# EXPANSION VALVES

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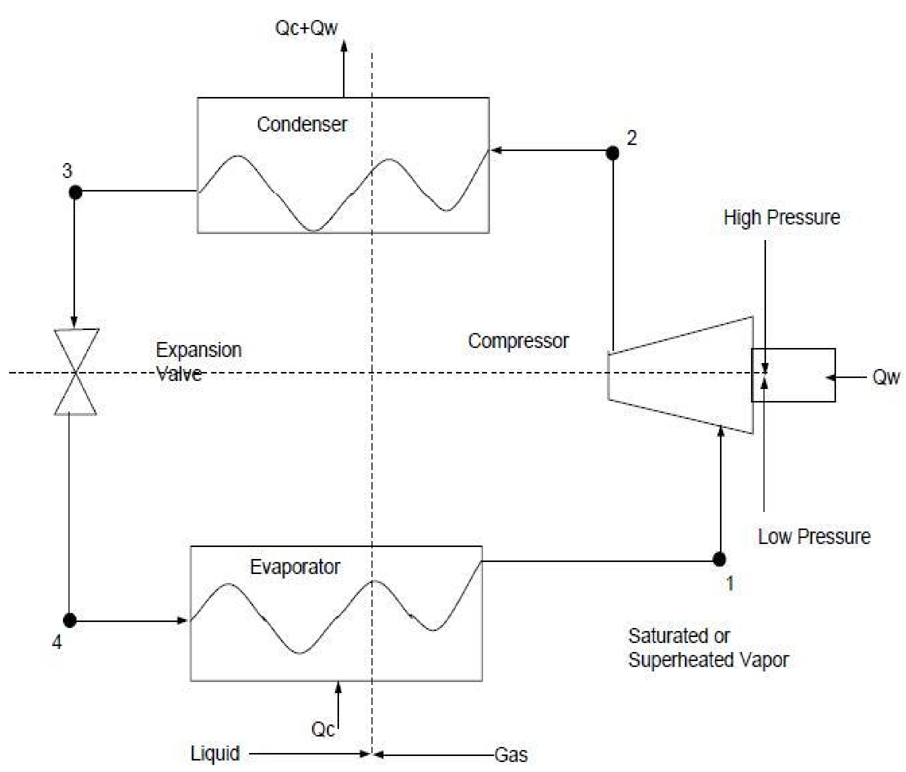
# ١- INTRODUCTION

Thermostatic expansion valve or TEV is one of the most commonly used throttling devices in the refrigerator and air conditioning systems. The thermostatic expansion valve is the automatic valve that maintains proper flow of the refrigerant in the evaporator as per the load inside the evaporator. If the load inside the evaporator is higher it allows the increase in flow of the refrigerant and when the load reduces it allows the reduction in the flow of the refrigerant. This leads to highly efficient working of the compressor and the whole refrigeration and the air conditioning plant.

The thermostatic expansion valve also prevents the flooding of the refrigerant to the compressor ensuring that the plant would run safely without any risk of breakage of the compressor due to compression of the liquid. The thermostatic expansion valve does not controls the temperature inside the evaporator and it does not vary the temperature inside the evaporator as its name may suggest.

Beside the capillary tube, the thermostatic expansion valve is used widely in the refrigeration and air conditioning systems. While the capillary tube is used in the small domestic systems, the thermostatic expansion valve is used in the systems of higher capacities. It is commonly used in the industrial refrigeration plants, high capacity split air conditioners, packaged air conditioners, central air conditioners and many other systems.



## ٢. THE REFRIGERATION SYSTEM

To understand the function of the thermostatic expansion valve, a short discussion of the refrigeration system is necessary. The refrigeration system can be defined as a closed system in which the process of absorbing and rejecting heat is performed by flowing a refrigerant in a vapor compression cycle. In its simplest form, the refrigeration system consists of five components: the compressor, condenser, evaporator,

Expansion device and interconnecting piping. The heart of the system is the compressor since it causes the refrigerant flow. Its function is simply to receive low pressure (and temperature) refrigerant vapor from the evaporator and compress it into high pressure (and temperature refrigerant vapor. The high pressure vapor is then converted performs this function by removing heat from the vapor and rejecting the heat to the air, or to water in the case of a water cooled condenser. The liquid, which remains at a high pressure, passes through the expansion device and becomes a low pressure two phase (liquid and vapor) mixture.

This refrigerant mixture returns to its vapor phase in the evaporator by absorbing heat from the medium being cooled. The selection of the expansion device is of particular importance to the operation of the refrigeration system because it regulates refrigerant flow into the evaporator. An expansion device which is misapplied or incorrectly sized will ordinarily result in operational difficulties and poor system performance. For example, an undersized expansion device will prevent sufficient refrigerant from flowing into the evaporator causing a reduction in the design cooling capability of the system. An oversized expansion device may allow too much refrigerant into the evaporator causing liquid refrigerant to flow back to the compressor. The latter condition is referred to as **flood back**. Both conditions will invariably result in compressor damage if not quickly remedied. Therefore, the expansion device requires attention to its selection and application

## ٣. TYPES OF EXPANSION DEVICES

Expansion devices can be divided into four general categories: the fixed area restrictor, the automatic (constant pressure) expansion valve, the thermostatic expansion valve, and the electric expansion valve. The fixed area restrictor expansion device is simply a precisely formed restriction through which liquid refrigerant flows. Two common examples of this type of device are the capillary tube, or *cap tube*, and the short tube restrictor, or plug orifice. These devices are typically used on certain small air conditioning and refrigeration systems where operating conditions permit moderately constant evaporator loading and constant
condenser pressures. The drawback associated with these devices is their limited ability to efficiently regulate refrigerant flow in response to changes in system operating conditions, since they are sized based on one set of conditions like the fixed area restrictor, the automatic expansion
valve (AEV) is best suited for applications having moderately constant evaporator loading. The AEV regulates refrigerant flow by simply maintaining a constant evaporator or valve outlet pressure. As the heat load on the evaporator rises, the AEV decreases refrigerant flow to maintain evaporator pressure at the valve's setting. Conversely, the
AEV increases refrigerant flow when the evaporator heat load decreases to maintain evaporator pressure at the valve's setting. As a result, the AEV starves the evaporator at high load conditions, and overfeeds it at low load conditions. The thermostatic expansion valve provides an excellent solution to regulating refrigerant flow into a direct expansion
type evaporator. The TEV regulates refrigerant flow by maintaining a nearly constant superheat at the evaporator outlet. As superheat at the evaporator outlet rises due to increased heat load on the evaporator, the TEV increases refrigerant flow until superheat returns to the valve's setting. Conversely, the TEV will decrease refrigerant flow when superheat lowers as a result of a decreased heat load on the evaporator. The effect of this type of regulation is it allows the evaporator to remain as nearly fully active as possible under all load conditions. The concept of
superheat,
The thermostatic expansion valve provides an additional benefit when charging the system with refrigerant. When a TEV is used, the system refrigerant charge is usually not as critical as with the other expansion devices. The proper operation of a fixed restriction and, to a lesser extent, an automatic expansion valve depends on having an exact amount of refrigerant in the system. The electric expansion valve (EEV) provides a means by which applications can be designed with sophisticated system Control functions. This type of valve is controlled by an electronic circuit which is often designed to allow the valve to control some aspect of system operation in addition to superheat at the outlet of the evaporator. For example, evaporator discharge air temperature or water temperature
from a chiller could be monitored by the EEV's controller.

## ٤. Functions of the Thermostatic Expansion Valve

The thermostatic expansion valve performs following functions:

**١) Reduce the pressure of the refrigerant:**

The first and the foremost function of the thermostatic expansion valve is to reduce the pressure of the refrigerant from the condenser pressure to the evaporator pressure. In the condenser the refrigerant is at very high pressure. The thermostatic expansion valve has a constriction or orifice due to which the pressure of the refrigerant passing through it drops down suddenly to the level of the evaporator pressure. Due this the temperature of the refrigerant also drops down suddenly and it produces cooling effect inside the evaporator.

**٢) Keep the evaporator active:**

The thermostatic expansion valve allows the flow of the refrigerant as per the cooling load inside it. At higher load the flow of the refrigerant is increased and at the lower loads the flow is reduced. It won't happen that the load on the evaporator is high and the flow of the refrigerant is low thereby reducing the capacity of the evaporator. The thermostatic expansion valve allows the evaporator to run as per the requirements and there won't be any wastage of the capacity of the evaporator. The TEV constantly modulates the flow to maintain the superheat for which it has been adjusted.

**٣) Allow the flow of the refrigerant as per the requirements:**

This is another important function of the thermostatic expansion valve. It allows the flow of the refrigerant to the evaporator as per the load on it. This prevents the flooding of the liquid refrigerant to the compressor and efficient working of the evaporator and the compressor and the whole refrigeration plant.

# ٥. HOW THE THERMOSTATIC EXPANSION VALVE WORKS

### ٥-١ Basic Operation

In order to understand the principles of thermostatic expansion valve operation, a review of its major components is necessary. A **sensing bulb** is connected to the TEV by a length of cap- illary tubing which transmits bulb pressure to the top of the valve's **diaphragm**. The sensing bulb, capillary tubing, and diaphragm assembly is referred to as the **thermostatic element**. The thermostatic element on all standards Sporlan
TEVs is replaceable. The diaphragm is the actuating member of the valve. Its motion is transmitted to the **pin** and **pin carrier** assembly by means of one or two **pushrods**, allowing the pin to move in and out of the valve **port**. The **superheat spring** is located under the pin carrier, and a **spring guide** sets it in place. On externally adjustable valves, an external **valve**
**Adjustment** permits the spring pressure to be altered. There are three fundamental pressures acting on the valve's diaphragm which affect its operation: sensing bulb pressure**P١**, equalizer pressure **P٢**, and equivalent spring pressure **P٣** (see Figure ١). The sensing bulb pressure is a function of the temperature of the **thermostatic charge**, i.e., the substance within the bulb. This pressure acts on the top of the valve diaphragm causing the valve to move to a more open position. The equalizer and spring pressures act together underneath the diaphragm causing the valve to move to a more closed position. During normal valve operation, the
sensing bulb pressure must equal the equalizer pressure plus the spring pressure, i.e.:
**P١ = P٢ + P٣**

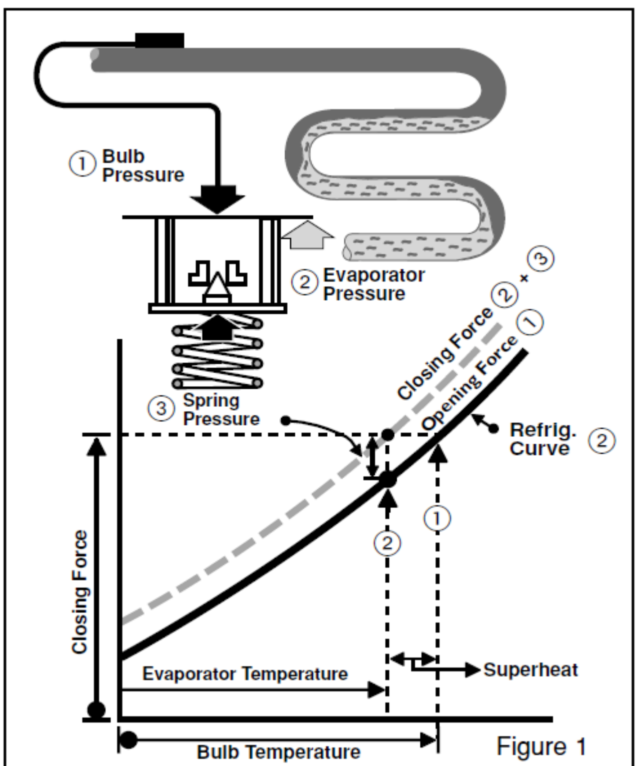


Figure 1

Equivalent spring pressure is defined as the spring force divided by the effective area of the diaphragm. The effective area of the diaphragm is simply the portion of the total diaphragm area which is effectively used by the bulb and equalizer pressures to provide their respective opening and closing forces. Equivalent spring pressure is essentially constant once the valve has been adjusted to the desired superheat. As a result, the TEV functions by controlling the difference between bulb and equalizer pressures by the amount of the spring pressure. The function of the sensing bulb is to sense the temperature of the refrigerant vapor as it leaves the evaporator. Ideally, the bulb temperature will exactly match the refrigerant vapor temperature. As the bulb temperature increases, bulb pressure also increases causing the valve pin to move away from the valve port, allowing more refrigerant to flow into the evaporator. The valve continues in this opening direction until the equalizer pressure increases sufficiently such that the sum of the equalizer and spring pressures balance with the bulb pressure. Conversely, as the bulb temperature decreases, the bulb pressure decreases causing the valve pin to move toward the valve port, allowing less refrigerant to flow into the evaporator. The valve continues to close until the equalizer pressure decreases sufficiently such that the sum of the equalizer and spring pressures balance with the bulb pressure. A change in refrigerant vapor temperature at the outlet of the evaporator is caused by one of two events: (١) the spring pressure is altered by means of the valve adjustment, and (٢) the heat load on the evaporator changes. When spring pressure is increased by turning the valve adjustment clockwise, refrigerant flow into the evaporator is decreased. Vapor temperature at the evaporator outlet increases since the point where the refrigerant completely vaporizes moves further back within the evaporator, leaving more evaporator surface area to heat the refrigerant in its vapor form. The actual refrigerant vapor and bulb temperature will be controlled at the point where bulb pressure balances with the sum of the equalizer and spring pressures. Conversely, decreasing spring pressure by turning the valve adjustment counterclockwise increases refrigerant flow into the evaporator and decreases refrigerant vapor and bulb temperature. Spring pressure determines the superheat at which the valve controls. Increasing spring pressure increases superheat, decreasing spring pressure decreases superheat. An increase in the heat load on the evaporator causes refrigerant to evaporate at a faster rate. As a result, the point of complete vaporization of the refrigerant flow is moved further back within the evaporator. Refrigerant vapor and bulb temperature increase, causing bulb pressure to rise and the valve to move in the opening direction until the three pressures are in balance. Conversely, a reduction in the heat load on the evaporator will cause the vapor and bulb temperature to fall and the valve to move in a closed direction until the three pressures are in balance. Unlike a change in the spring pressure due to valve adjustment, a change in the heat load on the evaporator does not appreciably affect the superheat at which the thermostatic expansion valve controls. This is due to the fact that the TEV is designed to maintain an essentially constant difference between bulb and equalizer pressures, thus controlling superheat regardless of the heat load.

## ٥-٢ Effect of Pressure Drop Across the Valve Port

An additional pressure affecting valve operation, which is not considered fundamental, arises from the actual pressure drop across the valve port. This pressure **P٤** can be related to the three fundamental pressures as the product of pressure drop across the valve port and the ratio of the port area to the effective area of the diaphragm, i.e.:

**P٤** = Pressure Drop x (Port Area / Effective Diaphragm Area)

With Sporlan's conventional TEV design, this pressure is an opening influence since refrigerant flow tends to move the valve in an opening direction. As a result, our original equation is modified as follows:
**P١ + P٤ = P٢ + P٣**
**P٤** becomes more significant to TEV operation the greater the port area to effective diaphragm area ratio, and the greater the pressure drop varies across the valve port.

## ٥-٣ Balanced Port TEVs

Sporran introduced the concept of the **balanced port** thermostatic expansion valve in ١٩٤٦ on large tonnage Types T and W valves. This concept provided the means to either largely reduce or eliminate the effect of pressure drop across the valve port. This design utilized a double seating piston operated by a single pushrod. The two port construction divided the refrigerant flow in opposite directions, thereby providing a semi balanced pressure differential across the piston. Improved balanced port designs resulted in a fully balanced Type O valve, and then the Types (E) BF, SBF, and EBS valves for smaller capacity applications. For additional information on the types and applications of balanced port
TEV

**٤-٥ Equalization Method**

The operation of the thermostatic expansion valve is determined by the relationship between three fundamental pressures: bulb pressure, equalizer pressure, and equivalent spring pressure. illustrated in Figure ١. The equalizer pressure is the evaporator pressure the valve senses. The means used to transmit this pressure from the refrigeration system to the underside of the valve diaphragm is referred to as the equalization method. Evaporator pressure is transmitted to the underside of the valve diaphragm by one of two methods. If the valve is **internally equalized**, the evaporator pressure at the valve outlet is transmitted to the diaphragm via a passageway within the valve body or through a clearance around the pushrods. If the valve is **externally equalized**, the underside of the valve diaphragm is isolated from the valve outlet pressure by the use of packing material around the pushrods or with pushrods which are closely fitted.
Evaporator pressure is transmitted to the diaphragm by a tube connecting the suction line near the evaporator outlet to an external fitting on the valve. The external fitting is connected to a passageway which leads to the underside of the valve diaphragm See Figure ٢.

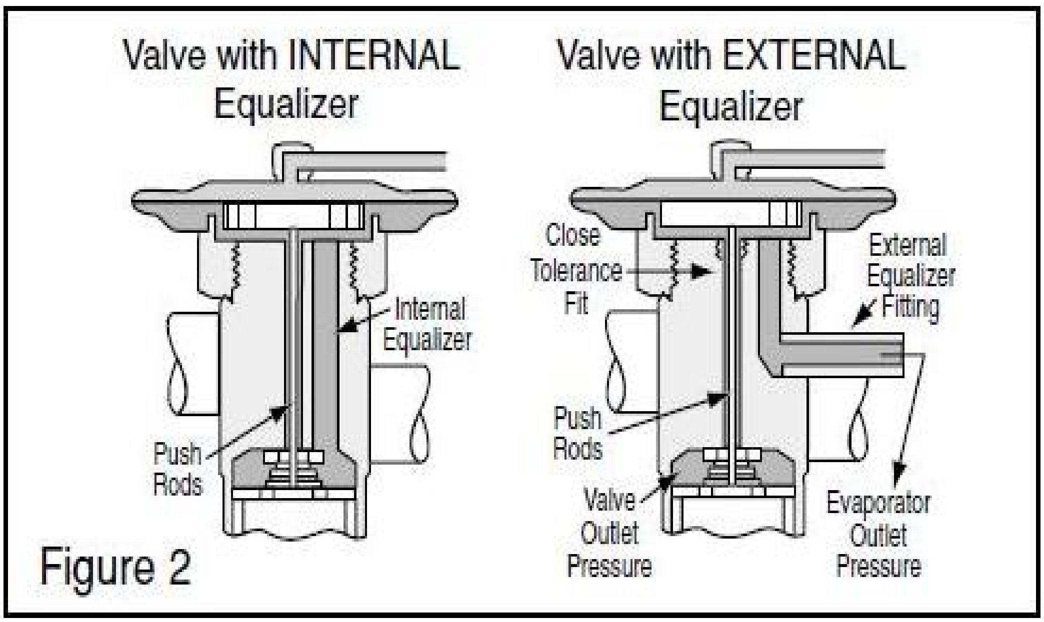


Figure 2

## ٥-٥ Thermostatic Charges

As previously mentioned, the TEV's sensing bulb transmits pressure to the top of the diaphragm by a length of capillary tubing. The **thermostatic charge** is the substance in the TEV's sensing bulb which responds to suction line temperature to create the bulb pressure, and it is designed to allow the TEV to operate at a satisfactory level of superheat over a specific range of evaporating temperatures. The subject of thermostatic charges is best approached by describing the categories into which charges are classified. These categories are the following:

١. Liquid Charge
٢. Gas Charge
٣. Liquid-Cross Charge
٤. Gas-Cross Charge
٥. Adsorption Charge

The conventional liquid charge consists of the same refrigerant in the thermostatic element that is used in the refrigeration system, while the liquid-cross charge consists of a refrigerant mixture. The term **cross charge** arises from the fact that the pressure-temperature characteristic of the refrigerant mixture used within the sensing bulb will cross the saturation curve of the system refrigerant at some point. Both the liquid and liquid-cross charges possess sufficient liquid such that the bulb, capillary tubing, and diaphragm chamber will contain some liquid under all temperature conditions. This characteristic prevents **charge migration** of the thermostatic charge away from the sensing bulb if the sensing bulb temperature becomes warmer than other parts of the thermostatic element. Charge migration will result in loss of valve control. An additional characteristic of these charges is their **lack of a maximum operating pressure (MOP)** feature. A thermostatic charge with an MOP feature causes the TEV to close above a predetermined evaporator pressure, thereby restricting flow to the evaporator and limiting the maximum evaporator pressure at which the system can operate. Similarly, the gas charge consists of the same refrigerant in the thermostatic element that is used in the refrigeration system, while the gas-cross charge consists of a refrigerant mixture. Unlike the liquid type charges, both gas charges are distinguished by having a vapor charge in the thermostatic element which condenses to a minute quantity of liquid when the TEV is in its normal operating range. This characteristic provides an MOP for the valve at the bulb temperature of which the liquid component of the charge becomes vapor. Above this bulb temperature, a temperature increase does
Not significantly increase thermostatic charge pressure, limiting the maximum evaporator pressure at which the system can operate. A disadvantage of this type of thermostatic charge is the possibility of charge migration. The adsorption charge consists of a noncondensable gas and an adsorbent material located in the sensing bulb. As the temperature of the bulb increases, gas is expelled (desorbed) from the adsorbent material increasing bulb pressure. Conversely, as the temperature of the bulb decreases, gas is adsorbed thus decreasing bulb pressure. Like the liquid and liquid-cross charges, the adsorption charge does not provide an MOP, and it will not migrate.

# ٦ - THERMOSTATIC EXPANSION VALVE APPLICATIONS

Due to its superior operating characteristics, the TEV is currently used on a wide variety of applications. These applications include both large and small capacity air conditioning and heat pump systems; commercial refrigeration systems including refrigerated display cases, ice cubers,
And soft drink dispensers; and low temperature refrigeration
systems. Most air conditioning and refrigeration systems use some
method of capacity reduction to match the capacity of the system to a reduced heat load condition, commonly referred to as partload operation. The simplest method of capacity reduction is cycling the compressor, usually in response to a thermostat. Other methods of capacity reduction include using compressors equipped with cylinder unloaders, bypassing hot gas, or some combination of the above. A discussion on these capacity reduction methods and their effect on TEV operation is presented later in this section. The thermostatic expansion valve is a modulating type flow control device with the capability to adjust to low load conditions and maintain reasonable refrigerant flow control. The range of effective TEV control, however, has limits and may not be capable of operating properly on a system requiring a high degree of capacity reduction. As a result, systems using capacity reduction methods require the use of proper design and installation practices.

## ٦-١ System Design Factors

Predicting TEV performance at reduced system capacities is difficult due to the many influencing design factors present in any system. These factors include: TEV sizing, refrigerant distribution, TEV setting, evaporator coil design, suction line piping, and bulb location. General recommendations which address these factors are provided below. By observing these recommendations, a conventional TEV can be expected to operate satisfactorily down to approximately ٣٥ percent of its rated capacity. The Types (E)BF, SBF, EBS, and O valves, featuring the balanced port design, can be expected to operate satisfactorily down to
Approximately ٢٥ percent of its rated capacity. Valve Size. The TEV should be sized as close as possible to the system's maximum designed heat load condition. A valve with a capacity rating up to ١٠ percent below the full load conditions may be selected if the system is to operate at reduced loads for long periods of time, and if slightly higher than normal
superheats can be tolerated at full load conditions. **Distributor Sizing .** The proper sizing of the distributor is extremely important for systems using methods of capacity reduction. The function of the refrigerant distributor is to evenly distribute refrigerant to a multi-circuited evaporator. If the distributor cannot perform its function at all load conditions erratic TEV operation can be expected. For the pressure drop type

distributor, the distributor nozzle and tubes must be checked for proper sizing at both minimum and maximum load conditions.

**Superheat Adjustment .** The superheat setting of the TEV Should be set at the highest possible superheat that can be tolerated at full load conditions. A high superheat setting will reduce problems associated with mild TEV hunting at low load conditions. High superheats are more acceptable on air conditioning systems where the wide temperature difference between the refrigerant and the air allows the TEV to operate at higher superheats without a significant loss in coil capacity.

**Evaporator Coil Design .** When the evaporator is circuited to provide counterflow of the refrigerant relative to the direction of the air flow, superheat will normally have theleast effect on evaporator capacity and suction pressure fluctuations will be minimized.Refrigerant velocity inside the evaporator should be high enough to prevent excessive trapping of liquid refrigerant and oil, which may cause TEV hunting. Multi-circuited coils should be designed in such a manner that each circuit is exposed to the same heat load. Air flow across the coil must be evenly distributed. Large capacity air conditioning evaporator coils are often split into multiple sections so that one or more of these sections can be shut off for capacity control during part-load operation. Therefore, a TEV is required to feed each of these sections. The methods used to split these coils are referred to as: **row split, face split,** and **interlaced**. Generally,
Manufacturers have tested and approved other methods of piping, these methods should be used when installing or servicing their systems.

**Sensing Bulb Location .** The TEV's sensing bulb should be located on a horizontal section of suction line near the evaporator outlet and, in the case of an externally equalized valve, upstream of the equalizer connection on the suction line

**Vapor Free Liquid Refrigerant.** Another important aspect in assuring proper TEV operation is providing vapor free liquid refrigerant to the inlet of the TEV. Vapor in the liquid line may severely reduce thecapacity of the TEV hindering
sized liquid-to-suction heat  Proper refrigerant flow to the evaporator. An adequately exchanger will help assure vapor free liquid by providing some amount of sub cooling to the liquid. In addition, the heat exchanger provides an added advantage to the system by vaporizing small quantities of liquid refrigerant in the suction line before the liquid reaches the
Compressor. A Sporlan See All Moisture-Liquid Indicator installed near the TEV inlet offers a visual check for vapor free refrigerant.

## ٦-٢ Balanced Port TEVs

One of the factors limiting a TEV's ability to operate at partload conditions is a variation in pressure drop across the TEV during normal system operation due to changes in head pressure, pressure drop across the TEV influences valve operation, particularly with the larger capacity valves which possess larger port areas. To counteract the effects of this force Sporlan has incorporated balanced port design features into selected valve types.

Sporlan introduced this feature in ١٩٤٦ using a double port construction on two large capacity valves: the Types T and W. The Type T valve later became our Type V valve when the valve design was modified. This double port construction features a piston which seats against two ports, and significantly reduces the effects of pressure drop across the valve.

The refrigerant flow entering these valve types is divided between the two ports, the force of the refrigerant flow being transmitted to the midsection of the piston. The force of the flow heading to the lower port is largely canceled out by the force of the flow heading to the upper port due to the design of the piston. A **semi-balanced** valve is achieved, allowing the valve to operate at a lower percentage of its rated capacity

Than a conventionally designed valve. Sporlan introduced a patented discharge bypass valve with a **fully balanced** design in ١٩٦٥, the Type ADRHE-٦. This design was later used with the Type O TEV, which was introduced in ١٩٧١. The Type O valve is designed to eliminate the effects of pressure drop across the valve. The Type O valve features a piston which seats against the valve's single port. See Figure ٣. A passageway drilled through the piston allows liquid line pressure to be transmitted to the bottom side of the piston. A synthetic cup seal encircling the piston traps this pressure underneath the piston, which causes the force due to the liquid line pressure on top of the piston to be canceled. Satisfactory operation down to ٢٥% or lower of rated capacity can be expected with the Type O valve provided that the aforementioned design

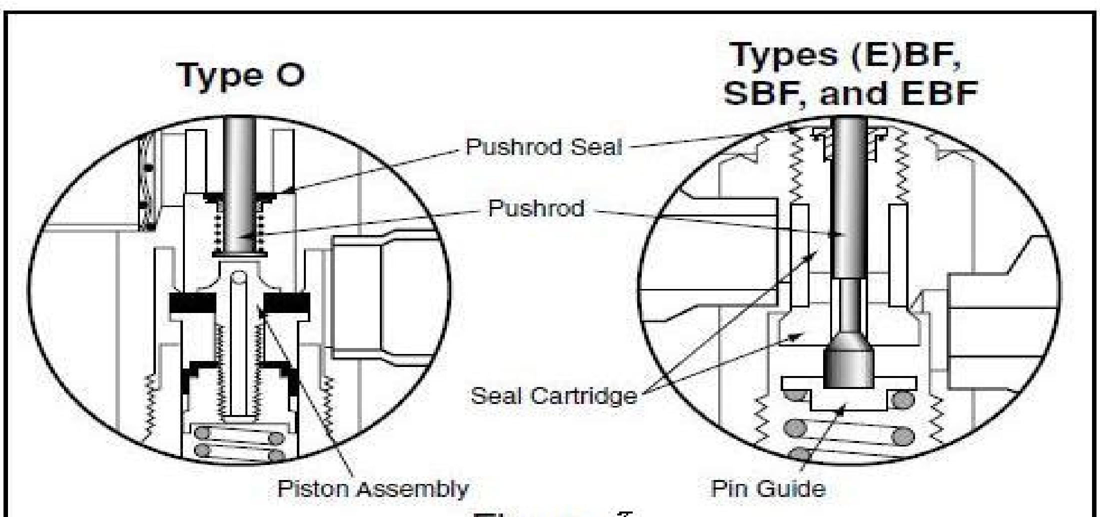
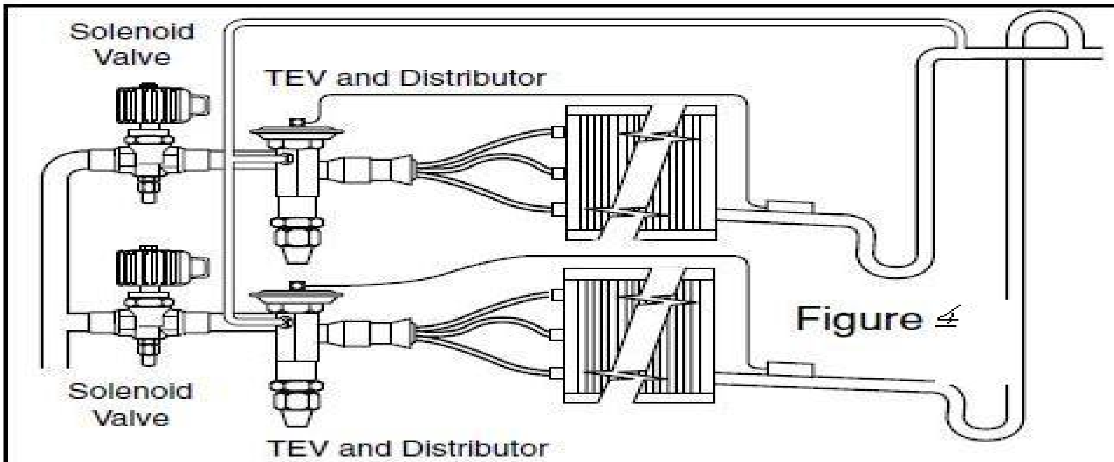


Figure ٣

Recommendations are followed. Recent efforts by system manufacturers to reduce operating costs of refrigeration systems by allowing condenser pressures to fall or float with lower ambient temperatures has created a need for a small capacity TEV with a balanced port design and superior modulating characteristics. This effort is particularly apparent with supermarket applications. Sporran introduced the Types (E) BF and EBS valves in ١٩٨٤ to meet this need. The Types (E) BF and EBS valves feature a single pushrod which extends through the port of the valve. See Figure ٣. The port and pushrod cross sectional areas are identical so
that the opening force created by pressure drop across the port is canceled by the pressure drop across the pushrod. Furthermore, excellent pin and port alignment is provided by this design. Refer to the section,

**٦-٣ System Design For Part-Load Conditions Two or More Evaporator Sections Handling the Same Load**

On systems where the compressor can unload to ٥٠ percent of its rated capacity, care must be exercised when selecting expansion valves and refrigerant distributors. If the compressor can unload below ٣٣ percent of its rated capacity, special design considerations may be necessary to assure proper TEV operation. Figures ٤, ٥ are piping schematics illustrating three possible methods of balancing the capacity of the TEV and distributor with the compressor during low load operation. Recognized piping references such as the equipment manufacturer's literature and the ASHRAE Handbooks should be consulted for further information on this subject. **Sporlan cannot be responsible For damages arising from improper piping practices or the improper use of its products**




**Capacity Reduction — 2 or more evaporator sections handling same load.**

**Two or More Evaporator Sections Handling the Same Load**

Figure ٤ illustrates two parallel evaporators each controlled

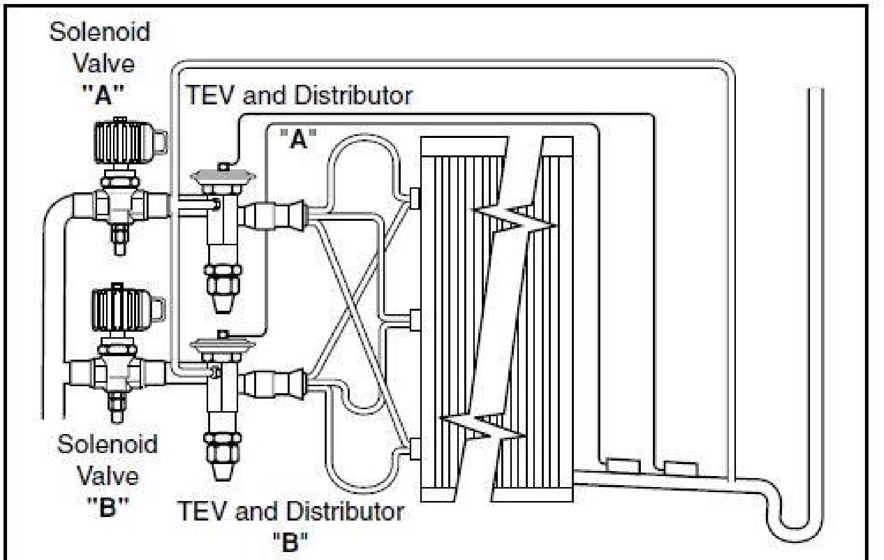
By a separate TEV and refrigerant distributor. Each vapor rator shares half of the total common load. The liquid line solenoid valve ahead of each TEV is electrically connected to
The compressor capacity modulating system. When the compressor capacity is reduced to ٥٠%, one of the two solenoid valves closes stopping refrigerant flow to one TEV. The TEV remaining in operation will then have a rated capacity approximately equal to the compressor capacity operating ٥٠% unloaded. This technique may be carried further by using additional evaporator sections, each controlled by a separate TEV and refrigerant distributor. Using multiple evaporator sections
Will let highly reduced loads to be properly controlled

## ٦-٤ Single Evaporator Controlled by Two TEVs

For evaporator coils which are not split by design, i.e., row split, face split, or interlaced, the following techniques may be employed to improve part-load operation. Figure ١٠ illustrates the use of two TEVs and two distributors feeding a single evaporator. Each evaporator circuit is
Fed by two distributor circuits, one from each distributor. The solenoid valves are connected to the compressor capacity modulating system as mentioned before. Using this configuration, TEV and distributor capacities can be reduced in three stages. As an example, assume that TEV and distributor combination **A** are sized to handle ٦٧% of the load and combination **B** ٣٣% of the load. The three stages of valve
And distributor capacity reduction result from opening or
Closing the solenoid valves according to the following table:

| Compressor Capacity<br>Percent of Full Capacity | Position of Solenoid Valve "A" | Position of Solenoid Valve "B" | Total Valve and Distributing Loading<br>Percent of Rated Capacity |
|---|---|---|---|
| 100% | Open | Open | 100% |
| 83% | | | 83% |
| 67% | | Closed | 100% |
| 50% | | | 75% |
| 33% | Closed | Open | 100% |
| 16% | | | 50% |

Another variation of this technique is to have each evaporator circuit fed by a single distributor circuit and size the TEVs and distributors on the expected load of the total number of circuits fed by each TEV. Reducing evaporate




**Capacity Reduction –** Single evaporator controlled with 2 TEVs and 2 Solenoid Valves.

Capacity is accomplished by closing a solenoid valve which deactivates the circuits being fed by the TEV and distributor downstream of the solenoid valve. This method of capacity control, however, requires a degree of care since the heat load on the evaporator circuits will be affected in the manner
In which circuits are deactivated

## ٦-٥ Hot Gas Bypass and Desuperheating TEVs

Systems which are required to operate at load conditions below the unloading capabilities of their compressors present an additional design problem. To balance the system under these conditions, bypassing a controlled amount of hot gas to the suction side of the system provides a practical solution. Bypassing hot gas is accomplished with a modulating
Control valve known as a **discharge bypass valve**. Sporlan manufactures a complete line of these valves. For details.
For close coupled systems, the preferred method of hot gas bypass is bypassing to the inlet of the evaporator. This method has three advantages: (١) the TEV will respond to the increased superheat of the vapor leaving the evaporator and will provide the liquid required for desuperheating; (٢) the evaporator serves as an excellent mixing chamber for the bypassed hot gas and the liquid vapor mixture from the TEV; and (٣) oil return from the evaporator is improved since the refrigerant velocity in the evaporator is kept high by the hot gas.

## ٦-٦ Off-Cycle Pressure Equalization

Certain applications utilizing low starting torque single phase compressor motors (e.g., a permanent split capacitor motor) require some means of pressure equalization during system offcycle. Pressure equalization is necessary since low starting torque compressors are not capable of restarting against a large pressure differential. Typical applications
requiring pressure equalization are small air conditioning and heat pump systems which frequently cycle on and off in response to a thermostat

## ٦-٧ R-٧١٧ (Ammonia) Applications

Thermostatic expansion valves for ammonia applications require special design considerations due to the erosive effects of ammonia vapor. For this type of application, Sporlan has developed the Types D and A thermostatic expansion valves. Like other components of any ammonia System, the Types D and A valves are made from steel and steel alloys.
With ammonia systems, the formation of flash vapor at the expansion valve port causes valve seat erosion or wire drawing to occur. This effect is further aggravated by high velocity ammonia mixed with dirt or scale passing through the port of the expansion valve. Fortunately, seat erosion can be minimized and valve life extended if the following steps are
taken:
١. Maintain vapor-free liquid at the TEV inlet at all times.
٢. Maintain clean ammonia through effective filtration.
٣. Reduce the velocity of the ammonia through the TEV
port by reducing the pressure drop across the port.

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