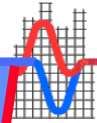


Existing Building Commissioning (EBCx)

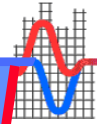


Workshop Series 2019-2020
Class 10

Lab:

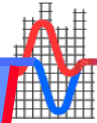
**Hydronic Valve
Types & Properties**

Lab Overview



- Valve functions
- Types of valves commonly used in buildings
- Valve components
- Valve selection
- Summary

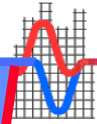
Valve Functions



What roles do valves play in hydronic systems?



Valve Functions

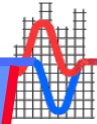


What roles do valves play in hydronic systems?

- Start or stop flow; i.e., 2-position
- Regulate or throttle flow; i.e., modulating
- Balance flow
- Prevent reverse flow; e.g., check valve
- Change flow direction; e.g., diverting
- Limit system pressure; e.g., PRV

In hydronic systems, a valve is any device that regulates or stops the flow of water.

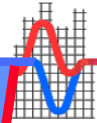
Valves in Building Mechanical Systems



What building systems include hydronic valves?

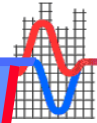
- Chilled water
- Heating hot water
- Steam and steam condensate
- Domestic hot water
- Domestic cold water
- Industrial water (e.g., DI and RO water)
- Grey water
- Wastewater

Common Valve Types



- Ball Valve
- Butterfly Valve
- Gate Valve
- Plug Valve
- Globe Valve
- Check Valve
- Pressure Reducing Valve
- Flow Balancing Valve
- Flow Control Valve
- Other

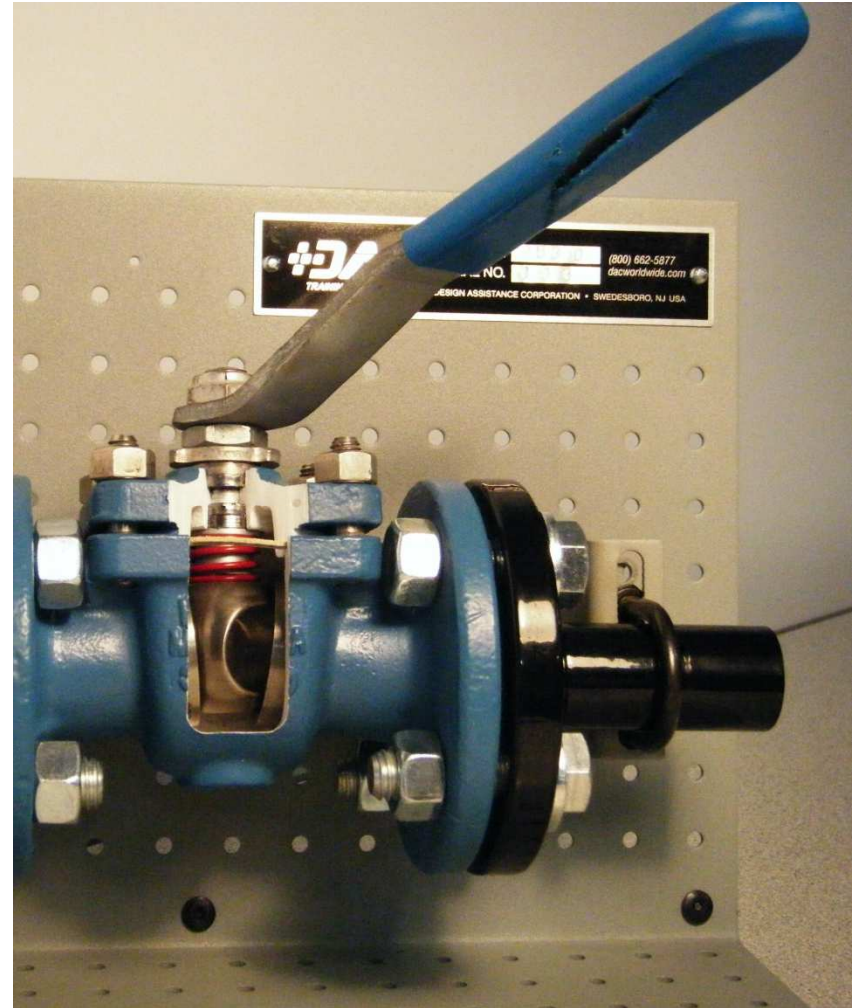
Ball Valve



Ported ball regulates flow through the valve.

Turning the handle 90° moves the valve from open to closed.

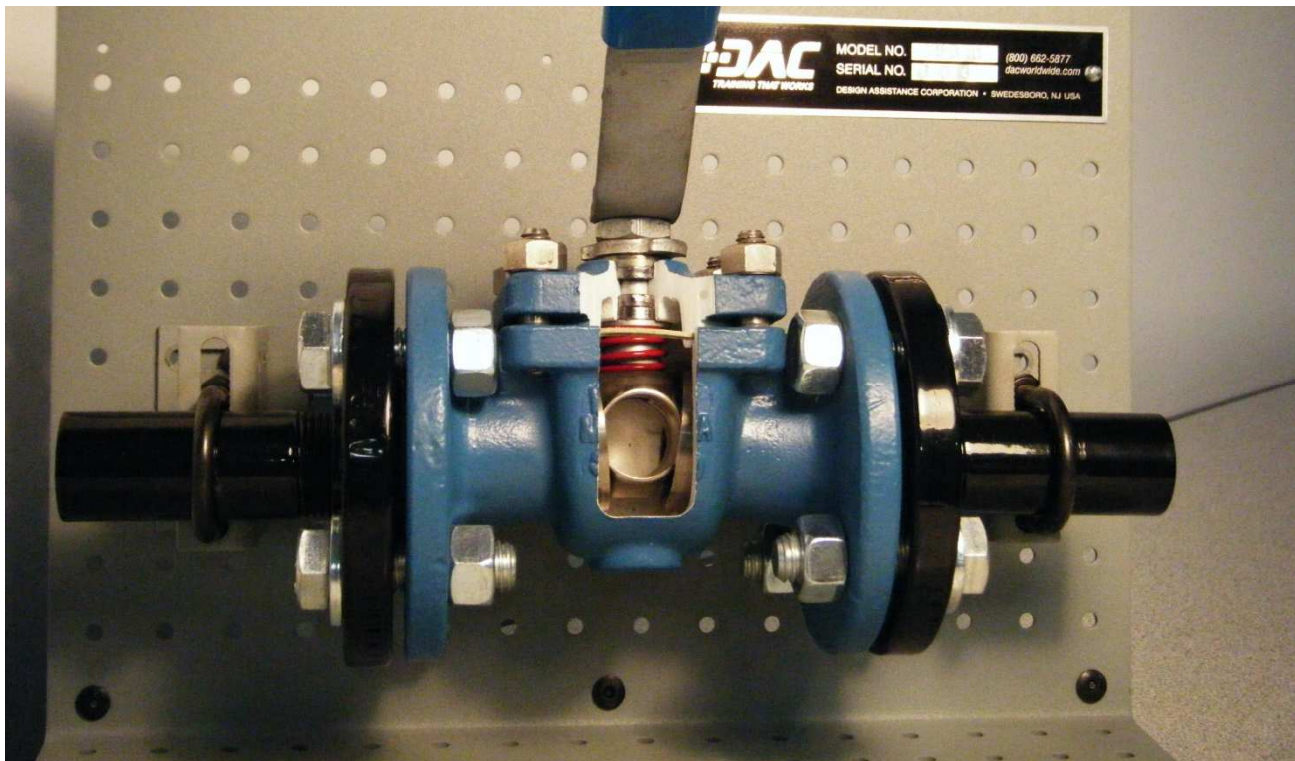
[Video of Ball Valve.MP4](#)



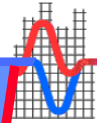
Ball Valve (cont'd)

Common uses?

- Manual isolation in small pipe sizes; e.g., 2" and under
- Modulation with 90° actuators; usually with ported ball



Butterfly Valve



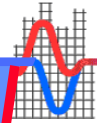
Rotating disk regulates flow through the valve.

Turning the handle 90° moves the valve from open to closed.

[Video of Butterfly Valve.MP4](#)

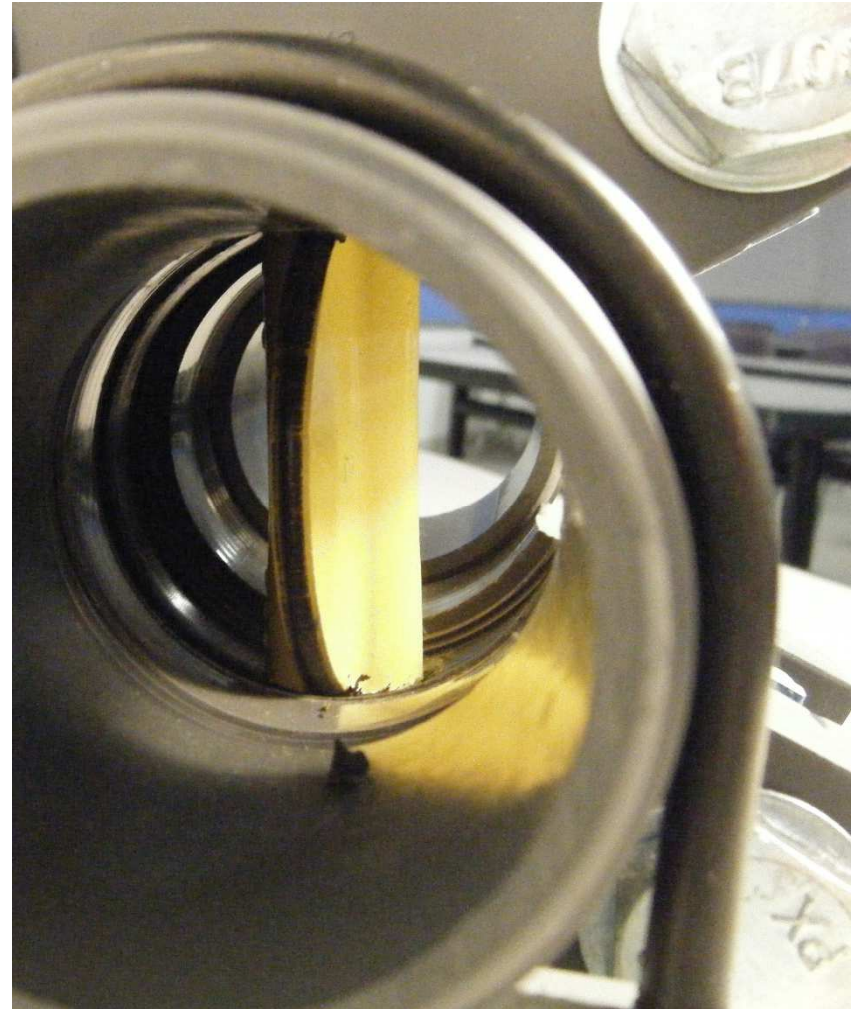


Butterfly Valve (cont'd)

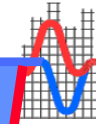


Common uses?

- When a compact installation is needed
- Modulation with 90° actuators

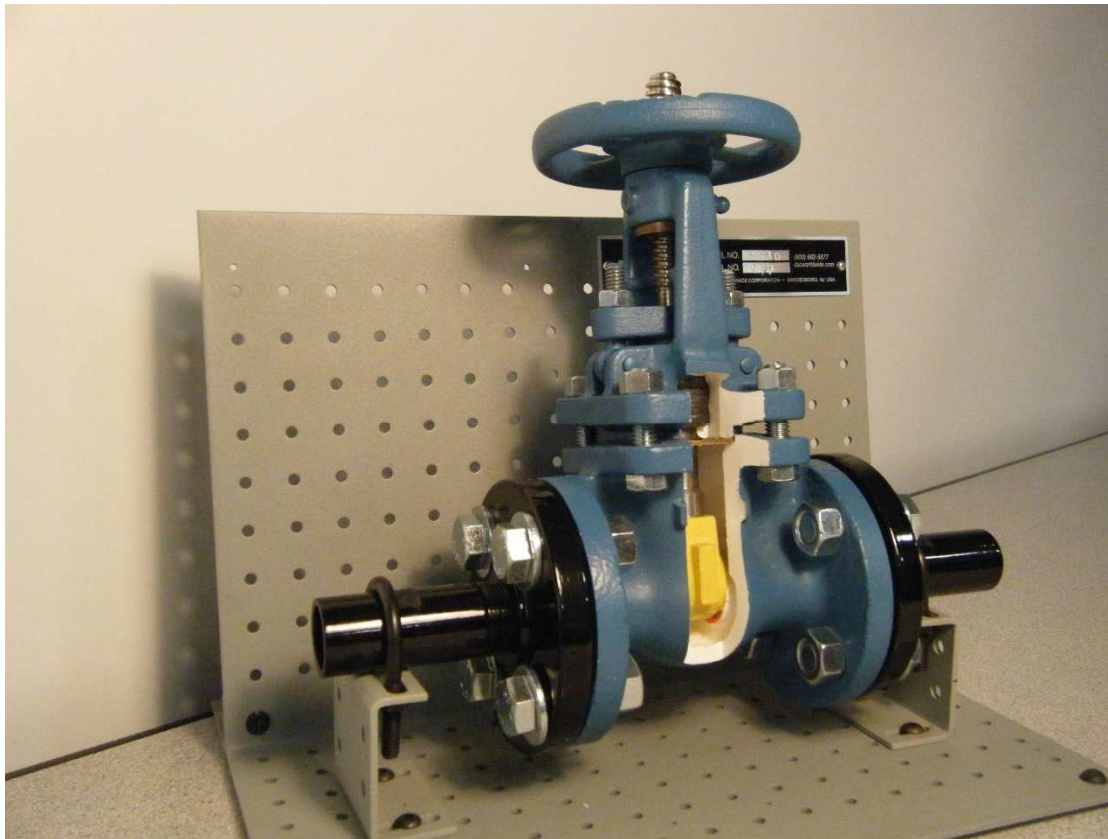


Gate Valve

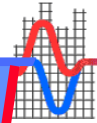


Wedge or disk moves between machined surfaces perpendicular to the water flow path.

[Video_of_Gate_Valve.MP4](#)

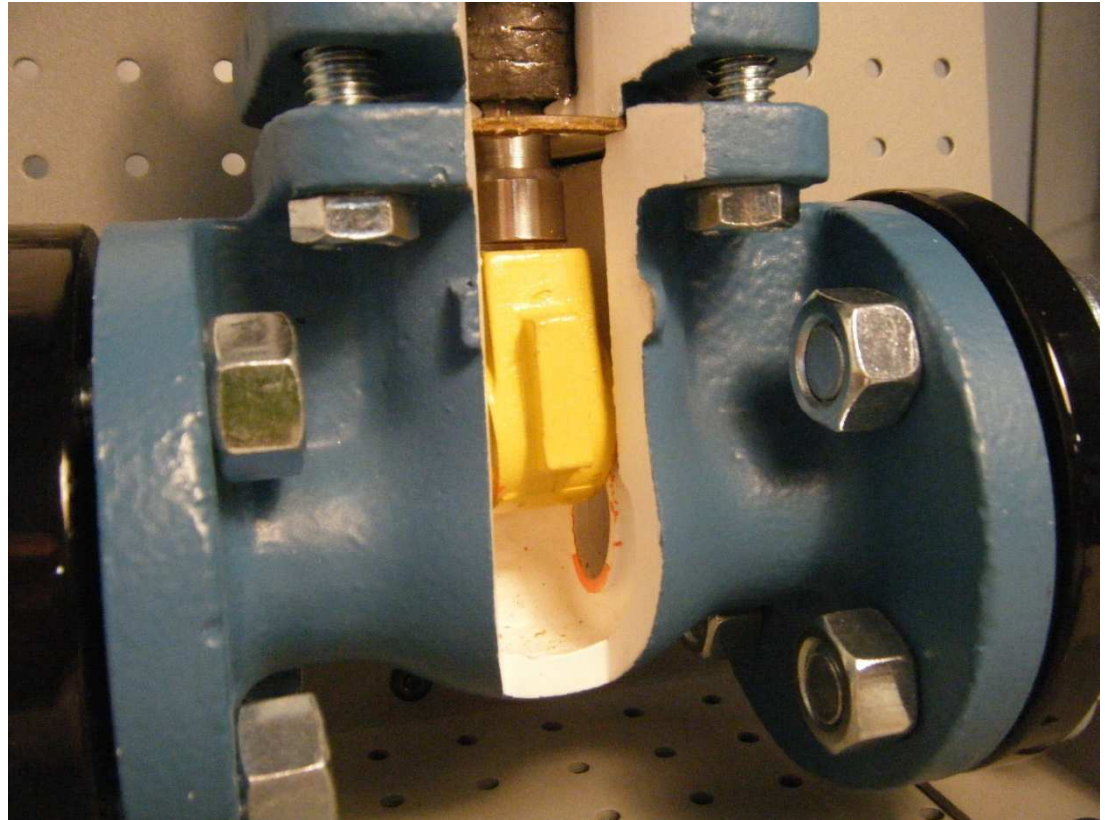


Gate Valve (cont'd)

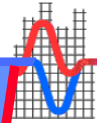


Common use?

- ▣ Shut off flow

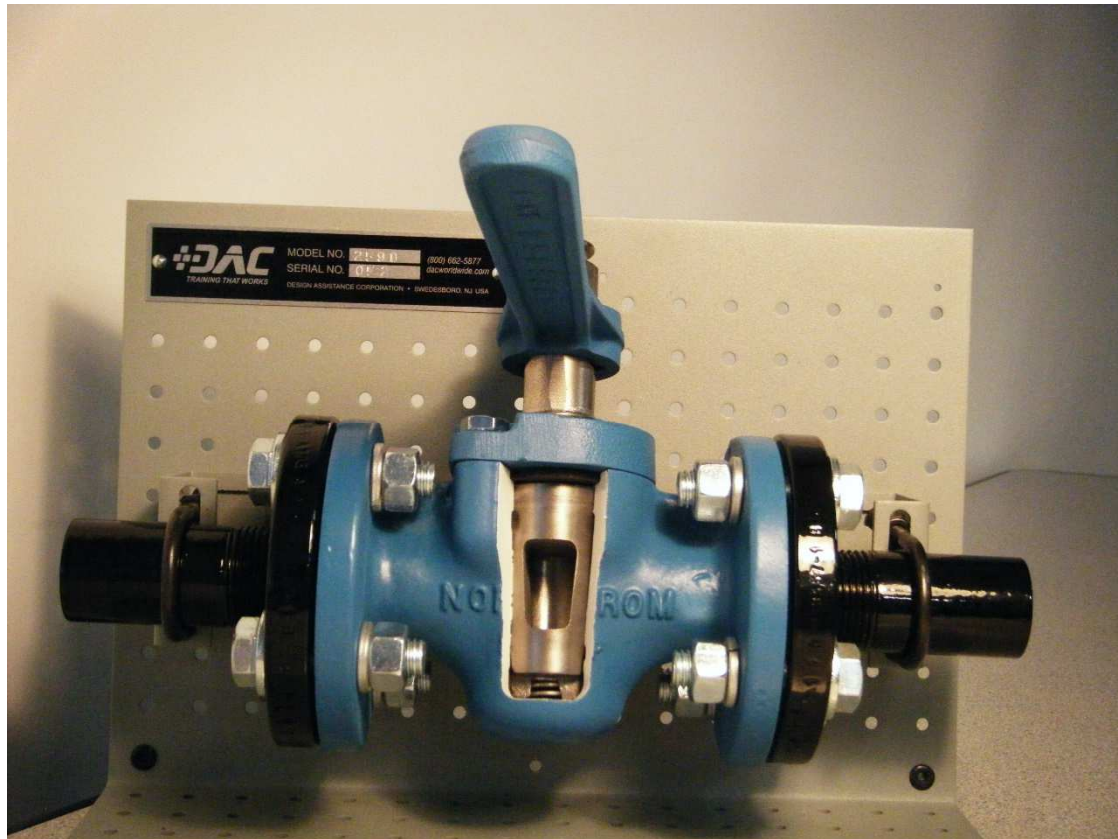


Plug Valve

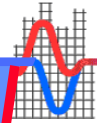


Ported plug turns 90° to control flow.

[Video of Plug Valve.MP4](#)

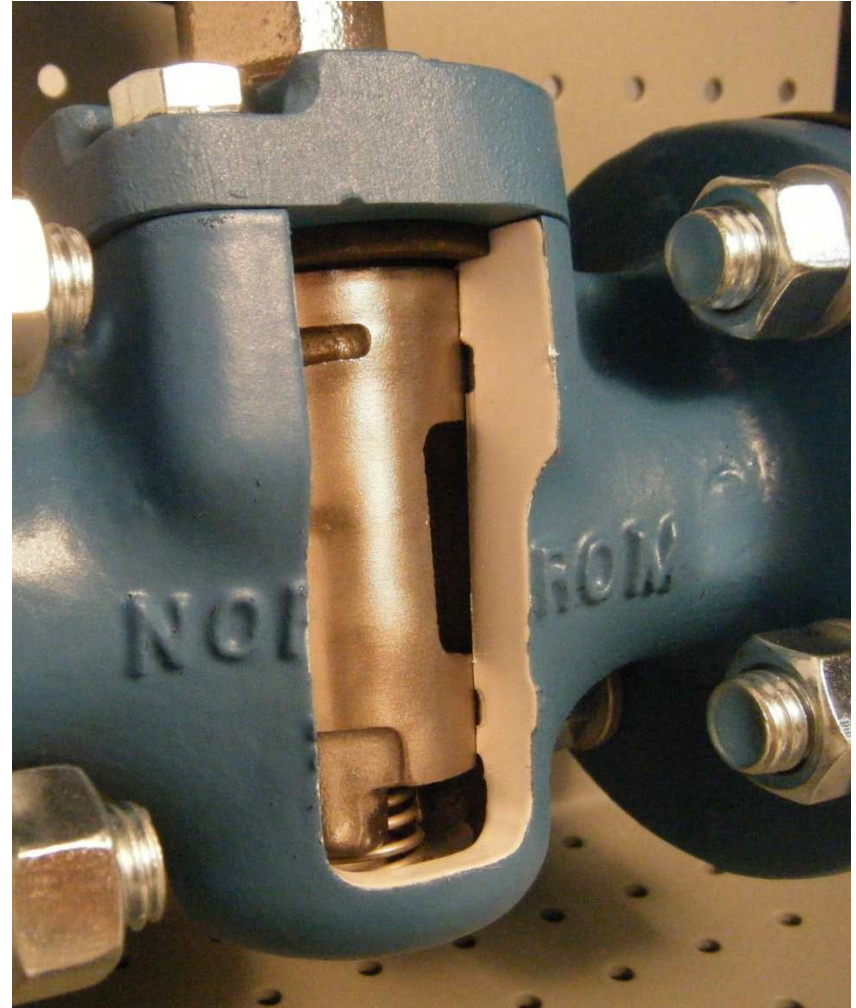


Plug Valve (cont'd)

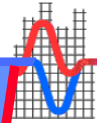


Common use?

- ❑ Shut off flow
- ❑ Modulate flow with custom orifice
- ❑ Gas shutoff with lubricated plug



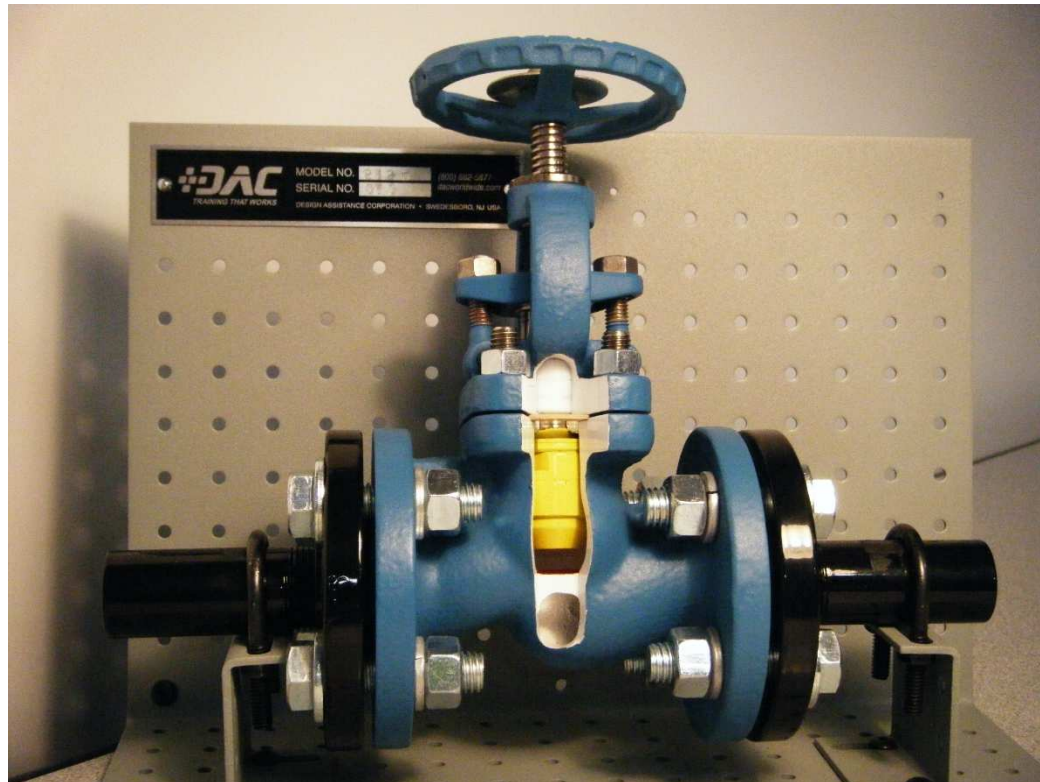
Globe Valve



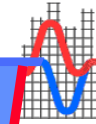
Circular disk, or globe, moves perpendicular to flow.

Disk seats in an annular ring.

[Video of Globe Valve.MP4](#)



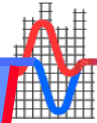
Globe Valve (cont'd)



Seating ring

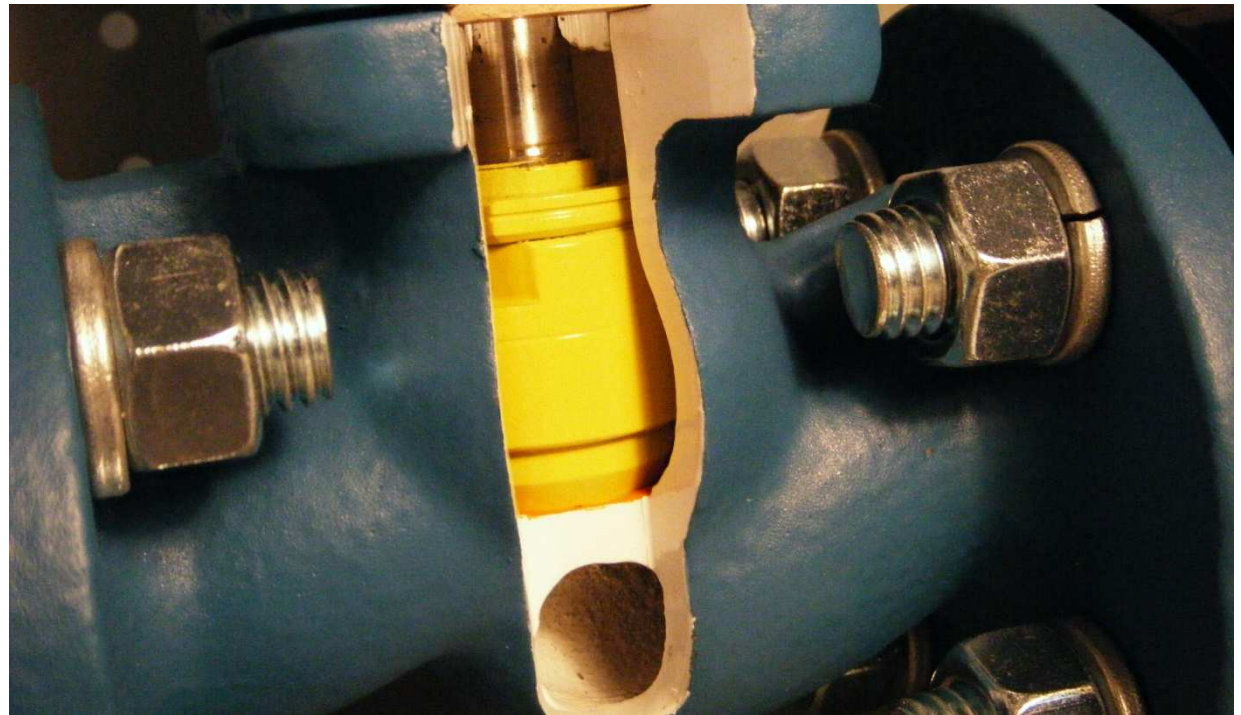


Globe Valve (cont'd)

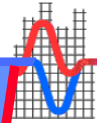


Common uses?

- Small diameter pipes
- Modulate flow
- Shut off flow

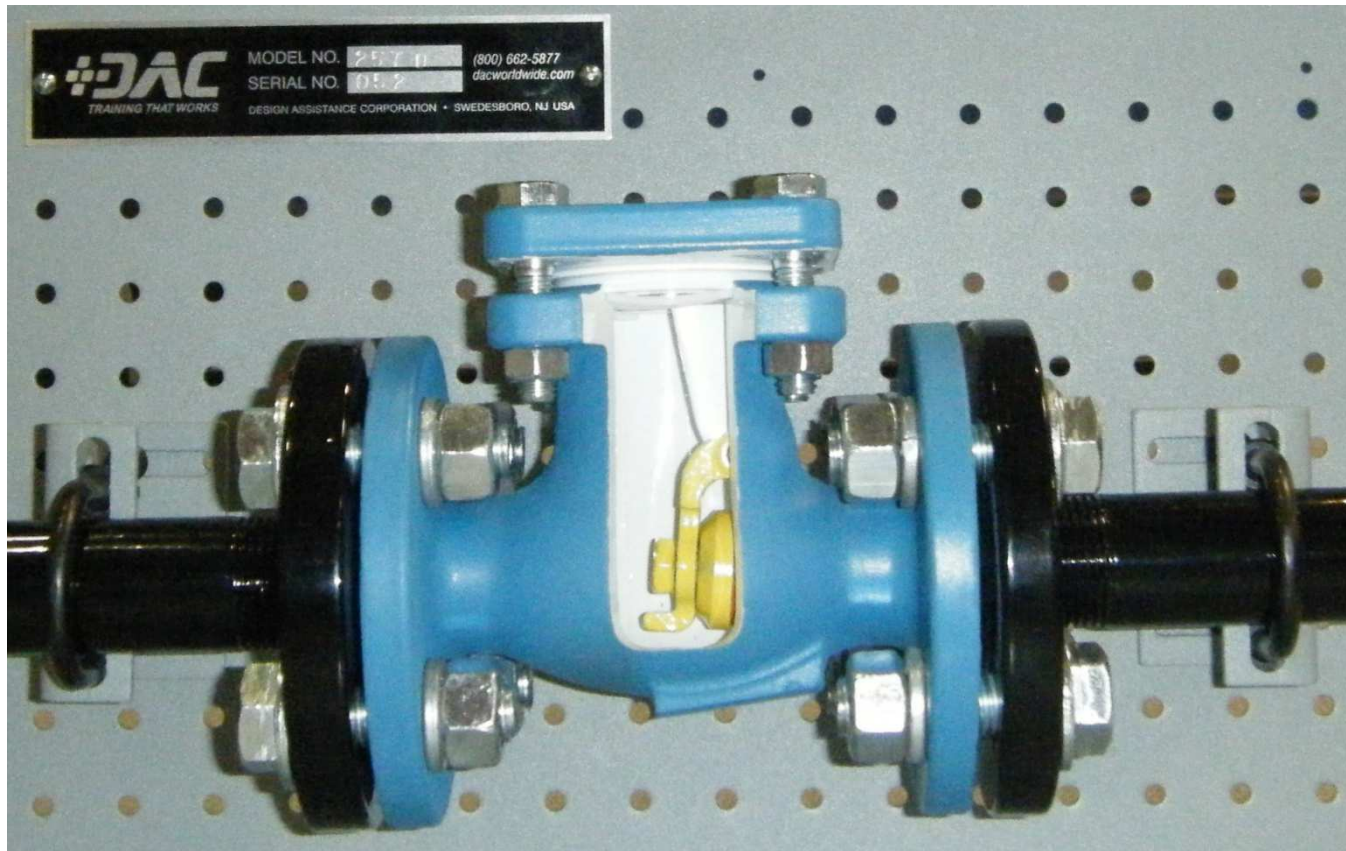


Check Valve



Swing check type uses disk to stop backflow

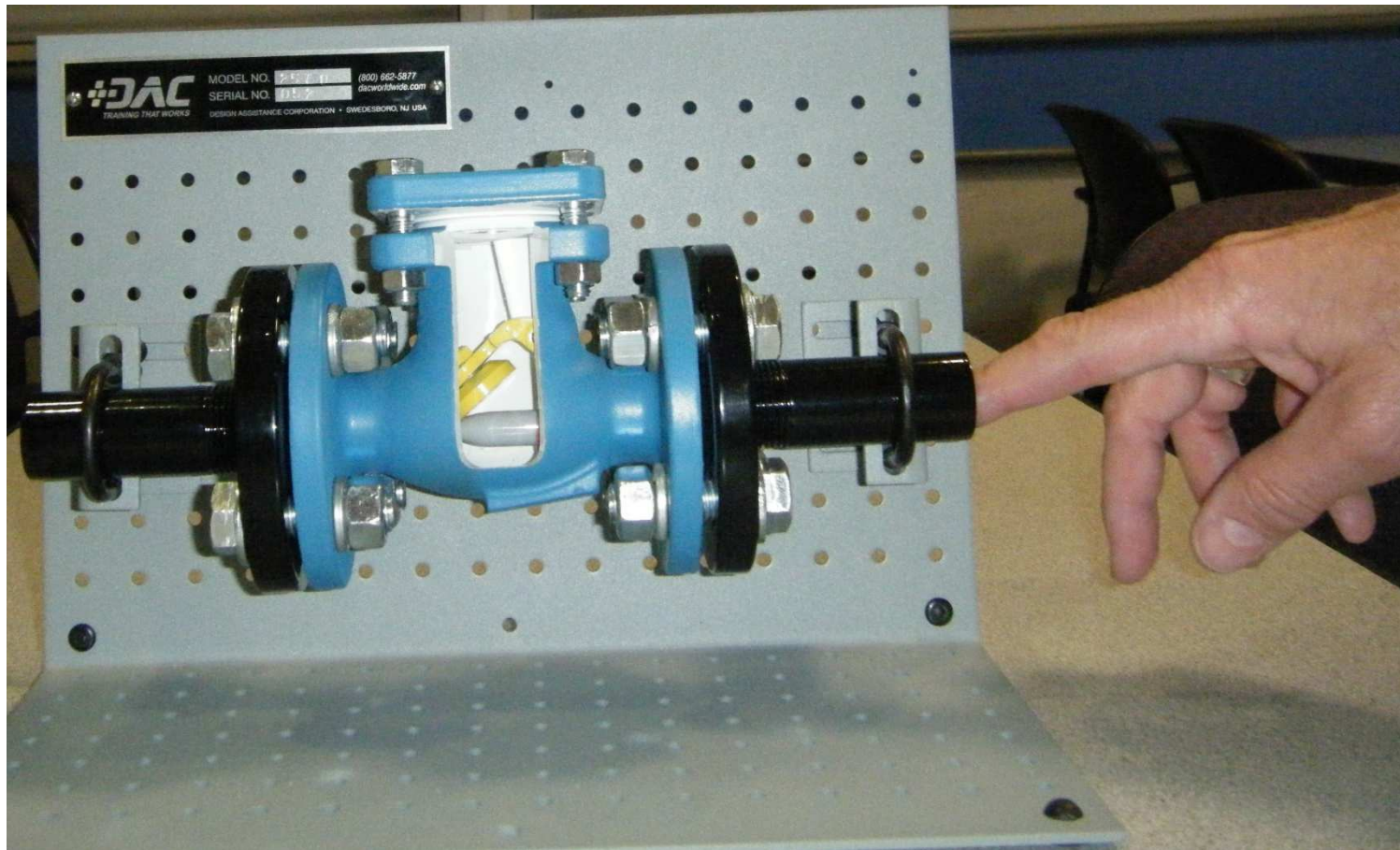
Can also a ball or wafer (similar to butterfly disk)



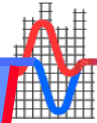
Check Valve (cont'd)



Swing check disk in action



Check Valve (cont'd)

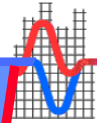


Common uses?

- Discharge line of parallel pumps
- Backflow preventers

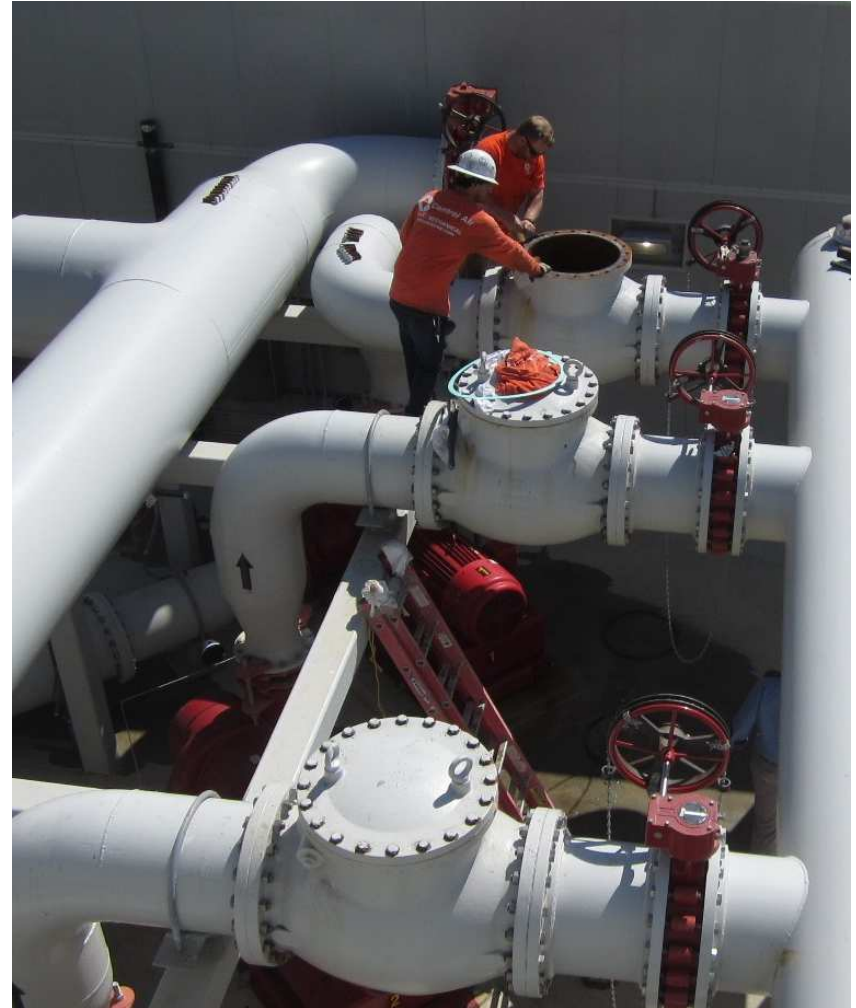


Check Valve (cont'd)

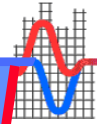


Many uses

- E.g., condenser water pump discharge line



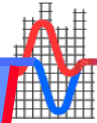
Check Valve (cont'd)



... and a wide range of sizes



Pressure Reducing Valve

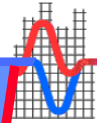


Disk lifts against a spring to allow flow up to a specified pressure

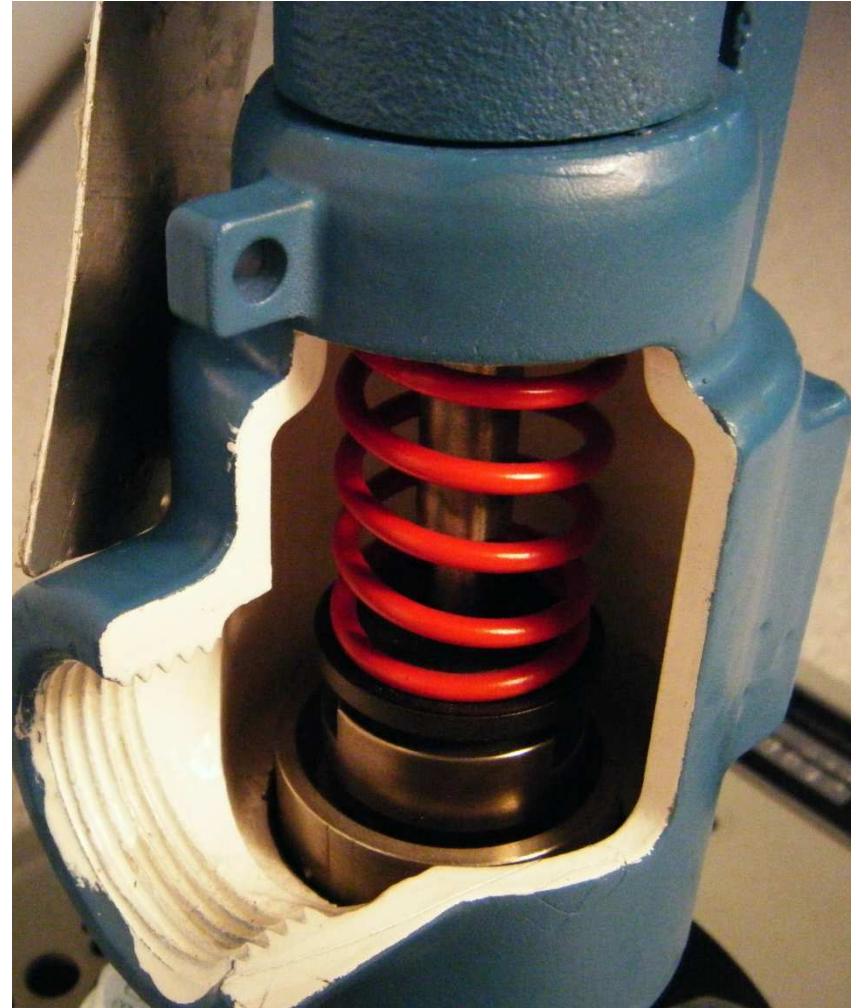
Typically includes a test lever

[Video_of_PRV.MP4](#)

PRV(cont'd)



**Spring over valve
piston**



Flow Balancing Valve



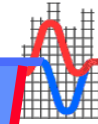
System balance is important, but there is a cost associated with using a balancing valve

Multi-purpose or "triple-duty" valves may, or may not, be a good solution



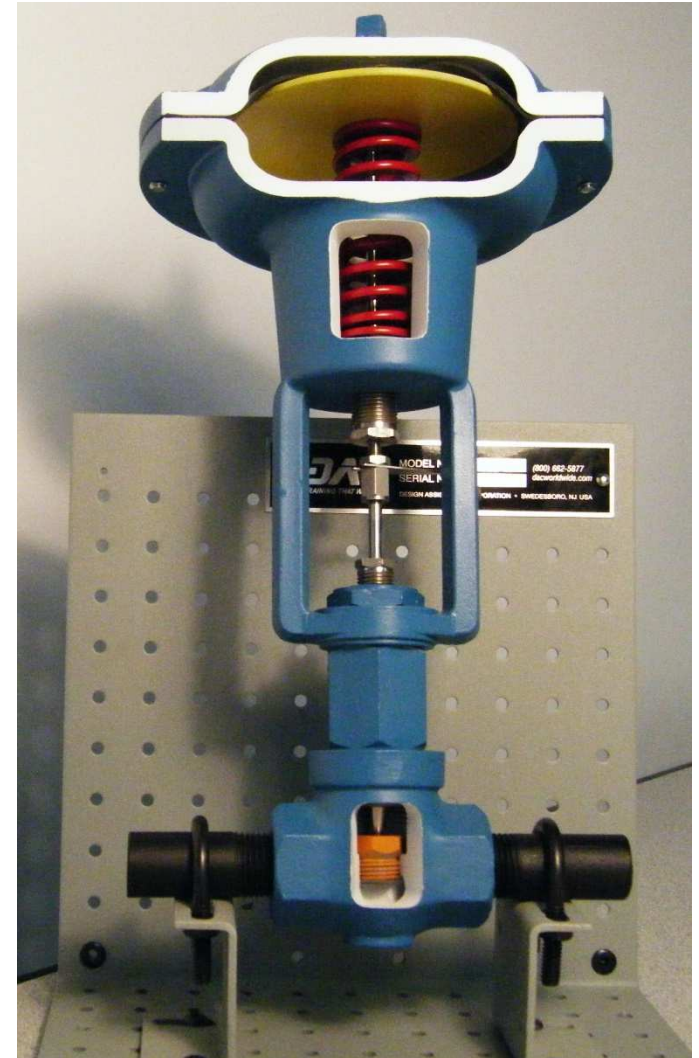
Image from www.BellGossett.com

Flow Control Valve

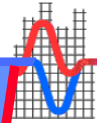


Any valve used to modulate flow

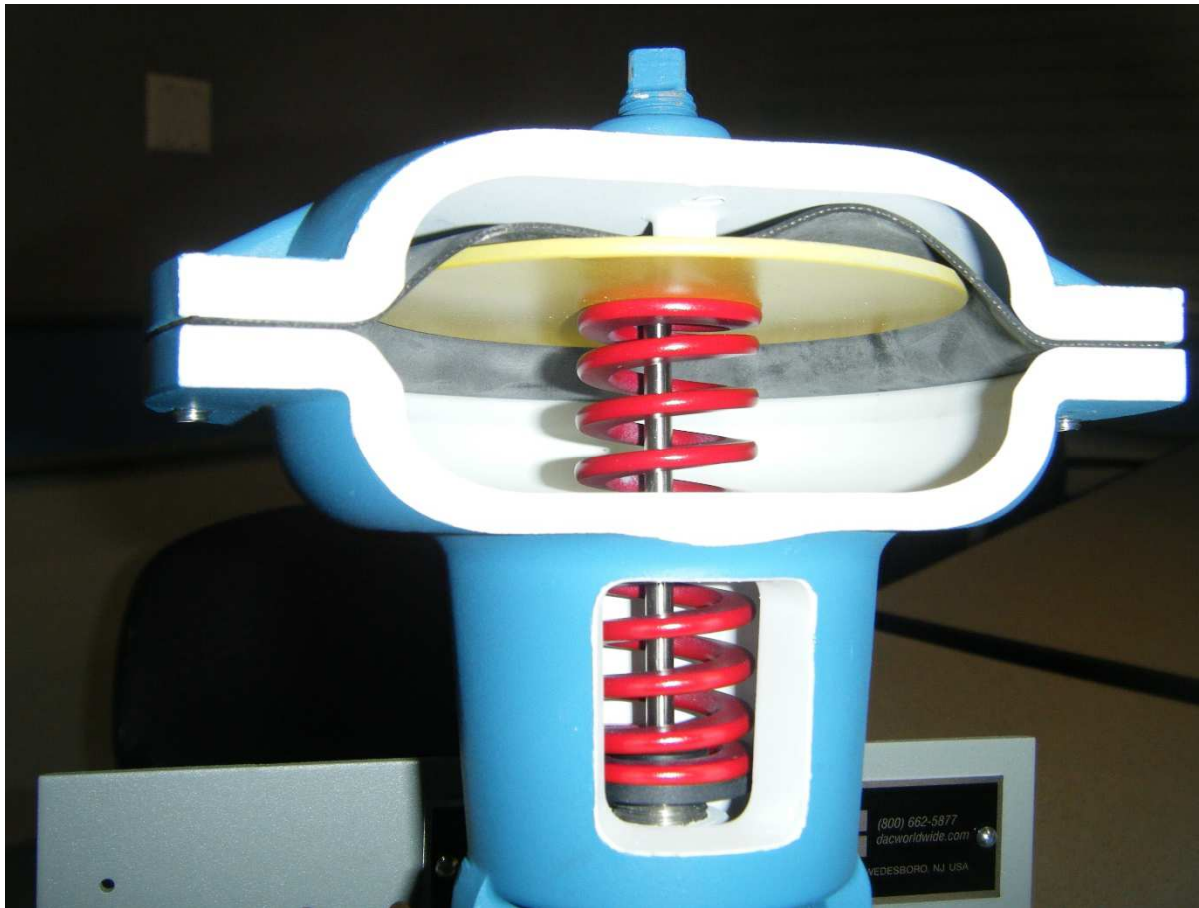
Actuator can be pneumatic as shown
in this picture
, electric, or electronic



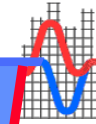
Flow Control Valve (cont'd)



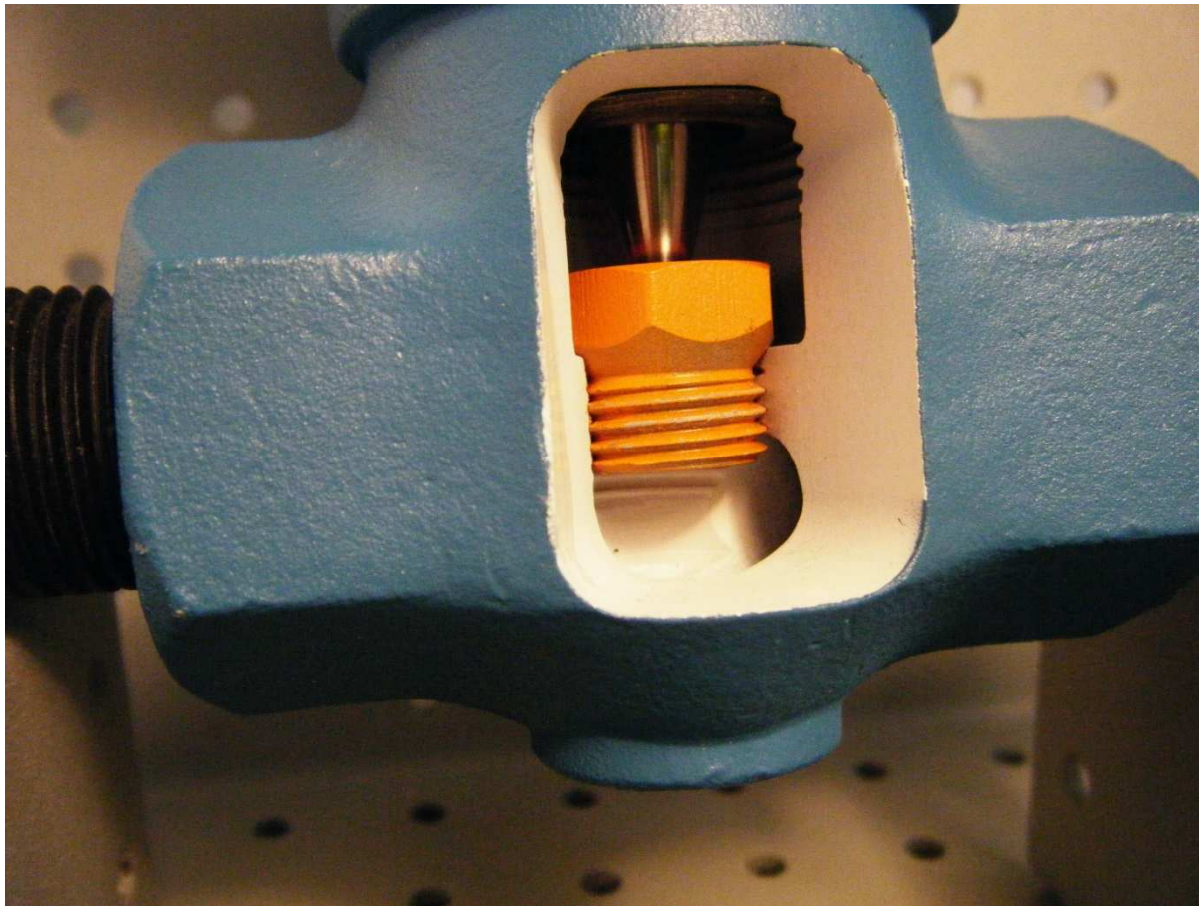
Pneumatic actuator disk and spring



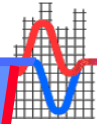
Flow Control Valve (cont'd)



Pneumatic actuator valve seat



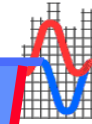
Flow Control Valve (cont'd)



Selection of the proper control valve is critical to maintaining efficient system operation

E.g., what's the C_v ?

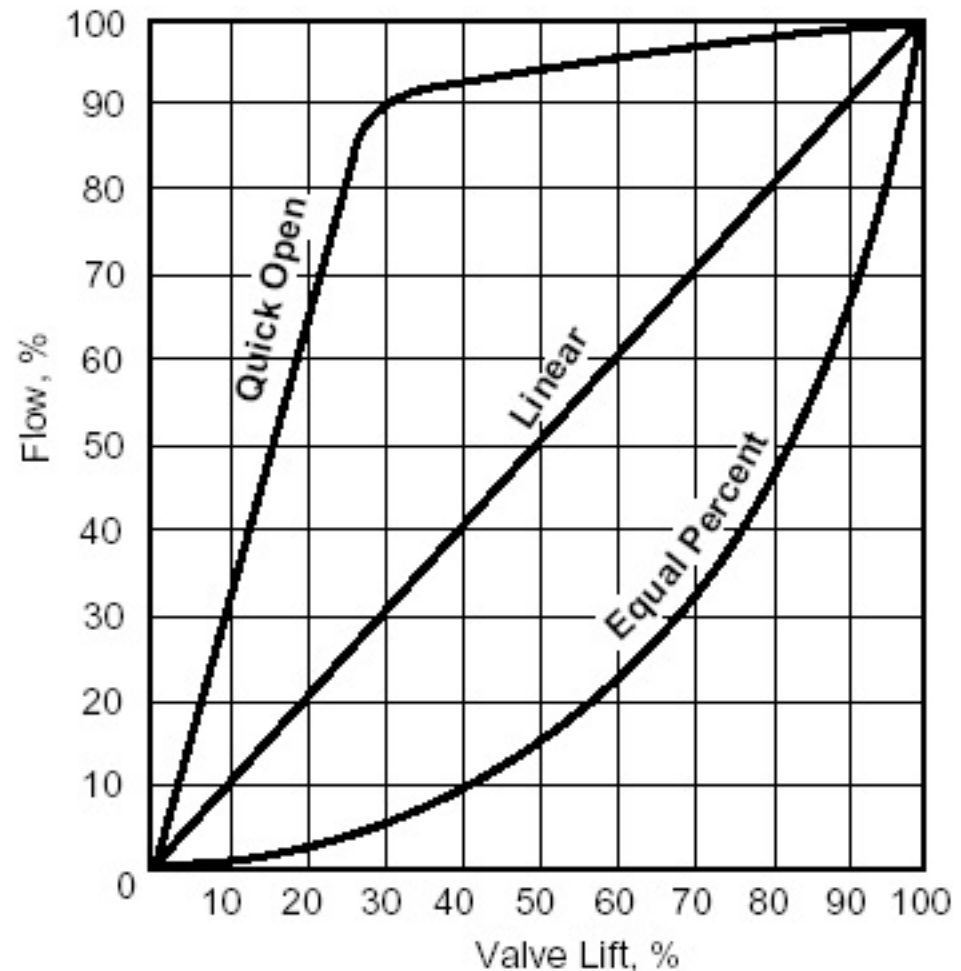
Flow Control Valve (cont'd)



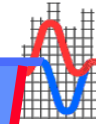
Control valves have characterized ports that produce different flow responses to valve position:

- Quick opening
- Linear
- Equal percentage

Often, select equal percentage valve types for linear throttling control of an air coil



3-Way Valve

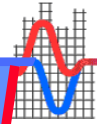


Applications:

- Mixing
- Diverting

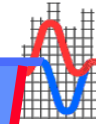


Valve Components

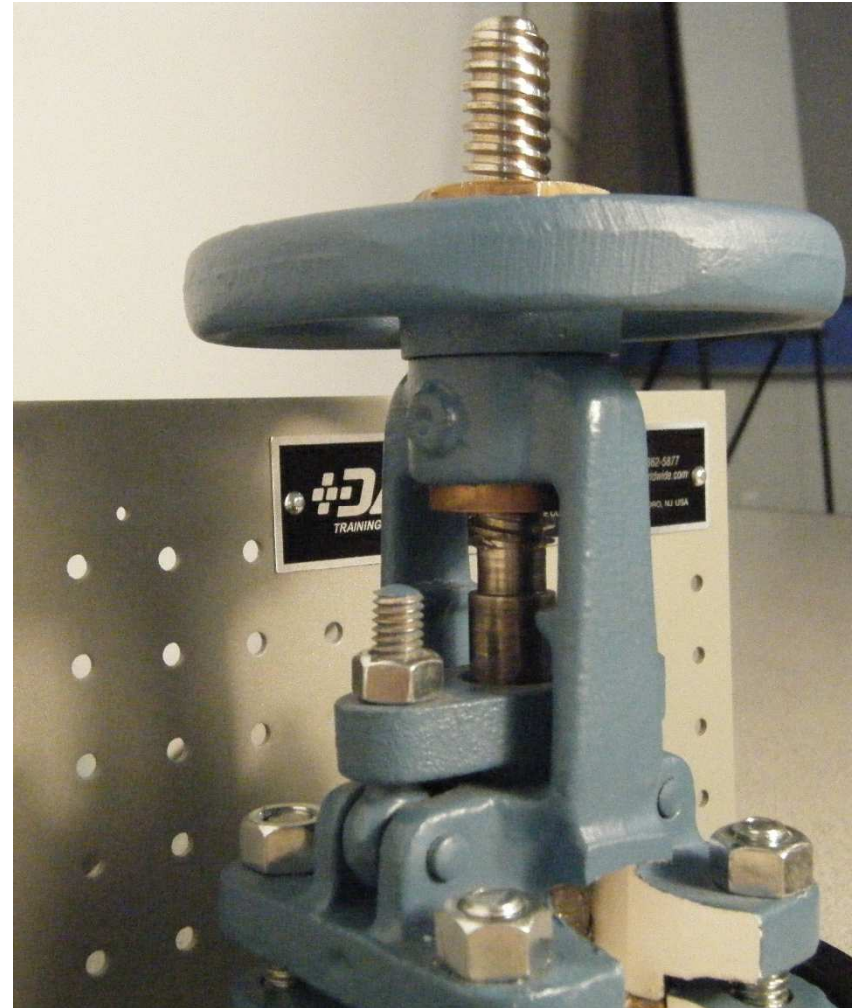


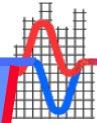
- **Body**
- **Bonnet**
- **Seat**
- **Disk**
- **Stem**
- **Packing**

Bonnet Types



- Various connection options
 - Threaded
 - Union connection; connects unthreaded bonnet to valve body
- Bolted connection
 - Utilizes a gasket to maintain seal
- Pressure seal connection
 - High pressure applications
- Welded connection
 - Bonnet welded to valve body
 - Disposable valves

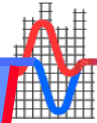




Valve Trim

- **Trim Components**
 - Disk
 - Seat
 - Stem (most, but not all, valves)
- **Function**
 - Allow for flow control
 - Disk-to-seat interface determines flow performance
 - Disk must withstand full system pressure if closed and outlet is opened to atmosphere
 - Disk shape varies

Valve Trim



- ▣ **Stem designs**

- ▣ **ISRS**

- ▣ Inside screw rising stem
 - ▣ Stem threads in contact with fluid moving through valve

- ▣ **NRS**

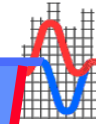
- ▣ Non-rising stem
 - ▣ Stem threads turn into disk
 - ▣ Stem threads in contact with fluid moving through valve

- ▣ **OS&Y**

- ▣ Outside stem and yoke
 - ▣ Stem threads are outside of valve
 - ▣ Stem threads exposed to outside environment

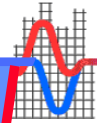
-

Valve Selection - Size



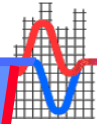
- Size defined by pipe connection sizes
- Availability based on type, body material, and pressure class
- Body material and available sizes
 - Bronze ; 1/8" to 3"
 - Cast Iron ; 2" to 30"
 - Forged Steel ; 1/4" to 3" (some types up to 24")
 - Cast Steel ; 2" to 30"

Valve Pressure Classes



- **Greater ability to withstand pressure = higher pressure class number**
 - Class number often equated to psi
 - Misleading as actual ability may vary
- **Typical pressure classes assigned by material**
 - 125 ; bronze, cast iron
 - 150 ; bronze, cast iron, steel
 - 200 ; bronze
 - 250 ; cast iron
 - 300 ; bronze, steel
 - 400 up to 4,500 ; steel

Valve Working Pressure



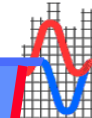
- ▣ Pressure ratings determined by ASME
- ▣ Stress tolerance decreases as operating temperature increases

Valve Working Pressure (cont'd)

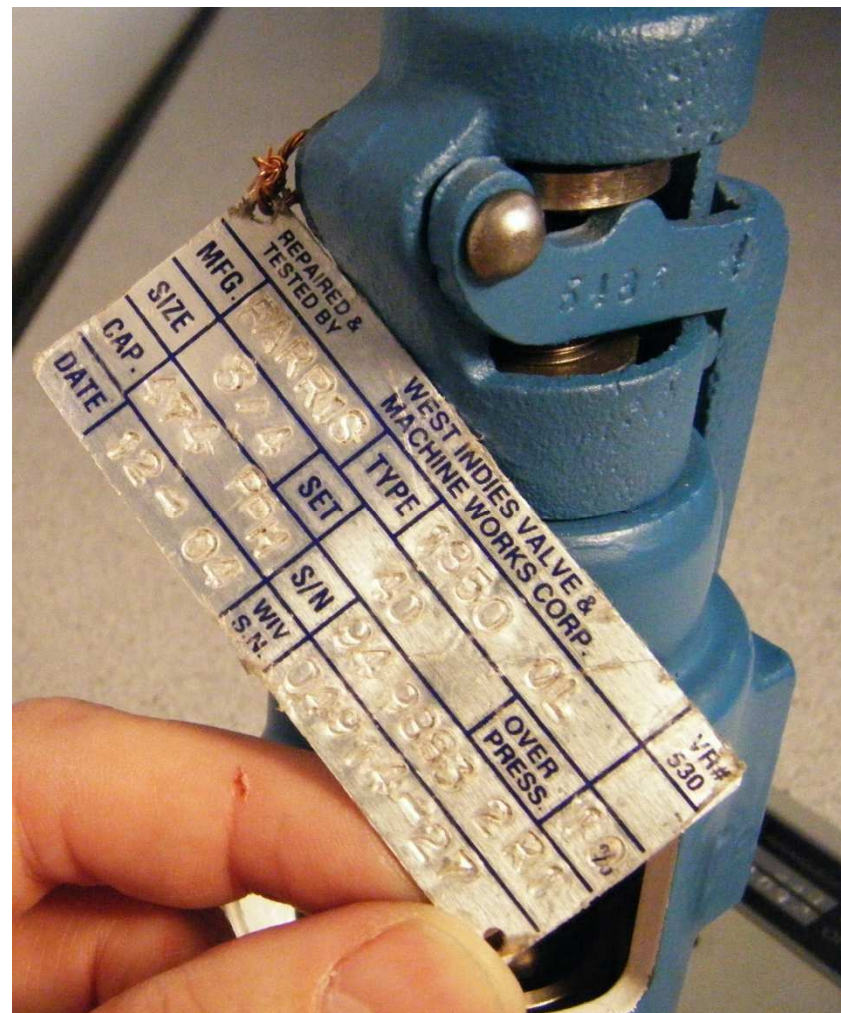


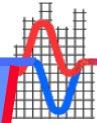
- Working Pressure = actual pressure limit of the valve at a prescribed operating temperature
- Typical working pressure assigned by material at defined temperature
- Example for Class 150 carbon steel valve
 - If $T = 200\text{ }^{\circ}\text{F}$; then $(P)_w = 260\text{ psig}$
 - If $T = 600\text{ }^{\circ}\text{F}$; then $(P)_w = 140\text{ psig}$
 - If $T = 1,000\text{ }^{\circ}\text{F}$; then $(P)_w = 20\text{ psig}$!

Valve Nameplate Data



- Pressure class markings
- Intended use
- May have multiple classifications; e.g.:
 - Maximum operating steam pressure class, "S"
 - ... or "SP" for steam pressure
 - ... or "SWP" for steam working pressure
 - AND an ambient, -20 to 100 °F, temperature rating, indicated by "WOG" (waste, oil, gas) or "CWP" (cold working pressure)

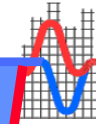




Summary - Valve Selection

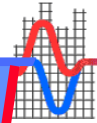
- ▣ **Identify Usage**
- ▣ **Identify Component Materials Needed**
- ▣ **Select Type**
- ▣ **Select Trim**
- ▣ **Optimize**
 - ▣ **Minimize pressure loss**
 - ▣ **Locate for ease of maintenance**

Summary - Valve Types and Service



- **Ball** - start/stop; direction change
- **Butterfly** - start/stop; throttling
- **Gate** - start/stop
- **Plug** - start/stop; direction change
- **Globe** - start/stop; throttling
- **Check** - prevent reverse flow
- **Relief** - pressure and temperature limiting
- **Control** - start/stop; throttling

Resources



- ▣ ASHRAE Handbooks
- ▣ Stojkov, Brent T., The Valve Primer. New York, NY: Industrial Press Inc., 1997
- ▣ Design Assistance Corporation, Valve Principles Training Program, Course 251-500, 1998, revised 9-14-2007
- ▣ .. and, of course, the internet for access to manufacturer's websites and other engineering sites