Introduction to Control Valves

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Introduction to Control Valves

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There are many different types of final control elements that are used to manipulate or control the flow of fluids. These elements can take the form of metering pumps, dampers or louvers, variable pitch fan blades, or even speed regulators for engines, but the most often used final control element is the control valve. A control valve acts as a variable resistance in a pipeline and provides a pressure drop, often referred to as throttling.

Throughout their functional life, most control valves will be a certain percentage open for the purpose of throttling. However, there are occasions when the flow has to stop; therefore, a control valve must also be able to achieve a tight shut-off condition.

It should be noted now that subject of control valves and flowing fluid behavior has become a science within itself. There have been many books compiled by valve manufacturers and independent publishers alike that cover all aspects of valve construction, valve characteristics, fluid behavior, valve sizing, valve noise, and so on. This course is simply an introduction to the subject.

Despite its wide use, there is probably no other element in a system that receives more abuse and less attention than a control valve.

In most control systems, a control valve is subjected to more severe conditions of temperature, pressure, corrosion, and contamination than other components, yet it still must perform satisfactorily with a minimum amount of maintenance as it manipulates the flow of process fluids.

The next page figure shows a typical pattern of a pneumatically operated valve. Note that the control valve consists of two major components; the valve body assembly and the actuator. This style of valve falls into the category of sliding-stem valves. (The other group of valves is rotary shaft valves.

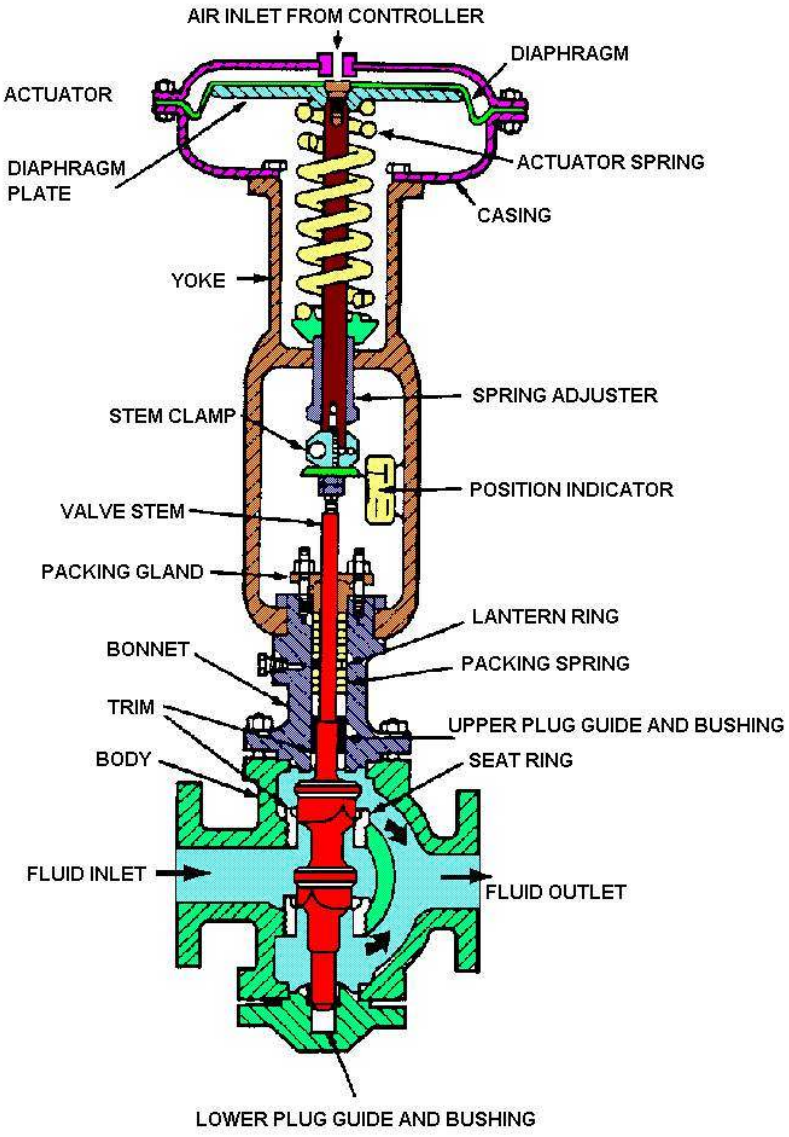


Figure 1 Typical control valve

Its operation is relatively simple. Air pressure is applied to the top of the flexible diaphragm and exerts a downward force. The force moves the valve stem downwards against the restraining action of the spring. This downward movement will continue until either the plug is fully mated with the seat or until the upward force of the spring (and flowing fluid pressure if the valve is in service) equals the downward force of the actuator. At this point, the valve stem stops moving.

Control Valve Terminology

Control valve terminology is quite extensive and can best be learned from manufacturers' handbooks and catalogs. However, the following paragraphs should be sufficient to give the reader some of the basic terms.

Valve Body

The part of the valve that connects to the process piping and through which the flowing fluid passes is called the valve body. The valve body must be able to withstand the same pressures and temperatures as the process piping. Small valves are connected to the piping by means of screwed threads, whereas larger valves are connected to the piping by means of flanges and welded end connections. Whatever the method of connection, these joints should be leak-free, and the valve positioned so that it is easily accessible for maintenance purposes.

Bonnet

The bonnet assembly is a metal casing that is threaded or bolted to the top of the valve body. It serves as a guide for the plug stem, houses the stem seal, and supports the actuator assembly. For extreme temperature service, extension or longer bonnets are used to prevent extreme temperatures from damaging the sealing materials. Valves in very hot service have cooling fins attached to the bonnet.

Packing Box Assembly

This is part of the bonnet assembly and is used to help prevent leakage around the valve plug stem. It allows the valve stem to move up and down with minimal leakage of the process fluid.

All other valve connections and valve bodies to process pipework are fixed or non-moving and are, therefore, easily gasketed. The valve stem, however, must move up and down. Packing rings within the packing box seal in the process fluid whilst allowing the valve stem to move with the minimum of friction. The packing rings themselves are usually made from a relatively soft and compressible material such as asbestos, Teflon, etc.

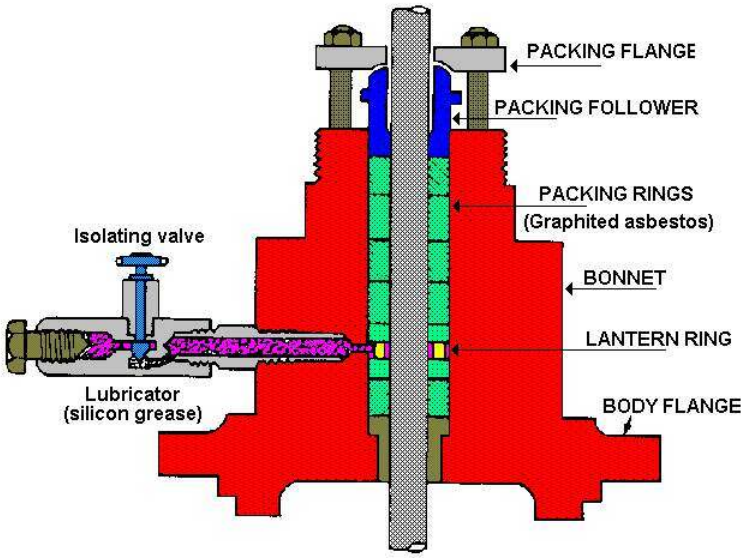


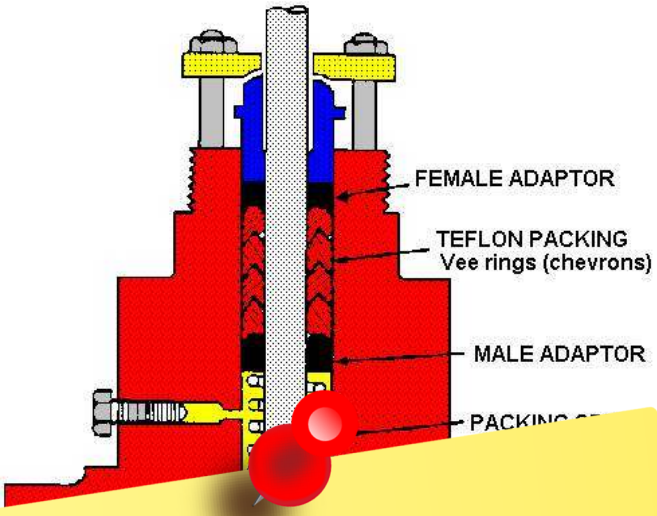
Figure 2 - Typical packing box

The function of the packing or pressure gland or flange is to compress the packing rings tightly around the valve stem, forming a leak-proof seal. However, in normal operation of the control valve, it is not unusual to see some fluid leakage around the valve stem. With regular maintenance, the packing gland nuts can be adjusted to the correct pressure. Just tight enough to minimize leakage, but not so tight so as to cause stem binding.

Valve Trim

In general terms, valve trim refers to the plug seat arrangement, but in a broader sense, trim refers to all those internal parts of the valve that come into contact with the process fluid. This would include the valve stem, valve plug (a device connected to the valve stem that controls fluid flow), seat ring (a ring that forms the valve body port), valve guides, and bushings (metal inserts that fit into the valve body and guide the moving parts), but excluding the valve body or bonnet assembly.

Valve manufacturers often provide different sets of *trim*, which can be fitted within a specific valve body. This enables a valve's characteristics to be changed without replacing the whole valve.



Yoke

The yoke is the upp ase assembly. It is rigidly fixed to the v e provides access to the spring tension ad t the yoke must be strong enough to with ition the valve stem. Salt-water corro fficiently to cause the yoke to snap or bre

Actuator

There are many different ators (sometimes referred to as motor elements) used in industrial facilities. The type of actuator used in a specific plant application depends on many factors, including the process to be controlled, the action that is to be performed, and the speed with which the action must occur. There are electrical and hydraulic actuators, but the spring and diaphragm actuator is by far the most common type of actuator used in automatic process control systems. Pneumatic actuators use air or gas pressure to produce mechanical motion. The motion produced is then used to position the controlling element anywhere within the actuator's limits of travel.