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Selection of Control Valves

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This guide is intended to help you understand the complex topic of control valves in HVAC systems, how they work and some basics on how to size and select the right valve.

Ball Valves

Butterfly Valves

Globe Valves

Magnetic Valves

Pressure Independant Control Valves

Zone Valves

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Valve components

An HVAC valve assembly has two major components: **the valve body and the valve actuator.**

Actuator

The actuator is the “engine” that powers the valve. The valve actuator is responsible for receiving a control signal, and moving the components in the valve body to the position required by the controller.

Valve

The valve body is the outer housing and components through which the fluid we control will flow.

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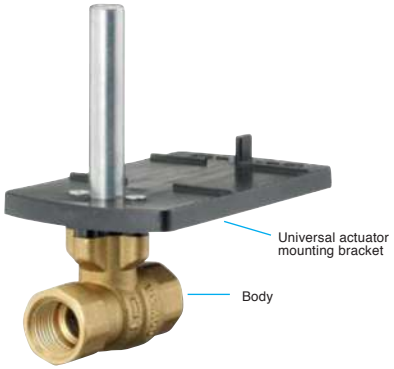
Valve components



Ball Valve

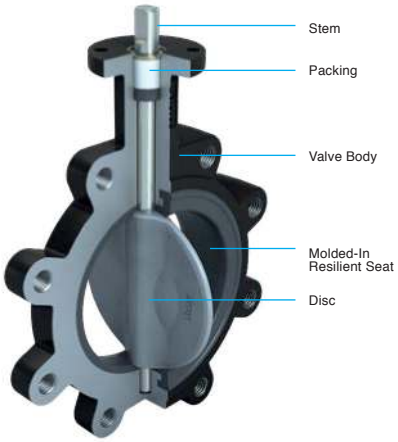
Ball = trim component that varies the area of the flow within the valve body.

Ball seals = outside, on either side of the ball, to prevent let-by.

Flow characteriser or integral flow insert = provides ball valves with their flow characteristic.

Stem and packing = are at the top. Connects the valve to the actuator and prevents leakage around the stem.

Mounting bracket = where the actuator gets mounted to the valves.



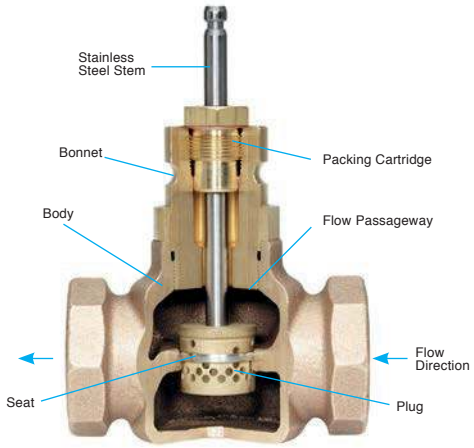
Butterfly Valve

Valve body = contains the plate at the top, which is also used for mounting the actuator. The most common type of butterfly valve is the lug type, which is the valve type pictured.

Stem = connects the actuator to the valve.

Disc = component which makes contact around the resilient seat. The position of the disc, controls the amount of flow, and closes into the seat to provide close off.

Seat = provides a surface for the plug to seal and stop flow.



Globe Valve

Bonnet = top of the globe valve which contains the packing and is where the actuator attaches to the valve plug.

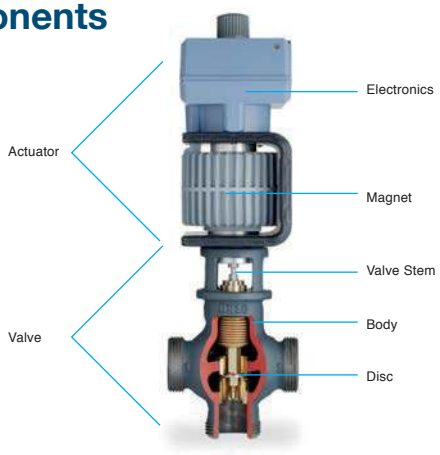
Packing cartridge = prevents leakage around the stem.

Trim = refers to the material of the plug and the seat components.

Plug = varies the area of flow within the valve body, and determines the flow characteristic of the valve.

Seat = provides a surface for the plug to seal and stop the flow.

Valve components

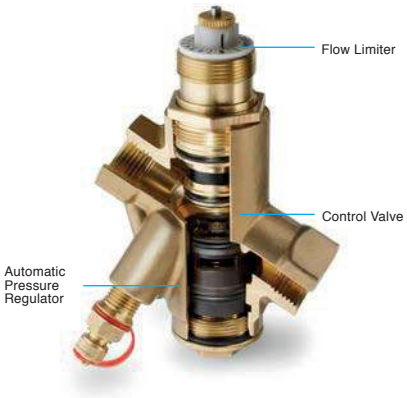


Magnetic Valve

Magnetic valves have two components, the actuator and the valve.

Actuator = composed of the electronics, is where the actuator receives power, and the control signal to determine the electrical signal required by the magnet to move the stem to the correct position.

Valve = has the stem that connects the actuator to the valve disc. The disc varies the area of flow through the valve body.

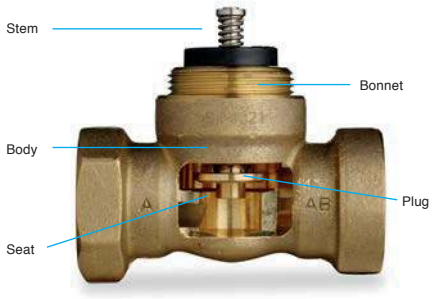


Pressure Independent Control Valve (PICV)

Flow limiter = the maximum flow allowed through the valve is determined by the flow limiter, and is adjustable in the field by hand.

Control valve = is composed of a plug, stem and seat. It's used to vary the flow through the valve based on the load or demand.

Automatic pressure regulator = makes the PICV pressure independent and dynamically adjusts an orifice in response to pressure changes to maintain the desired flow.



Zone Valve

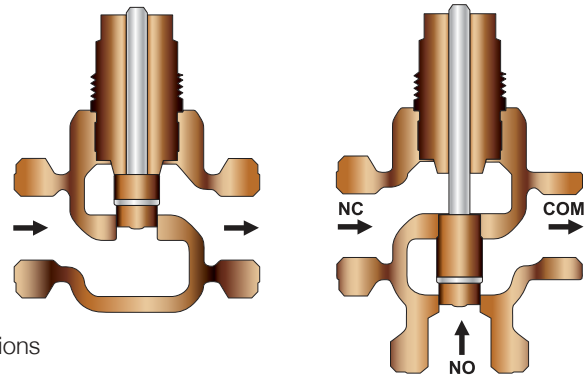
Stem = connects the valve actuator to the valve plug.

Bonnet = contains the packing, and attaches the valve to the actuator.

Plug = varies the area of flow through the valve body.

Seat = provides a surface for the plug to seal and stop the flow.

How valves work



Number of openings in a valve

- **2-way** for water/steam
- **3-way** for water only

A two-way valve can be either normally open, or normally closed.
Three-way valves can be mixing, (or less commonly diverting).
Smaller three-way valves may feature 4-ports to aid pipework connections

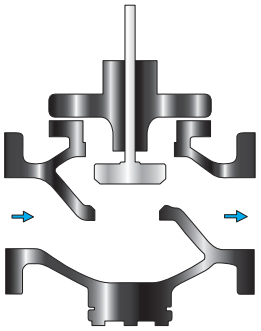
NC: Normally Closed **NO:** Normally Open **COM:** Common Port

Position of valve upon power failure when using a fail-safe actuator

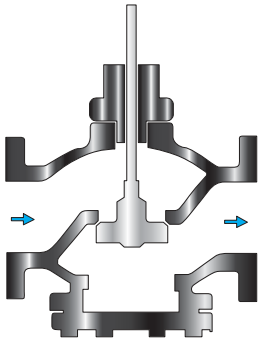
Normally Open (NO): Stem up to open
Normally Closed (NC): Stem up to close

For mixing the stem up position will usually open the bypass port (AB-B).

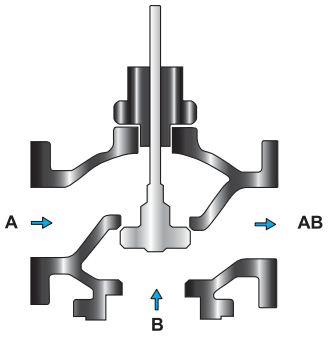
Normally Open



Normally Closed



Mixing



Valve action describes whether the valve is NO or NC upon power failure. The normal position is the flow position that the valve will be positioned when a fail-safe actuator is connected to the valve or the position of the valve when zero volts is applied to a modulating actuator.

A 2-way valve body can be either stem-up-to open, which is NO, or stem-up-to-close, which is NC. For example, for steam, you'd always want the valve to be NC or to fail closed, not open.

In the image above on the left, a normally open valve stem up is open, and on the right in the stem up position it is normally closed. This also is where the valve will fail, if it's on power failure with a fail safe actuator.

Mixing Valves – Mixing valves have two inputs and one output. The plug closes against the flow, either against A or against B.

Diverting Valves – Diverting means there is one input and two outputs, diverting the input to one or both of the outputs. These are less common in HVAC applications.

Although mixing and diverting valves look similar from the outside, they have very different trim assemblies and their applications are not interchangeable by re-piping in the field.

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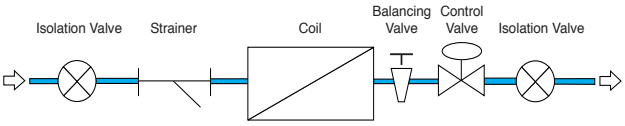
How valves work

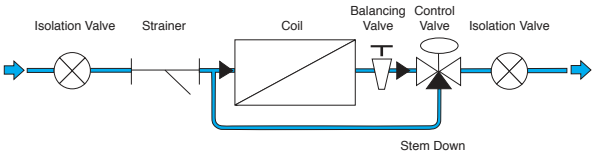
2-Way piping

The heating/cooling coil (for air/water heat exchange) and a balancing valve equalizes the water flow through the various branches of the system. The control valve and actuator regulate flow through the coil. This arrangement is called a throttling circuit and the control valve causes a variable flow to match the required load.



3-Way piping

Mixing Valve – This arrangement allows for a constant water flow through the system. The valve is modulating, and determines how much water is flowing through the coil, and how much water is bypassing the coil. The flow is constant.



Sizing and selection basics

Steps in selecting valve assembly

1. Determine valve type
2. Determine medium being controlled
3. Calculate/find the Cv or flow coefficient. In the case of a PICV, determine the flow that is needed through the valve.
4. Determine close-off psi to select the actuator

Control valves are ‘sized’ so that their duty matches the load and control authority is achieved. The valve flow characteristic describes the relationship between valve opening and water flow volume. This enables a more linear heat transfer when properly matched to the load. Static pressure, close-off pressure, rangeability and let-by are factors to be considered.

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Valve type by application

This application matrix identifies which type of valve is generally used in each application.

	Fan Coil Unit	Unit Ventilators	Variable Air Volume Unit	Air Handling Unit	Critical Environments	Campus Distribution	Boiler Plant	Chiller Plant	Cooling Tower
Ball	•	•	•	•					
Butterfly						•	•	•	•
Globe	•	•	•	•	•	•	•	•	
Magnetic					•				
PICV	•	•	•	•	•	•	•	•	
Zone	•	•							