigerant (the temperature at which the refrigerant changes from a liquid state to vapor. This is the same as its boiling point. For water at sea level, the saturation temperature is 212F. The saturation temperature of a liquid increases as pressure increases.

• **the actual temperature** of the refrigerant (the temperature of refrigerant vapor by the time it reaches the evaporator outlet).

The TXV controls superheat by controlling the flow of liquid refrigerant. As it does this, it also reduces refrigerant pressure.

Liquid refrigerant enters the TXV under high pressure. As the flow of liquid refrigerant is reduced, its pressure drops. The refrigerant leaving the TXV is now a combination of low-pressure liquid and vapor.

As the flow is restricted, several things happen:

• The pressure on the liquid refrigerant drops;

• A small amount of the liquid refrigerant is converted to gas, in response to the drop in pressure;

• This "flash gas" represents a high degree of energy transfer, as the sensible heat of the refrigerant is converted to latent heat;

• The low-pressure liquid and vapor combination moves into the evaporator, where the rest of the liquid refrigerant "boils off" into its gaseous state as it absorbs heat from its surroundings.

Changes in gas temperature at the evaporator outlet are detected by the sensing bulb, which then causes the valve pin to move in or out, regulating the flow of refrigerant through the TXV. In this way, the valve allows just enough refrigerant into the evaporator, to maintain the correct level of superheat in the suction line.

The TXV controls superheat by varying the size of the orifice through which the refrigerant flows. The pin angle, the size of the stroke (typically 0.015- to 0.035-in.) and the diameter of the orifice itself all affect how much refrigerant can pass through the valve. In addition, all valves have some leakage around the valve pin, although this is normally kept within acceptable limits.

It's important to remember that valve capacity is a function of the orifice diameter, pin angle, and stroke. Adjusting the superheat spring doesn't change valve capacity. CB

— Al Maier, vice president, applications engineering, Emerson Climate Technologies. Table on p. 82 courtesy Danfoss.

SERVICE TIP

One Technician's TXV Advice

The thermostatic expansion valve (TXV) is like the carburetor in your car's engine. It opens and closes to allow the correct amount of refrigerant into your system. When the TXV isn't working properly, the efficiency of your unit is crippled. If you suspect you have a faulty TXV, perform these tests:

1. First, connect your gauges to the system and check that the refrigerant pressures, subcooling and superheat are where they should be (for pressures settings, refer to unit's pressure chart; for subcooling (usually around 10F) and superheat (between 8F-12F) follow manufacturer's specification sheet.

2. Check to see if airflow through the system is good . There should be no dirty coils or air filters. Also check for proper CFMs readings across the system.

3. Make sure there's the right amount of refrigerant charge in the system (this step may require weighing out the refrigerant in the system). Once you've added or removed charge as necessary, check the pressures, subcooling and superheat again. If there is no change then it is probably the TXV.

4. Check the evaporator coil and remove the TXV's sensing bulb from the suction line.

5. Check the subcooling, superheat and pressures again. If there's no change, that's a further indication of a TXV problem.

6. Another test is to put the sensing bulb in ice water and checking the pressures superheat, and subcooling again. If they don't change, it's a bad TXV.

— Eloy Saban, owner, Temp Contol LLC, Nashville, TN