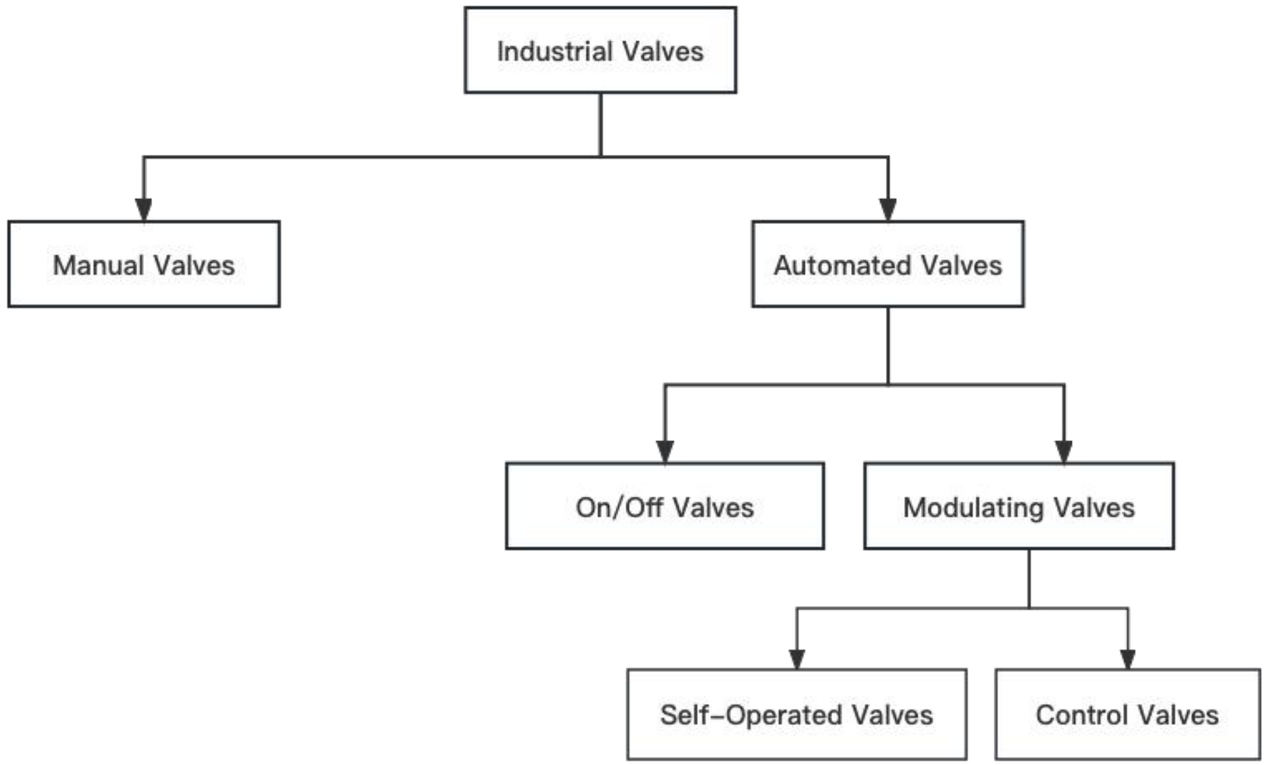
Control Valve

Comprehensive Training Module

This module is ideal for engineers, technicians, and professionals in process industries, aiming to enhance their knowledge in control valve technology and applications. It combines theoretical knowledge with practical skills, ensuring a comprehensive learning experience.

Will. Don | Marketing Director
marketing@cncontrolvalve.com
https://cncontrolvalve.com/

Category of Industrial Valves



Automated Valves:

These valves are operated automatically.

Self-Operated Valves:

Self-operated valves operate receiving energy from fluid pressure or fluid temperature. It has high responsibility but generally is not good at accuracy.

Control Valves:

Control valves operate receiving energy from compressed air, electric power, etc. used with controllers and sensors. Control valves and related equipment realizes most accurate control.

Introduction

What Is A Control Valve?

The control valve functions to adjust the flow of fluids like gas, steam, water, or chemical compounds. Its role is to counteract any disturbances in the load, maintaining the process variable being regulated as close to the desired set point as possible.

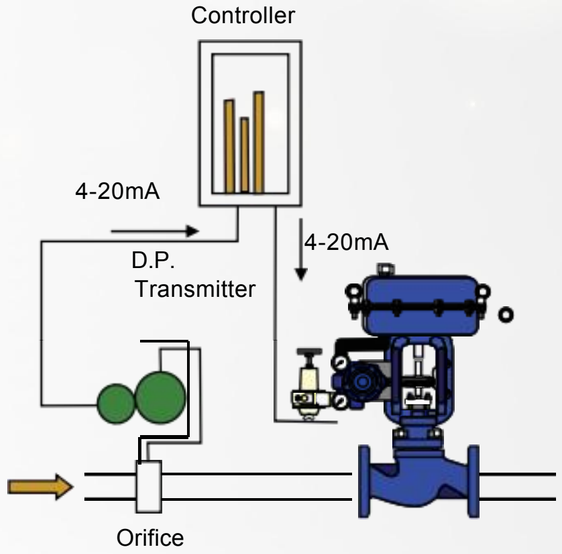
The control valve assembly typically consists of the:

- Valve body
- Internal trim parts
- An actuator to provide the motive power to operate the valve.
- A variety of additional valve accessories, which can include positioners, transducers, supply pressure regulators, manual operators, snubbers, or limitswitches.

Roles of Control Valves

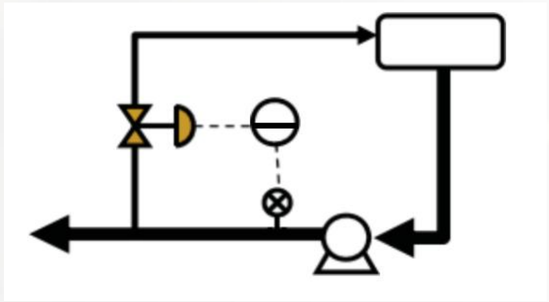
Process Parameters	Sensor
Flow Sensor	Orifice, Flow Meter
Pressure Sensor	Pressure Transmitter
Level Sensor	Level Transmitter
Temperature Sensor	Temperature Transmitterer

Control Valve



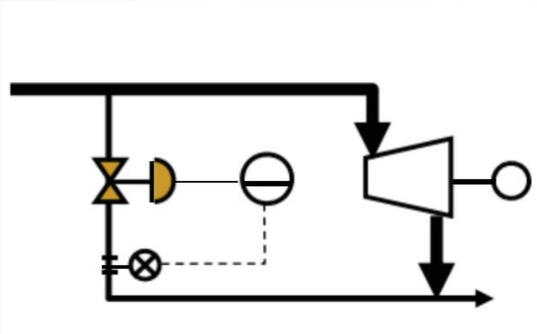
Example of Process Control

FLOW CONTROL



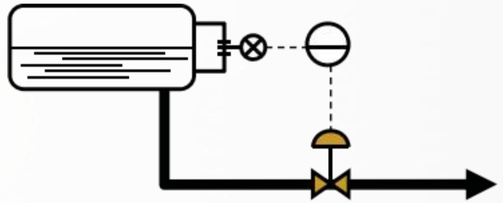
Boiler feed pomp
Minimum flow control valve

PRESSURE CONTROL



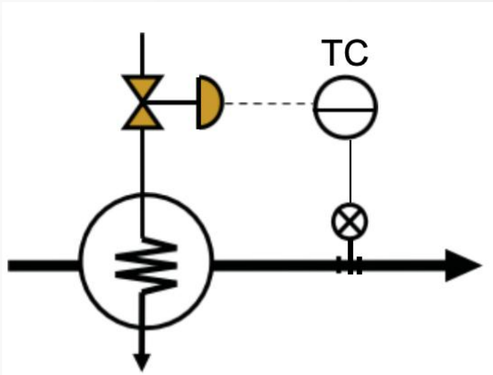
Turbine bypass valve

LEVEL CONTROL



Reactors

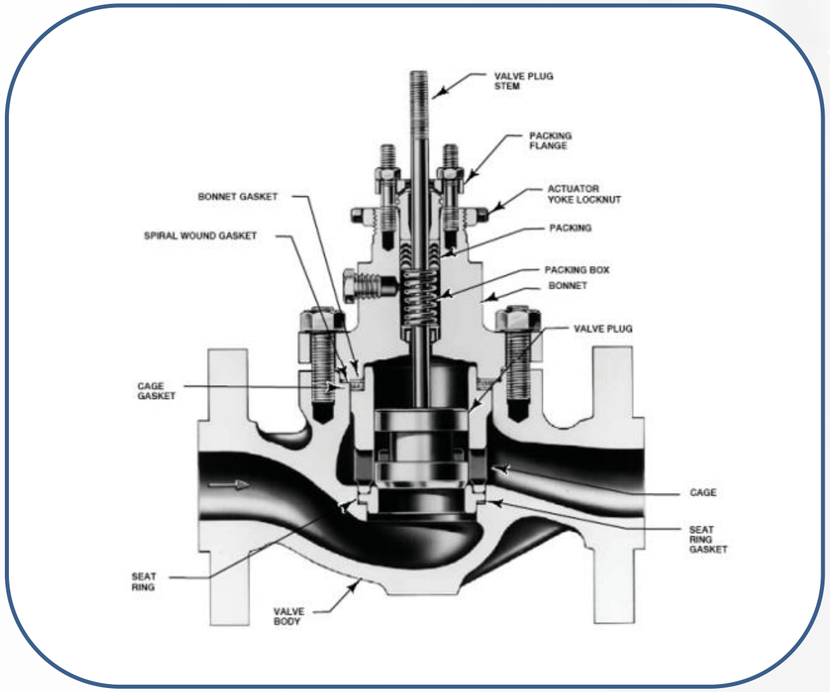
TEMPERATURE CONTROL



Heat Exchanger

Introduction

Typical Control Valve Assembly



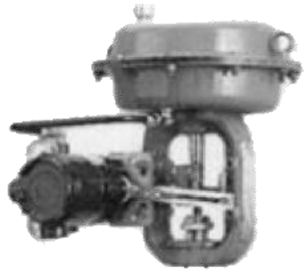
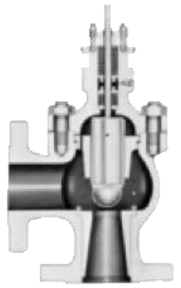
Typical Control Valve Assembly

Major Component of Typical Control Valve

Features of Each Actuator Types

	Pneumatic type	Hydraulic type	Motorized type
Response time	Dead time is rather long. Action speed is fast.	Dead time is short. Action speed is fast	No dead time. Action speed is slow
Maintaining safety position at supply fail time	Possible by using integrated spring or connecting volume tank easily and certainly.	Difficult to maintain	Can stop and maintain only the position at an emergency time.
Output power	Middle for spring diaphragm type. Big for piston cylinder type	Small for oil integrated type. Big for oil separated installation type	Bigger than pneumatic type and oil pressure type
Structure	Simple	Complicated	Complicated
Weatherproof and Exprosion proof	Not necessary	Should be considered	Should be considered
Air piping or electric wiring	Simple	Simple for oil integrated type. Complicated for oil separated installation	Simple
Maintenance work	Easy	Complicated	Complicated
Cost	Reasonable	Expensive	Expensive

Combination of Body and Actuator

Actuator		Body	
	 Pneumatic		 Globe
 Motorized	 Hydraulic	 Angle	 Butterfly

Cv Calculation

When you decide port size of control valve, you need to calculate required Cv value with fluid condition given on control valve data sheet. Then, you can specify appropriate Rated Cv value and port size.

At this chapter, most popular Cv calculation formula that is established by FCI (Fluid Controls Institute, Inc.) is introduced.

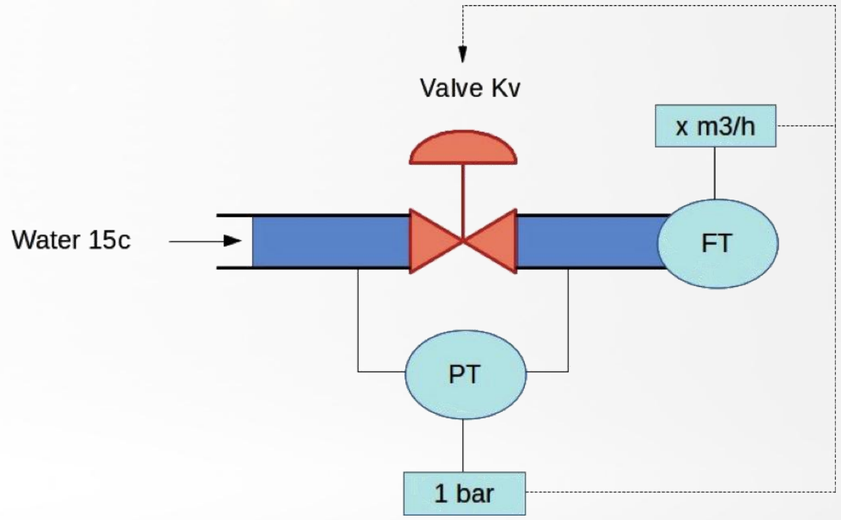
What is Cv Value?

One of the popular coefficients that express flow capacity. Cv value us defined as follows.

Flow rate of 60 degF (15.6 degC) clean water with the unit of US gal/min at differential pressure of 1 psi and specific travel of valve.

Rated Cv value: Cv value at a valve is fully opened.

Required Cv value: Cv value calculated with fluid condition



Flow Control Characteristics

As the actuator moves the valve plug through its travel range, the unobstructed flow area changes in size and shape depending on the contour of the valve plug.

When a constant pressure differential is maintained across the valve, the changing relationship between percentage of maximum flow capacity and percentage of total travel range can be portrayed, and is designated as the inherent flow characteristic of the valve.

Commonly specified inherent flow characteristics include:

- **Linear Flow Characteristic**
- **Equal-Percentage Flow Characteristics**
- **Quick-Opening Flow Characteristic**

Flow Characteristic

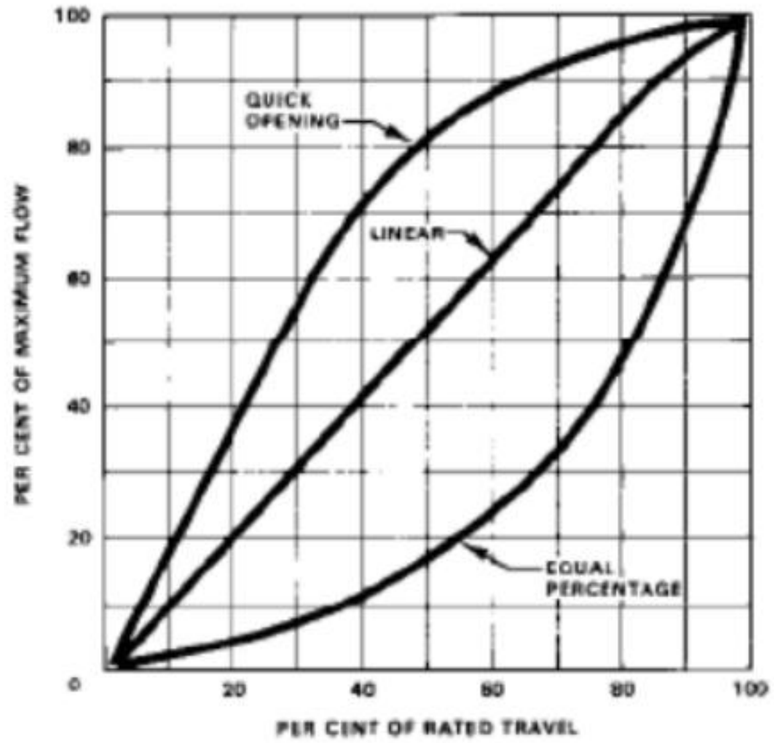
Linear Flow Characteristic

$Cv = K \cdot L$

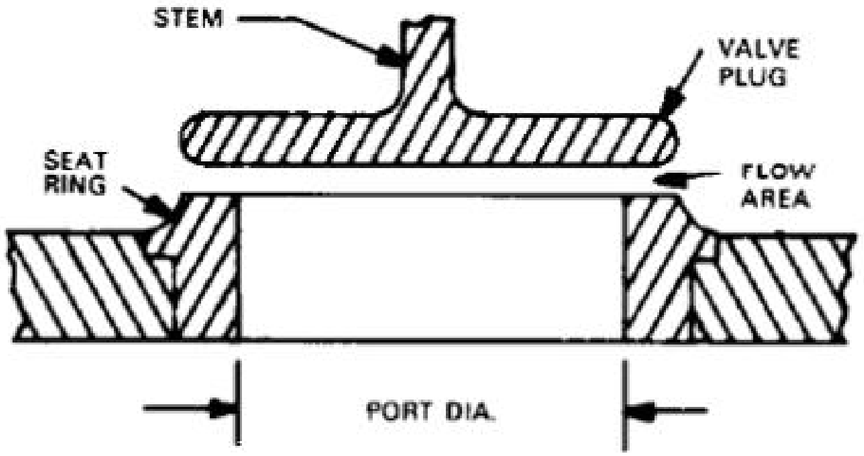
(K: Constant, L: Valve plug travel)

Equal-Percentage Flow Characteristics

$$\frac{dCv}{dL} = K \cdot Cv$$



Quick-Opening Flow Characteristic



Typical Construction to Provide Quick-Opening Flow Characteristic

Selection of Flow Characteristic

Control Valve Pressure Drop	Best Inherent Characteristic
Constant ΔP	Linear
Decreasing ΔP with Increasing Load , ΔP at Maximum Load > 20% of Minimum Load ΔP	Linear
Decreasing ΔP with Increasing Load , ΔP at Maximum Load < 20% of Minimum Load ΔP	Equal Percentage
Increasing ΔP with Increasing Load , ΔP at Maximum Load < 200% of Minimum Load ΔP	Linear
Increasing ΔP with Increasing Load , ΔP at Maximum Load < 200% of Minimum Load ΔP	Quick Opening

Liquid Level Systems

Control Valves

Valve and Actuator Types

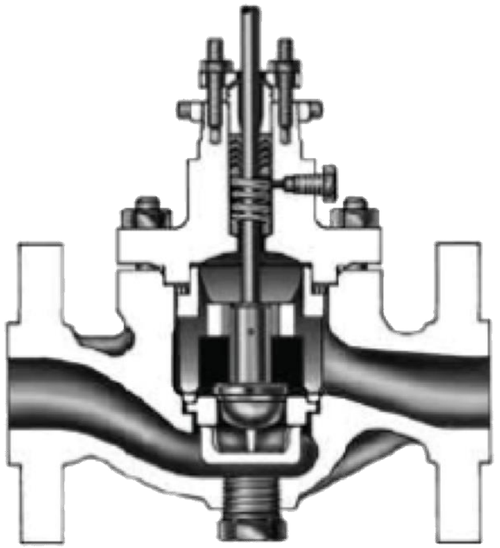
The control valve regulates the rate of fluid flow as the position of the valve plug or disk is changed by force from the actuator. To do this, the valve must:

- Contain the fluid without external leakage;
- Have adequate capacity for the intended service;
- Be capable of withstanding the erosive, corrosive, and temperature influences of the process; and
- Incorporate appropriate end connections to mate with adjacent pipelines and actuator attachment means to permit transmission of actuator thrust to the valve plug stem or rotary shaft.

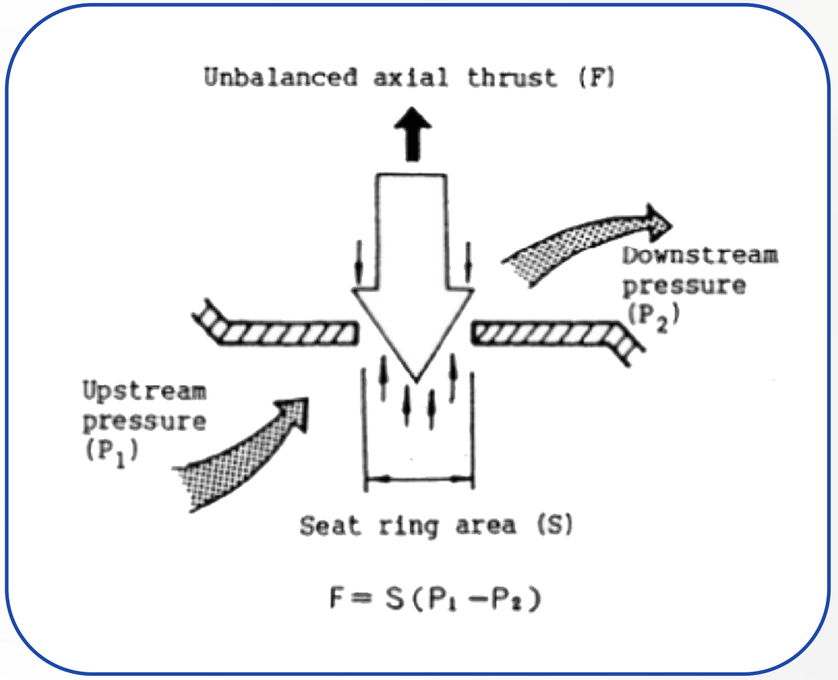
Valve Bodies

Globe Valves

Single-Port Valve Bodies



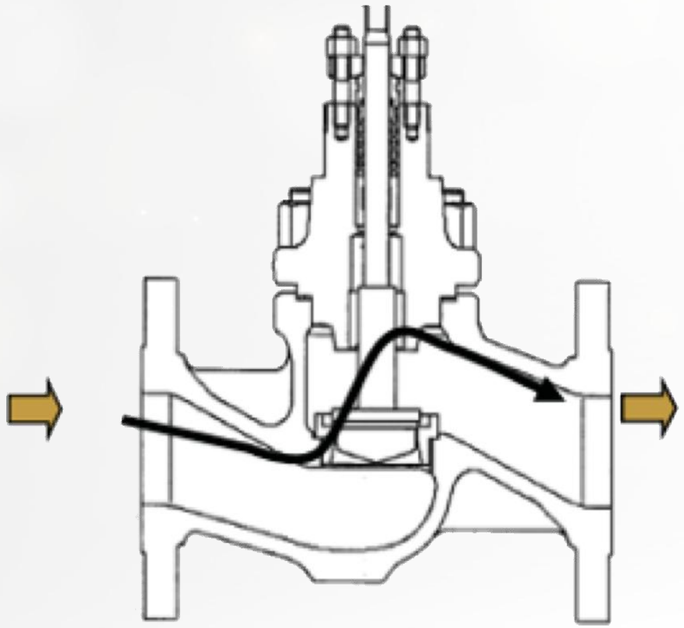
Single-Ported Globe-Style
Valve Body



Valve Bodies

Globe Valves

Single-Port Valve Bodies



Most Popular Type

Valve plug has only one seat to shut-of fluid

Seat leakage is low even though it has metal seat

Unbalancing fluid force is higher than pressure balancing type

When required valve size is lower than 2 inch,

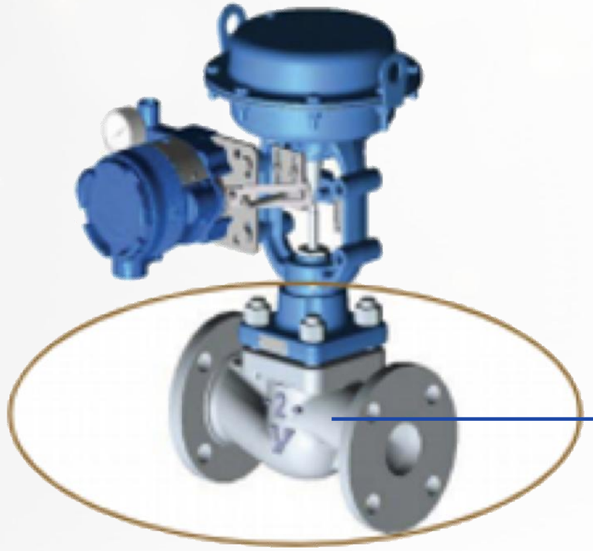
This type is most advantageous because small sized actuator can be mounted.

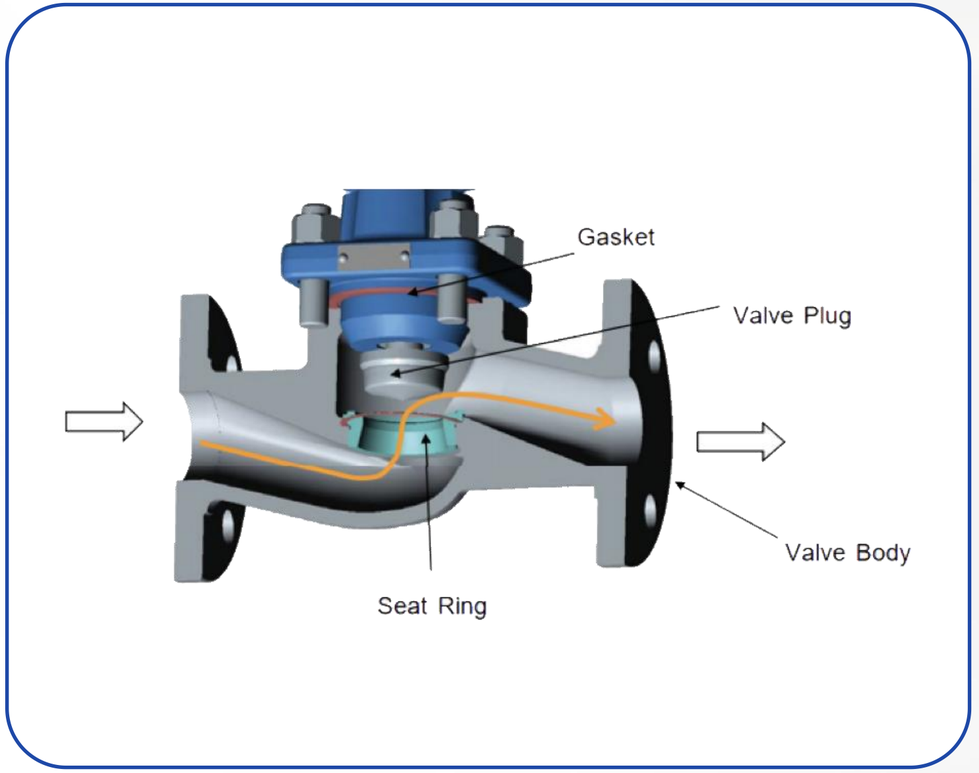
That means price is reasonable.

When required size is larger than 2 inch, generally, price is not reasonable because the larger the valve size is, the bigger the actuators size is comparing single seated type to pressure balancing type.

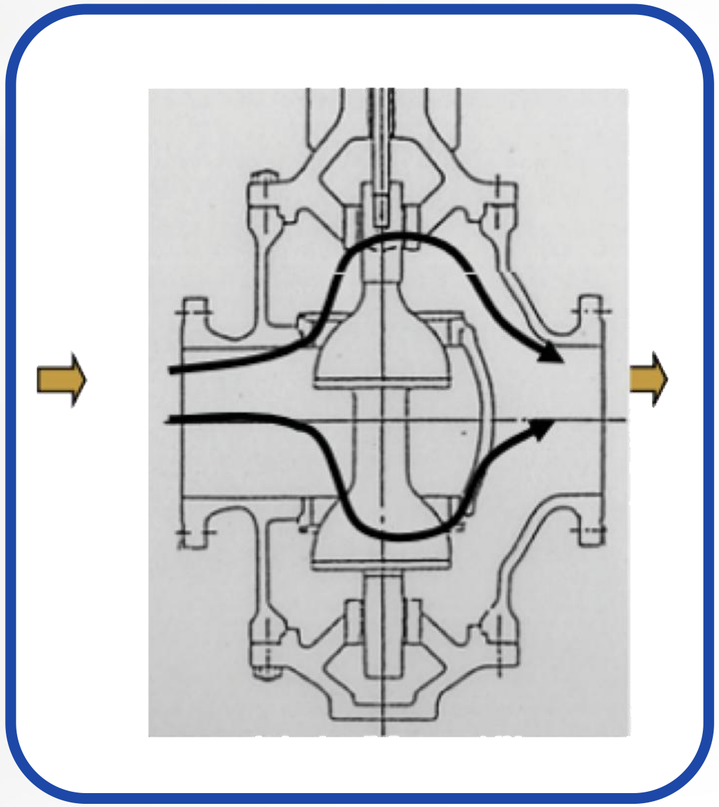
Valve Bodies

Globe Type Control Valves



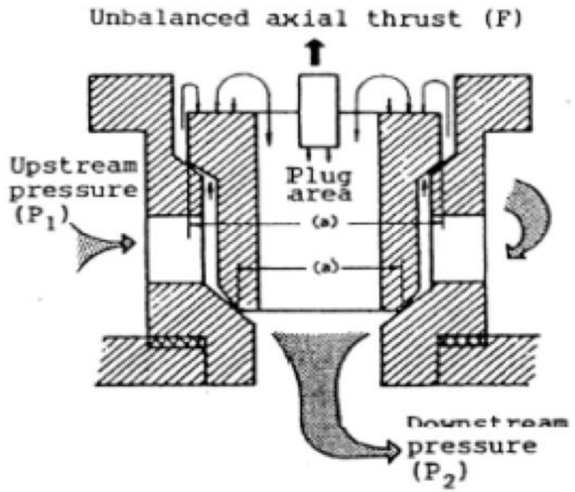


Top and Bottom Guided valve



- The valve plug is guided at top and bottom
- Pressure balanced type
- This type is used mainly for oil refinery industry.
- Generally, seat leakage is larger than single seated valves.

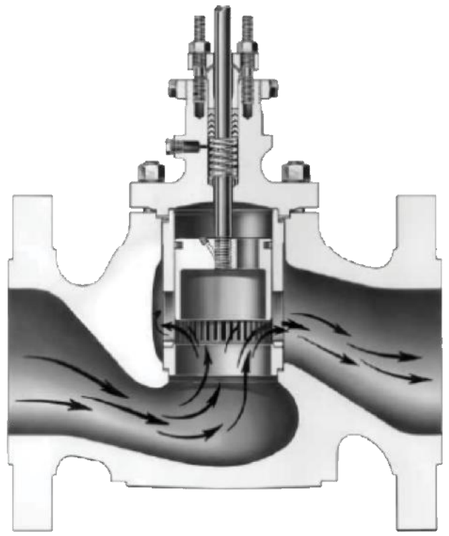
Cage Valve



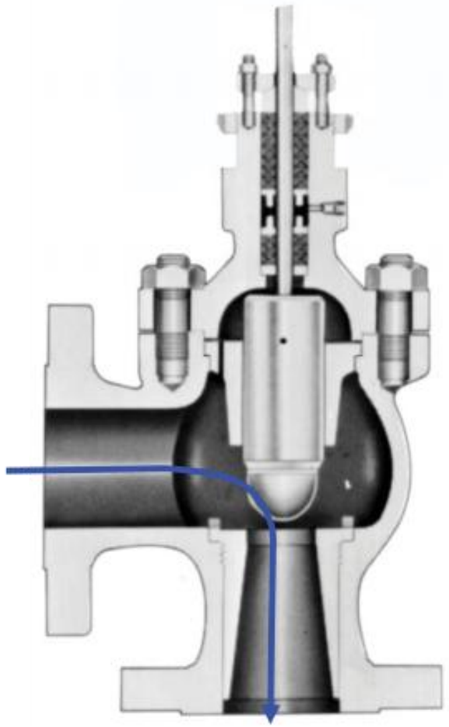
- This type comes after single seated type in market.
- Valve plug is guided by cage (shaped like pipe and set in valve body. It has window that consists of flow characteristics.)
- Pressure balanced type is more popular than unbalanced type.
- For pressure balanced cage type, actuator size is smaller than single seated type when body size is same.
- Therefore price is more competitive than single seated type when valve size larger than 3 inch or used with high- pressure rating.
- This type can reduce cavitation erosion and aerodynamic noise that are typical control valve claim.
- Generally, seat leakage is larger than single seated valve.

High Capacity, Cage-Guided Valve Bodies

High Capacity Valve Body with
Cage-Style Noise Abatement Trim



Angle Valve



Center of inlet and outlet of valves are right angle.

This type is advantageous for erosive or abrasive fluid.

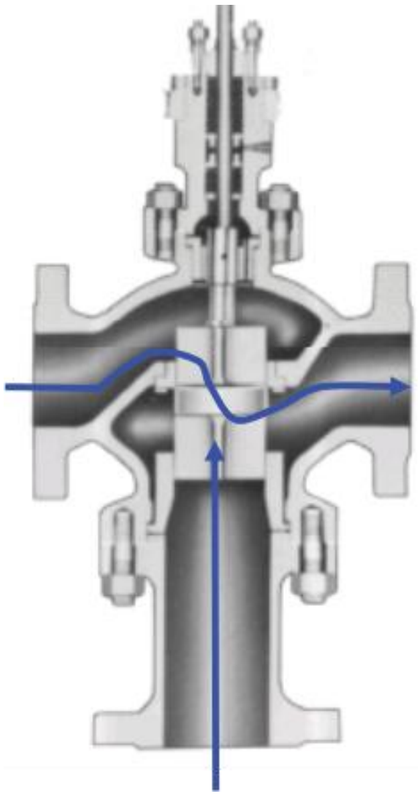
Also used because of piping design advantage.

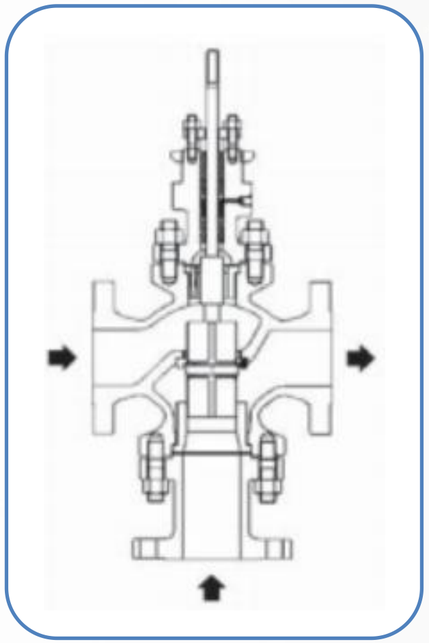
Wetted parts design is simpler than general 2 way valves. So this type is also advantageous for viscous fluid.

Erosion: Destruction of valve bodies or trims due to high fluid velocity.

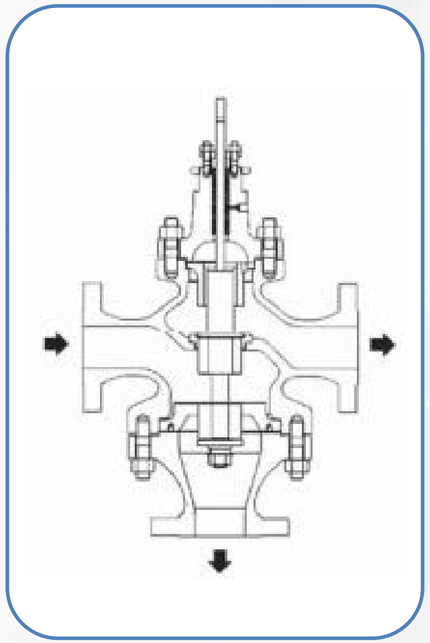
Abrasion: Erosion due to slurry that contains solids or particles.

Three-Way Valve





Mixing Type



Diverting Type

Three-Way Valve Bodies

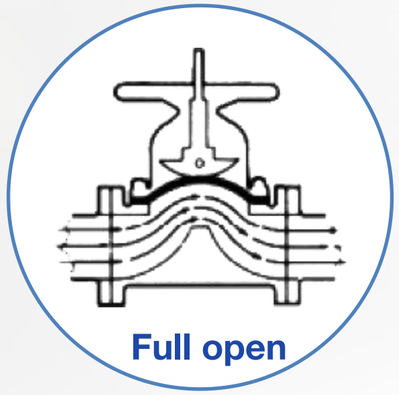
Diverting type is used to separate flow to 2 way

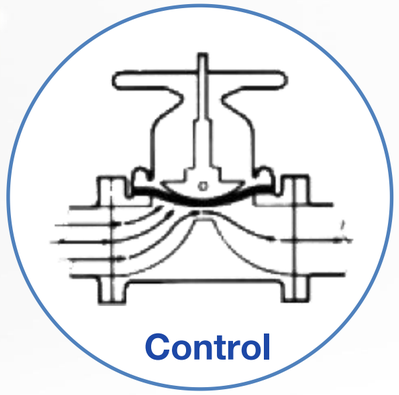
Mixing type is used to mix 2 flow.

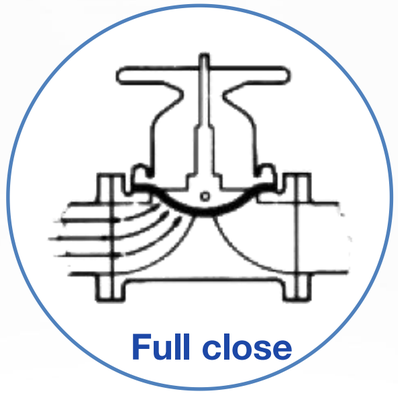
Mainly used for temperature control.

Diaphragm Valve

- Elastic diaphragm made with rubber and PTFE modulate the flow passage.
- Wetted parts can be lined with several materials (PTFE, Glass, and rubbers). So this type is advantageous for slurry or corrosive fluid.
- This type is cost effective.







Rotary Valves
Butterfly Valve Bodies

High-Performance
Butterfly Control Valve

- A disk that is almost same diameter as pipe size rotate so as to modulates flow.
- Valve capacity is highest for all types of valves.
- Generally, this type is used at pressure rating 300# or lower. For higher-pressure rating, this type cannot be applied.

V-Notch Ball Control Valve Bodies

Rotary-Shaft Control Valve with V-Notch Ball

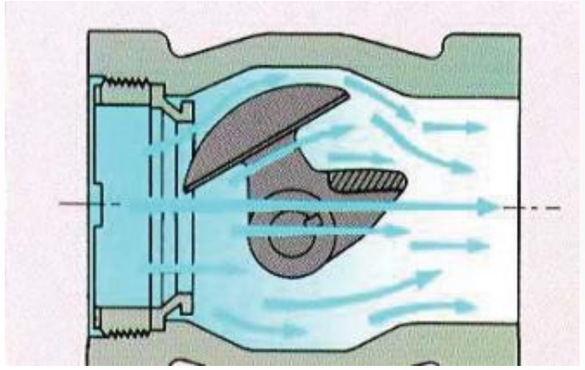
Eccentric-Disk Control Valve Bodies

Eccentric-Disk
Rotary-Shaft Control Valve

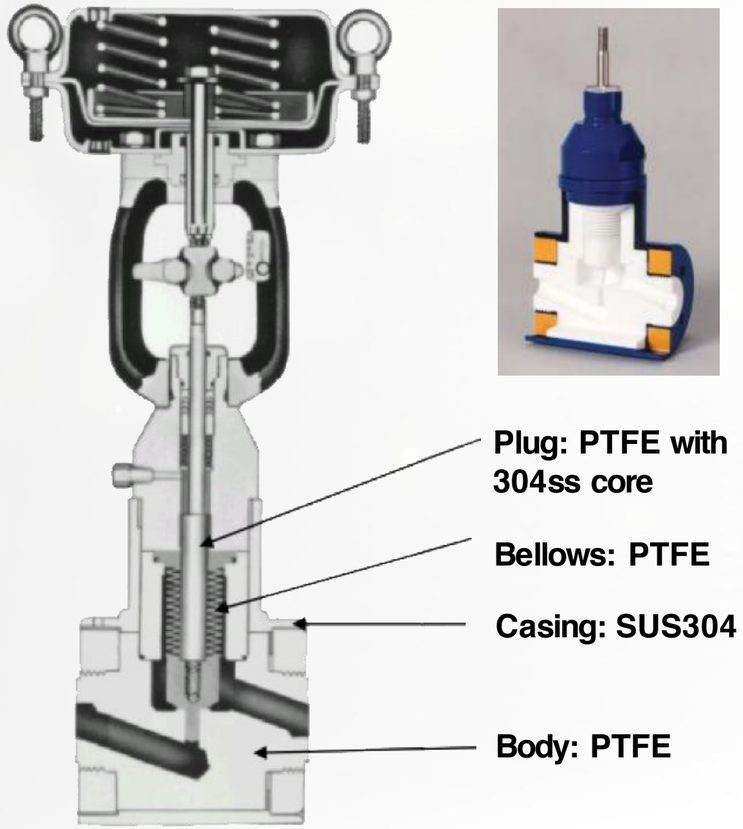
Center of the plug rotating point is eccentric from the center of valve body.

CV capacity is bigger than that of other globe valves.

Fluid can be passed easily because of straight trough construction.



PTFE Valve



A branch of single seated control valve.

Especially used for corrosive fluid.

All wetted parts are made with PTFE, which resist most of acids and alkalis.

Body has rigid stainless casing to avoid warp with piping stress.

Applicable pressure and temperature is limited.

Max Operating Temperature: 140 deg C

PVC / Polypropylene Valve

A branch of single seated control valve. Especially used for corrosive fluid.

All wetted parts are made with PVC or Polypropylene, which resist most of acids and alkalis.

Applicable pressure and temperature is limited.

Cheaper than PTFE valve

Max Operating Temperature:

PVC: 50 deg C.

Polypropylene: 80 deg C

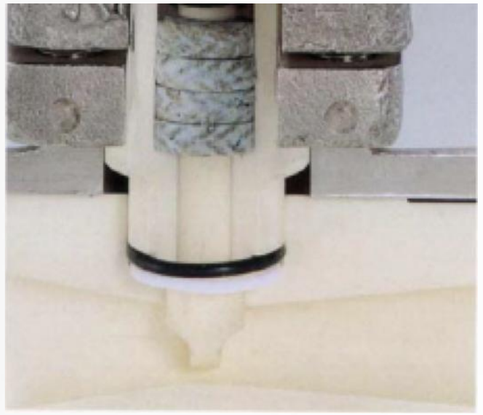
Ceramic Valve

Wetted part materials are all ceramics

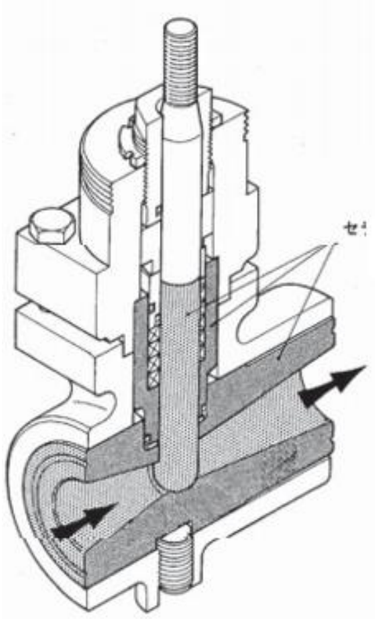
All wetted parts are made with ceramics that resists most of acids and alkalis.

Highest abrasion resistance.

There are application limitations for temperature, pressure and seat leakage class.



Model: HMC CV ≤ 4.0
Model: HIC 13<CV<120

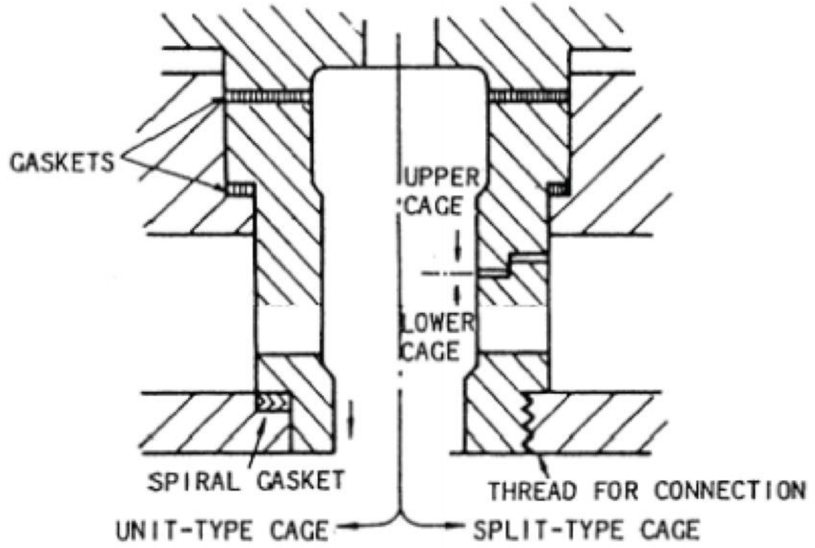


Aluminum ceramic: 70 deg C

Valve Plugs

Types of Valve Plugs

Valve Plugs


GASKETS
UPPER CAGE
LOWER CAGE
SPIRAL GASKET
THREAD FOR CONNECTION
UNIT-TYPE CAGE
SPLIT-TYPE CAGE

Cage-Guided

Characterization of Cage-Guided Valve Bodies

W0958/1L

QUICK OPENING

W0959/1L

LINEAR

W0957/1L

EQUAL PERCENTAGE

Characterized Cages for Globe-Style Valve Bodies

End Connections

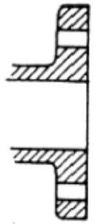
Control Valve End Connections

1

Thread type(S)

Primarily for connections of small valves - 1 in. (25mm) or less

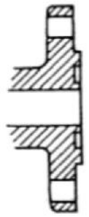
2



Flat face type(FF)

For cast iron valves for low pressure service

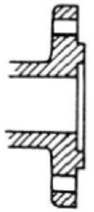
5



Groove type

To prevent leakage, for gas or vacuum service.(Normally,the valve flange is female)

6



Fit- in type

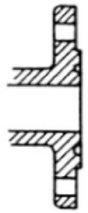
For the same purpose as those of the groove type

3

Raised face type(RF)

Most popular type for ANSI 600#,(JIS 40K) or lower

4



Ring joint type(RJ)

For high-temperature high-pressure service

7

Socket welded type(SW)

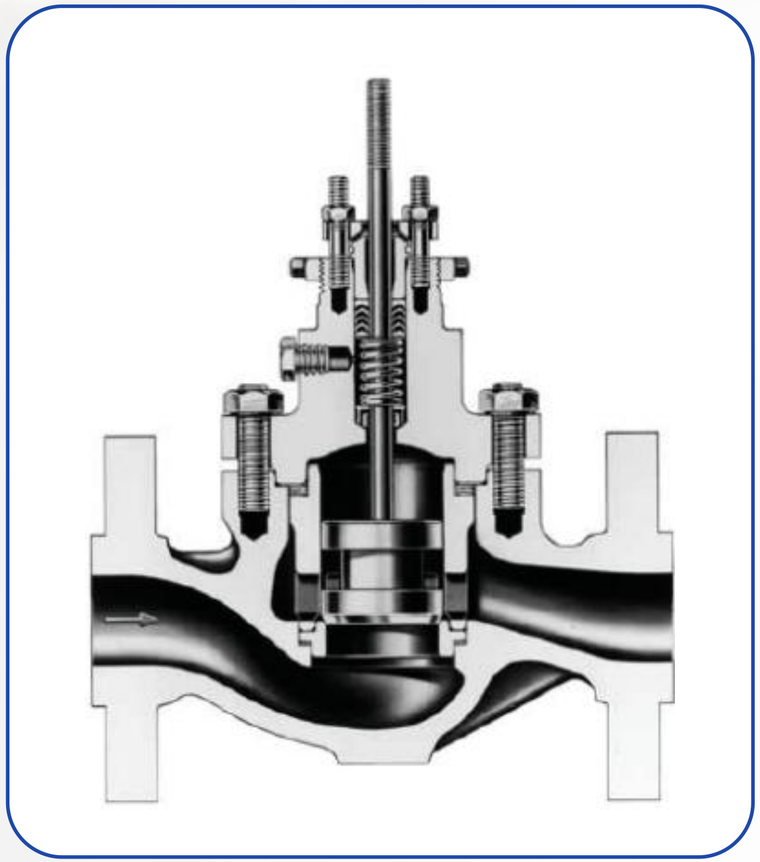
For high-temperature high-pressure service of ANSI 900# or higher.For poisonous fluids,Normally,for valves of 2 in.(50mm)or smaller.

8

Butt welded type(BW)

For the same purposes as those of the socket welded type.Normally,for valves of 2½ in.(80mm)or larger

Bonnets



Typical Bonnet, Flange, and Stud Bolts

Valve Body Bonnets

The bonnet of a control valve is that part of the body assembly through which the valve plug stem or rotary shaft moves.

Bonnets

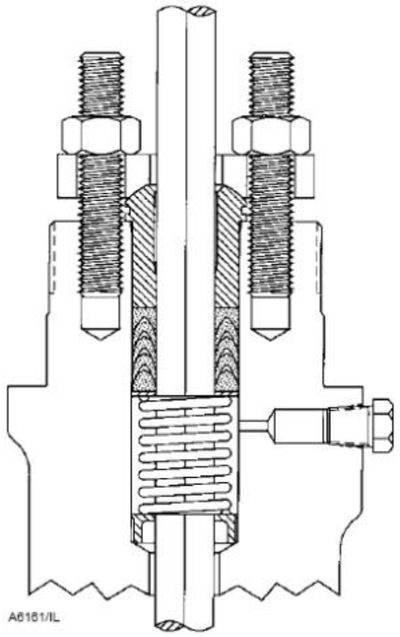
Extension Bonnets

Extension Bonnet

Valve Body with
Fabricated Extension Bonnet

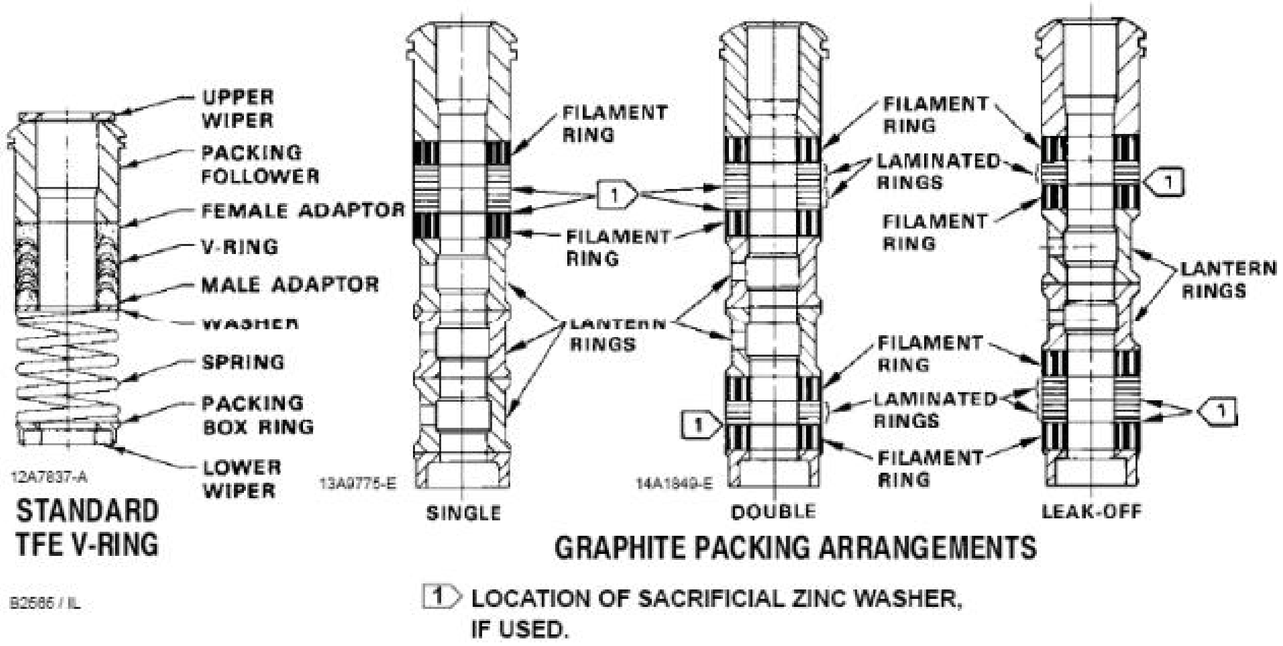
Packing

Control Valve Packing



Single PTFE V-Ring Packing

Packing



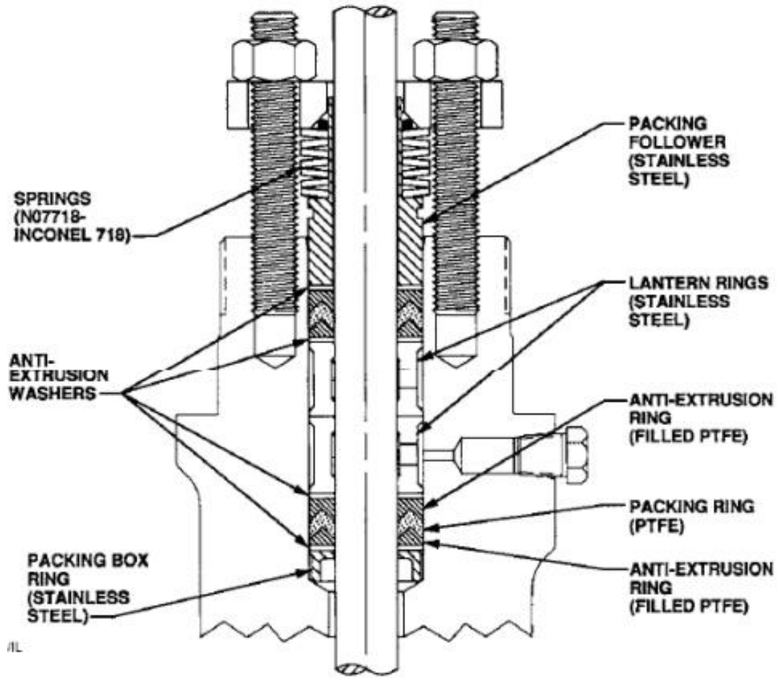
Comprehensive Packing Material Arrangements
for Globe-Style Valve Bodies

Packing

Typical Valve
Stem Packing Assemblies

Packing

- PTFE V-Ring
- Laminated and Filament Graphite
- Single PTFE V-Ring Packing
- ENVIRO-SEAL_ PTFE Packing



ENVIRO-SEAL PTFE Packing System

Packing

V-PTFE

V7132Y

#4519 yarn

Graphite (T2200)

SM636

TK2006

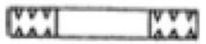
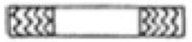
Packing

Graphite Ribbon for Rotary Valves

Sliding-Stem Environmental Packing Selection					
Packing System	Maximum Pressure & Temperature Limits for 500 PPM Service(1)		Seal Performance Index	Service Life Index	Packing Friction
	Customary US	Metric			
Single PTFE V-Ring	300 psi 0 to 200°F	20.7 bar -18 to 93°C	Betten	Long	Very Low
ENVIRO-SEAL PTFE	See Fig. 3-25 -50 to 450°F	See Fig. 3-25 -46 to 232°C	Superior	Very Long	Low
ENVIRO-SEAL Duplex	750 psi -50 to 450°F	51.7 bar -46 to 232°C	Superior	Very Long	Low
ENVIRO-SEAL Graphite ULF	1500 psi 20 to 600°F	103 bar -7 to 315°C	Superior	Very Long	Moderate

(1)The valves shown are only guidelines.These guidelines can be exceeded, but shortened packing life or increased leakage might result.The temperature ratings apply to the actual packing temperature, not to the process temperature.

Gaskets

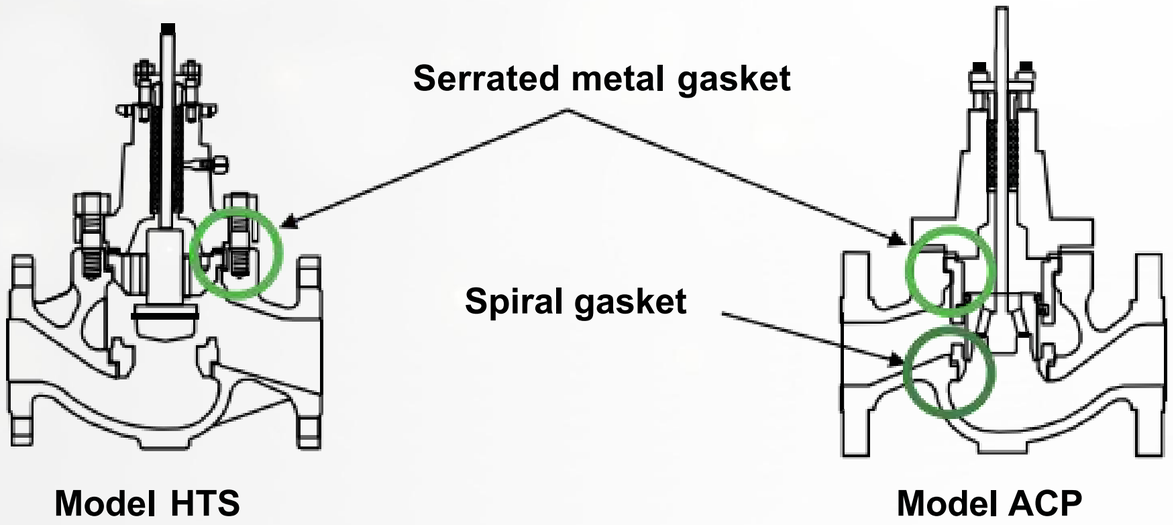
Type	Type No. Of gasket	Operable temperature range(℃)	Operable maximum pressure	Composition	Use
Flat type 	V562	-196 to +260	150 kgf/cm²	Copper Monel Aluminium	Oil-inhibited
	V564(Monel)	-5 to +566	ANSI 2500		
	V567	-196 to +400	150 kgf/cm²		Service Oil-inhibited coper inhibited service
Sawtooth Type 	V540	0 to +200	20 kgf/cm²	S15C	Material of valve body:FC20
	V542 V543 (SUS316L)	-196 to +260 -196 to +566	150 kgf/cm² ANSI 2500	Copper SUS316	Oil-inhibited service General Service
	V544	-196 to 450	ANSI 2500	SUS316L	
	V544(Monel)	-196 to +566	ANSI 2500	Monel	
	V547	-196 to 400	150 kgf/cm²	Aluminium	Oil-inhibited copper-inhibited service
Spiral shaped external pressure type 	V590	-100 to +500	ANSI 1600	SUS316+ Asbestos	For seat of unit-structure cage
	V590(SUS316L)	-100 to +450	ANSI 1600	SUS316L+ Asbestos or teflon	
	V7590	-196 to +100	20 kgf/cm²	SUS316L+ teflon	Oil inhibited service

Gaskets

Type	Type No. Of gasket	Operable temperature range(℃)	Operable maximum pressure	Composition	Use
Others(special uses)	V1500 V1501	0 to 100	20 kgf/cm^2	Asbestos	For HLS,HTS(when specified by customer)
	V1500AC V1501AC	+100 to +260	10 kgf/cm^2		
	V7010	-196 to +260	ANSI 300	Teflon	For HLS,HTS(when specified by customer)
	V7020	-196 to +260	ANSI 300	Teflon + ceramics fillers	
	V563 Teflon coating	-196 to +260	ANSI 300	SUS316+ teflon	Oil-inhibited with special material spur-water service
	V543 Teflon coating	-196 to +260	ANSI 300	SUS316+ teflon	
	V6590	-196 to +566	ANSI 2500	SUS316L+ graphite	When heat cycles are severe For nuclear energy service

Gaskets

Examples on Uses of Gaskets



V543

V543 PTFE coated

Serrated metal gasket

V8590

Spiral gasket

Grease

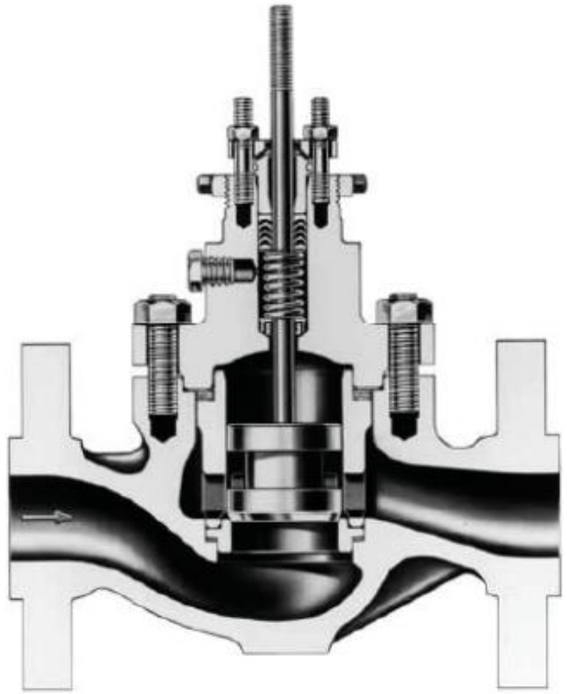
Lubricator

PS6 #800

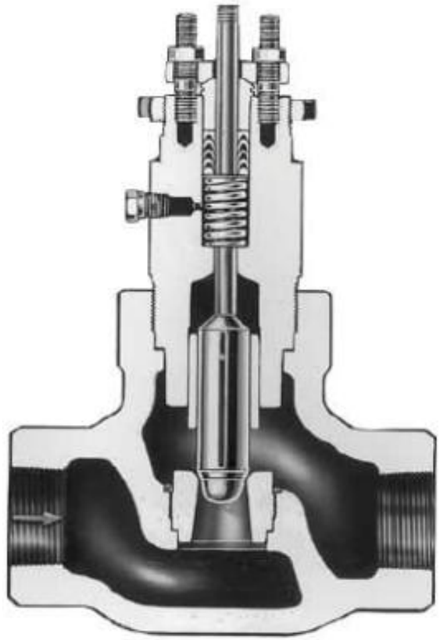
#400 #650

Valve Plug Guiding

1. Cage Guiding

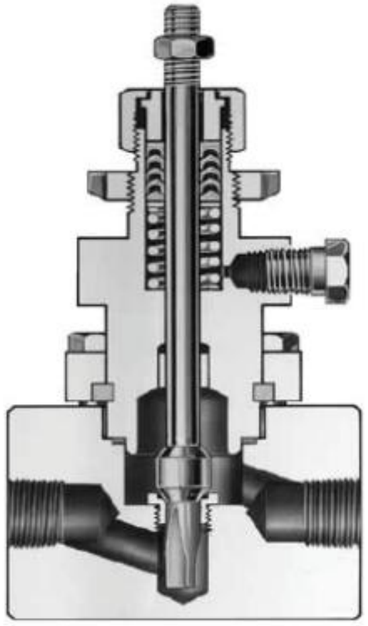


2. Top Guiding



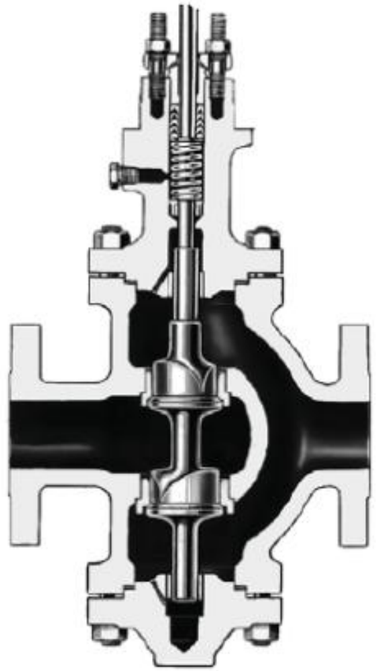
Valve Plug Guiding

3. Stem Guiding



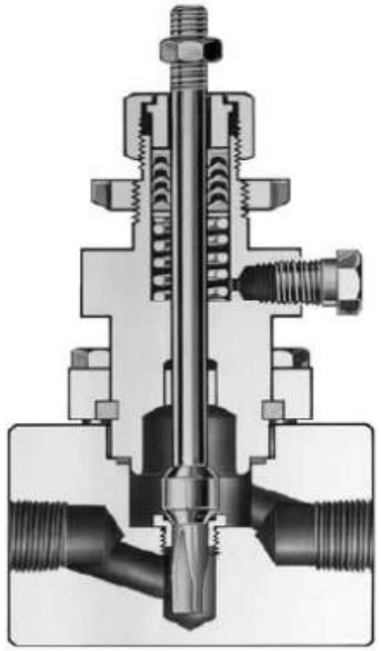
Left view

4. Top-and-Bottom Guiding



Valve Plug Guiding

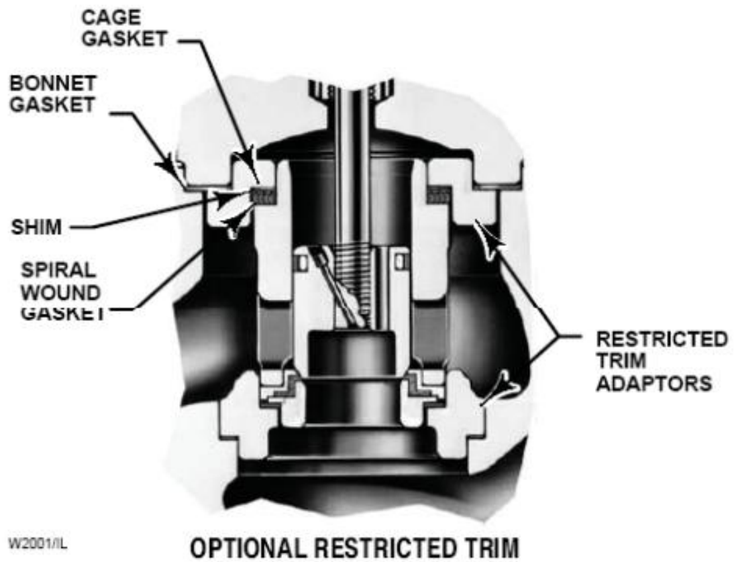
5. Port Guiding



Right view

Valve Plug Guiding

Restricted-Capacity Control Valve Trim



Adapter Method for Providing Reduced Flow Capacity

Actuators

Actuators

Pneumatically operated control valve actuators are the most popular type in use, but electric, hydraulic, and manual actuators are also widely used.

The spring-and-diaphragm pneumatic actuator is most commonly specified due to its dependability and simplicity of design. Pneumatically operated piston actuators provide high stem force output for demanding service conditions.

Actuators

1. Diaphragm Actuators

3/1L

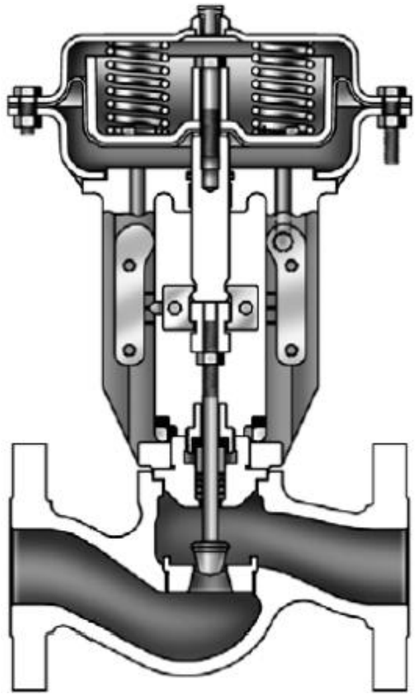
DIRECT- ACTING

W0364/1L

REVERSE-ACTING

Actuators

1. Diaphragm Actuators



Field-Reversible Multi-Spring Actuator

Diaphragm Actuator for
Rotary Shaft Valves

Actuators

2. Piston Actuators

Control Valve with
Double-Acting Piston Actuator

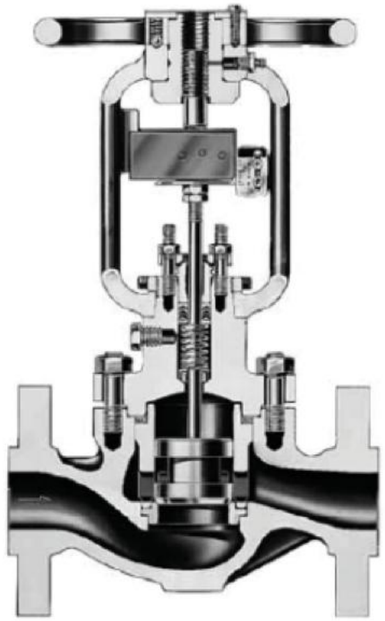
Actuators

3. Electrohydraulic Actuators

Control Valve with Double-Acting Electrohydraulic Actuator and Handwheel

Actuators

4. Manual Actuators



W0595/1L

FOR SLIDING-STEM VALVES

W8176-1

FOR ROTARY-SHAFT VALVES

Typical Manual Actuators

Actuators

5. Rack and Pinion Actuators

Typical Rack and Pinion Actuator

Actuators

6. Electric Actuators

Traditional electric actuator designs use an electric motor and some form of gear reduction to move the valve. Through adaptation, these mechanisms have been used for continuous control with varying degrees of success.

Actuators

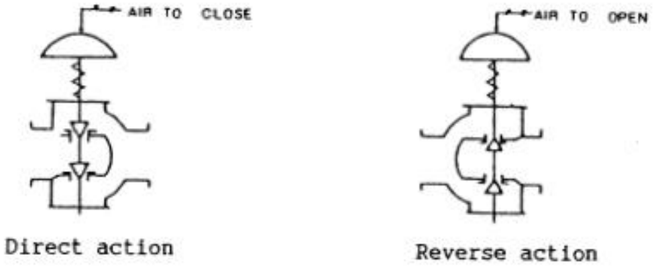
7. Types (Directions) of Valve and Actuator Actions

Types of valve and actuator actions should be correctly selected for fail-safe plant operation when the driving power (air supply) has failed. The type (direct and reverse) are defined as follows:

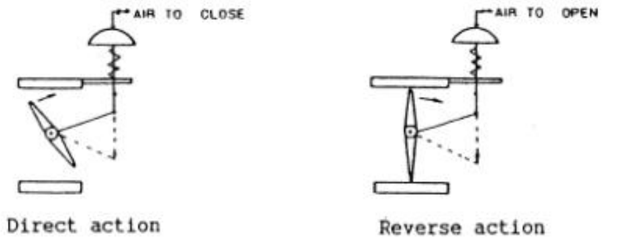
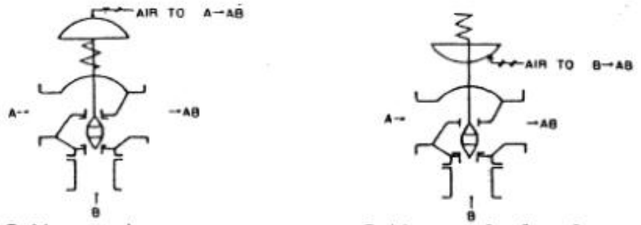
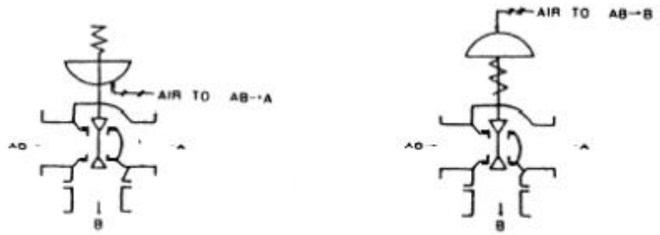
(a) Direct action: Valve opens when driving power has failed.

(b) Reverse action: Valve closes when driving power has failed.

Actuators

1. When valve action cannot be reversed(Top-guided single-seat valves, cage valves, angle valves,ceramics valves, and Saunders valves)Valve:Direct action → Actuator:Direct action Valve:Reverse action → Actuator:Reverse action	
2. When valve action can be reversed(Top-and-bottom guided single-seat or double-seat valves) Valve:Direct action → Valve body:normal Actuator:Direct action Valve:Reverse action → Valve body:Inverted Actuator:Direct action	

Actuators

3. When driving the valve via a lever mechanism(Butterfly valves,FloWing valves)Valve:Direct action → Valve:Direct action → Vane:Normal position Actuator:Direct action Valve:Direct action → Vane:Reverse position Actuator:Direct action	 Direct action Reverse action
4. To change flow direction(3-way valves) (1)Converging 3-way valves Valve:Bottom port open when air failure → Actuator:Direct action Valve:Bottom port closed when air failure → Actuator:Reverse action	 Bottom port open when air failure Bottom port closed when air failure
(2)Diverting 3-way valves Valve:Bottom port open when air failure → Actuator:Reverse action Valve:Bottom port closed when air failure → Actuator:Direct action	 Bottom port open when air failure Bottom port closed when air failure

Positioners

Control Valve Accessories

Positioners

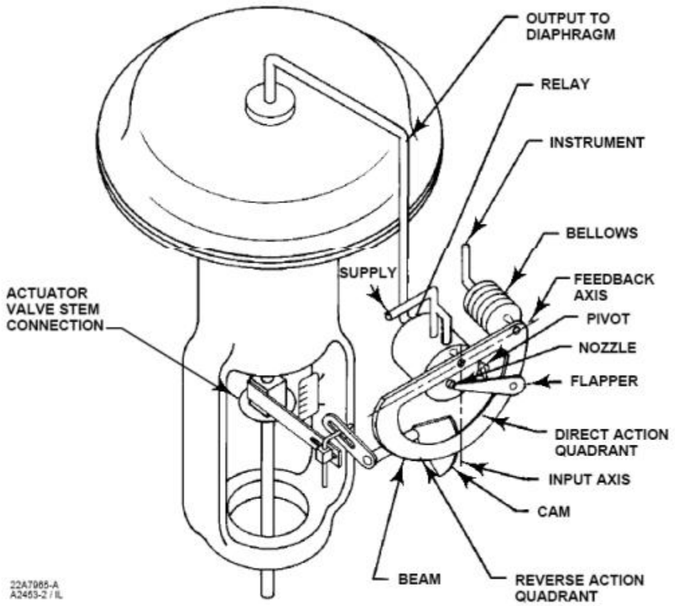
Pneumatically operated valves depend on a positioner to take an input signal from a process controller and convert it to valve travel. These instruments are available in three configurations:

1. Pneumatic Positioners
2. Analog I/PPositioner
3. Digital Controller

Positioners

1. Pneumatic Positioners:

Apneumatic signal (usually 3-15 psig) is supplied to the positioner.



Positioners

2.Analog I/PPositioner

This positioner performs the same function as the one above, but uses electrical current(usually 4-20 mA) instead of air as the input signal.

3. Digital Controller

Although this instrument functions very much as the Analog I/P described above,it differs in that the electronic signal conversion is digital rather than analog. The digital products cover three categories.

*** Digital Non-Communicating**

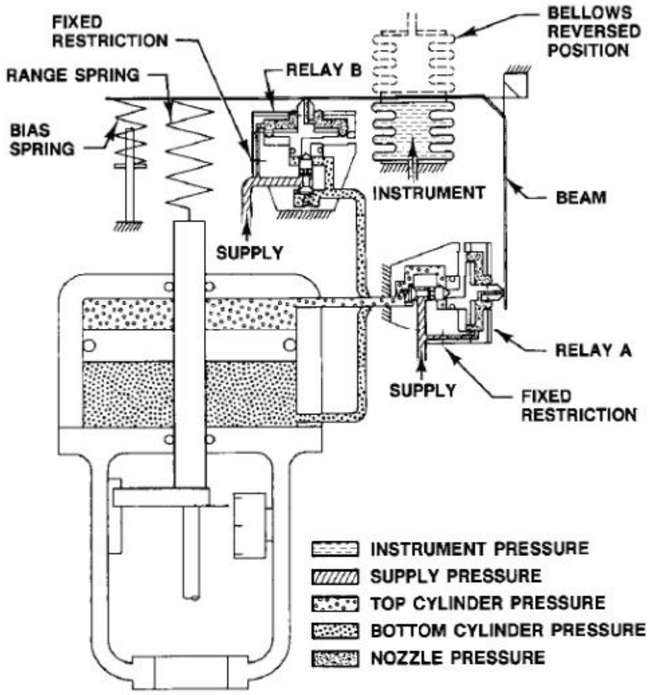
*** HART**

*** Fieldbus**

Positioners

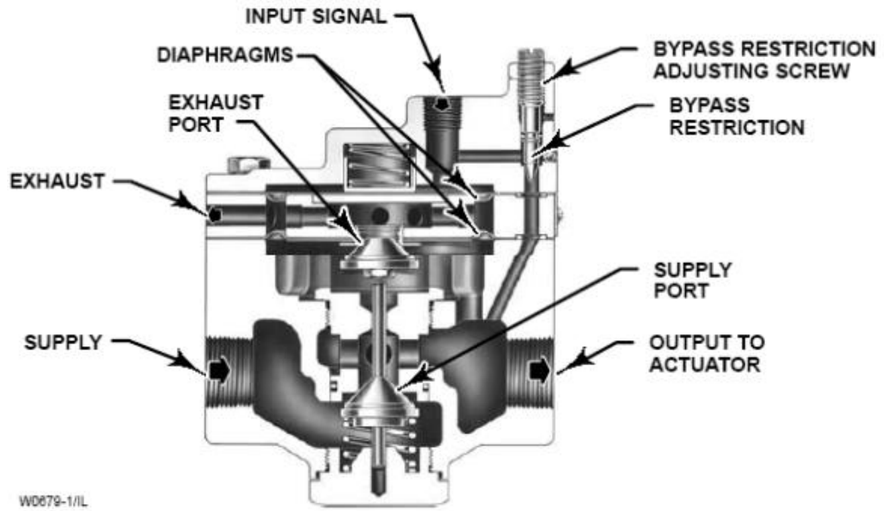
Modern Control Valves
Utilizing Digital Valve Controllers

Positioners



Positioner Schematic for Piston Actuator

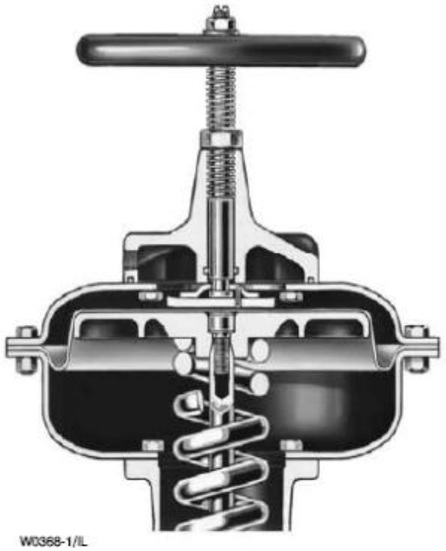
Volume Booster



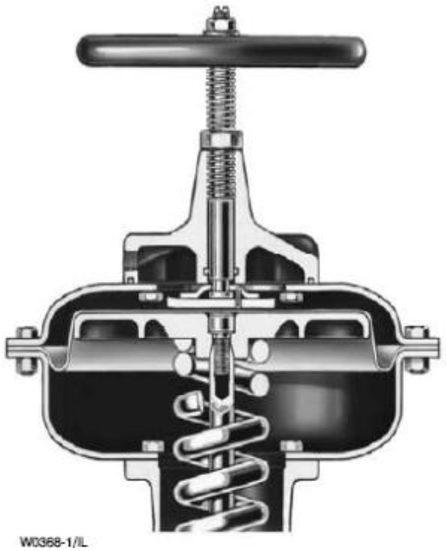
Volume Booster

Other Accessories

Other Control Valve Accessories



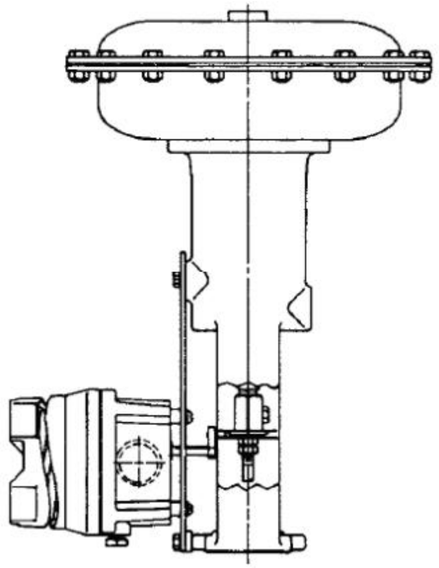
Top-Mounted Handwheel for Direct-Acting Diaphragm Actuator



Top-Mounted Handwheel for Reverse-Acting Diaphragm Actuator

Other Accessories

Limit Switches



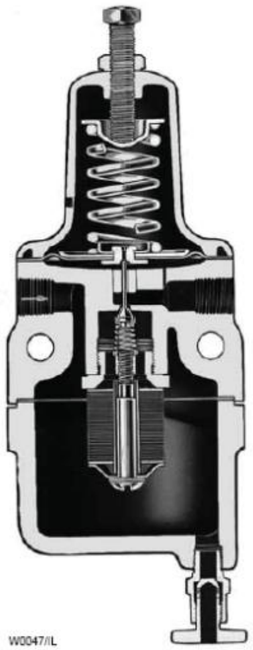
Cam-Operated Limit Switches

Other Accessories

Solenoid Valve Manifold

Other Accessories

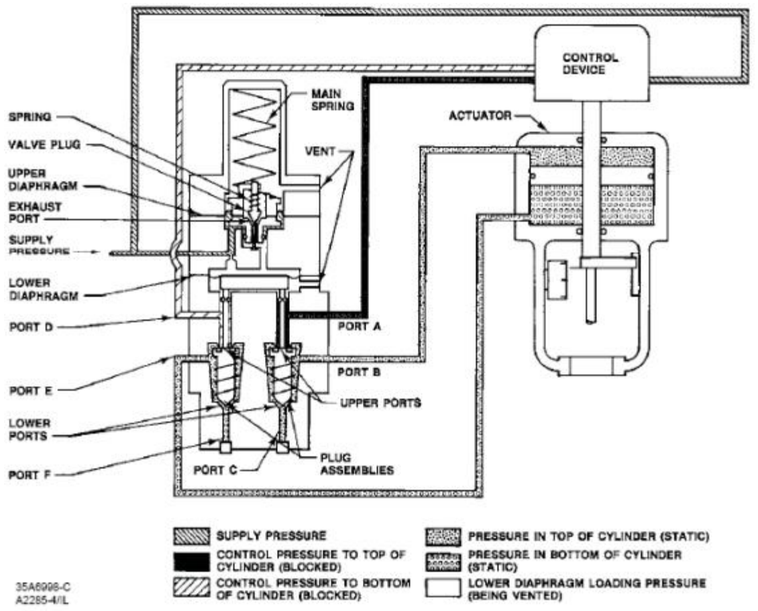
Supply Pressure Regulator



Supply Pressure Regulator with Filter and Moisture Trap

Other Accessories

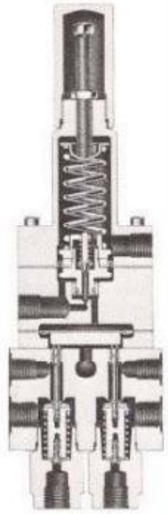
Pneumatic Lock-Up Systems



Supply Pressure Regulator with Filter and Moisture Trap

Other Accessories

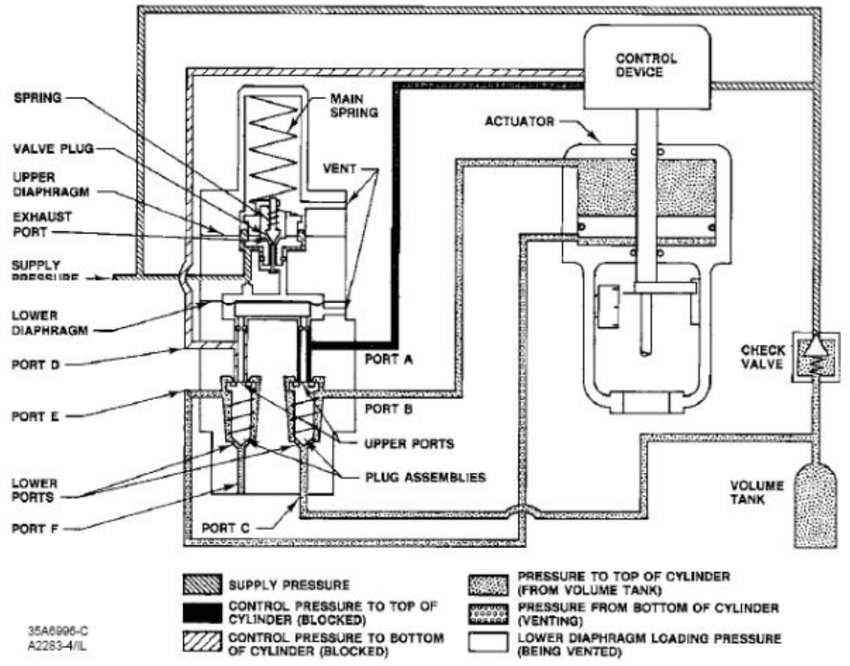
Pneumatic Lock-Up Systems



Trip Valve

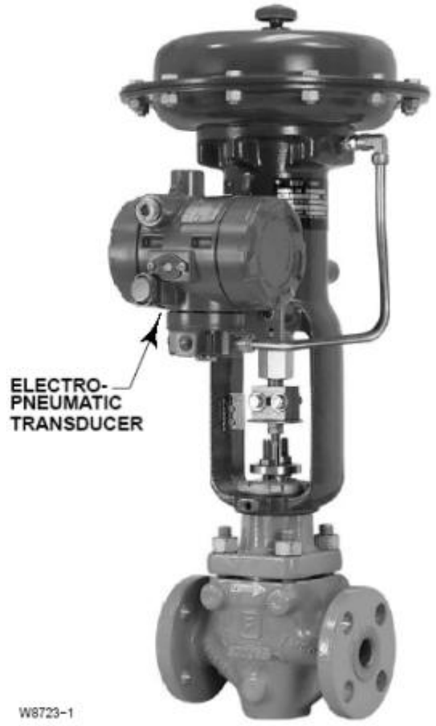
Other Accessories

Fail-Safe Systems for Piston Actuators



Other Accessories

Electro-Pneumatic Transducers



Electro-Pneumatic Transducer Mounted on a Diaphragm-Actuated Control Valve

Other Accessories

Electro-Pneumatic Valve Positioners

Other Accessories

Diagnostics

Digital valve controllers incorporate predefined instrument and valve diagnostics within firmware to provide alerts if there are problems with instrument mounting, electronics, hardware or valve performance.

Seat Leakage Classifications

Standards and Approvals

Control Valve Seat Leakage Classifications

(In accordance with ANSI/FCI 70—2 and IEC 60534-4)

Leakage class Designation	Maximum Leakage Allowable	Test Medium	Test Pressures	Testing Procedures Required for Establishing Rating
I	——-	——-	——-	No test required provided user and supplier so agree.
II	0.5% of rated capacity	Air or water at 10-52°C (50-125°F)	3-4bar(45-60psig) or max. operating differential, whichever is lower.	Pressure applied to valve inlet, with outlet open to atmosphere or connected to a low head loss measuring device, full normal closing thrust provided by actuator.

Seat Leakage Classifications

III	0.1% of rated capacity	As above	As above	As above.
IV	0.01% of rated capacity	As above	As above	As above.
V	0.0005ml per minute of water per inch of orifice diameter per psi differential(5 X $10^{-12}m^3$ per second of water per mm of orifice diameter per bar differential).	Water at 10-52°C(50-125°F)	Max.service pressure drop across valve plug, Not to exceed ANSI body rating, or lesser pressure by agreement.	Pressure applied to valve inlet after filling entire body cavity and connected piping with water and stroking valve plug closed.Use net specified max. Actuator thrust, but no more, even if available during test.allow time for leakage flow to stabilize.
VI	Not to exceed amounts shown in following table based on port diameter.	Air or nitrogen at 10-52°C(50-125°F)	3.5 bar (50 psig) or max. rated differential pressure across valve plug, whichever is lower.	Pressure applied to valve inlet. Actuator should be adjusted to operating conditions specified with full normal closing thrust applied to valve plug seat. Allow time for leakage flow to stabilize and use suitable measuring device.

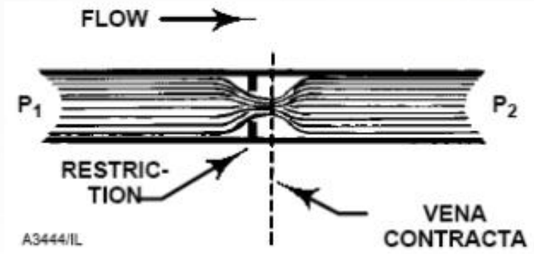
Cavitation and Flashing

Cavitation and Flashing

Choked Flow Causes Flashing and Cavitation

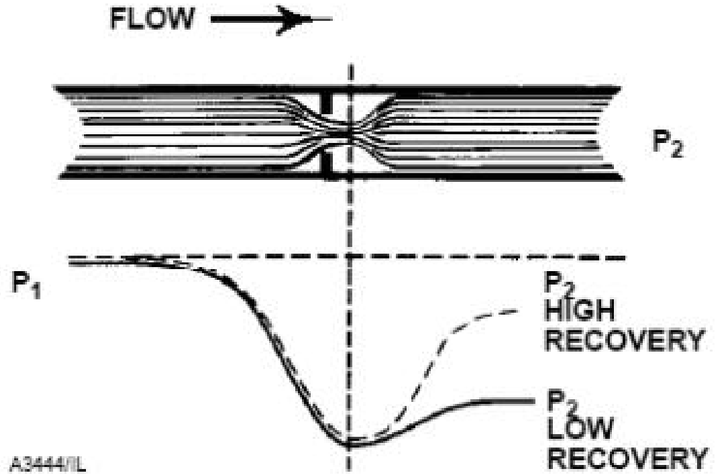
The IEC liquid sizing standard calculates an allowable sizing pressure drop, Δpmax. If the actual pressure drop across the valve, as defined by the system conditions of P1 and P2, is greater than Δpmax theneither flashing or cavitation may occur.

The change is from the liquid state to the vapor state and results from the increase in fluid velocity at or just downstream of the greatest flow restriction, normally the valve port.



Vena Contracta Illustration

Cavitation and Flashing



Comparison of Pressure Profiles for High and Low Recovery Valves

Cavitation and Flashing

Typical Appearance of Flashing Damage

Typical Appearance of Cavitation Damage

Noise Prediction

Noise Prediction

1. Aerodynamic

The method defines five basic steps to a noise prediction:

1. Calculate the total stream power in the process at the vena contracta.
2. Determine the fraction of total power that is acoustic power
3. Convert acoustic power to sound pressure.
4. Account for the transmission loss of the pipewall and restate the sound pressure at the outside surface of the pipe
5. Account for distance and calculate the sound pressure level at the observer’s location

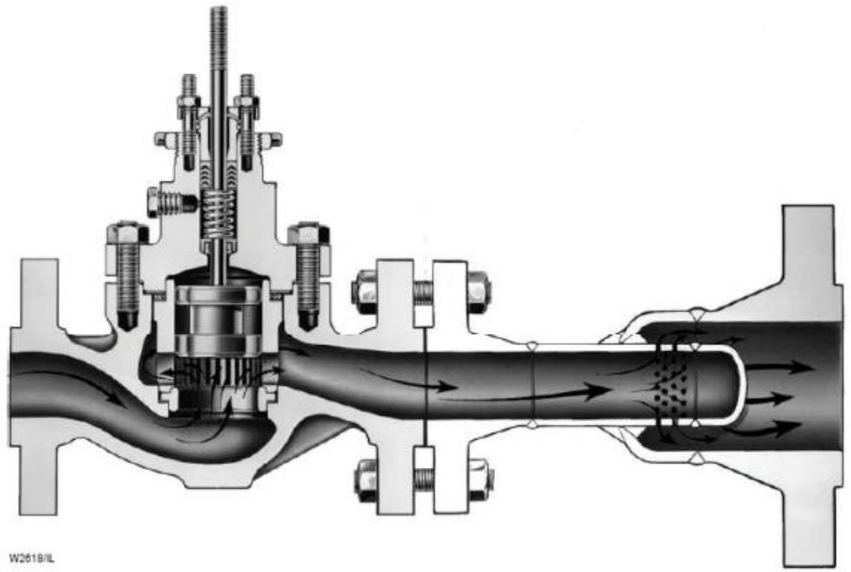
2. Hydrodynamic

Noise Prediction

Noise Control

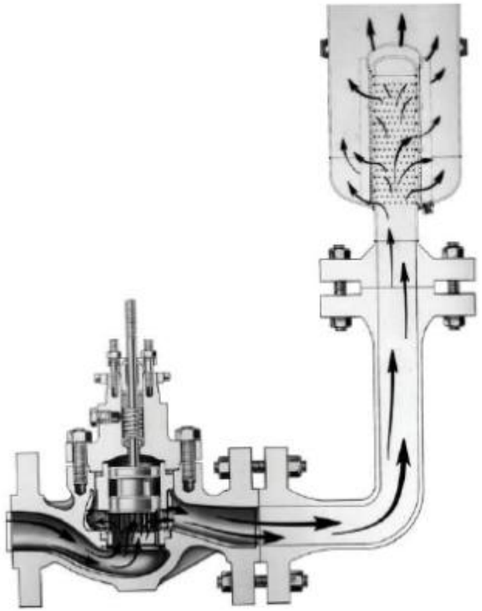
Valve Trim Design for Reducing Aerodynamic Noise

Noise Prediction



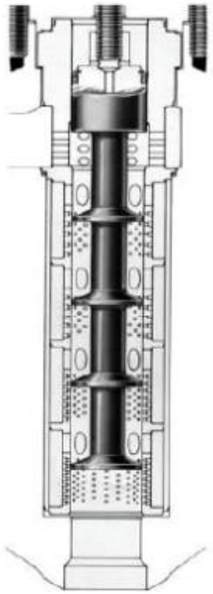
Valve and Inline Diffuser Combination

Noise Prediction



Valve and Vent
Diffuser Combination

Noise Prediction



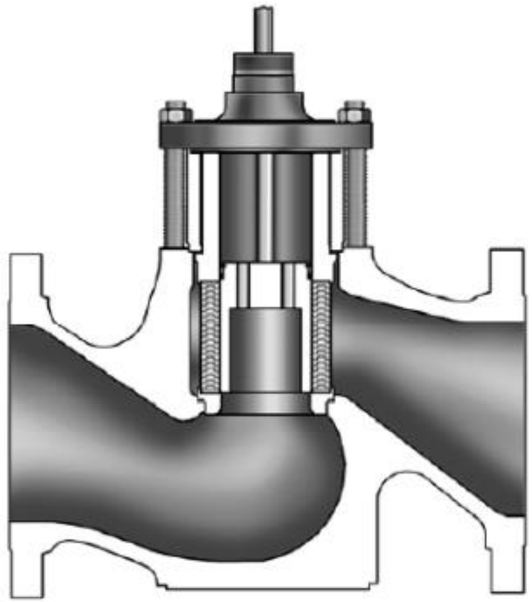
Special Valve
Design to Eliminate Cavitation

Noise Prediction

Typical In-Line Silencer

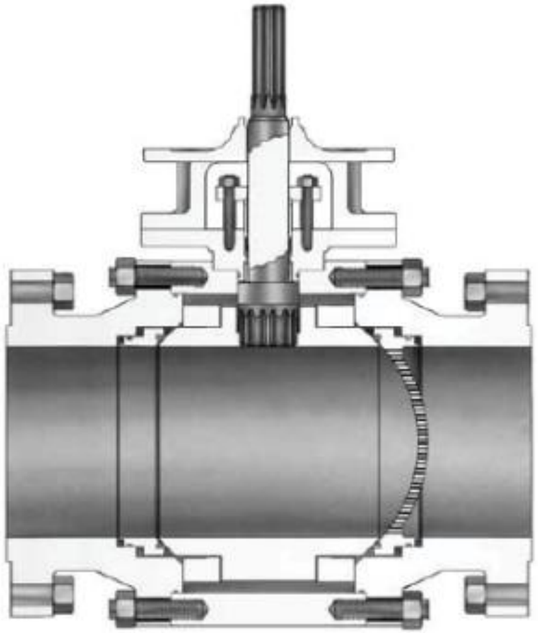
Noise Prediction

Noise Summary



Globe Style Valve
with Noise Abatement Cage for Aerodynamic Flow

Noise Prediction



Ball Style Valve with Attenuator to Reduce Hydrodynamic Noise

THANK YOU

+86 199 2125 0077

marketing@cncontrolvalve.com