ANSI/ISA-S75.05-1983

Approved September 29, 1986

American National Standard

Control Valve Terminology

ANSI/ISA-S75.05 — Control Valve Terminology

ISBN 0-87664-753-0

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Preface

This Preface is included for informational purposes and is not part of ISA-S75.05.

This standard has been prepared as a part of the service of ISA toward a goal of uniformity in the field of instrumentation. To be of real value, this document should not be static, but should be subject to periodic review. Toward this end, the Society welcomes all comments and criticisms, and asks that they be addressed to the Secretary, Standards and Practices Board, ISA, 67 Alexander Drive, P.O. Box 12277, Research Triangle Park, NC 27709, Telephone (919) 549-8411, e-mail: standards@isa.org.

The ISA Standards and Practices Department is aware of the growing need for attention to the metric system of units in general, and the International System of Units (SI) in particular, in the preparation of instrumentation standards. The Department is further aware of the benefits to USA users of ISA Standards of incorporating suitable references to the SI (and the metric system) in their business and professional dealings with other countries. Towards this end this Department will endeavor to introduce SI-acceptable metric units in all new, and revised standards to the greatest extent possible. *The Metric Practice Guide*, which has been published by the Institute of Electrical and Electronics Engineers, Inc. as ANSI/IEEE 268-1982, and future revisions, will be the reference guide for definitions, symbols, abbreviations, and conversion factors.

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Prior to the issue of this standard, there had been no standard which provided terminology for control valve functions, types of valves and parts of valves used for control of fluid flow. This standard provides terminology for control valves of seven different types and also for common types of actuators used with these valves. This standard names individual valve parts, defines assemblies of parts, and provides terminology for part and assembly functions. Terminology is provided for differently shaped parts performing the same function. Operating terminology is furnished for the complete valve-actuator unit as well as limited terminology for the function of auxiliary equipment used with control valves. Type of construction terminology is provided where there may be a reason to specify a particular construction.

This standard is provided with a subject index for cross-reference and a glossary to define commonly used control valve terms. Defined terms, where used as a part of other definitions, are set in italics to provide a ready cross reference.

Valve classification charts are provided to show the control valve function within the entire grouping of valves and the charts are extended to show the relationship of control valves by type.

This standard replaces ASME Standard 112, issued in 1961, "Diaphragm Actuated Control Valve Standard," which is now inactive and is to be withdrawn. For additional information see the ISA Handbook of Control Valves.

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Contents

1 Scope and purpose

1.1 To provide terminology and classification for the following types of *control valves.*

1.1.1 *Linear motion type control valves* covered are: (Section 5)

Globe (Subsection 5.1)

Gate (Subsection 5.2)

Diaphragm (Subsection 5.3)

Pinch or Clamp (Subsection 5.4)

1.1.2 *Rotary motion type control valves* covered are: (Section 6)

Ball (Subsection 6.1)

Butterfly, (Subsection 6.2)

Plug (Subsection 6.3)

1.2 To provide terminology and classification for the following types of control valve actuators.

1.2.1 *Actuator types* covered are: (Section 7)

Diaphragm (Subsection 7.1.1.1)

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Bellows (Subsection 7.1.1.4)

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Electro Mechanical Type (Subsection 7.1.2.1)

Electro Hydraulic Type (Subsection 7.1.2.2)

Hydraulic (Subsection 7.1.3)

1.3 To provide the description and classification of *auxiliary equipment* which may be used with *control valves*. (Section 8)

1.4 To provide a glossary to define other terms commonly used in the control valve industry.

2 Basic definitions

2.1 Control valve*: A power operated device which modifies the fluid flow rate in a process control system. It consists of a *valve* connected to an *actuator* mechanism that is capable of changing the position of a flow controlling element in the valve in response to a signal from the controlling system.

2.1.1 Valve: A *valve* is a device used for the control of fluid flow. It consists of a fluid retaining assembly, one or more ports between end openings and a movable *closure member* which opens, restricts or closes the *port(s)*.

2.1.2 Actuator: An *actuator* is a fluid powered or electrically powered device which supplies force and motion to a *valve closure member*.

2.1.3 Motion conversion mechanism: A mechanism between the *valve* and the power unit of the *actuator* to convert between linear and rotary motion. The conversion can be from *linear actuator* action to *rotary valve* operation or from *rotary actuator* action to *linear valve* operation.

3 Classification

The classification of *valves*, *actuators,* and *valve positioners* is illustrated in the following charts:

3.1 Valves

3.2 Control valves

3.3 Actuators

3.4 Valve positioners

*The following types of valves are excluded from this standard:

1) **Regulator** — A regulator, whether for flow, level, pressure or temperature is a valve with a positioning actuator using a self-generated power signal for moving the closure member relative to the valve port or ports in response and in proportion to the changes in energy of the controlled variable. The force to position the closure member is derived from the same fluid. Source: "Standard Classification and Terminology for Power Actuated Valves," (Fluid Controls Institute) FCI 55-1 (1962).

2) **Relief Valve** — A generic term applying to relief valves, safety valves or safety relief valves. Source: ANSI B95.1 or API RP520.

3) **Hand Valve** — A generic term applying to valves used in process piping to provide shut off or isolation.

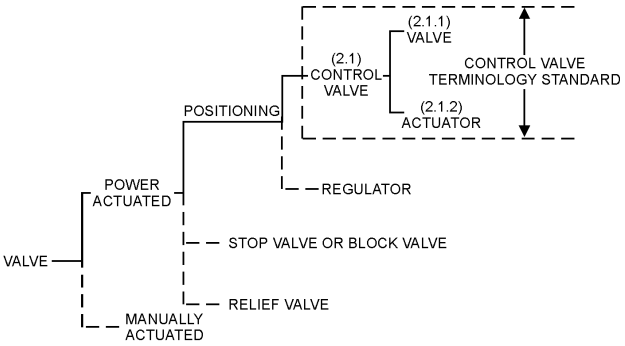


Chart 3.1 — Valves (taken in part from FCI 55-1, 1962 Std.)

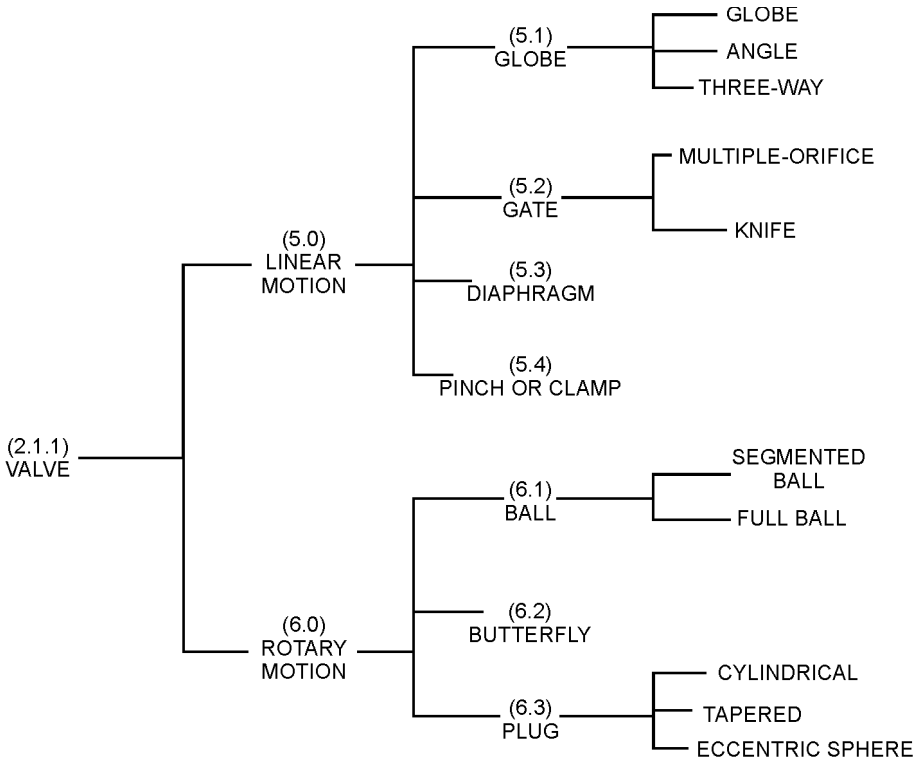


Chart 3.2 — Control valves

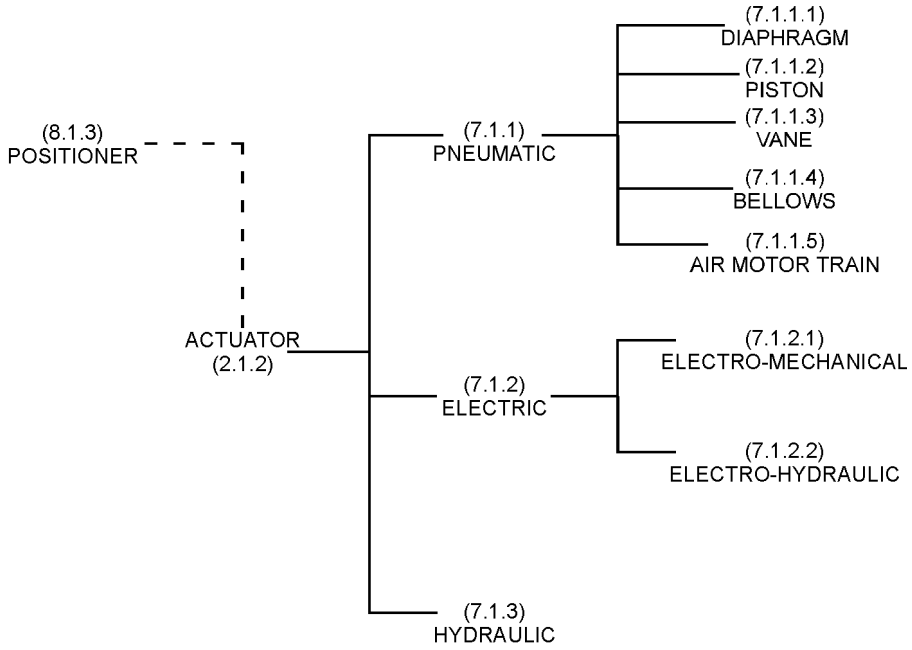


Chart 3.3 — Actuators

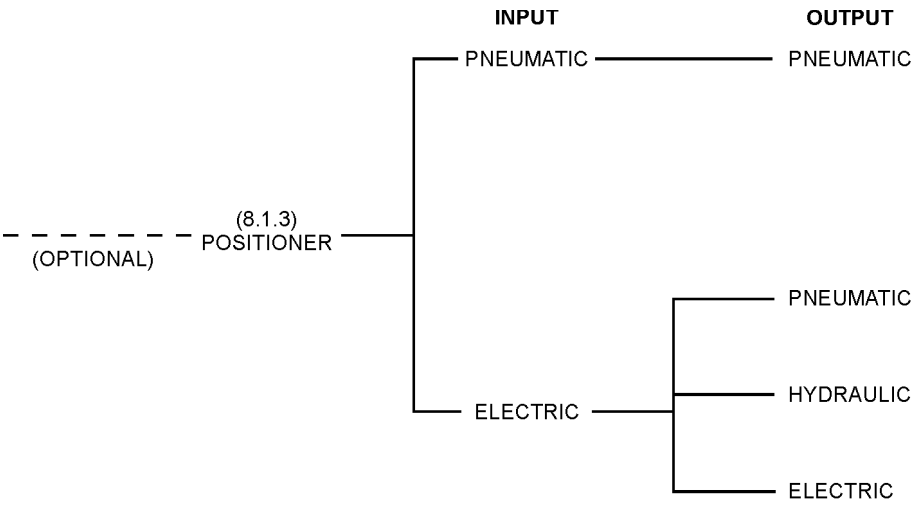


Chart 3.4 — Valve positioners

4 Definitions of parts common to many types of valves

4.1 Body: The part of the *valve* which is the main pressure boundary. The *body* also provides the pipe connecting ends, the fluid flow passageway, and may support the seating surfaces and the *valve closure member*.

4.2 Bonnet: That portion of the valve pressure retaining boundary which may guide the *stem* and contains the *packing box* and *stem seal*. It may also provide the principal opening to the *body* cavity for assembly of internal parts or be an integral part of the *valve body*. It may also provide for the attachment of the actuator to the valve body.

4.2.1 Bonnet types: Typical bonnets are bolted, threaded, or welded to or integral with the *body*. Other types sometimes used are defined below.

4.2.1.1 Extension bonnet: A *bonnet* with a *packing box* that is extended above the *bonnet* joint of the *valve body* so as to maintain the temperature of the packing above or below the temperature of the process fluid. The length of the extension *bonnet* is dependent upon the difference between the fluid temperature and the packing design temperature limit as well as upon the *valve body* design.

4.2.1.2 Seal welded bonnet: A *bonnet* welded to a *body*, at assembly, to provide a zero leakage joint. This construction consists of a low-strength weld with the bonnet retained to the *body* by other means to withstand the body pressure load acting on the *bonnet* area.

4.2.2 Bonnet gasket: A deformable sealing element between the mating surfaces of the *body* and *bonnet*. It may be deformed by compressive stress or energized by fluid pressure within the *valve body.*

4.2.3 Bonnet bolting: A means of fastening the *bonnet* to the body. It may consist of studs with nuts for a flanged *bonnet* joint, studs threaded into the *bonnet* neck of the body, or bolts through the *bonnet* flange.

4.3 Closure member: A movable part of the *valve* which is positioned in the flow path to modify the rate of flow through the *valve.*

4.3.1 Closure member types

4.3.1.1 Ball: A spherically shaped part which uses a portion of a spherical surface or an internal path to modify flow rate with rotary motion.

4.3.1.2 Disk: An essentially flat, circular shaped part which modifies the flow rate with either linear or rotary motion.

4.3.1.3 Gate: A flat or wedge-shaped sliding element that modifies flow rate with linear motion across the flow path.

4.3.1.4 Plug: A cylindrical part which moves in the flow stream with linear motion to modify the flow rate and which may or may not have a contoured portion to provide flow characterization. It may also be a cylindrical or conically tapered part, which may have an internal flow path, that modifies the flow rate with rotary motion.

4.4 Flow control orifice: The part of the flow passageway that, with the *closure member,* modifies the rate of flow through the *valve*. The orifice may be provided with a seating surface, to be contacted by or closely fitted to the *closure member,* to provide tight shutoff or limited leakage.

4.4.1 Seat ring: A part that is assembled in the *valve body* and may provide part of the flow control orifice. The *seat ring* may have special material properties and may provide the contact surface for the *closure member*. Typical *seat ring* hard facing is shown in Appendix A.

4.4.2 Cage: A part in a *globe valve* surrounding the *closure member* to provide alignment and facilitate assembly of other parts of the *valve trim*. The *cage* may also provide flow characterization and/or a seating surface for *globe valves* and flow characterization for some *plug valves*.

4.4.3 Integral seat: A *flow control orifice* and seat that is an integral part of the *body* or *cage* material or may be constructed from material added to the *body* or *cage*.

4.5 Stem: The rod, shaft or spindle which connects the valve *actuator* with the *closure member*.

4.6 Stem seals: The part or parts needed to effect a pressure-tight seal around the *stem* while allowing movement of the *stem*.

4.6.1 Packing: A sealing system consisting of deformable material of one or more mating and deformable elements contained in a packing box which may have an adjustable compression means to obtain or maintain an effective pressure seal.

4.6.1.1 Packing box: The chamber, in the *bonnet*, surrounding the stem and containing *packing* and other *stem* sealing parts.

4.6.1.2 Packing follower: A part which transfers mechanical load to the *packing* from the packing flange or nut.

4.6.1.3 Lantern ring: A rigid spacer assembled in the *packing box* with packing normally above and below it and designed to allow lubrication of the *packing* or access to a leak-off connection.

4.6.2 Pressure energized stem seal: A part and/or *packing* material deformable by fluid pressure that bears against the *stem* to make a tight seal.

4.6.3 Bellows stem seal: A thin wall, convoluted, flexible member which makes a seal between the *stem* and *bonnet* or *body* and allows *stem* motion while maintaining a positive seal.

4.6.4 Back seat: A seating surface in the bonnet area that mates with the *closure member* or *valve stem* in the extreme open position to provide pressure isolation of the *stem* seal.

4.7 Bushing: A fixed member which supports and/or guides the *closure member*, *valve stem* and/or *actuator stem*. The bushing supports the nonaxial loads on these parts and is subject to relative motion of the parts.

5 Linear motion control valve types

Types of *valves* with a *closure member* that moves with a linear motion to modify the rate of flow through the *valve*.

5.1 Globe valve: A *valve* with a linear motion *closure member,* one or more ports and a *body* distinguished by a globular shaped cavity around the port region. Typical *globe valve* types are illustrated on the next page. Flow arrows shown indicate a commonly, used flow direction.

TWO-WAY BODIES

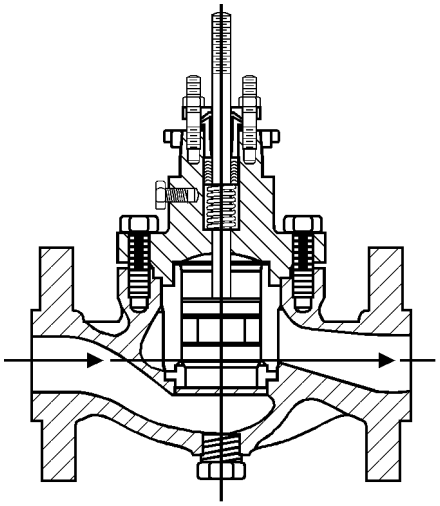


Figure 5.1a — Cage guided

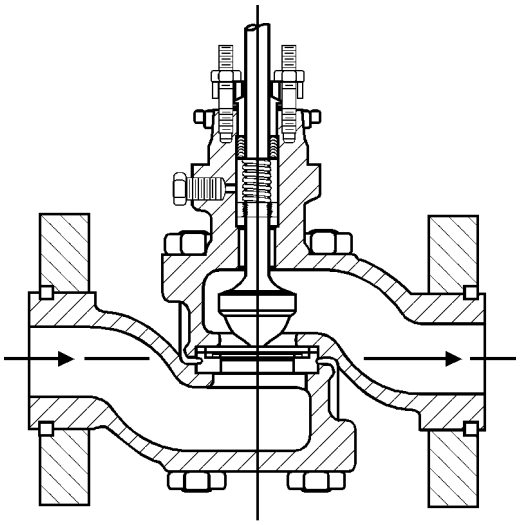


Figure 5.1b — Split body stem guided

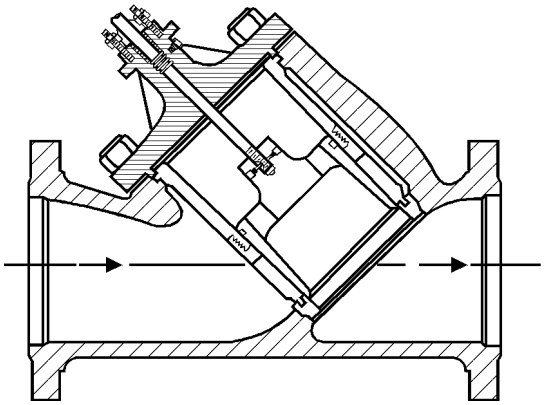


Figure 5.1c — Y-type cage guided

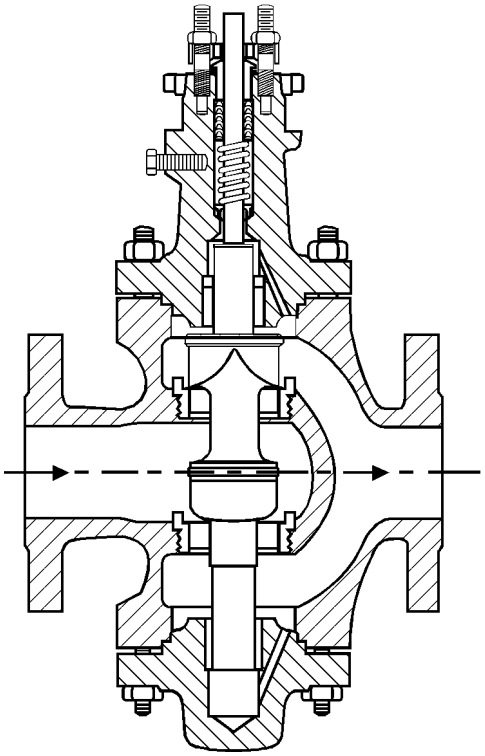


Figure 5.1d — Double ported post (or top & bottom) guided

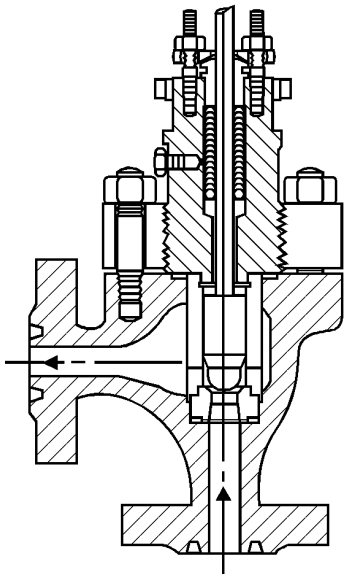


Figure 5.1e — Angle body

THREE-WAY BODIES

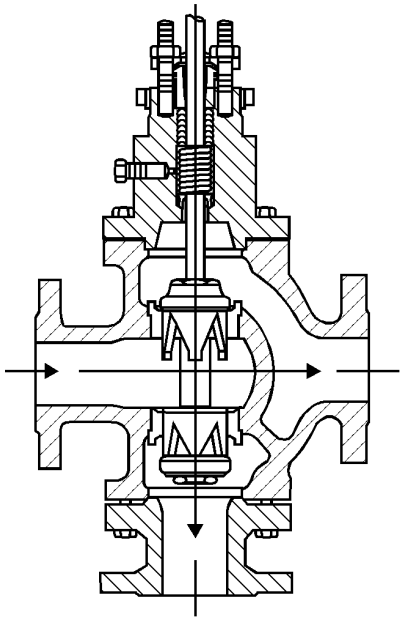


Figure 5.1f — Diverging

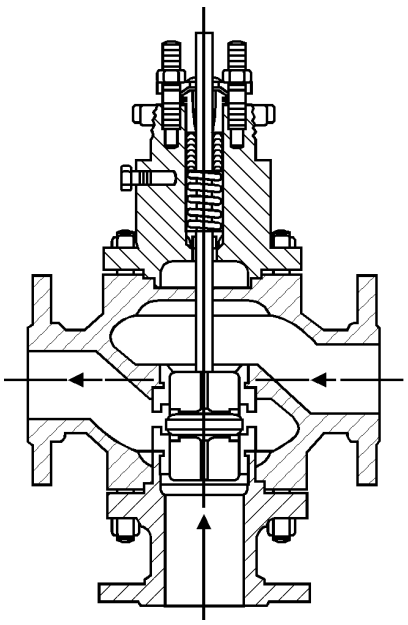


Figure 5.1g — Converging

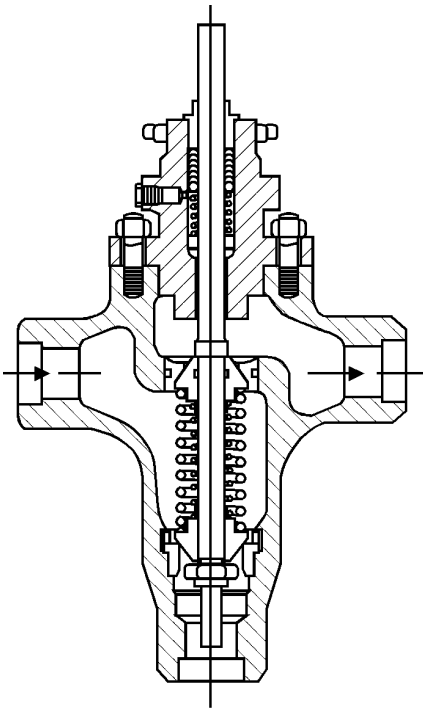


Figure 5.1h — Three position

5.1.1 Bonnet (See 4.2)

5.1.2 Bottom flange: A part which closes a *valve body* opening opposite the *bonnet* opening. It may, include a *guide bushing* and/or serve to allow reversal of the *valve* action. In *three-way valves* it may provide the lower flow connection and its *seat*.

5.1.3 Globe valve trim: The internal parts of a *valve* which are in flowing contact with the controlled fluid. Examples are the *plug, seat ring, cage, stem* and the parts used to attach the *stem* to the *plug*. The *body, bonnet, bottom flange, guide* means and *gaskets* are not considered as part of the *trim*.

5.1.3.1 Plug (See 4.3.1.4)

5.1.3.2 Cage (See 4.4.2)

5.1.3.3 Stem (See 4.5)

5.1.3.4 Anti-noise trim: A combination of *plug* and *seat ring* or *plug* and *cage* that by its geometry reduces the noise generated by fluid flowing through the *valve*.

5.1.3.5 Anti-cavitation trim: A combination of *plug* and *seat ring* or *plug* and *cage* that by its geometry permits non-cavitating operation or reduces the tendency to cavitate, thereby minimizing damage to the *valve* parts, and the downstream piping.

5.1.3.6 Balanced trim: An arrangement of *ports* and *plug* or combination o*f plug, cage, seals* and *ports* that tends to equalize the pressure above and below the *valve plug* to minimize the net static and dynamic fluid flow forces acting along the axis of the *stem* of a *globe valve*.

5.1.3.7 Erosion resistant trim: *Valve trim* which has been faced with very hard material or manufactured from very hard material to resist the erosive effects of the controlled fluid flow. See Appendix A.

5.1.3.8 Soft seated trim: *Globe valve trim* with an elastomeric, plastic or other readily deformable material used either in the *valve plug* or *seat ring* to provide tight shutoff with minimal *actuator* forces. See ANSI B16.104 for leakage classifications.

5.1.3.9 Seat ring (See 4.4.1)

5.1.4 Globe valve plug guides: The means by which the *plug* is aligned with the *seat* and held stable throughout its travel. The guide is held rigidly in the *body* or *bonnet*.

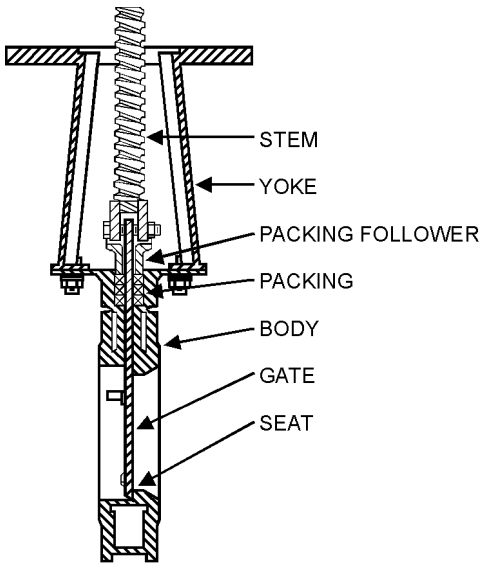
5.1.4.1 Stem guide: A *guide bushing* closely fitted to the *valve stem* and aligned with the *seat*.

5.1.4.2 Post guide: *Guide bushing* or *bushings* fitted to posts or extensions larger than the *valve stem* and aligned with the *seat*.

5.1.4.3 Cage guide: A *valve plug* fitted to the inside diameter of the *cage* to align the *plug* with the seat.

5.1.4.4 Port guide: A *valve plug* with wings or a skirt fitted to the *seat ring* bore.

5.2 Gate valve: A *valve* with a linear motion *closure member* that is a flat or wedge shaped gate which may be moved in or out of the flow stream. It has a straight-through flow path.



5.2.1 Types

5.2.1.1 Bonnetted: *Gate valve* having a *bonnet* which encloses the *gate* within the pressure boundary when in the open position. *Packing* is provided at the stem.

5.2.1.2 Bonnetless*: Gate valve* which has packing between the *gate* and *body*, such that the *gate* extends outside the pressure boundary in the open position.

5.2.2 Body (See 4. 1)

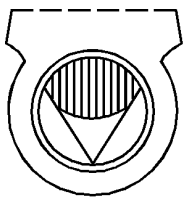
5.2.2.1 Single flange (lugged): A thin annular section *body* whose end surfaces mount between the pipeline flanges, or may be attached to the end of a pipeline without any additional flange or retaining parts, using either thru bolting and/or tapped holes.

5.2.2.2 Flanged body: *Valve body* with full flanged end connections.

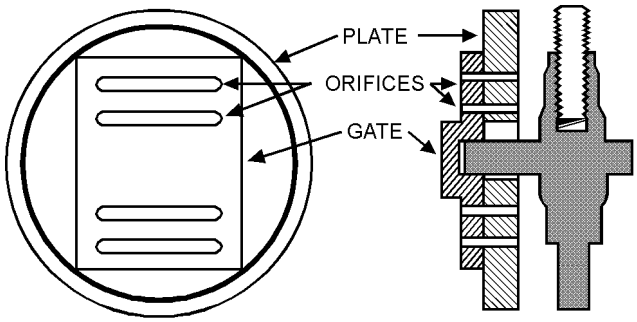
5.2.3 Bonnet (See 4.2)

5.2.4 Flow control orifice: (See 4.4)

5.2.4.1 Vee orifice: "V" shaped *flow control orifice* which allows a characterized flow control as the gate moves in relation to the fixed Vee opening.



5.2.4.2 Multiple orifice: A *flow control orifice* consisting of a moving member (*gate*) which slides reciprocally against a stationary member (*plate*). Both elements contain several matching orifices and the flow area is changed as the *gate* slides.



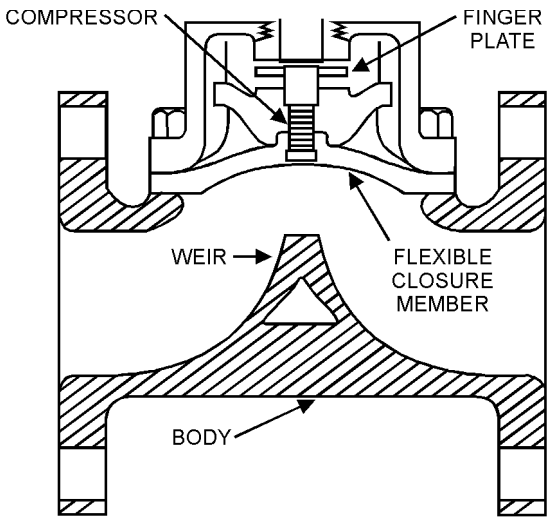
5.2.5 Stem: (See 4.5)

5.2.6 Packing follower: (See 4.6.1.2)

5.2.7 Packing: (See 4.6.1)

5.2.8 Seat Joint: (See Glossary)

5.3 Diaphragm valve: A valve with a flexible linear motion *closure member* that is forced into the internal flow passageway of the *body* by the *actuator*.



5.3.1 Body: (See 4. 1).

5.3.1.1 Weir type: A *body* having a raised contour contacted by a diaphragm to shut off fluid flow.

5.3.2 Adaptor bushing: The part which attaches a close coupled diaphragm *actuator* to the *bonnet* of the diaphragm *valve body.*

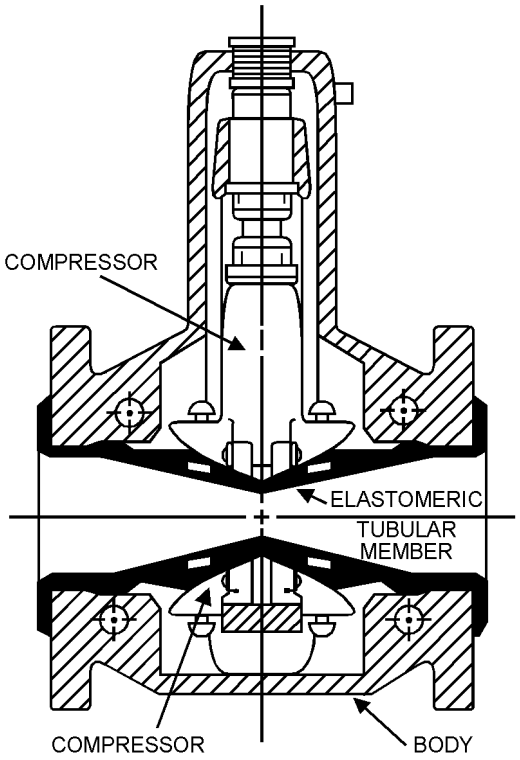
5.3.3 Valve diaphragm: A flexible member which is moved into the fluid flow passageway of the *body* to modify the rate of flow through the *valve*.

5.3.4 Compressor: A device which the *valve stem* forces against the backside of the diaphragm

to cause the diaphragm to move toward and seal against the internal flow passageway of the *valve body*.

5.3.5 Finger plate: A plate used to restrict the upward motion of the diaphragm and prevent diaphragm extrusion into the *bonnet* cavity in the full open position.

5.4 Pinch or clamp valve: A *valve* consisting of a flexible elastomeric tubular member connected to two rigid flow path ends whereby modulation and/or shut off of flow is accomplished by squeezing the flexible member into eventual tight sealing contact. The flexible member may or may not be reinforced. The flexible member may or may not be surrounded by a pressure retaining boundary consisting of a metal housing with *stem packing box*. Squeezing of the flexible member may be accomplished by: 1) single *stem* and leverage acting from both sides so that the total collapse and sealing occurs along the horizontal center line of the flexible member; 2) double *stem* action involving two separate *actuator* assemblies diametrically opposed, or 3) a separate source of fluid pressure applied to an annulus surrounding the flexible member. A *clamp valve* is a *pinch valve* but with clamps and shaped inserts used to provide stress relief in the creased area of the tubular member.

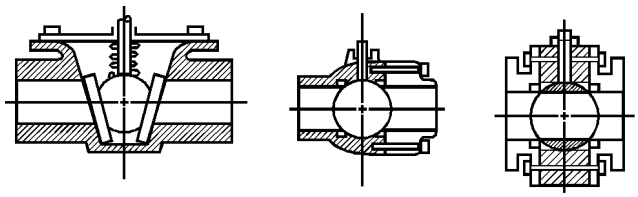


6 Rotary motion control valve types

Types of *valves* with a *closure member* that moves with a rotary motion to modify the rate of flow through the *valve*.

6.1 Ball valve: A *valve* which modifies flow rates with rotary motion of the *closure member*, which is either a sphere with an internal passage or a segment of a spherical surface.

6.1.1 Body: (See 4.1) General body constructions are illustrated below:



(a) One Piece **(b) Two Piece** **(c) Three Piece**

6.1.2 Typical ball types

6.1.2.1 Segmented ball: A *closure member* that is a segment of a spherical surface which may have one edge contoured to yield a desired flow characteristic.

(a) Segmented Ball with Contoured Edge **(b) Segmented Ball with "V" Edge**

6.1.2.2 Full ball: A *closure member* that is a complete spherical surface with a flow passage through it. The flow passage may be round, contoured or otherwise modified to yield a desired flow characteristic.

6.1.2.3 Three-way ball: A *closure member* that is a spherical surface with one or more flow passages through it. The passages may be round, contoured or otherwise modified to yield a desired *flow characteristic*.

6.1.2.4 Floating ball: A full ball positioned within the valve that contacts either of two *seat rings* and is free to move toward the *seat ring* opposite the pressure source when in the closed position to effect tight shutoff.

6.1.3 Seat ring: (See 4.4.1)

6.1.3.1 Downstream seating: Seating is accomplished by pressure differential thrust across the ball in the closed position, moving the ball slightly downstream into tighter contact with the *seat ring* seal which is supported by the *body.*

6.1.3.2 Upstream seating: A *seat* on the upstream side of the ball, designed so that the pressure of the controlled fluid causes the *seat* to move toward the ball.

6.1.3.3 Spring loaded seat: A *seat* design that utilizes a mechanical means, such as a spring, to exert a greater force at the point of ball contact to improve the sealing characteristics, particularly at low pressure differential. The spring action may be accomplished by a metal spring arrangement or a compressed elastomer.

6.1.4 Stem: (See 4.5)

6.1.4.1 Loose stem: A design in which the *stem* is not physically or mechanically attached to the ball, but drives the ball through intimate contact of surfaces. Typical Loose *Stem* Drives are:

a) Tang

b) Pin

c) Splined

6.1.4.2 Integral stem: A design in which the *stem* is either physically a part of the ball or mechanically made part of the ball. Some integral *stems* are designed to perform a turning and then lifting action.

6.1.4.3 Trunnion: Extensions of the ball used to locate, support and turn the ball within the *valve body.* May be integral or attached to the ball.

6.1.5 Stem seal: (See 4.6)

6.2 Butterfly valve: A *valve* with a circular body and a rotary motion disk *closure membe*r, pivotally supported by its *stem.*

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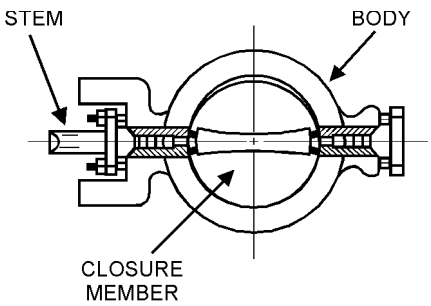


6.2.1 Body types

6.2.1.1 Wafer body: A *body* whose end surfaces mate with the pipeline flanges. It is located and clamped between the piping flanges by long bolts extending from flange to flange. A *wafer body* is also called a flangeless *body*.

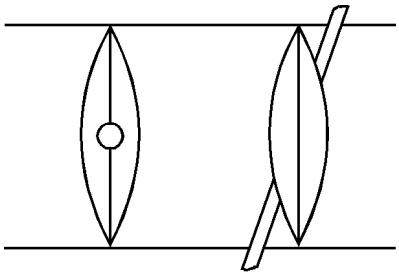
6.2.1.2 Split body: A *body* divided in half by a plane containing the longitudinal flow path axis.

6.2.1.3 Unlined body: A *body*, without a lining.

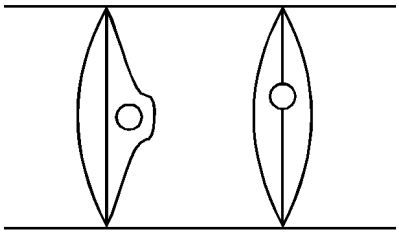
6.2.1.4 Lined body: A *body*, having a lining which makes an interference fit with the *disk* in the closed position thus establishing a seal. See Appendix B.

6.2.1.5 Single flanged body (lugged): (See 5.2.2.1)

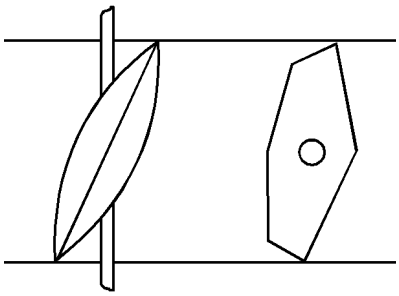
6.2.2 Typical disk orientations



(a) Aligned (b) Aligned with Canted Stem

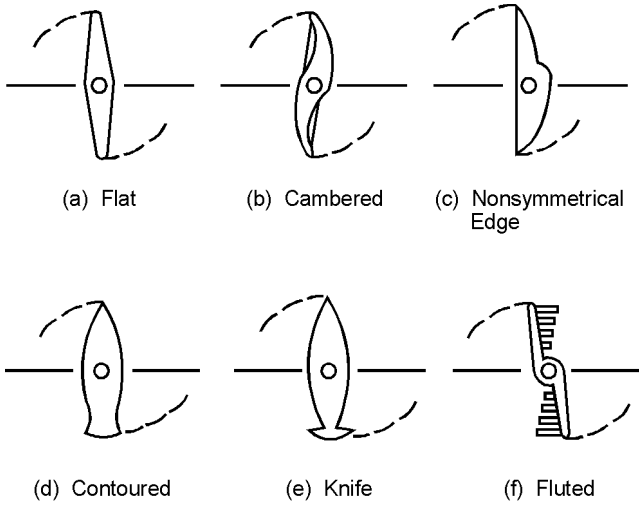


(c) Offset (d) Cammed



(e) Canted Disk (f) Angle Seated

6.2.3 Typical disk shapes



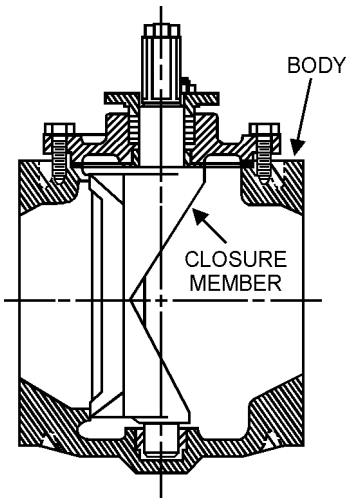
6.2.4 Seal on disk: A seal ring located in a groove in the *disk* circumference. The *body* is unlined in this case.

6.2.5 Stem: (See 4.5)

6.2.6 Stem bearings: Butterfly *stem* bearings are referred to as either the outboard or the inboard type, depending on their location, outside or inside of the *stem seals*.

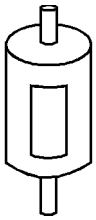
6.2.7 Stem seal: (See 4.6)

6.3 Plug valve: A valve with a *closure member* that may be cylindrical, conical or a spherical segment in shape. It is positioned, open to closed, with rotary motion.



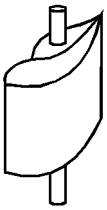
6.3.1 Body: (See 4.1)

6.3.2 Plug configurations

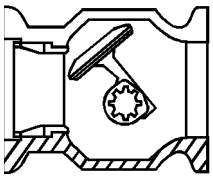


(a) Cylindrical: Plug is cylindrical, with a flow passage through it, or is a partial cylinder.

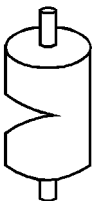
(b) Tapered: Plug is tapered and may be lifted from seating surface before rotating to close or open.



(c) Eccentric: Plug face is not concentric with plug *stem* centerline and moves into *seat* when closing.

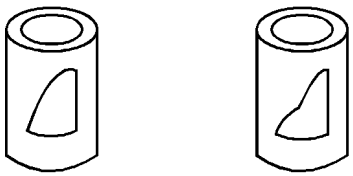


(d) Eccentric Spherical Disk: *Disk* is spherical segment, not concentric with the *disk* stem.

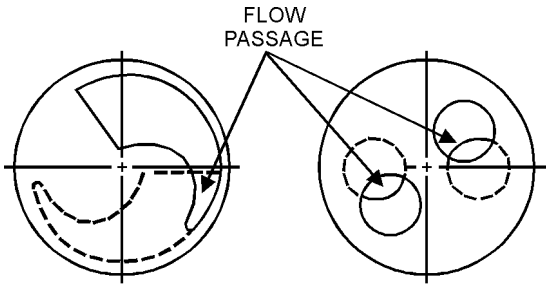


(e) Characterized Plug: Plug with contoured face, such as the "vee" plug shown, to provide various flow characteristics.

6.3.3 Characterized sleeve: A part added to a plug valve to provide various flow characteristics.



6.4 Disk Valve: A *valve* with a *closure member* that consists of a *disk* which moves with a rotary motion against a stationary *disk*, each *disk* having flow passages through it.



7 Control valve actuators

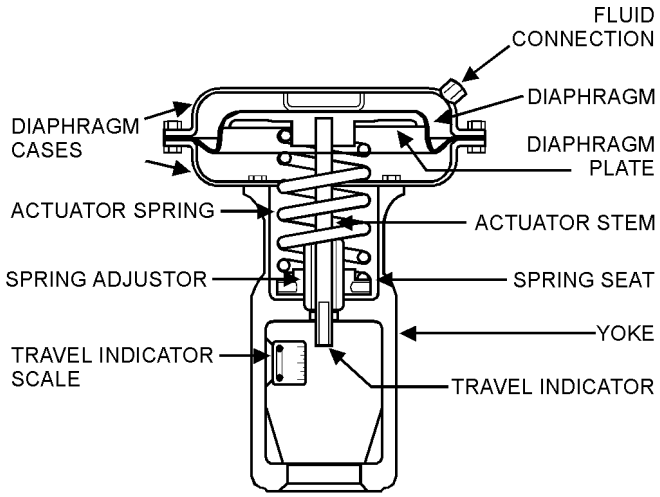
An *actuator* consists of the complete assembly of parts required to operate a specific valve (See 2.1.2).

7.1 Power unit: The portion of the *actuator* which converts fluid, electrical or mechanical energy into *stem* motion to develop thrust or torque.

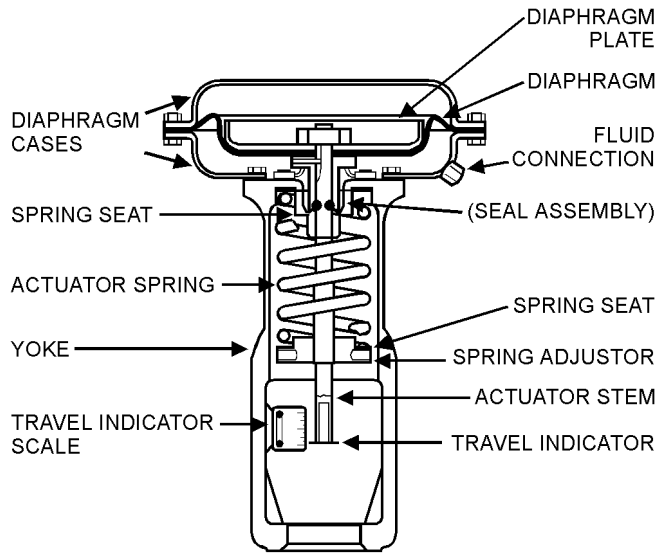
7.1.1 Pneumatic: A device which converts the energy of a compressible fluid, usually air, into motion.

7.1.1.1 Diaphragm type: A fluid powered device in which the fluid acts upon a flexible member, the diaphragm, to provide linear motion to the *actuator stem.*

SINGLE ACTING DIAPHRAGM ACTUATORS



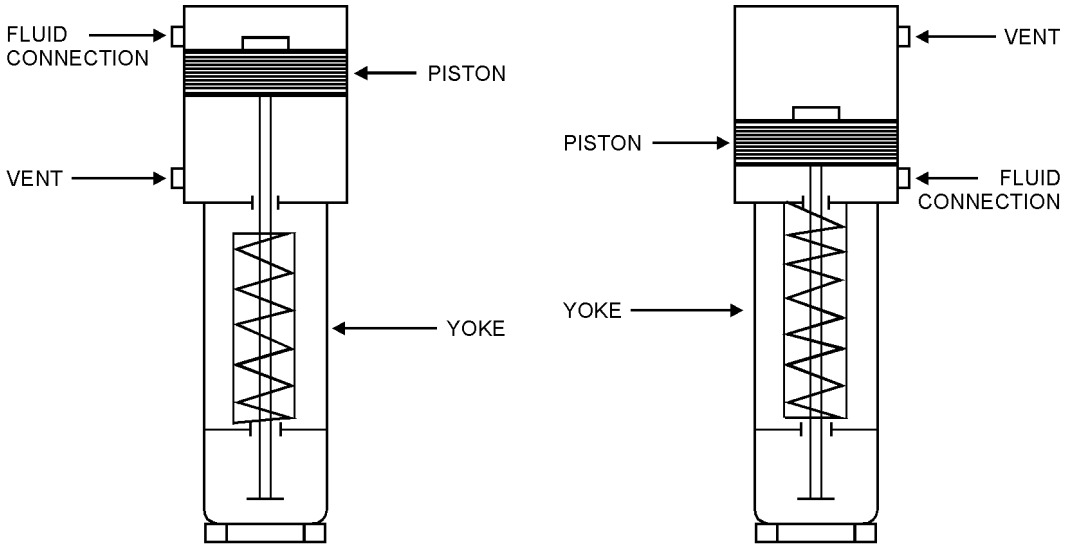
(A) Fluid-to-Extend Stem



(B) Fluid-to-Retract Stem

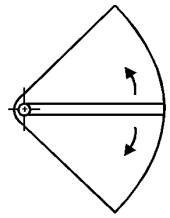
7.1.1.2 Piston type: A fluid powered device in which the fluid acts upon a movable cylindrical member, the piston, to provide linear motion to the actuator stem.

SINGLE ACTING PISTON ACTUATORS

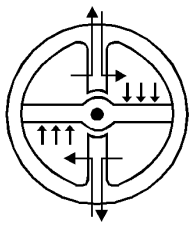


(a) Fluid-to-Extend Stem **(b) Fluid-to-Retract Stem**

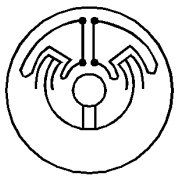
7.1.1.3 Vane type: A fluid powered device in which fluid acts upon a movable pivoted member, the vane, to provide rotary motion to the *actuator stem*.



(a) Single Vane

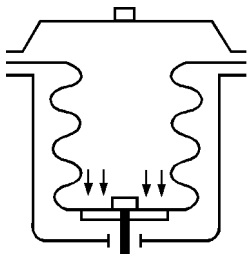


(b) Multiple Vane



(c) Rolling Diaphragm Vane

7.1.1.4 Bellows type: A fluid powered device in which the fluid acts upon a flexible convoluted member, the bellows, to provide linear motion to the *actuator stem.*



7.1.1.5 Fluid motor type: A fluid powered device which uses a rotary motor to position the *actuator stem*.

7.1.2 Electric: A device which converts electrical energy into motion.

7.1.2.1 Electro-mechanical type: A device which uses an electrically, operated motor driven gear train or screw to position the *actuator stem*. Such *actuators* may operate in response to either analog or digital electrical signals. The electro-mechanical actuator is also referred to as a motor gear train *actuator*.

7.1.2.2 Electro hydraulic type: A self contained device which responds to an electrical signal, positioning an electrically operated hydraulic pilot valve to allow pressurized hydraulic fluid to move an actuating *piston, bellows, diaphragm or fluid motor* to position a *valve stem*.

7.1.3 Hydraulic: A fluid powered device which converts the energy of an incompressible fluid into motion.

7.2 Yoke: The structure which rigidly connects the *actuator power unit* to the *valve*.

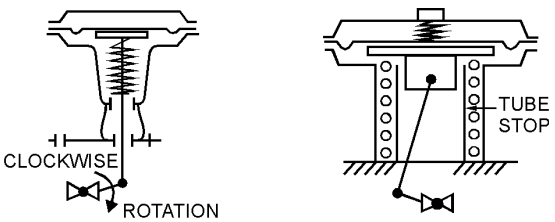
7.3 Stem: The part, usually a rod or shaft, which connects to the *valve stem* and transmits motion (force) from the *actuator* to the *valve*. The *actuator stem* delivering an output thrust may or may not be the same stem as that on the power unit *stem*.

7.4 Stem connector: The device which connects the *actuator stem* to the *valve stem*.

7.5 Position indicator: The device, such as a pointer and scale, which indicates the position of the *closure member*.

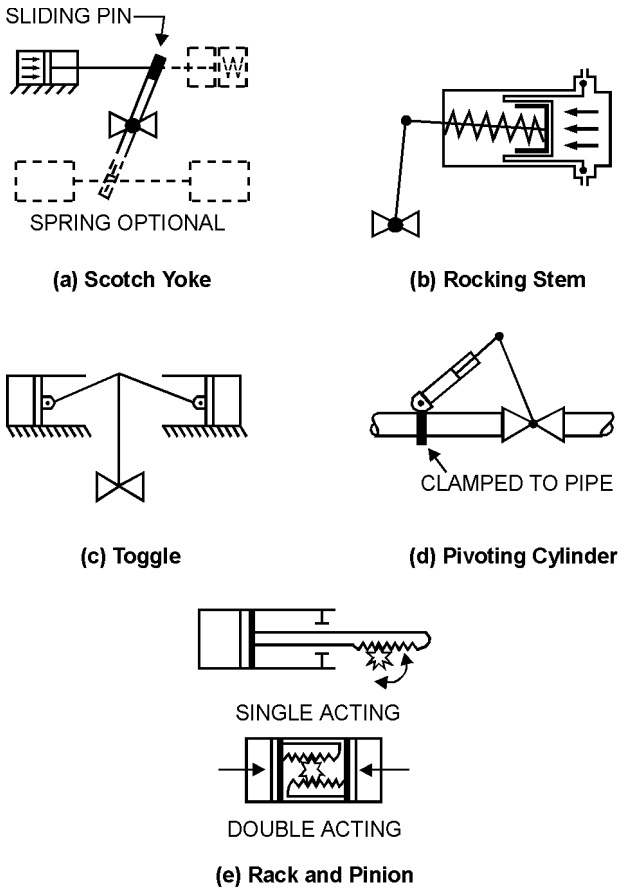
7.6 Motion conversion mechanism: (See 2.1.3). Device needed on some, but not all, assemblies to convert linear action to *rotary valve* operation.

7.6.1 Diaphragm type power unit



(a) Double Linkage (b) Rocking Stem

7.6.2 Piston type power unit



7.7 Action

7.7.1 Single acting: An *actuator* in which the power supply acts in only one direction. In a spring and *diaphragm actuator,* for example, the spring acts in a direction opposite to the diaphragm thrust. Single acting spring and diaphragm *actuators* may be further classified as to direction of *stem* movement on increasing fluid pressure: a) air to extend *actuator stem*, b) air to retract *actuator stem.*

7.7.2 Double acting: An *actuator* in which the power supply acts both to extend and retract the *actuator stem*.

8 Auxiliary equipment

8.1 Attached equipment: The auxiliary equipment which must be located on the *valve* or *actuator*.

8.1.1 Manual override: A device to manually impart motion in either one or two directions to the *valve stem*. It may be used as a limit stop. (Also see "Handwheel" in glossary.)

8.1.2 Snubber: A device which is used to damp the motion of the *valve stem*. This is usually accomplished by an oil filled cylinder/piston assembly. The *valve stem* is attached to the piston and the flow of hydraulic fluid from one side of the piston to the other is restricted.

8.1.3 Positioner: A position controller, which is mechanically connected to a moving part of a final control element or its *actuator*, and automatically adjusts its output pressure to the actuator in order to maintain a desired position that bears a predetermined relationship to the input signal. The *positioner* can be used to modify the action of the *valve* (reversing *positioner*), extend the stroke/ controller signal (split range *positioner*), increase the pressure to the *valve actuator* (amplifying *positioner*) or modify the *control valve* flow *characteristic* (characterized positioner).

8.1.3.1 Single acting positioner: A *positioner* is single acting if it has a single output.

8.1.3.2 Double acting positioner: A *positioner* is double acting if it has two outputs, one with "direct" action and the other with "reversed" action.

8.1.3.3 Positioner types: *Positioners* characterized by their input and output are available as:

a) pneumatic/pneumatic

b) electric/pneumatic

c) electric/hydraulic

d) electric/electric

8.1.4 Mechanical limit stop: A mechanical device to limit the *valve stem* travel.

8.1.5 Stem anti-rotation device: A mechanical means of preventing rotation of the linear *actuator stem* and/or *valve stem*.

8.1.6 Position transmitter: The position transmitter is a device that is mechanically connected to the *valve stem* and generates and transmits a pneumatic or electrical signal representing the *valve stem* position.

8.1.7 Position switch: A position switch is a pneumatic, hydraulic or electrical device which is linked to the *valve stem* to detect a single, preset *valve stem* position.

8.2 Adjacent equipment: The auxiliary equipment which may be located adjacent to the *valve* or *actuator*.

8.2.1 Air set: A device which is used to control the supply air pressure to the *valve actuator* and its auxiliaries.

8.2.2 Signal booster relay: A pneumatic relay that is used to reduce the time lag in pneumatic circuits by reproducing pneumatic signals with high volume and/or high pressure output. These relays may be either volume boosters, amplifying or a combination of both.

8.2.3 Transducer: A device to convert one form of signal to another.

8.2.4 Control signal override device: A device which overrides the effect of the control signal to the *valve actuator* to cause the *closure member* to remain stationary or assume a pre-selected position.

9 Glossary

Accuracy: The degree of conformity of an indicated value to a recognized accepted standard value or ideal value. (Source: ISA S51.1)

Action, air-to-close: See "Fail-Open."

Action, air-to-open: See "Fail-Close."

Actuator effective area: The net area of *piston*, the *bellows*, *vane* or *diaphragm* acted on by fluid pressure to generate actuator output thrust. It may vary with relative *stroke* position depending upon the actuator design.

Actuator environment: The temperature, pressure, humidity, radioactivity and corrosiveness of the atmosphere surrounding the *actuator*. Also, the mechanical and seismic vibration transmitted to the *actuator* through the piping or heat radiated toward the *actuator* from the *valve body*.

Actuator travel time: See "*Stroke Time.*"

Back face: The machined surface on the side of a through-bolted flange, opposite the gasket face, that is provided for nut seating.

Back seat: (See 4.6.4)

Bench set: The shop calibration of the *actuator* spring range of a *control valve,* to account for the in service process forces.

Body cavity: The internal chamber of the *valve body* including the *bonnet* zone and excluding the *body* ends.

Boss: A localized projection on a *valve* surface provided for various purposes, such as attachment of drain connections, or other accessories.

Bubble tight: A nonstandard term. Refer to ANSI B16.104 for specification of leakage classifications.

Capacity: The rate of flow through a *valve* under stated test conditions.

Cage: (See 4.4.2)

Cavitation: A two-stage phenomenon of liquid flow. The first stage is the formation of voids or cavities within the liquid system; the second stage is the collapse or implosion of these cavities back into an all-liquid state.

Center-to-end dimension: The distance from the center line of a v*alve body* to the extreme plane of a specific end connection. See *"Face-to-Face Dimension"* and *"End-to-End Dimension."*

Characteristic, equal percentage: The *inherent flow characteristic* which, for equal increments of *rated travel*, will ideally give equal percentage changes of the existing *flow coefficient* (C_V).

Characteristic, flow: Indefinite term, see *Characteristic, Inherent Flow* and *Characteristic, Installed Flow.*

Characteristic, inherent flow: The relationship between the flow rate through a *valve* and the travel of the *closure member* as the *closure member* is moved from the closed position to *rated travel* with a constant pressure drop across the *valve*.

Characteristic, installed flow: The relationship between the flow rate through a *valve* and the travel of the *closure member* as the *closure member* is moved from the closed position to *rated travel* when the pressure drop across the *valve* varies as influenced by the system in which the *valve* is installed.

Characteristic, linear flow: An *inherent flow characteristic* which can be represented by a straight line on a rectangular plot of *flow coefficient (C_V)* versus per cent *rated travel*. Therefore, equal increments of travel provide equal increments of *flow coefficient (C_V)* at constant pressure drop.

Characteristic, modified parabolic flow: An *inherent flow characteristic* which provides fine throttling action at low *valve plug* travel and approximately a *linear characteristic* for upper portions of *valve* travel. It is approximately midway between *linear* and *equal percentage*.

Characteristic, quick opening flow: An *inherent flow characteristic* in which there is a maximum flow with minimum travel.

Clearance flow: That flow below the minimum controllable flow with the *closure member* not seated.

Coefficient, flow: A constant *(C_V)*, related to the geometry of a *valve*, for a given *valve* opening, that can be used to predict flow rate. See ANSI/ISA S75.01 "Control Valve Sizing Equations" and ANSI/ISA S75.02 "Control Valve Capacity Test Procedure."

Coefficient, rated flow: The *flow coefficient (C_V)* of the *valve* at *rated travel*.

Coefficient, relative flow: The ratio of the *flow coefficient (C_V)* at a stated travel to the *flow coefficient (CV)* at *rated travel*.

Coefficient, valve recovery: See "Liquid Pressure Recovery Factor."

Cold working pressure: The maximum pressure rating of a valve or fitting coincident with ambient temperature, generally the range from –20°F to + 100°F (–29°C to +38°C).

Common port: The *port* of a *three-way valve* that connects to the other two flow paths.

Control valve gain: The change in the flow rate as a function of the change in *valve* travel. It is the slope of the installed or of the *inherent valve flow characteristic* curve and must be designated as installed or inherent.

Cycling life: The specified minimum number of full scale excursions or specified partial range excursions over which a *control valve* will operate as specified without changing its performance beyond specified tolerance.

Dashpot: A mechanical damping device consisting of a cylinder and piston apparatus arranged so as to dampen the movement of a *valve stem.* A less preferred term. See "Snubber" (8.1.2).

Data plate: A plate bearing the name of the manufacturer and other information related to the product as may be required by various regulations or codes. See also "*Nameplate.*"

Dead band: The range through which an input can be varied without initiating an observable response.

Dead end shut off: A nonstandard term. Refer to ANSI B16.104 for specification of leakage classifications.

Drift: A change in output over a period of time with constant input.

Drip tight: A nonstandard term. Refer to ANSI B16.104 for specification of leakage classifications.

Drop tight: A nonstandard term. Refer to ANSI B16.104 for specification of leakage classifications.

Dual sealing valve: A *valve* which uses a resilient seating material for the primary seal and a metal-to-metal *seat* for a secondary seal.

End connection: The configuration provided to make a pressure tight joint to the pipe carrying the fluid to be controlled.

End-to-end dimension: See "Face-to-Face Dimension" and "Center-to-End Dimension."

Face-to-face dimension: The dimension from the face of the inlet opening to the face of the outlet opening of a valve or fitting. See *"End-to-End Dimension"* and *"Center-to-End Dimension."* See ANSI/ISA S75.03 "Uniform Face-to-Face Dimensions for Flanged Globe Style Control Valve Bodies" and ANSI/ISA S75.04 "Face-to-Face Dimensions of Flangeless Control Valves."

Facing, flange: The finish on the end connection gasket surfaces of *flanged or flangeless valves*.

Fail-close: A condition wherein the *valve closure member* moves to a closed position when the actuating energy source fails. See *"Normally Closed."*

Fail-open: A condition wherein the *valve closure member* moves to an open position when the actuating energy source fails. See *"Normally Open."*

Fail-safe: A characteristic of a particular *valve* and its *actuator*, which upon loss of actuating energy supply, will cause a *valve closure member* to fully close, fully open or remain in fixed position. Fail-safe action may involve the use of auxiliary controls connected to the *actuator*.

Flanged ends: Valve end connections incorporating flanges which allow pressure seals by mating with corresponding flanges on the piping.

Flangeless control valve: A *valve* without integral line flanges, which is installed by bolting between companion flanges, with a set of bolts, or studs, generally extending through the companion flanges.

Full face gasket: A flat gasket which contacts the entire flat contact surface of two mating flanges, extending past the bolt holes. This term applies to flat face flanges only.

Gland: See *"Packing Follower"* (4.6.1.2) or *"Lantern Ring"* (4.6.1.3).

Grease seal ring: A nonstandard term. See *"Lantern Ring"* (4.6.1.3).

Hand jack: A lesser used term. See *"Handwheel."*

Handwheel: A manual override device to stroke a *valve* or limit its *travel*.

Types of Handwheels

Top mounted: The *handwheel* is mounted on top of the *valve actuator* case. This type of *handwheel* does not have a clutch and is usually used to restrict the motion of the *valve stem* in one direction only.

Side-mounted: Bellcrank lever types are externally mounted on the *control valve yoke.* They can provide a limit to the extent a *valve stem* will travel in either direction, but not in both directions.

In-yoke mounted: In-yoke gear types are designed with a worm gear drive which is contained in a lubricated housing. The gear box is integral with the *yoke* which is usually elongated to provide space for the worm gear assembly. With this type of *handwheel*, stops may be set in either or both directions to limit the travel of the *valve stem*. This type of *handwheel* is declutchable.

Shaft mounted, declutchable: A shaft mounted worm gear drive that can be de-clutched from the power *actuator*.

Hysteresis: The maximum difference in output value for any single input valve during a calibration cycle, excluding errors due to dead band. See ISA S51.1 "Process Instrumentation Terminology."

Identification plate: See "Data Plate."

Inlet: The *body* end opening through which fluid enters the *valve*.

In-line valve: A *valve* having a piston actuated *closure member* shaped like a *globe valve plug* which moves to seat axially in the direction of the flow path. In-line valves are normally operated by a fluid energy source but may be operated mechanically.

Jacketed valves: A *valve body* cast with a double wall or provided with a double wall by welding material around the body so as to form a passage for a heating or cooling medium. Also refers to *valves* which are enclosed in split metal jackets having internal heat passageways or electric heaters. Also referred to as "Steam Jacketed" or "Vacuum Jacketed." In a vacuum jacketed *valve*, a vacuum is created in the space between the *body* and secondary outer wall to reduce the transfer of heat by convection from the atmosphere to the internal process fluid, usually cryogenic.

Lapped-in: Mating contact surfaces that have been refined by grinding and/or polishing together or separately in appropriate fixtures.

Leakage: The quantity of fluid passing through a *valve* when the *valve* is in the fully closed position under stated closure forces, with the pressure differential and temperature as specified. Leakage is usually expressed as a percentage of the *valve* capacity at full *rated travel*. Refer to ANSI B16.104 for specification of leakage quantity.

Leak-off gland: A *packing box* with packing above and below the *lantern ring* so as to provide a sealed low pressure leak collection point for fluid leaking past the primary seal (lower packing).

Lens joint ends: *Valves* with the ends prepared for lens ring gaskets.

Lift: A nonstandard term. See "Travel."

Limit Switch: See "Position Switch" (8.1.7).

Linearity: The closeness to which a curve approximates a straight line. See ISA S51.1 "Process Instrumentation Terminology."

Lined valve body: A *valve body* to which a protective coating or liner has been applied to internal surfaces of pressure containing parts or to the surfaces exposed to the fluid.

Liquid pressure recovery factor: The ratio (F_1) of the *valve flow coefficient (C_v)* based on the pressure drop at the vena contracta, to the usual *valve flow coefficient (C_v)* which is based on the overall pressure drop across the *valve* in non-vaporizing liquid service. These coefficients compare with the orifice metering coefficients of discharge for vena contracta taps and pipe taps, respectively. See ANSI/ISA-S75.01 "Control Valve Sizing Equations."

Lubricant ring: A nonstandard term. See *"Lantern Ring"* (4.6.1.3).

Lubricated packing box: A *packing* arrangement consisting of a *lantern ring* with *packing* rings above and below with provision to lubricate the *packing*.

Lubricator isolating valve: In a *control valve*, an isolating *valve* is a small hand operated *valve* located between the *packing* lubricator assembly and the *packing box* assembly. It shuts off the fluid pressure from the lubricator assembly.

Modulating: The actions to keep a quantity or quality in proper measure or proportion. Also see "*Throttling*."

Mounting position: The location and orientation of an *actuator* or auxiliary component relative to the *control valve*. This can apply to the *control valve* itself relative to the piping.

Nameplate: A plate attached to a *control valve* bearing the name of the manufacturer. It may also contain specification and limitation information. See also *"Data Plate."*

Needle point valve: A type of *valve* having a needle point plug.

Noise: *Control Valve* noise can be caused by:

1) Turbulent flow of liquid.

2) Aerodynamic flow.

3) Liquid cavitation flow.

4) Mechanical vibration.

Normally closed valve: A *valve* with means provided to move to and/or hold in its closed position without *actuator* energy supply. See "Fail-Close."

Normally-open valve: A *valve* with means provided to move to and/or hold in its wide-open position without *actuator* energy supply. See "Fail-Open."

Port: The *flow control orifice* of a *control valve*. It is also used to refer to the inlet or outlet openings of a *valve*.

Precision: A nonstandard term. See "Repeatability."

Purged packing box: A *packing* arrangement consisting of a *lantern ring* inside the packing rings to permit introduction of a purge fluid to continually flush the space between the *stem* and *body*. It is usually used to purge, admit cooling fluid or detect *stem seal* leakage.

Rangeability, inherent: The ratio of the largest *flow coefficient (C_v)* to the smallest *flow coefficient (C_v)* within which the deviation from the specified inherent flow characteristic does not exceed the stated limits.

Rated travel: The amount of movement of the *valve closure member* from the closed position to the rated full open position.

Relative travel: The ratio of the travel at a given opening to the *rated travel*.

Repeatability: The closeness of agreement among a number of consecutive measurements of the output for the same value of input under the same operating conditions, approaching from the same direction, for full range traverse. It does not include *hysteresis*. (Source: ISA S51.1).

Reproducibility: The closeness of agreement among repeated measurements of the output for the same value of input made under the same operating conditions over a period of time, approaching from both directions. It includes *hysteresis, dead band, drift* and *repeatability*. See ISA S51.1 "Process Instrumentation Terminology."

Resolution: The least interval between two adjacent discrete details which can be distinguished one from the other. See ISA S51.1 "Process Instrumentation Terminology."

Reversible seat: Refers to a *seat ring* with *seating surfaces* on both sides such that when one surface has worn, the ring may be reversed to present a new surface to contact the *closure member*.

Seat angle: The angle between the axis of the *seat orifice* and the *seating surface*. A flat *seated valve* has a *seat angle* of 90°. The *seat angle* of the *closure member* and *seat* may differ slightly to provide line contact.

Seat joint: The area of contact between the *closure member* and the *valve seat* which establishes the sealing action.

Seat load: The total net contact force between the *closure member* and *seat* with stated static conditions.

Sensitivity: The ratio of change in output magnitude to the change of the input which causes it after the steady-state has been reached. See ISA S51.1 "Process Instrumentation Terminology."

Shaft: (See 4.5 and 7.3)

Split clamp ends: *Valve* end connections of various proprietary designs using split clamps to apply gasket loading.

Spot face: A machined annular surface around a bolt hole on the side of a through bolted flange, opposite the gasket face, that is provided for nut seating.

Spring rate: The force change per unit change in length. This is usually expressed as pounds per inch or Newtons per millimeter.

Stem: (See 4.5 and 7.3)

Stem boot: A protective device similar to a flexible bellows, used outside the *bonnet* to protect the *valve stem* from the surrounding atmosphere.

Stroke: See "Travel."

Stroke cycle: *Travel* of the *closure member* from its closed position to the *rated travel* opening and return to the closed position.

Stroke time: The time required for one-half a *stroke cycle* at specified conditions.

Swell plug: Consists of a *piston actuator* coaxial with the flow-path axis and suspended from the *body* wall by radial fins. The piston compresses an annular elastomer member which forces it to close the annulus between the piston outside diameter and the *body* internal diameter.

Threaded ends: *Valve* end connections incorporating threads, either male or female.

Three-way valve: A *control valve* with three end connections. (See 5.1 and 6.1.2.3)

Throttling: The actions to regulate fluid flow through a *valve* by restricting its orifice opening. Also see "Modulating."

Topworks: A nonstandard term. (See 7)

Travel: The amount of movement of the *closure member* from the closed position to an intermediate or the rated full open position.

Travel characteristic: The relationship between signal input and travel.

Travel indicator: A means of externally showing position of the *closure member*; typically in terms of percent of or degrees of opening. Can be a visual indicator at or on the *valve* or a remote indicating device by means of transmitter or appropriate linkage. See 7.5.

Travel indicator scale: A scale or plate fastened to a *valve* and marked with graduations to indicate the *valve* opening position.

Trim: The internal parts of a *valve* which are in flowing contact with the controlled fluid.

Trim, restricted: *Control valve trim* which has a flow area less than the full flow area for that *valve*.

Turndown: An obsolete term: See "Rangeability, Inherent."

Two-way valve: A *valve* with one inlet opening and one outlet opening.

Unbalance, dynamic: The net force produced on the *valve stem* in any given open position by the fluid pressure acting on the *closure member* and *stem* within the pressure retaining boundary, with the *closure member* at a stated opening and with stated flowing conditions.

Unbalance, Static: The net force produced on the *valve stem* by the fluid pressure acting on the *closure member* and *stem* within the pressure retaining boundary with the fluid at rest and with stated pressure conditions.

Valve plug: An obsolete term, see "*Closure Member.*" (See 4.3.)

Vena contracta: The location where cross-sectional area of the flowstream is at its minimum. The vena contracta normally occurs just downstream of the actual physical restriction in a *control valve*.

Weld ends: *Valve* end connections which have been prepared for welding to the line pipe or other fittings. May be butt weld (BWE), or socket weld (SWE).

Appendix A Hard facing of control valve trim

This appendix is nonmandatory. Use for reference only.

A.1 Hard facing A material harder than the surface to which it is applied. Used to resist fluid erosion and/or to reduce the chance of galling between moving parts, particularly at high temperature.

A.1.1 Hard facing may be applied by:

a) Fusion welding, other welding, diffusion, or spray coating material

b) Attaching a hard alloy insert to the surface to be protected by:

1) Brazing

2) Electric (projection) welding

3) Bonding

c) Interference fit of an insert to part to be protected

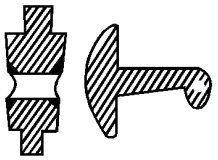
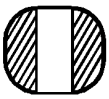
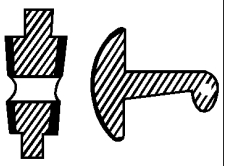
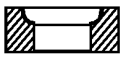
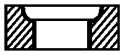
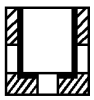
4) Press Fit

5) Shrink Fit

A.1.2 Hard facing is not to be confused with "hard plating" which means an electro plated, or thin metal deposit, or induced surface hardening which is many orders of magnitude thinner than hard facing.

A.2 In addition to the use of the term "hard facing" the valve parts and specific areas of each part to be hard faced must be specified.

Table A.1 — Specific location of hard facing

	Linear Motion Valves			Rotary Motion Valves		
	Gate	Globe	Diaphragm	Ball	Butterfly	Plug
Seat Joint Area						
Complete Flow Control Area						
Solid Plug Cap Brazed to Plug Body						
Seat Joint Area						
Seat Insert Brazed in Bore						
Complete Flow Control Orifice Area						
Guide						
Bearing						
Cage						
Body Bore Back Seat						
Stem Back Seat						

Appendix B Butterfly valve body liners and seals

This appendix is nonmandatory. Use for reference only.

B.1 Contents

This appendix provides the recommended terminology for various types of *butterfly valve body* elastomeric and plastic liners and *body*-to-*disk* sealing means.

B.2 Liner types

B.2.1 Slip-in: An annular shaped liner which makes a slight interference fit with the body bore and which may be readily forced into position through the *body* end. May be plain or reinforced.

B.2.2 Locked-in: A liner retained in the body bore by a key ring or other means.

B.2.3 Bonded: A liner vulcanized or cemented to the body *bore*.

B.2.4 Wrap-around: A liner extending around the end faces of the *wafer body* to form a gasket seal with the pipe flanges. The liner may cover all or part of the flange contact area of the *wafer body*.

B.2.5 Flange retained: A liner retained in the *body* by the pipe flanges or by a continuous or segmented ring. The segmented ring provides a means of adjusting the liner to *disk* interference to achieve improved sealing. The bore of the pipe flanges is smaller in diameter than the *body* bore, therefore the flanges retain the liner in the *body*.

B.2.6 Elastomeric energized liner: A resilient elastomeric ring under the main liner is compressed by the *disk* acting through the main liner, thus generating a resilient sealing action between the *disk* and the main liner.

B.2.7 Pressure energized: A pressure source, either internal fluid pressure or an external fluid pressure source, energizes the liner forcing it into tighter contact with the disk.

B.2.8 Encapsulated body: All surfaces of the body are covered by a continuous surface layer of a different material, usually an elastomeric or plastic material. A soft elastomer behind a harder encapsulating material may be used to provide interference for *disk* and *stem* sealing areas.

B.3 Seals

B.3.1 Flexible lip seal: A seal ring retained in the body bore with raised flexible lip which contacts an offset *disk* in the closed position yet is clear of the *disk* in other positions.

B.3.2 Pressure energized seal: A seal energized by interference fit between the disk groove and *valve* liner and also by differential pressure acting across the seal. The seal may be a solid section or have internal pressure *ports*.

B.3.3 Metal piston type seal: A self-expandable metal seal ring installed in a groove on the *disk* circumference to block the clearance between the *disk* outer diameter and the liner bore with the *disk* in closed position.

Subject Index

(Not including terms listed in the Glossary)

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ISBN: 0-87664-753-0