2. The Three Position Service Valve for Air Conditioners and Heat Pumps

There is one main difference between the pathways of a three position service valve used on refrigeration units and the three position service valve used on air conditioners and heat pumps. The front-seat position on an air conditioner or heat pump allows the line set and the service port pathways to be connected while the pathway to the outdoor unit is shut off.

A. The Three Positions for Air Conditioners and Heat Pumps

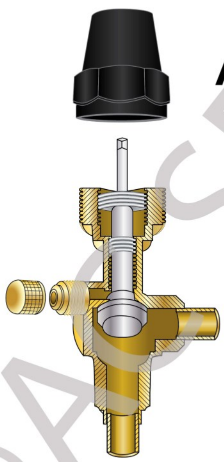

Figure 6-6: Back Seat

1. Back-Seat is when the stem is turned counterclockwise all the way up. In the back-seat position the service port is closed off and the outdoor unit and line set are connected (See Figure 6-6). This is the same as the three position service valve for refrigeration.

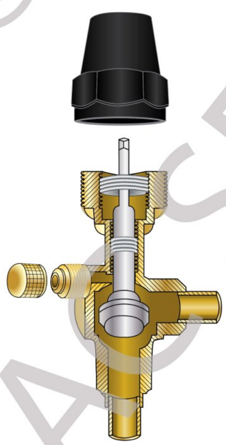

Figure 6-7: Mid Seat

2. Mid-Seat is when the stem is turned clockwise roughly 180° downward from the back-seat position. Mid-seat connects all three ports, the outdoor unit, the line set, and the service port. The mid-seat position is used to measure pressure or to adjust the refrigerant charge while the system is running. Mid-seat also refers to positioning the stem halfway between the back-seat and front-seat positions when the system's power is off for recovery and vacuuming (See Figure 6-7). This is the same as the three position service valve for refrigeration.

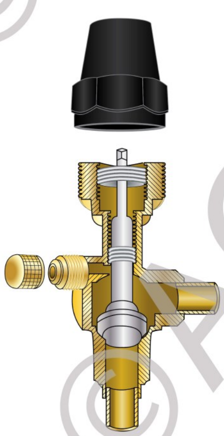

Figure 6-8: Front Seat

3. Front-Seat is when the stem is turned clockwise all the way down until it stops. Front-seat shuts off the outdoor unit pathway while the service port and line set remain connected. On the suction line, front-seat shuts off the pathway into the compressor but keeps the opening between the service port and suction line set connected. Front-seat on the liquid line shuts off the pathway to the condenser but keeps the opening between the service port and the liquid line set connected. (See Figure 6-8).

The Two Positions

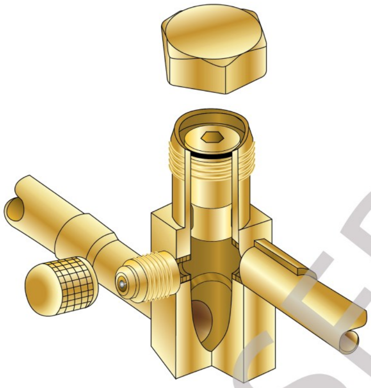

Figure 6-12: Two Position Service Valve Fully Open

1. Fully Open is when the valve stem is turned counterclockwise almost all the way up. Fully open is not technically a back-seat since the service port does not get sealed by the valve stem being all the way up. Rather, the valve core seals the port which stops the pressure from escaping (See Figure 6-12).

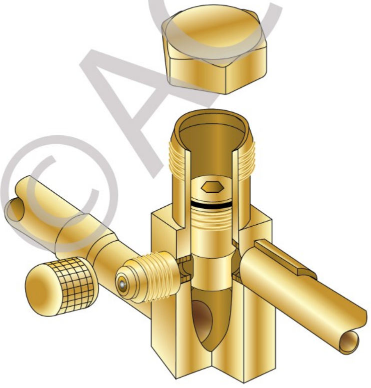

Figure 6-13: Two Position Service Valve in Front-Seat

2. Front-Seat is when the valve stem is turned clockwise all the way down. The valve stem seals up against the seat and the valve shuts off the lower pathway of the outdoor unit from the line set and port. The line set and service port remain connected. (See Figure 6-13).

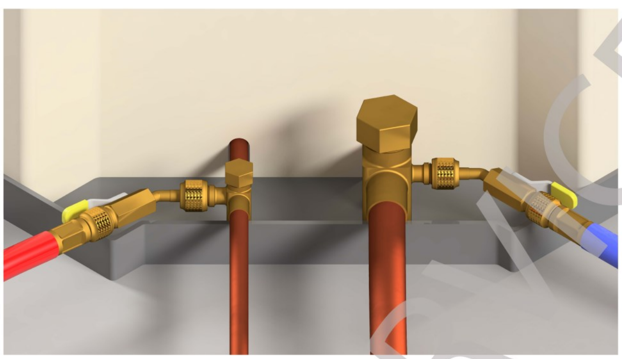

Figure 6-14: Refrigerant Hoses Connected

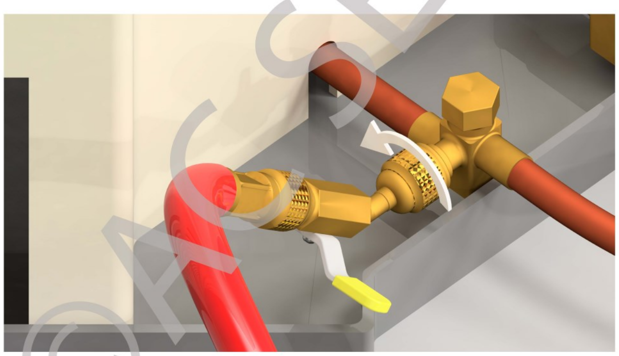

Figure 6-15: Disconnection of the Refrigerant Hose

To measure the system pressure, connect the manifold gauge set hoses to the service ports on the two position service valves. Connect the blue hose to the vapor service valve port and connect the red hose to the liquid service valve port (See Figure 6-14). A low loss fitting with a valve core depressor should be attached to the end of each refrigerant hose prior to connecting to the ports. This will reduce refrigerant loss when connecting to and disconnecting from each port. Turn the hose fitting clockwise to connect it to the port. The valve core depressor pushes the valve core stem inward when connecting. This opens the valve core and allows refrigerant through the service port. To disconnect the refrigerant hose fitting from the port, close the fitting valve and then turn the fitting end counterclockwise until the valve core stem re-seats and the hose end comes off the port (See Figure 6-15).

A. Low Indoor Airflow

Indicators of a <u>low indoor airflow problem</u> are based on the type of metering device.
<u>TXV:</u> Vapor Sat Temp Below 32° F, Normal Superheat, Normal to High Subcooling
<u>Fixed Orifice:</u> Vapor Sat Temp Below 32° F, Low Superheat, Normal to Low Subcooling

Low indoor airflow can be due to undersized ducts, collapsed ducts, undersized or blocked off grilles and/or registers, a clogged air filter, dust clogging the indoor coil, dust clogging the secondary heat exchanger of a furnace, low blower speed, a dirty blower wheel, a broken blower motor, or overall static pressure too high for the blower motor to overcome.

Figure 13-1 shows an R-410A system with a fixed orifice that has a **<u>low indoor airflow problem</u>** and a **<u>correct refrigerant charge</u>**. The measurements were taken after the ice was melted from the coil and after 10-15 minutes of run time. Troubleshooting low airflow problems is discussed in Chapter 15**.**

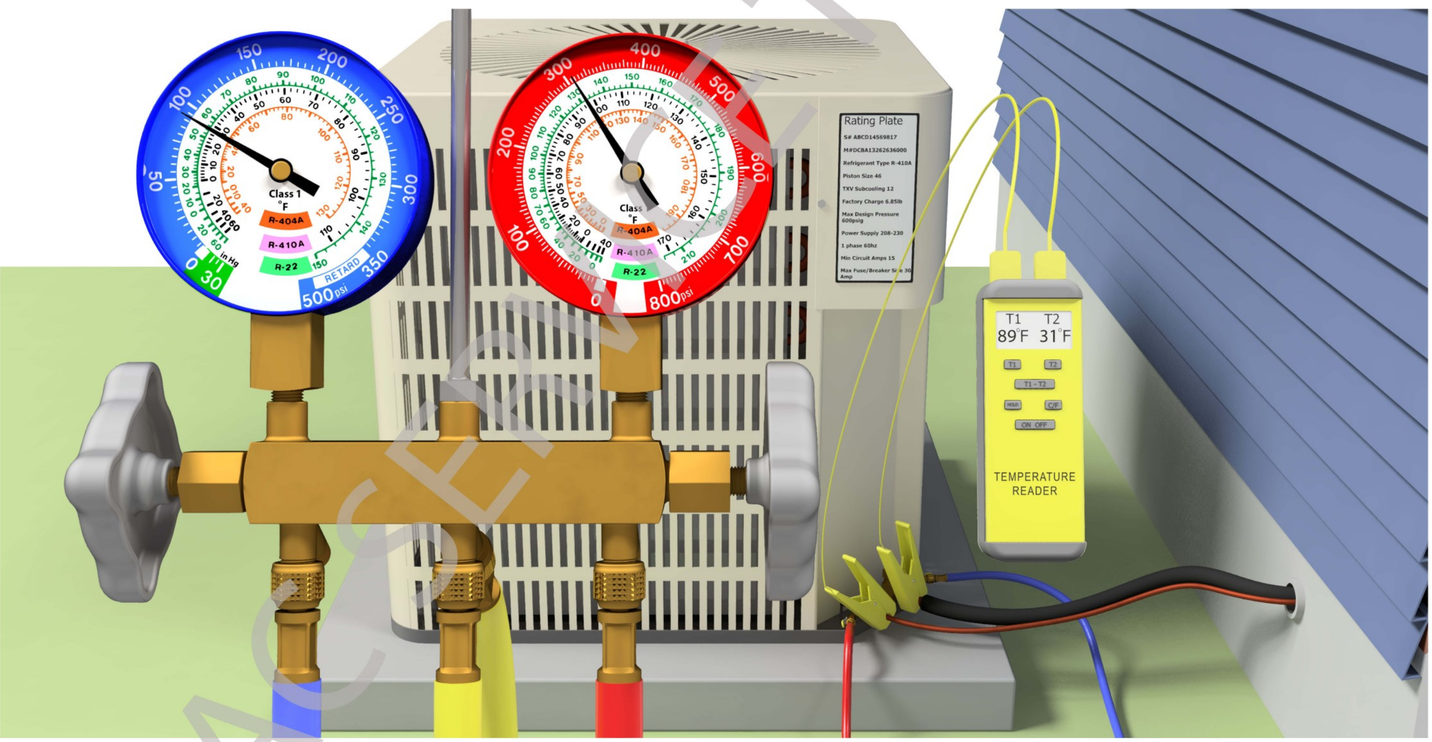

Figure 13-1: R-410A System, Low Indoor Airflow, Correct Charge

<u>Scenario in Figure 13-1: R-410A, Fixed Orifice, Low Indoor Airflow, Correct Charge</u>

- **Actual Temp on the Vapor Line 31° F, Vapor Sat Temp 28° F**
- **31° F - 28° F = Superheat of 3° F**
- **High Side Sat Temp 98° F , Actual Temp on the Liquid Line 89° F**
- **98° F - 89° F = Subcooling of 9° F**

Figure 13-2 shows an R-410A system with a fixed orifice that has a **<u>low indoor airflow problem</u>** and is **<u>overcharged with refrigerant</u>**.

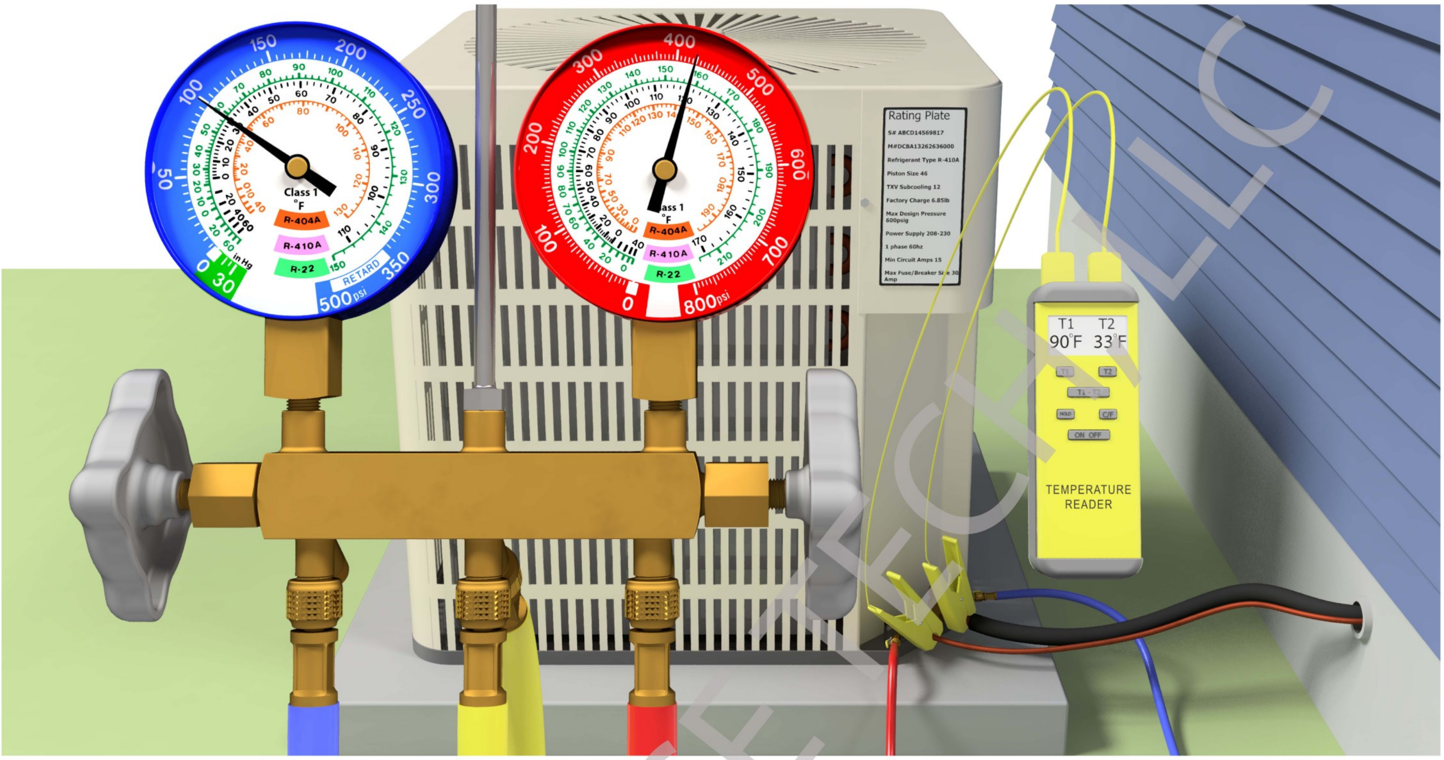

Figure 13-2: R-410A System, Low Indoor Airflow, Overcharged

<u>Scenario in Figure 13-2: R-410A, Fixed Orifice, Low Indoor Airflow, Overcharged</u>

- **Actual Temp on the Vapor Line 33° F, Vapor Sat Temp 31° F**
- **33° F- 31° F = Superheat of 2° F**
- **High Side Sat Temp 120° F , Actual Temp on the Liquid Line 90° F**
- **120° F - 90° F = Subcooling of 30° F**

B. Low Refrigerant Charge

Indicators of a <u>low refrigerant charge</u> are based on the type of metering device.
<u>TXV:</u> Vapor Sat Temp Below 32° F, High to Normal Superheat, Low Subcooling
<u>Fixed Orifice:</u> Vapor Sat Temp Below 32° F, High Superheat, Low Subcooling

If an air conditioning system worked correctly in the past and is now low on refrigerant, the system has a refrigerant leak. This leak should be found and fixed before adding more refrigerant into the system. Some systems have multiple leak points where corrosion has occurred. If a new system is installed and low on refrigerant, slowly add refrigerant into the suction port while the system is running until the superheat and subcooling measurements are correct. (A low refrigerant charge may result in a hunting action read on the manifold gauge set. This is when the refrigerant pressures dramatically rise and fall back and forth as the TXV tries to maintain its set superheat while not having a steady stream of liquid entering it.)

chamber head. This is the side that is closest to the distributor tubes. The refrigerant will only be able to flow through the middle hole of the piston and into the distributor tubes. The distributor tubes (See Figure 16-4) feed the refrigerant into the evaporator coil tubing. Newer pistons may have a Teflon seal on the face of the piston in order to make a better seal up against the piston chamber head. This is done so that the refrigerant does not leak around the piston.

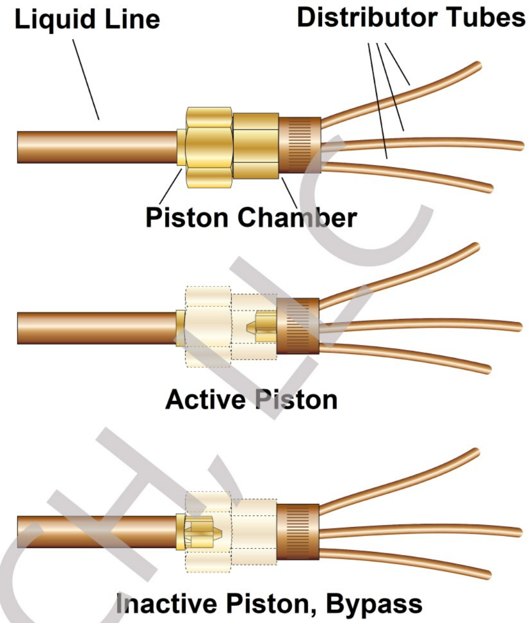

Figure 16-4: Active and Inactive Piston

If the piston installed in the chamber is too small for the system capacity, then the evaporator coil will have high superheat. If the piston size installed in the chamber is too large for the system capacity, then the evaporator coil will have little or no superheat and the compressor will be in danger of having saturated refrigerant entering in.

4. TXV (Thermostatic Expansion Valve) Metering Device

The TXV (Thermostatic Expansion Valve) is commonly installed as the metering device in new residential and light commercial air conditioning and heat pump systems (See Figure 16-5). This metering device is referred to as a TXV or TEV. It can dramatically increase the efficiency of the system compared to a fixed orifice piston or capillary tube. This is because it is able to change the size of its metering orifice, letting more refrigerant into the coil during high heat loads and less refrigerant in during low heat loads. However, the TXV's metering orifice size is limited to its range of capacity. The TXV measures the superheat across the coil and adjusts the volume of liquid refrigerant going through it in order to keep the superheat as constant as possible even with changing heat loads.

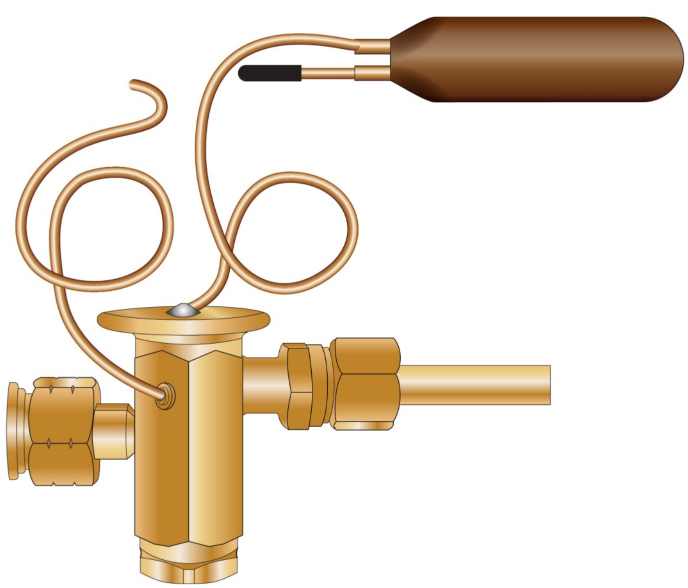

Figure 16-5: TXV

The TXV is able to adjust the refrigerant flow by using three main pressures. These open and close the metering orifice. A TXV used for air conditioning will not usually close all the way but just limit the orifice size to a very small opening. Most newer TXV's are equipped with an internal bypass valve which allows the metering device mounted at the indoor coil to become inactive during heating mode.

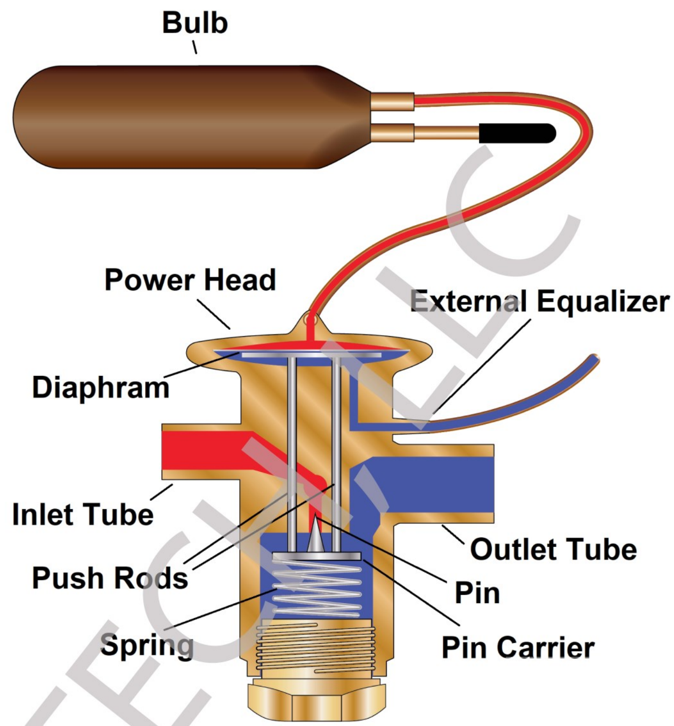

Figure 16-6: Labeled TXV

The TXV is made up of multiple parts (See Figure 16-6). The power head attaches to the TXV bulb. Inside the power head is a diaphragm that pushes down on the push rods and the internal pin carrier. The TXV is equipped with an equalizer which pushes up on the push rods. A spring is mounted inside the lower section of the TXV. The spring pushes up on the internal pin carrier. The other parts of the TXV are the inlet tube, the outlet tube, and the spring pressure adjustment stem at the bottom of the TXV, if equipped.

Most air conditioning TXV's are nonadjustable (See Figure 16-6), but some are adjustable (See Figure 16-12). Just about all refrigeration TXV's are adjustable. The adjustment to the spring pressure is made by accessing the stem after taking the seal cap off the bottom of the TXV. Increasing the spring pressure increases the superheat whereas decreasing the spring pressure decreases the superheat. If the TXV has a flat bottom without a cap, as in Figure 16-6, then it is nonadjustable.

There are three things that exert pressure on the opening and closing of the TXV. They are the bulb pressure connected to the power head (P1), the equalization pressure (P2), and the internal spring pressure (P3) (See Figure 16-7).

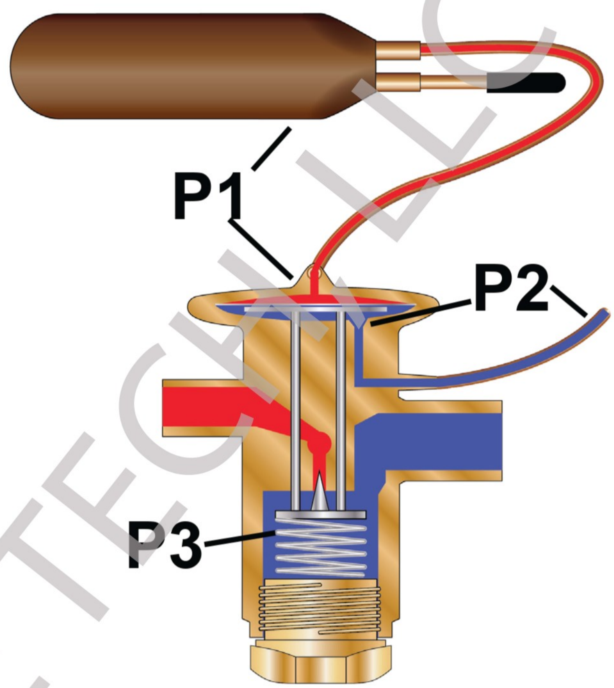

Figure 16-7: P1 = P2 + P3