

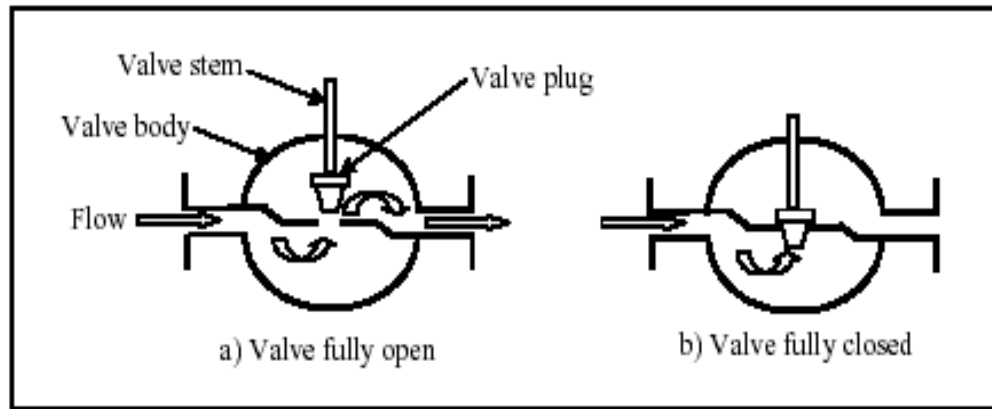
CONTROL VALVES



CONTROL VALVES

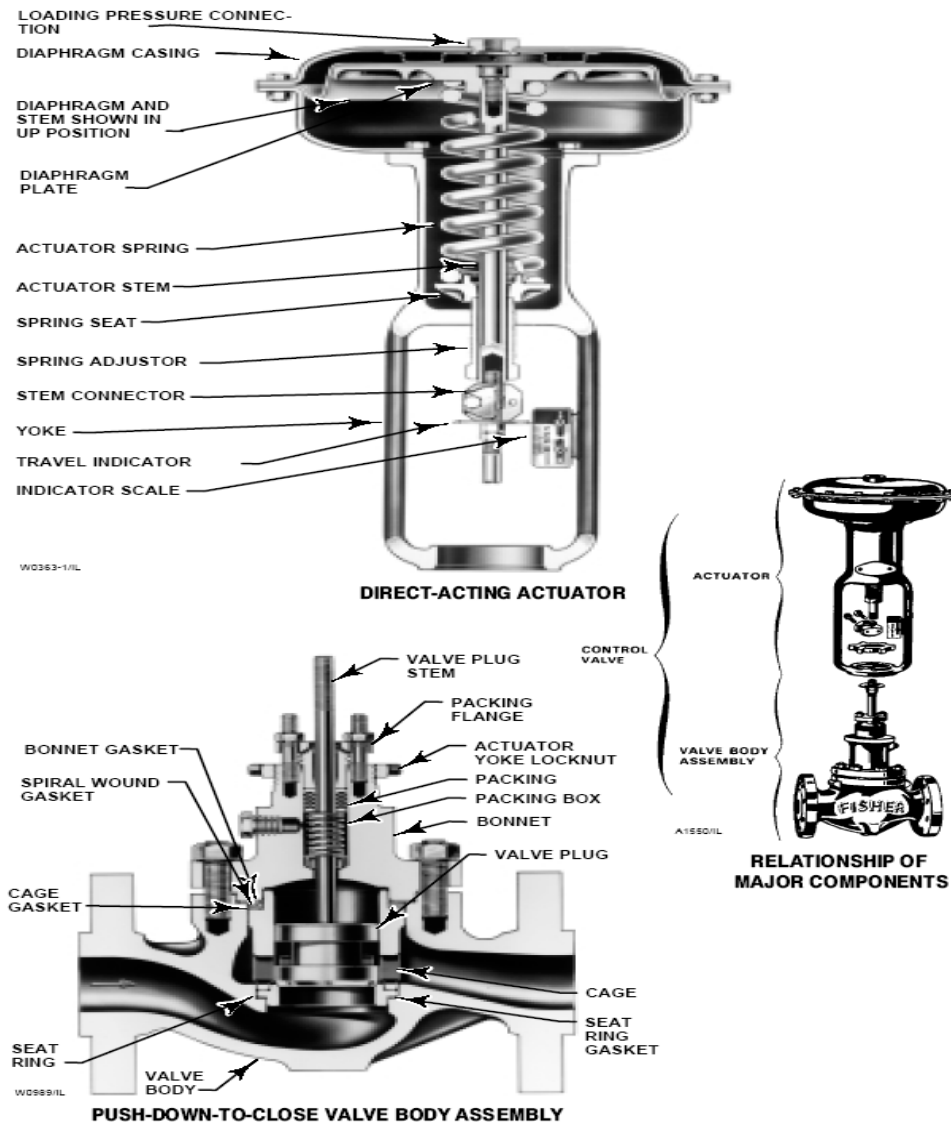
- INTRODUCTION

- CONTROL VALVE DEFINITION



- REQUIREMENTS FOR CONTROL VALVE :
 - 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
 - Incorporate appropriate end connections to mate with adjacent pipelines
 - actuator attachment means to permit transmission of actuator thrust to the valve plug stem or rotary shaft.

MAJOR COMPONENTS



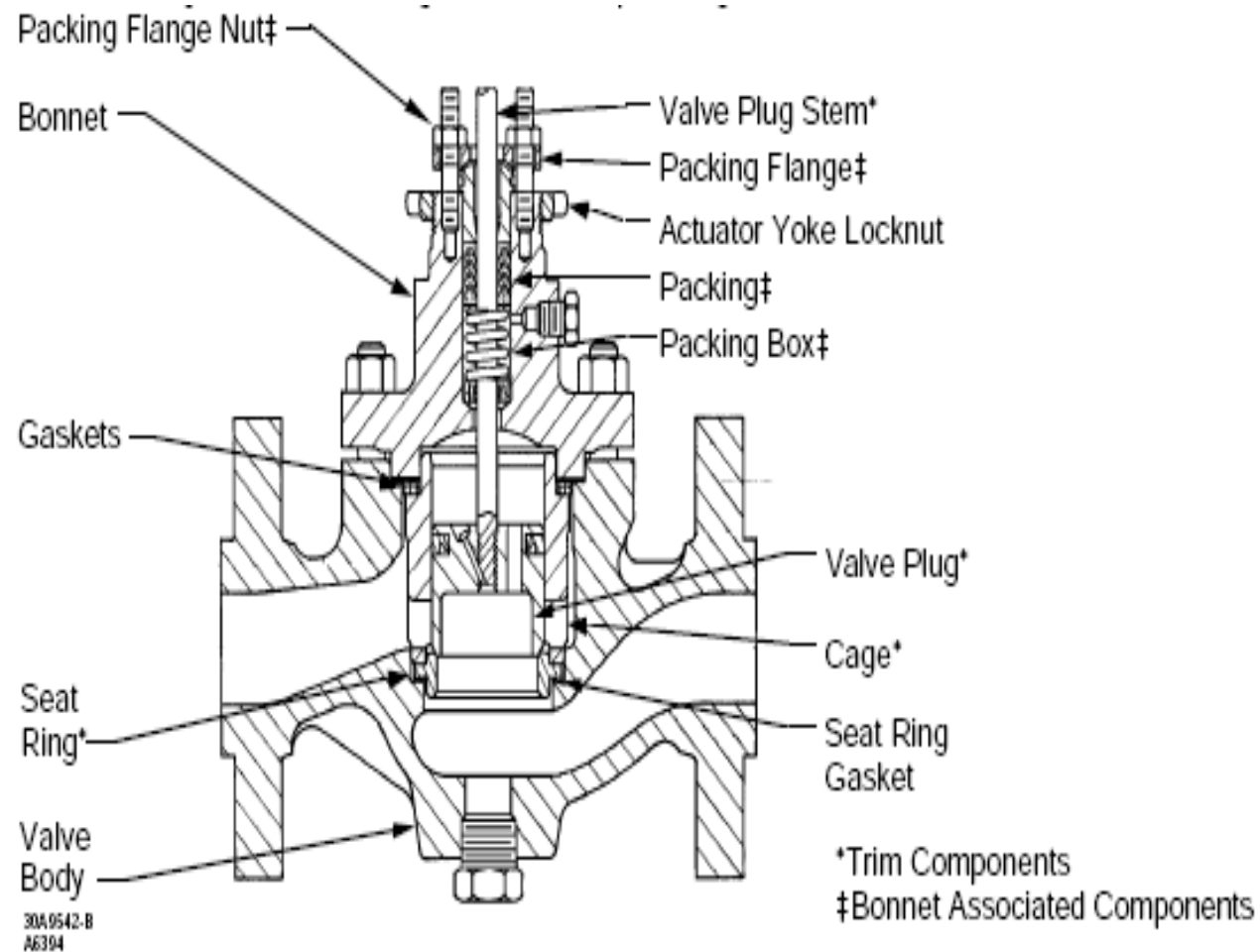
TYPES OF CONTROL VALVES

- Sliding-Stem Valves
- Rotary shaft valves

TYPES OF CONTROL VALVES

- **Sliding-Stem Valves**

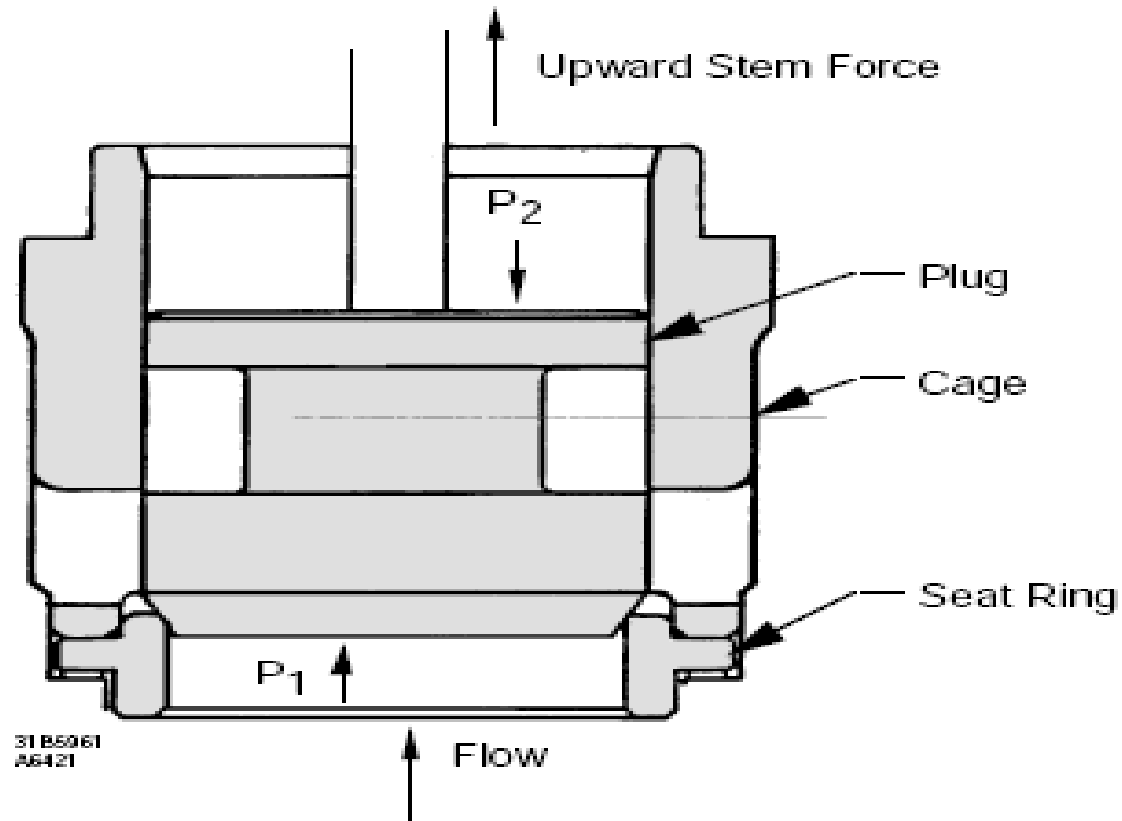
- include globe valves, angle valves, and double seat valves
- globe style valve is the most common used valve



COMPONENT DESCRIPTION

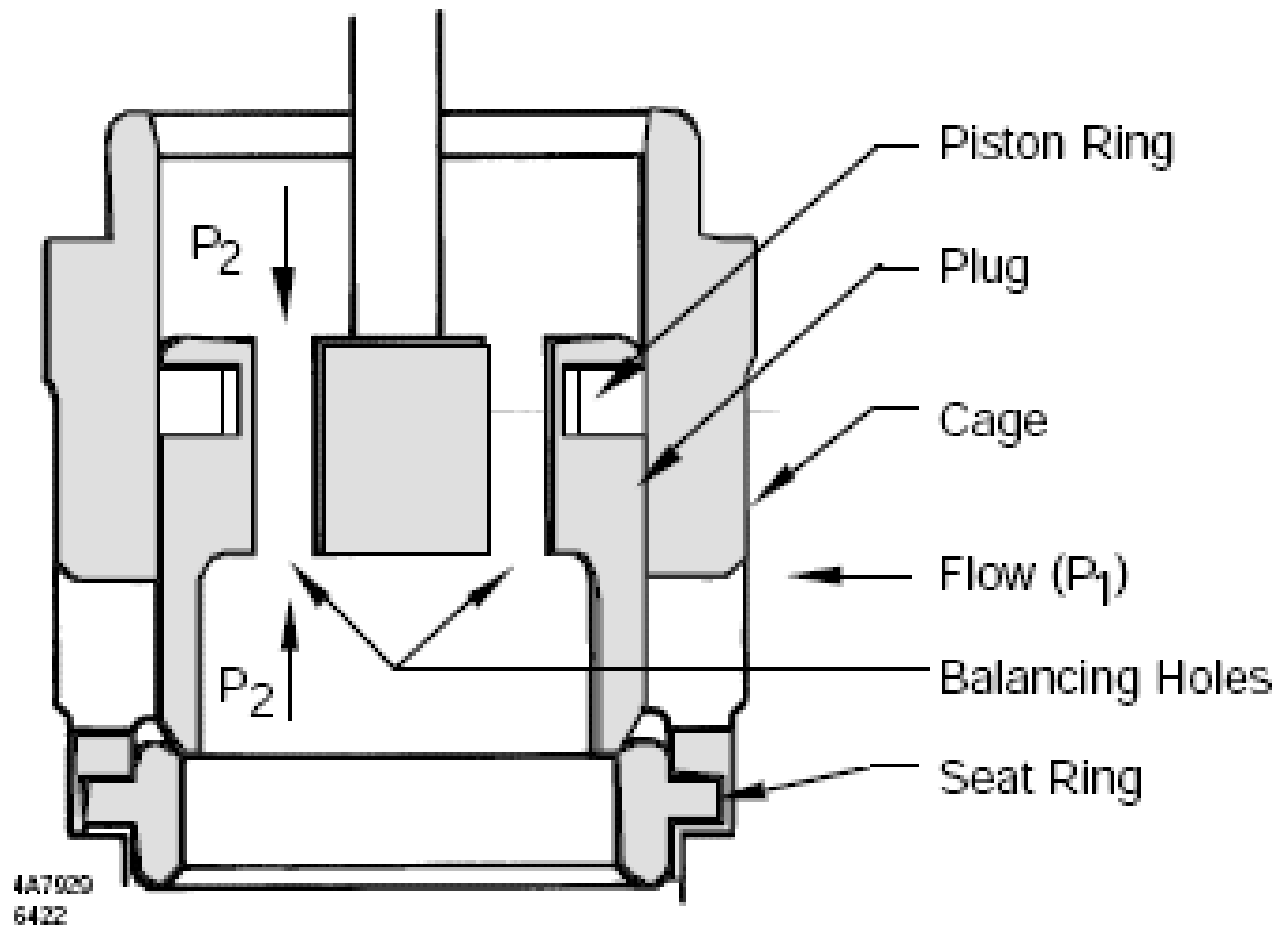
- VALVE BODY
- BONNET
- TRIM
- GASKETS
- PACKING

- Plug Balancing
 - Unbalanced plug



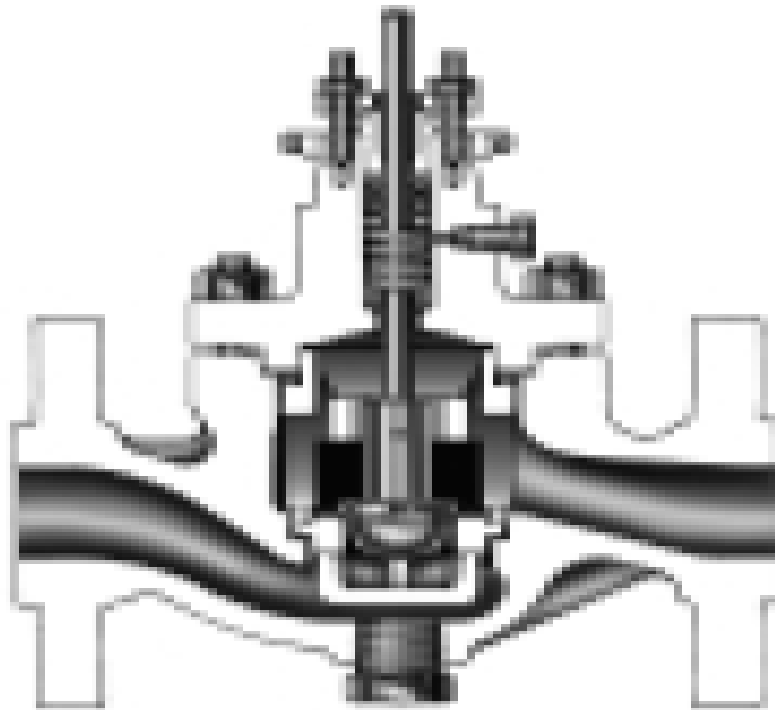
Unbalanced Valve Plug

- **Plug Balancing**
 - Balanced plug



Globe Valves body types

- Single-Port Valve Bodies

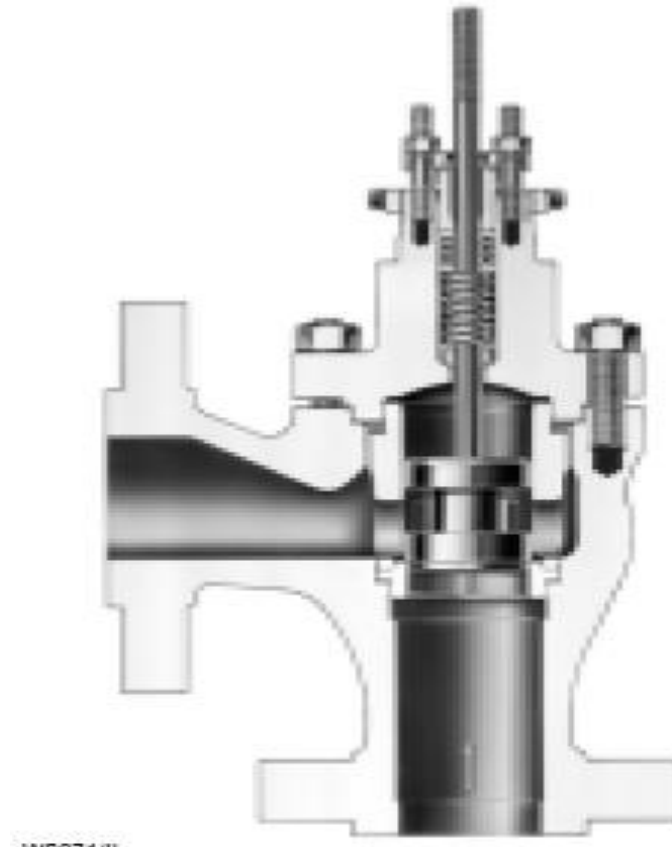


Globe Valves body types

- **Single-Port Valve Bodies**
 - is the most common valve body style and is simple in construction
 - specified for applications with stringent shutoff requirements
 - port valves can be used in 4-inch to 8-inch sizes with high-thrust actuators.
 - Many modern single-seated valve bodies use cage or retainer style construction

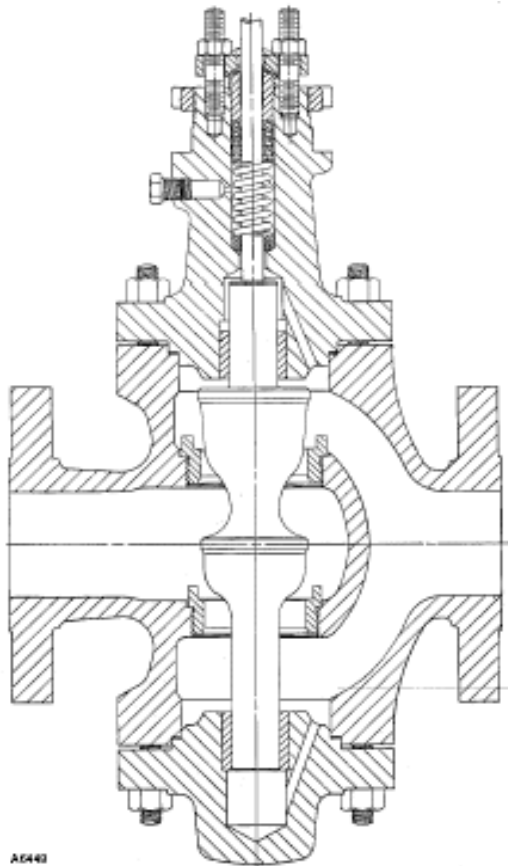
Globe Valves body types

- **Single-Port Valve Bodies**
 - Angle valves



Globe Valves body types

- Double-Ported Valve Bodies

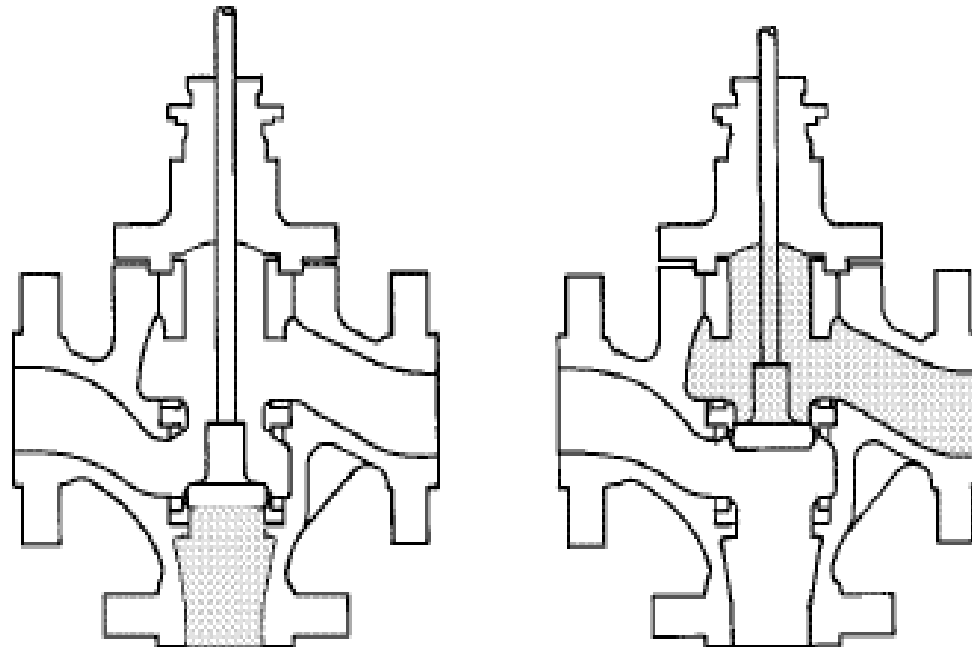


Globe Valves body types

- Double-Ported Valve Bodies
 - Dynamic force on plug tends to be balanced as flow tends to open one port and close the other.
 - Allow choosing a smaller actuator than single-ported valve body with similar capacity.
 - Bodies normally have higher capacity than single-ported valves of the same line size.
 - the valve plug can be installed as either push-down-to-open or push-down-to-close
 - typically used in refineries on highly viscous fluids
 - This valve type demonstrates a unique form of plug instability and vibration at high pressure drops
 - shutoff is limited to ANSI Class II.

Globe Valves body types

- Three-Way Valve Bodies



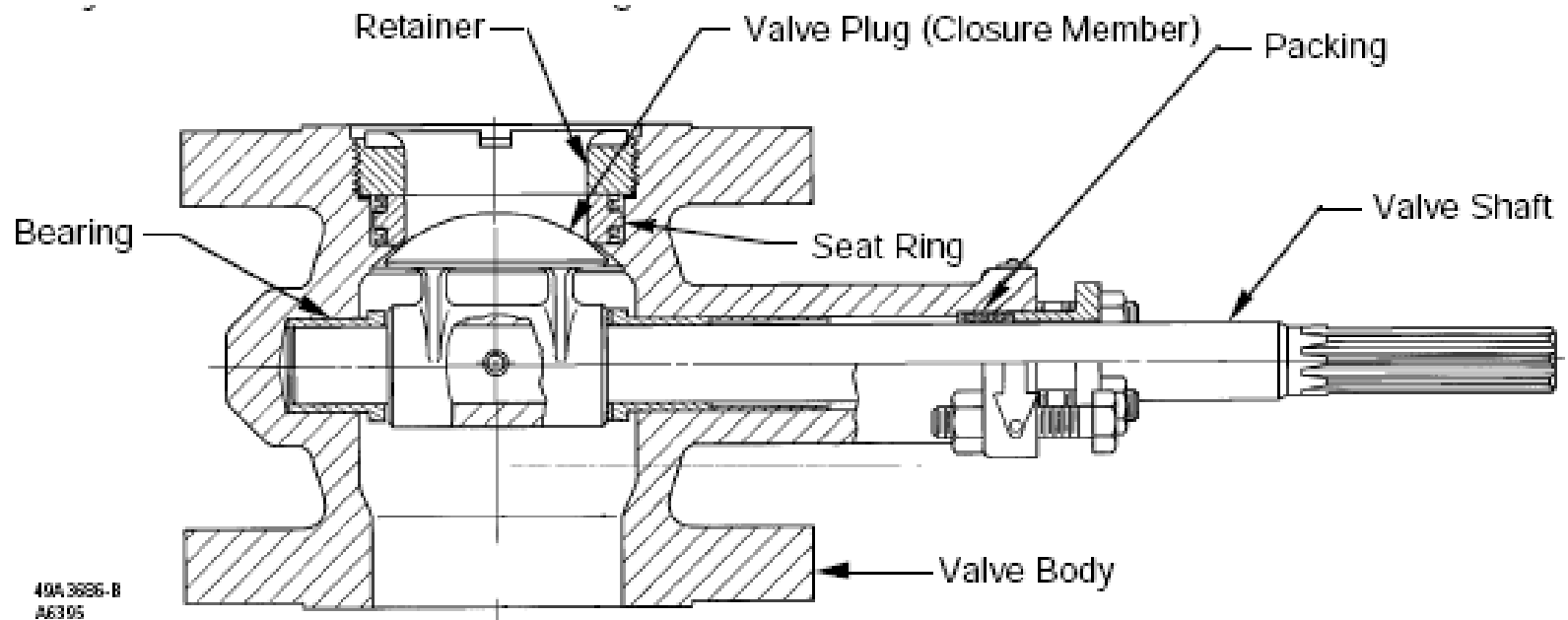
Globe Valves body types

- Three-Way Valve Bodies
 - Provide general converging (flow-mixing) or diverging (flow-splitting) service.

TYPES OF CONTROL VALVES

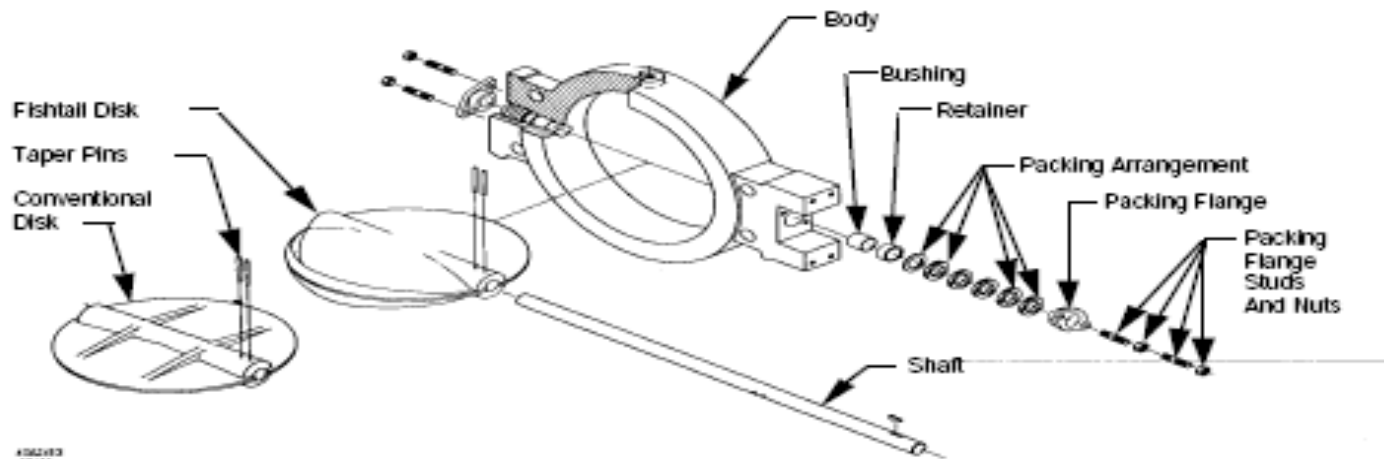
- **Rotary-Shaft Valves**

- include ball valves, butterfly valves, and rotary-plug valves



Rotary valve body types

- Butterfly Valve Bodies



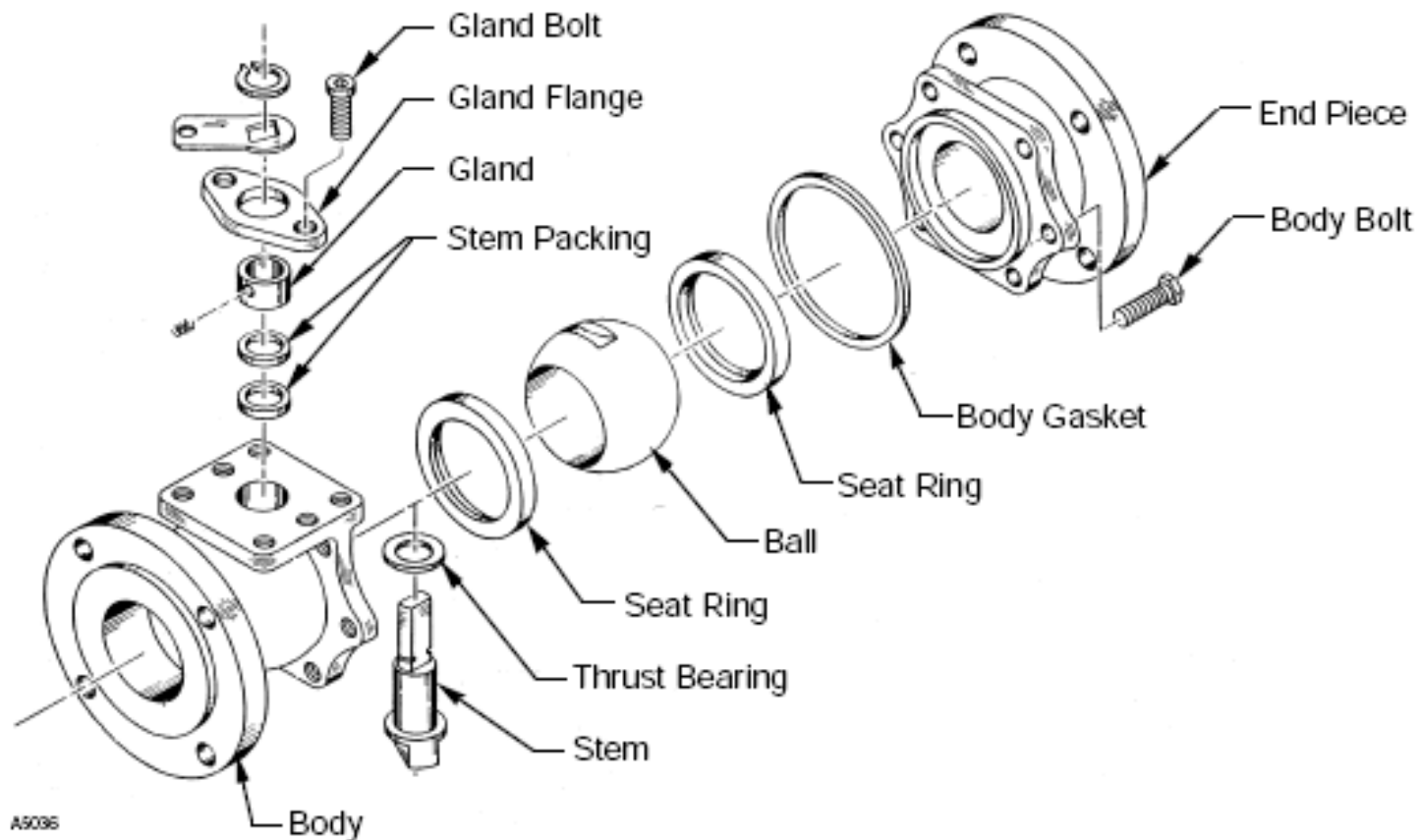
Rotary valve body types

- **Butterfly Valve Bodies**

- Bodies require minimum space for installation
- provide high capacity with low pressure loss through the valves.
- Butterfly valve bodies might require high-output or large actuators if the valve is big or the pressure drop is high, because operating torques might be quite large.
- Standard butterfly valves are available in sizes through 72-inch for miscellaneous control valve applications

Rotary valve body types

- Full Ball Valve Designs



Rotary valve body types

- **Full Ball Valve Designs**
 - ball valves have very high flow coefficients.
 - High pressure recovery
- **Limitations Of Full Bore Valves**
 - Poor flow characteristic
 - Flow control is imprecise in the first increments of valve opening or valve closing.
 - Floating ball designs have had chronic problems with line pressure forcing the seals out of the valve body.

COMPARISON

Sliding-Stem Valves	Rotary valve
• Tortuous flow path • Low recovery • Can throttle small flow rates • Offers variety of special trim designs • Suited to high-pressure applications • Usually flanged or threaded • Separable bonnet	• Streamlined flow path • High recovery • More capacity • Less packing wear • Can handle slurry and abrasives • Flangeless • Integral bonnet • High rangeability

CONTROL VALVE CLASSIFICATION

- Control Valve Packing

- PTFE V-Ring

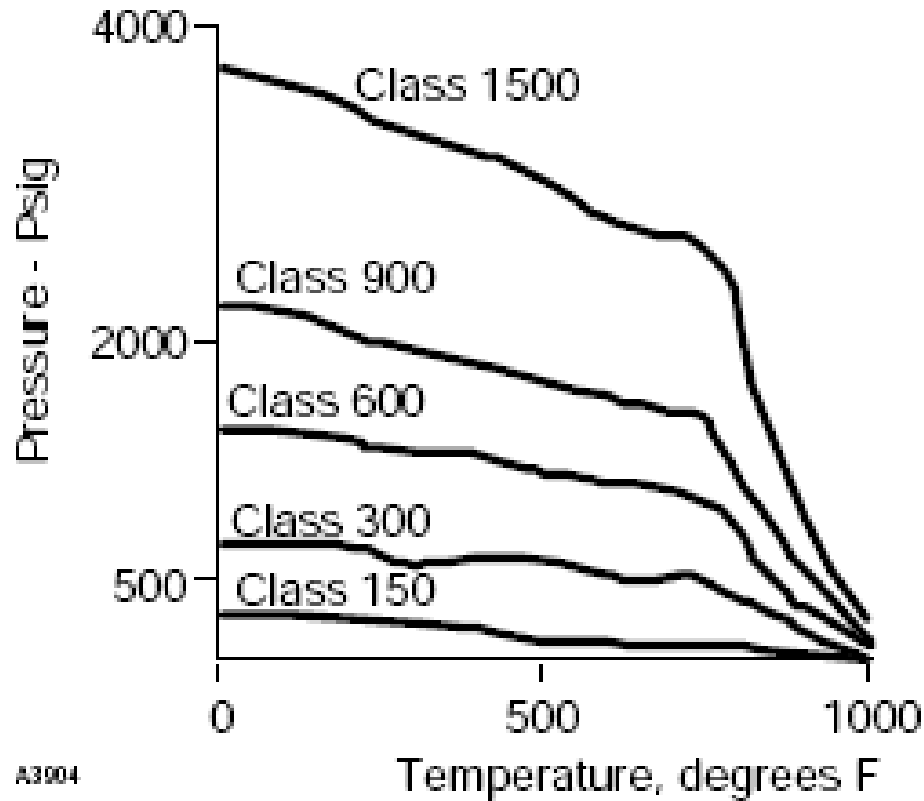
- Plastic material minimizing friction.
 - Packing lubrication not required.
 - Resistant to most known chemicals except molten alkali metals.
 - Requires extremely smooth stem finish to seal properly. Will leak if stem or packing surface is damaged.
 - Recommended temperature limits: -40 to +450_F (-40 to +232_C)

CONTROL VALVE CLASSIFICATION

- Control Valve Packing
 - Laminated and Filament Graphite
 - Suitable for high temperature nuclear service or where low chloride content is desirable.
 - Provides leak-free operation, high thermal conductivity, and long service life, but produces high stem friction and resultant hysteresis.
 - Impervious to most hard-to-handle fluids and high radiation.
 - Suitable temperature range: 1200F (649 °C)
 - Lubrication not required, but an extension bonnet or steel yoke should be used when packing box temperature exceeds 800F (427°C).

CONTROL VALVE CLASSIFICATION

- ANSI Class Ratings



ANSI Class Pressure Ratings For WCC Carbon Steel Valve Bodies And Bonnets

CONTROL VALVE CLASSIFICATION

- **Flow Capacity**
 - Flow Coefficient (Cv) Definition
 - Basic Liquid Flow Equation

To Solve For Flow: $Q = C_v \sqrt{\frac{\Delta P}{G}}$	To Solve For Cv: $C_v = Q \sqrt{\frac{G}{\Delta P}}$
--	--

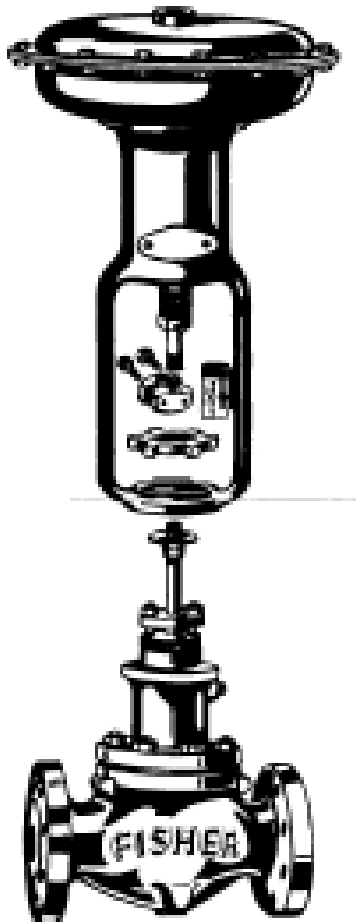
Valve Size	Travel, Percent	Rated Cv	
		Sliding-Stem Tortuous Path	Rotary-Shaft Streamlined Flow Path
1 inch	90	20	29
	10	3	0.5
8 inch	90	500	1180
	10	20	5

- **CAVITATION**
 - Cavitation Defined
 - Cavitation Damage
 - Valve Selection with CAVITATION
- **FLASHING**
 - Flashing Defined
 - Flashing Damage
 - Valve Selection with FLASHING



CONTROL VALVE ACTUATOR

- Actuator Functions



Position The Control Valve Closure Member

Hold The Closure Member In Position

Provide Seat Load

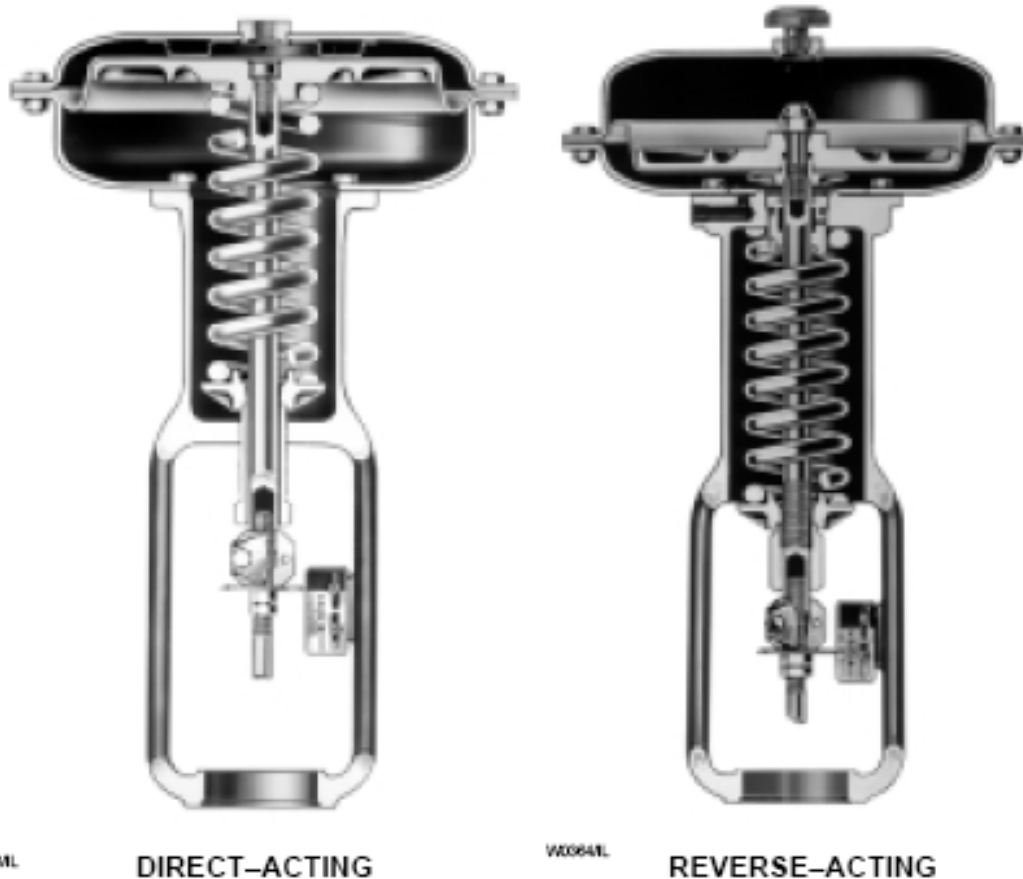
Provide Sufficient Valve Travel

Provide Adequate Stroking Speed

Provide A Fail Mode

CONTROL VALVE ACTUATOR

- Actuator types :
 - Diaphragm Actuators



CONTROL VALVE ACTUATOR

- Actuator types :

- Diaphragm Actuators

- The spring-and-diaphragm actuator is the most popular actuator type.
 - Various styles include: direct acting reverse-acting; reversible
 - Net output thrust is the difference between diaphragm force and opposing spring force.
 - Output thrust required and supply air pressure available dictate size.
 - Diaphragm actuators are simple, dependable, and economical.

CONTROL VALVE ACTUATOR

- Actuator types :
 - Piston Actuators



CONTROL VALVE ACTUATOR

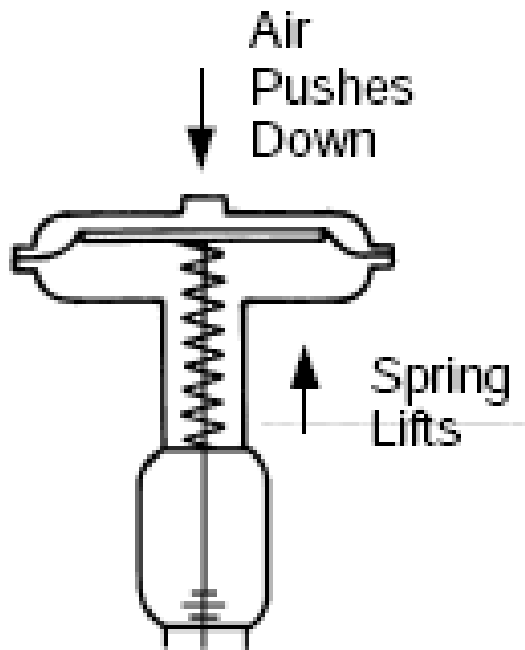
- **Actuator types :**

- **Piston Actuators**

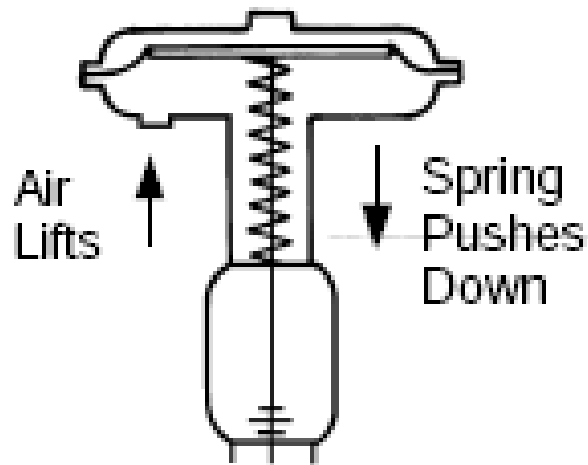
- Pneumatically operated using high-pressure plant air to 150 psig,
 - furnish maximum thrust output and fast stroking speeds.
 - Are double acting to give maximum force in both directions, or spring return to provide fail-open or fail-closed operation.
 - Rotary-shaft control valves include a sliding seal in the lower end of the cylinder. This permits the actuator stem to move laterally as well as up and down

CONTROL VALVE ACTUATOR

- Direct And Reverse-Acting Actuators



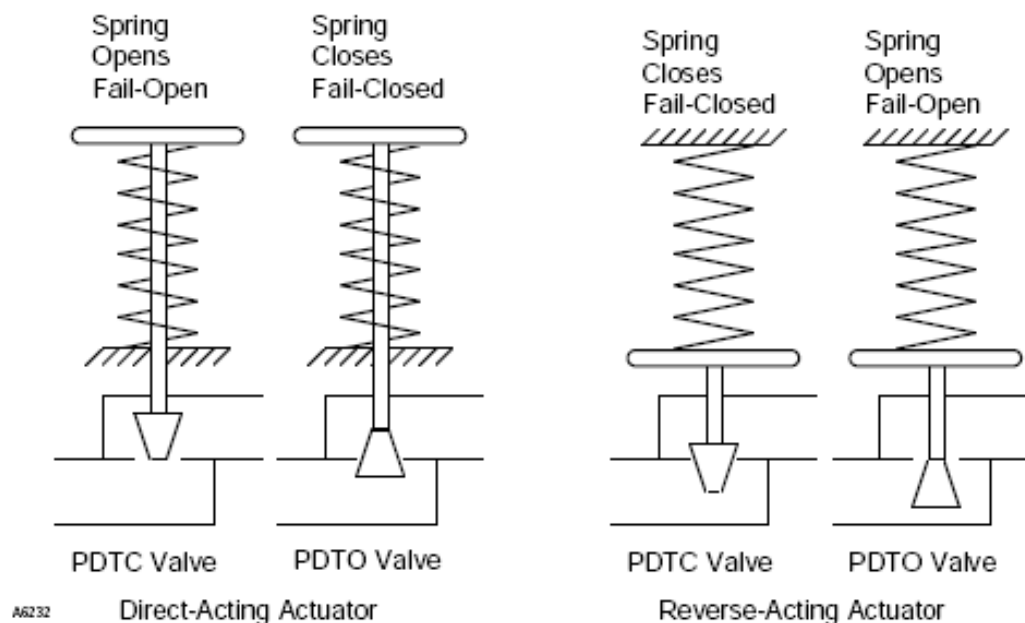
1A Direct-Acting



Reverse-Acting

CONTROL VALVE ACTUATOR

- The Desired Fail Mode



Desired Fail Mode	Valve Action	Actuator Action
Fail Close	PDTC	Reverse
	PDTO	Direct
Fail Open	PDTC	Direct
	PDTO	Reverse

ACTUATOR SIZING

- Unbalance force =
 - net pressure differential X net unbalance area
- Force to Provide Seat Load

Leak Class	Recommended Seat Load
Class I	As required by customer specification, no factory leak test required
Class II	20 pounds per lineal inch of port circumference
Class III	40 pounds per lineal inch of port circumference
Class IV	Standard (Lower) Seat only—40 pounds per lineal inch of port circumference (up through a 4-3/8 inch diameter port) Standard (Lower) Seat only—80 pounds per lineal inch of port circumference (larger than 4-3/8 inch diameter port)
Class V	Metal Seat—determine pounds per lineal inch of port circumference from figure 5-3
Class VI	Metal Seat—300 pounds per lineal inch of port circumference

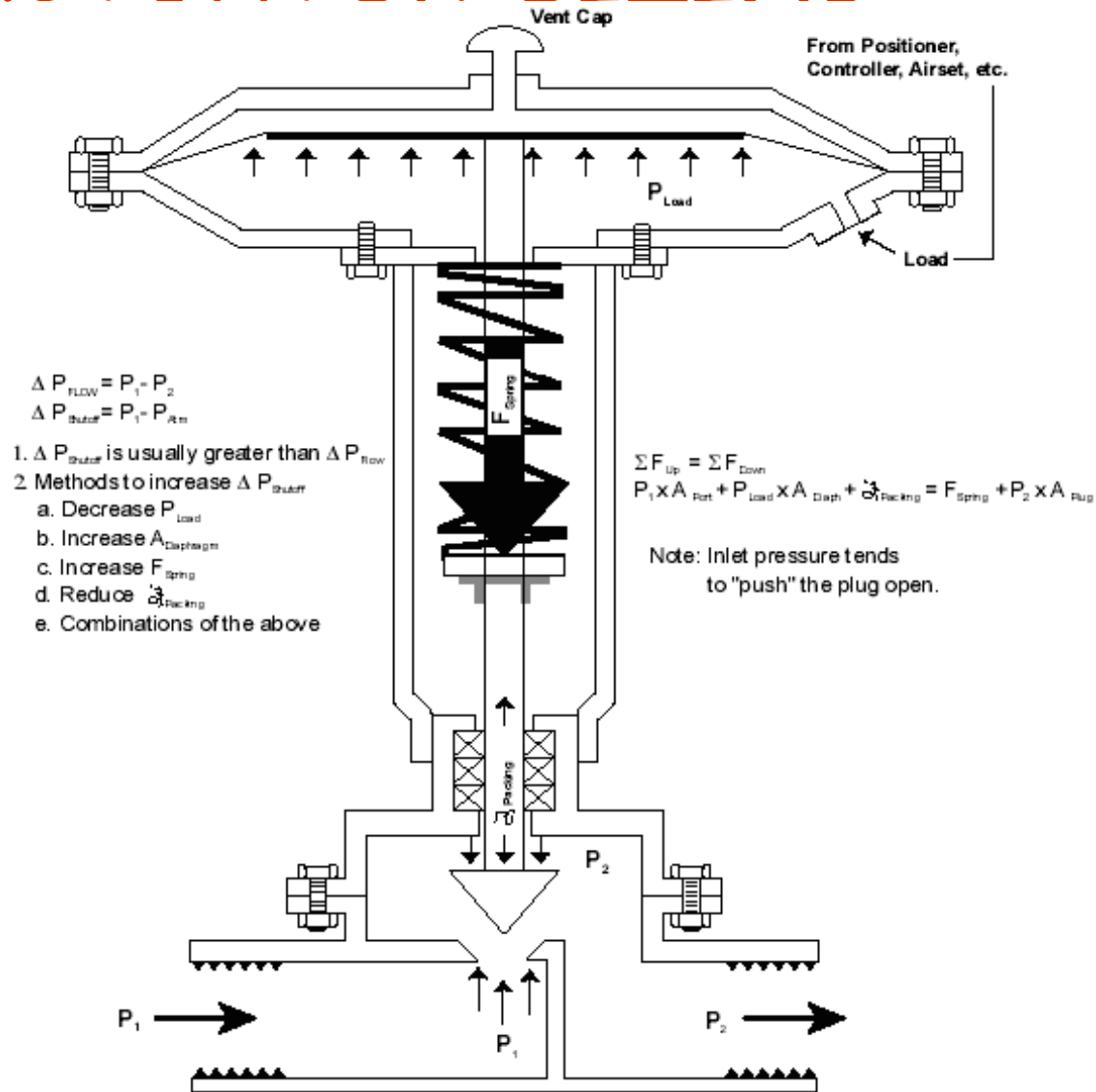
ACTUATOR SIZING

- Actuator Force Calculations
- Piston actuators

Piston Area X Minimum Supply Pressure = Available Thrust

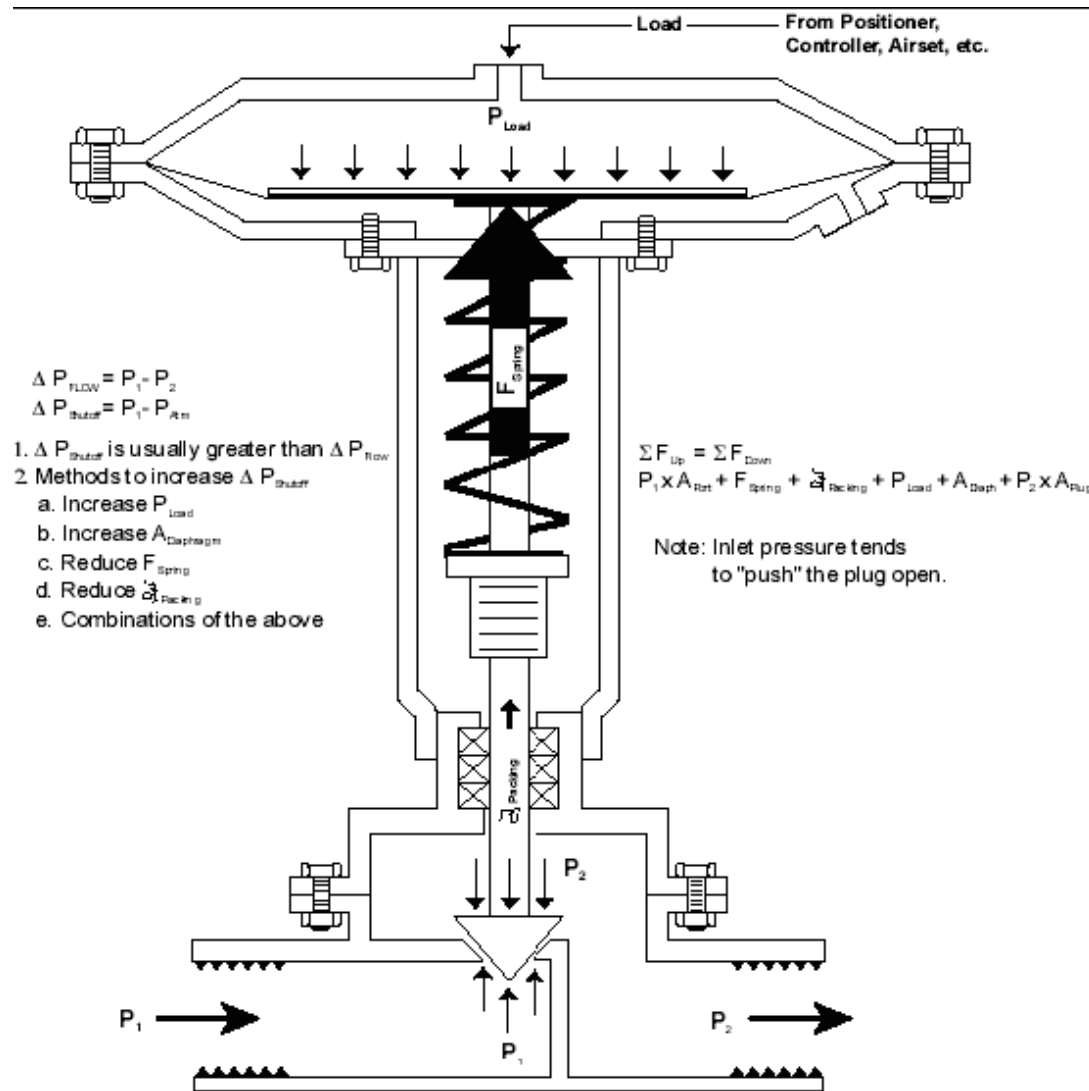
- Diaphragm Actuator
- BENCH SET

ACTUATOR SIZING



CONTROL VALVE ATC-FO ACTION

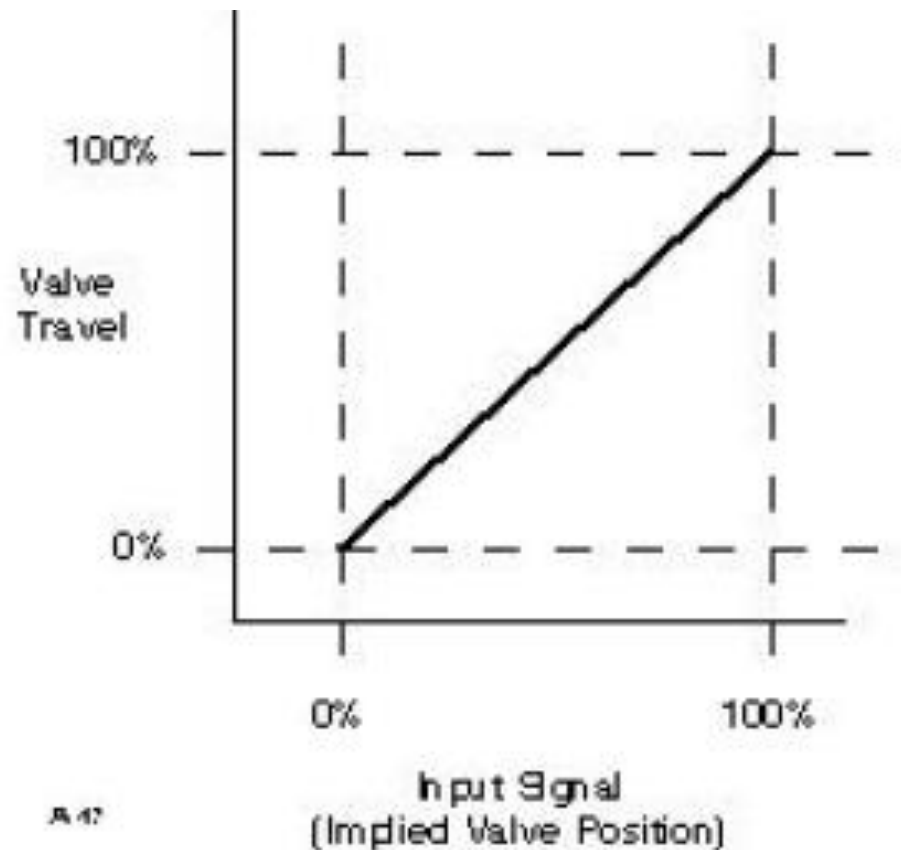
ACTUATOR SIZING



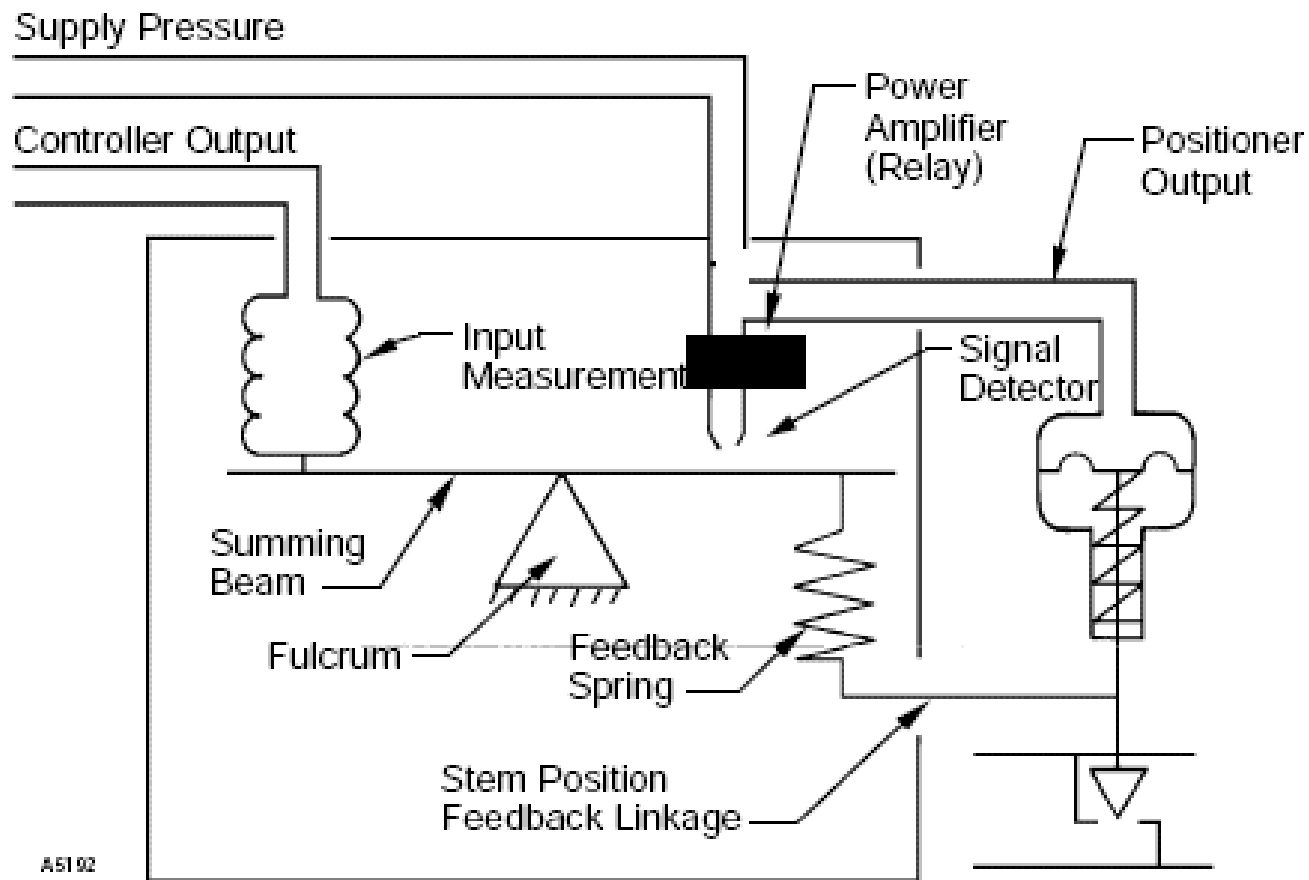
CONTROL VALVE ATO-FC ACTION

CONTROL VALVE POSITIONER

- Role

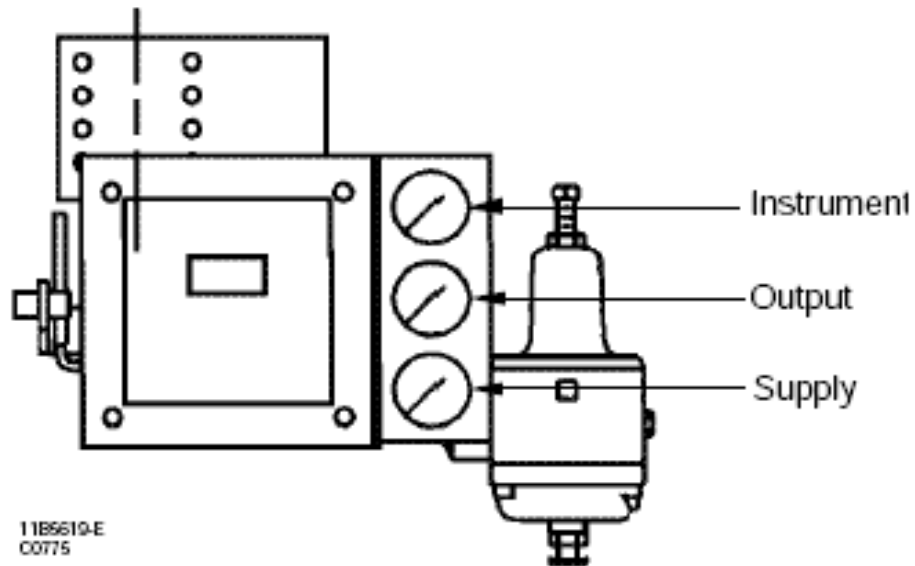


- **Positioner Operation**



- Positioner Options

- Positioner Action
- Gauges
- Bypass Valve
- Positioner Characteristics





Questions ?