TECH TIP #38
VALVE BASICS

CHOOSE THE RIGHT VALVE FOR THE RIGHT JOB.

Valves are the controlling element in any fluid-handling system. They should be properly selected and cared for to give the best service at the lowest cost.

Essentially valves have these primary functions:

1. Starting and stopping flow.
2. Regulating flow or throttling by change of direction or restriction
3. Preventing Backflow
4. Relieving and regulating pressure.

The secret to good valve performance is selecting the right valve for the service required.

Consider Service Conditions

In selecting the valve which will give the best service and, in turn, keep plant maintenance and operating cost at a minimum, the following things should be considered.

A. Type Medium to be Handled

1. What liquid or gas will the valve handle?
2. Is it a true fluid or does it contain solids?
3. Does it remain a liquid throughout its flow or does it vaporize and become a gas along the way? Does it crystallize?
4. Is it corrosive or erosive?

B. Pressure and Temperature

These may vary throughout the handling system and should be considered in selecting the right valve materials.

C. Flow Considerations

1. Is pressure drop critical?
2. Is valve to be for simple shutoff or for throttling?
3. Is valve needed for prevention of backflow?

D. Frequency of Operation

1. Will valve be normally open with infrequent operation?
2. If operated frequently, will valve design chosen provide maximum wear?

The Proper Type of Valve

Basic types of valves with which we will deal on the following pages are

1. Gate
2. Globe and Angle
3. Check
4. Plug
5. Butterfly
6. Ball
7. Slurry

MATERIALS OF CONSTRUCTION

Special attention must be given to selecting proper valve materials. It is often advisable to choose the valve body bonnet material first and then the trim.

Aside from the primary function of the valve (shutoff, throttling, etc.), other factors govern the basic material selection.

1. **Pressure-temperature ratings.**
2. **Corrosion resistance requirements.**
3. **Thermal shock.**
4. **Physical shock.**
5. **Line stresses.**
6. **Fire hazards.**

Trims are generally selected to meet corrosive conditions. In other cases, trims may be selected to solve problems from erosion or other conditions.

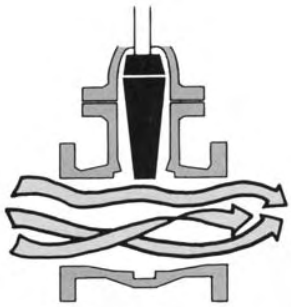
Temperature limitations on various valve materials as follows:

Range	Temperature (°F)	Material
Very High	2000	Refractory Metals, Ceramics
High	1600 1200	High Temperature Alloy Steels
Intermediate	1000 650 550 450 150	Carbon Steel Ductile Iron Bronze Cast Iron PVC Plastic
Low	-250	Low Alloy Steels, Bronze
Very Low (Cryogenic)	-450	Bronze, Austenitic Ductile Iron, Austenitic Stainless Steels

ON-OFF

Do you need an on-off valve, i.e., one that operates fully open or fully closed, non-throttling; a valve with minimum resistance to line flow; infrequent operation?

GATE VALVES

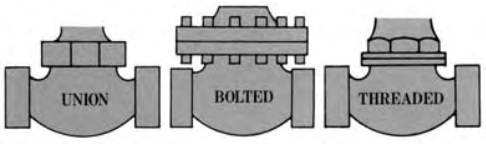


Gate valves are used where it is important that pressure drop through the valve is minimal.

Normally use gate valves either wide open or completely closed. They are designed to permit a straight, full and free flow or no flow at all.

Service conditions dictate the selection of the most suitable design options. Not only must you choose the right valve type, but also the right design options. On gate valves, the primary design options are the bonnet, stem and disc. A simplified approach to these considerations is shown here.

BODY BONNET CONNECTIONS



Is the primary service critical or noncritical?

Generally noncritical services such as plumbing and heating shutoff valves allow the use of threaded bonnet gate valves where possible on smaller lines.

Critical services, involving applications which could seriously endanger persons or property with piping or valve failure, call for union bonnets, bolted bonnets or pressure seal bonnets.

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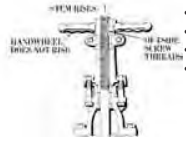
COURTESY STOCKHAM VALVES & FITTINGS

TECH TIP #38 (Cont.)

STEM CONSTRUCTION

Rising Stem-Outside Screw and Yoke



- Keeps threads out of media.
- Stem rises through bushing in handwheel.
- Stem threads easily lubricated.
- Visually detected open or closed.

Rising Stem-Inside Screw

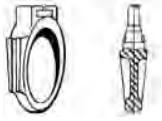
- Most common design.
- Visually detected open or closed.
- When fully open, threads are protected.

Non-rising Stem-Inside Screw

- Requires minimal headroom.
- Packing wear minimized.
- Most competitive.

DISC CONSTRUCTION

Solid Wedge Disc

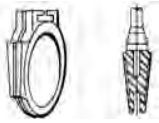


- Most widely used.
- Can be installed in any position.
- Recommended for steam service.

Split Wedge or Double Disc

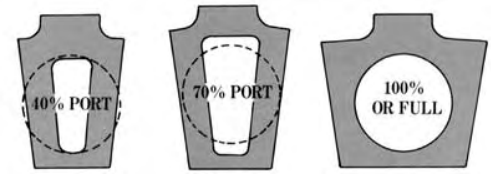
- Ball and socket design reduce wear.
- Recommended for non-condensing gasses and liquids.
- Aligns on each side of seat in event of scale buildup.
- Used in vertical position only.

Flexible Disc



- Compensates for variable temperatures on either side.
- Operates at lower torques.
- Usually offered on steel valves.

PLUG VALVES



Like the gate valve, the plug valve is used primarily for on-off service, non-throttling.

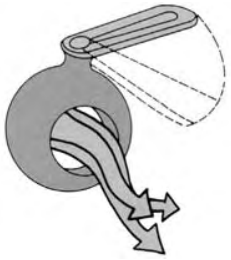
The advantage of plug valves over gate valves are:

- Minimum amount of installation space.
- Simple operation.
- Quick acting (90° rotation of the plug stops fluid flow).
- Ease of actuation.
- Tight shutoff characteristics of the tapered plug.
- Available in many port openings (larger opening, higher cost).

After determining the end connections needed for the piping, the next step is to narrow the selection to either lubricated or non-lubricated plug valves. Consider these factors:

	Lubricated	Nonlubricated		
		Lift Type	Nonmetallic Sleeve Type	Eccentric Plug Type
Temperatures above 450° F		√		
Some throttling (with minimum abrasion)	√			√
Slurries	√	√		
Minimum operating torques		√		√
Low operating cost (no lubrication)		√	√	√
Protected body seats		√		
Coking Service		√		

BALL VALVES



Quick operating 90° open-close
Ball valves offer a quick-operating design that is self-sealing, with dependence on torque for seating force.

Tight shutoff is achieved with plastomer or elastomer seat rings. Temperatures are limited by the seating material, which is usually synthetic rubber, TFE, reinforced TFE or nylon.

Why use ball valves? Generally many shut-off applications are suited to ball valves. Seals are easily replaced.

The valves have a low profile and are compact. The flow path through the ball and ports is smooth and unobstructed, permitting the handling of viscous fluids and slurries.

Selection can lead to the use of either end entry or top entry ball valves.

Some pressure drop is experienced through conventional ball valves, which have reduced ports. Full port valves are available, but are not as common.

Metal backup seats enable ball valves to be used in fire-safe situation.

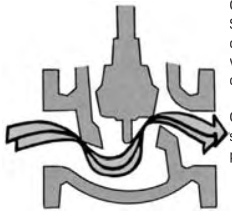
Although ball valves are sometimes used for throttling, they are most effective when fully open or closed because the seals are subject to damage from throttling.

Remote actuation can be accomplished rather easily by ball valves with compact actuators and remote controls.

THROTTLING

Throttling valves are used for flow regulation, frequent operation, increased flow resistance or for positive shutoff when closed.

GLOBE VALVES



Globe valves are used to throttle efficiently. Seating is parallel to the lone of flow. The change in direction of fluid flow through these valves produces increased resistance and considerable pressure drop.

Globe valves are also recommended for services requiring frequent operation and positive shutoff.

COURTESY STOCKHAM VALVES & FITTINGS

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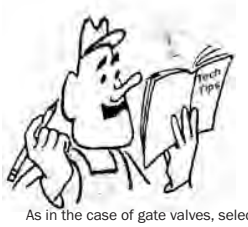


TECH TIP #38 (Cont.)

As in the case of gate valves, select the proper bonnet design for globe valves. In some non-critical services, threaded bonnet globe valves are adequate in smaller sizes.

Critical services require union bonnets, bolted bonnets and, in some cases, pressure seal bonnets.

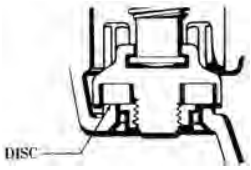
Discs and seats in most globe valves can be repaired or replaced without removing the valve body from the line.

The selection of the most suitable disc-seat design is the key to good performance in throttling service.

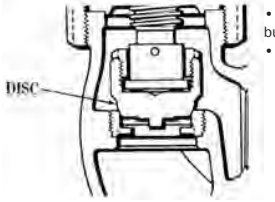
DISC CONSTRUCTION

Teflon or Composite Disc

- Offers tight shutoff.
- Recommended for light throttling in many services.
- Easily replaced.



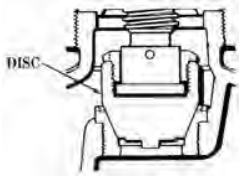
Fullway or Spherical-type Disc



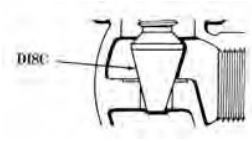
- Small seat surface breaks through build-up.
- Discs can be re-machined.

Plug-type Disc

- Wide seat surface.
- Recommended for severe throttling services.
- Often available in S.S.



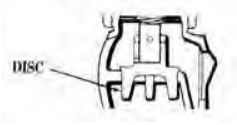
Needle-type Disc



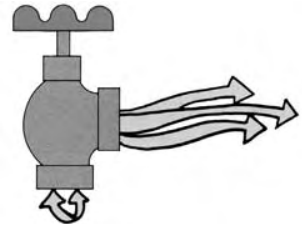
- Allows for more exact throttling.
- Good for instrumentation services.

Screw-down Check Type

Globe valves with screw-down check features have sliding action between the disc and stem so that they serve as globe valves and as check valves.



ANGLE VALVES

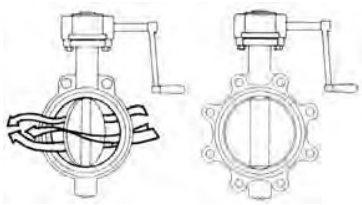


Angle valves have the same features of stem, disc and seat ring design as the globe valve. The fundamental difference between the two is that the fluid flow through the angle valve makes a 90° turn. These valves offer less resistance to flow than a globe valve with an elbow which it would replace. An angle valve reduces the number joints in a line, in addition to saving installation time.

SLURRY VALVES

These special service valves are useful in handling coarse and fine slurries, red mud and caustic alumina liquor. They are available in such patterns as: angle, three-way, straight-through, tee, bayonet, 45° bayonet, and 45° angle valves. They function basically as other throttling valve types discussed, but are especially designed for rugged slurry service with minimum flow resistance. They may be lined with special alloys, such as nickel, for corrosion resistance.

BUTTERFLY VALVES



When selecting larger throttling valves using flanged piping connections, butterfly valves should be considered.

Generally, butterfly valves are valves with a simple 90° disc-stem operation. In some cases they are used as shutoff valves, although offering pressure drop through the valve opening.

The usefulness of butterfly valves has increased with the development of elastomer liners with a wafer body, which provides a tight shutoff. Such liners normally utilize backup rings in the body to effectively support the liner. This provides sealing of the liner against the discs as well as the adjacent flanges.

Check the liner material for temperature limitations. Buna-N is the most common liner material, not suitable for steam service.

Other plastomeric materials are available for higher temperatures and corrosion resistance.

Other advantages are initial low costs, ease of installation and actuation.

Lug wafer valves and flanged end valves are also available.

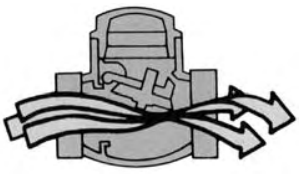
BACKFLOW PREVENTION CHECK VALVES

Prevent reversal of the direction of flow through a line.

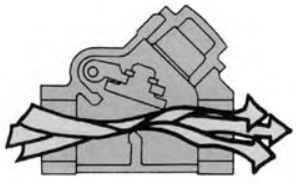
Check valves offer quick automatic reactions to flow changes. The pressure of flowing fluid keeps the valve open and any reversal of flow closes it.

SWING CHECK VALVES

- Minimum resistance to flow.
- Low velocity services, especially liquids.
- Infrequent change of direction in backflow prevention.
- Used generally with gate valves because of similar flow characteristics.



Y-PATTERN SWING CHECK VALVES



- Good flow characteristics.
- 45° seat aids in backseating under lower pressures.
- Screwed cap design allows for quick and easy removal of cap for internal inspection.
- May be installed in both horizontal and vertical lines with upward flow.

COURTESY STOCKHAM VALVES & FITTINGS

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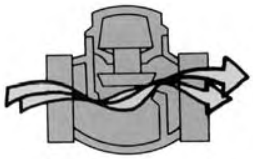
TECH TIP #38 (Cont.)

LIFT CHECK VALVES

- Frequent change of direction.
- Increased flow resistance.
- Prevention of backflow.
- Used with globe and angle valves because of compatible flow characteristics.



Special ball check valves are available for slurry applications.

WAFER CHECK VALVES

- Lighter, easier to install.
- Quick closing at zero flow.
- Used with gate and butterfly valves.

OTHER KEY FACTORS IN SELECTION OF VALVES

END CONNECTIONS

Threaded Ends

Threaded ends are tapped with ANSI Standard female taper pipe threads. Threaded end valves are the least expensive and can be easily installed.

Flanged Ends

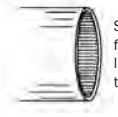
Flanged ends make a strong, tight joint and are generally used for line sizes above 3" that are frequently disassembled and assembled.

Flanged joints are recommended for heavy viscous media handled in refineries and process chemical plants.

Weld Ends

Welded end steel valves are recommended where high temperatures and pressures are encountered and absolutely tight, leakproof connections must be maintained over a long period of time. Valves are furnished in either butt weld or socket weld ends.

Solder Ends



Solder end valves are used with types K, L, and M copper tubing for many lower pressure services. The use of solder joints is limited to maximum of 250° because of the low melting-point of the solder.

PACKING

The selection of packing is a factor which is as important as the selection of the valve itself. Valve manufacturers originally equip valves with a suitable general purpose packing. This packing may not be satisfactory for special services. It is best to specify the service conditions and allow the manufacturer to recommend the correct packing.

MECHANICAL PROPERTIES

	TENSILE STRENGTH-PSI	YEILD STRENGTH-PSI	ELONGATION IN 2" (Ductility)
Gray Iron ASTMA 126 Class B	31,000	None	None
Malleable Iron ASTM Spec. No. A-197	40,000	30,000	5%
Ductile Iron ASTM Spec. No. A-395	60,000	40,000	18%
Cast Composition Bronze ASTM-B-62	30,000	14,000	20%
Cast Carbon Steel ASTM-A-216	70,000	36,000	22%

STANDARDS AND SPECIFICATIONS

AAR - Association of American Railroads
ANSI - American National Standards Institute
API - American Petroleum Institute
ASTM - American Society for Testing and Materials
AWWA - American Water Works Association
FM - Associated Factory Mutual

MARINE ENGINEERING REGULATIONS AND MATERIAL SPECIFICATIONS, CD-115
Regulations established by the U. S. Coast Guard containing the requirements of boilers, pressure vessels, and appurtenances applicable to merchang vessels including tank vessels.

MILITARY SPECIFICATIONS
Specifications, standards, and related documents establisned by the Department of Defense for use by military agencies.

MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
UL - Underwriters Labratories
USASI - United States of America Standards Institute

VALVE TERMINOLOGY
TE - Threaded End
FE - Flanged End
SE - Solder End
BWE - Butt Weld End
SWE - Socket Weld End

BB - Bolted Bonnet
UB - Union Bonnet
TB - Threaded Bonnet

DD - Double Disc
SWD - Solid Wedge Disc
RWD - Resilient Wedge Disc

OS&Y - Outside Screw and Yoke
NRS - Nonrising Stem
RS - Rising Stem

FF - Flat Face
RF - Raised Face
MJ - Mechanical Joint
RTJ - Ring Type Joint
IBBM - Iron Body, Bronze Mounted
SB - Silver Brazed

TC - Threaded Cap
BC - Bolted Cap

COURTESY STOCKHAM VALVES & FITTINGS