VARIANCE REQUEST Iowa Department of Natural Resources				
1.	Date: 7/21/09		14.	Decision: DENIED
2.	Reviewer/Engr.:	Larry Bryant		Date: 7/22/09
3.	Date Received:	7/07/09		
4.	Facility Name:	Urbana, City of STP		
5.	Facility Number:	6-06-80-0-01		
6.	County Number:	51 (Benton)	15.	Appealed:
7.	Program Area:	CP (Wastewater Construction)		Date:
8.	Facility Type:	C02 (Pumping)		
9.	Subject Area:	314 (Check Valve Location)		
10.	Rule Reference:	567 IAC 64.2(9)a		
11.	Design Std. Ref.:	13.5.2 (Discharge line)		
12.	Consulting Engr.:	Hart-Frederick Consultants, P.C.		
13.	Variance Rule:	567 IAC 64.2(9)c		

16. Description of Variance Request:

Allow the location of check valves in the discharge piping for three separate pumping stations in a vertical orientation rather than the horizontal position as required by IA 13.5.2.

17. Applicant's/Consulting Engineer's Justification:

"The valves will be located above the floor of the proposed control building in a separate room from the pump controls. This arrangement of valves and piping will allow for easy access for inspecting and maintaining the valves while decreasing the area needed for housing the valves compared to that required for horizontally installed check valves. According to the manufacturer's literature and recommendations, the specified check valve works equally well in either the vertical upward flow or horizontal position."

18. Department's Justification:

Recommend variance denial:

The proposed type of check valve is an air cushion swing check with an external weighted lever arm. Both IA design standards and 10-states standards allow ball check valves to be vertically oriented but require all other types to be installed in the horizontal plane. There are two issues of concern with respect to vertical mounting of swing check valves:

(a) The disk must be prevented from stalling. Plain swing check valves that rely on gravity (i.e. the weight of the clapper) to close should not be allowed in vertical orientations since proper closure relies on horizontal orientation of the valve. However, other types of check valves such as weighted outside lever and spring designs that force the valve closed under no flow conditions overcome this issue. In this case an external lever and weight valve closure mechanism is proposed and the specified valve manufacturer specifically states that the valve may be installed horizontally or vertically.

(b) In a vertical orientation, solids may settle out once flow has stopped and deposit on top of the clapper and in the valve bonnet. This may plug the valve and eventually prevent the clapper from opening fully. See the attached references. The specified valve manufacturer also states that the valve is recommended for raw sewage, but it is unclear how this concern is addressed if the valve is installed in a vertical position.

Other variances have been approved for the use of swing check valves in vertical installations. However, in this case there is no justification presented for why a ball valve could not be used if a vertical orientation is necessary for the piping arrangement or how the design addresses the solids deposition concern. Variance denial is recommended.	
19. Precedents Used: No variance denials were found for standard. The following variances for vertical installation of check valves were found: -City of DeSoto (11/14/03) -City of LeMars (12/9/03) -City of Parkersburg (5/16/00) -City of Marshalltown (10/18/89) -City of Gravity (5/23/06)	
20. Staff Reviewer: [signature]	Date: 7/21/09
21. Supervisor: [signature]	Date: 7/21/09
22. Authorized by: Charles Corell	Date: 7/22/2009

July 22, 2009

Keith Schmitz, Mayor
City of Urbana
906 West Main Street
Urbana, IA 52345

RE: Variance Request - Iowa Wastewater Facilities Design Standards Section 13.5.2

Honorable Mayor:

This letter is in response to Hart-Frederick Consultants, P.C. request on behalf of the City for a variance from Section 13.5.2 of the Iowa Wastewater Facilities Design Standards. Section 13.5.2 of the Iowa Wastewater Facilities Design Standards states that "Check valves shall be suitable for the material being handled and shall be placed on the horizontal portion of discharge piping except for ball checks, which may be placed in the vertical run". This design variance request has been denied.

Air cushioned swing check valves with external weighted lever arms are proposed for Urbana's lift stations. To our knowledge, there are two primary concerns with vertical installation of swing check valves:

(a) The valve disk must be prevented from stalling. The proposed valves overcome this concern by utilizing an externally weighted lever arm which prevent the valve disk from catching in the open position. As noted by Hart-Frederick, the specified valve manufacturer states that the valve may be installed either horizontally or vertically. We agree that the valve would function equally well in either the horizontal or vertical position in clean-water conditions.

(b) In raw wastewater applications, solids may settle against the disk and within the valve bonnet when flow stops. This may prevent the valve from functioning properly[1].

Our review of the justification presented did not find that the concern regarding solids deposition on the valve mechanism or in the valve bonnet was addressed sufficiently to demonstrate equivalent effectiveness as would be provided by compliance with the design standard in this instance. The City may appeal the denial of this decision in

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[1] See Sanks, Robert L. 1998, Pumping Station Design 2nd Edition, pp. 121, 124-125 & 834 and Tchobanoglous, G. 1981, Wastewater Engineering: Collection and Pumping of Wastewater, p. 362

accordance with 567 IAC 64.2(9)"c" or request further consideration if additional justification addressing the solids deposition concern is presented.

Please contact me at (515) 281-6759 or larry.bryant@dnr.iowa.gov if you have any questions.

Sincerely,

Larry Bryant, P.E.
IDNR Wastewater Engineering Section

cc: Randy Krutzfield, P.E./Hart-Frederick
Michael Hart, P.E./Hart-Frederick

SECOND EDITION

PUMPING STATION DESIGN

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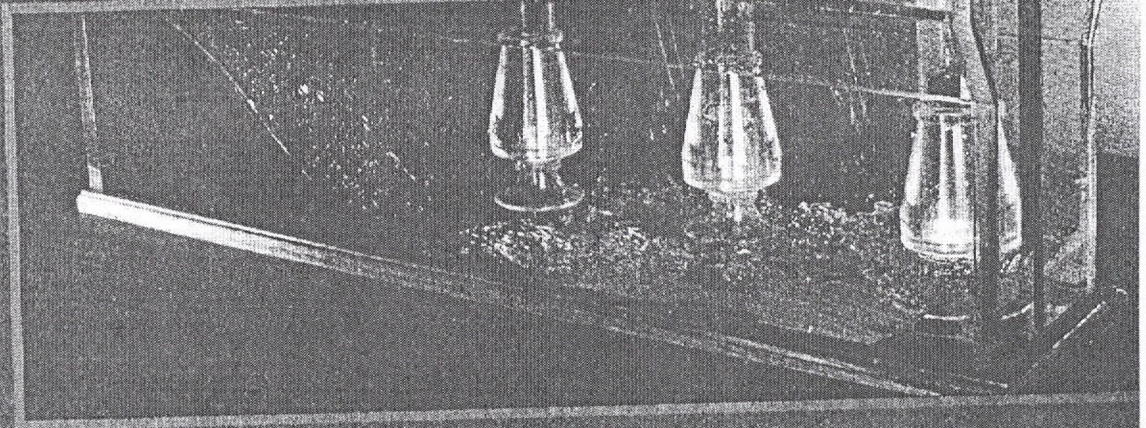


BH

sometimes used in the wet wells of pumping stations to block flow to part of the wet well so that a pump and its suction piping can be dewatered for maintenance. The plate may have its own actuator or may be lifted by hand. Large plates can be lifted with a crane or hoist and stored on a rack or in a pit when not in service.

The plate is usually aluminum, but wood, fiberglass, stainless steel, and other materials are sometimes used. A local fabricating shop can make stop plates if supplied with detailed design information. Alternatively, a somewhat more sophisticated plate can be obtained from manufacturers, which means the engineer need not design such details as reinforcing.

Except for very small units, stop plates cannot be moved up or down when there is a substantial difference (more than about 0.2 m or 6 in.) in water level across the gate. If it is necessary to move the plate under such conditions, (1) a sluice gate may be used instead or (2) a valve (typically a 100- to 200-mm [4- to 8-in.] gate or butterfly) or small stop plate can be mounted in a larger plate to allow equalization of water levels before the larger plate is moved. Stop plates are inexpensive, are simple, are suitable for local fabrication, and take up little of the valuable space in a wet well, but moving them is awkward and the leakage is high.

5-4. Check Valves

A check valve is usually (but not always) required to (1) prevent reverse flow and prevent runaway reverse pump speeds when the pump is shut off, (2) keep the pipeline full of water to prevent the entrance of air, and (3) minimize water hammer and surges for pump start-up and shut-down.

Vertical pipelines are poor locations for check valves if the water contains grit or solids. For vertically placed valves in clean water service, special springs or counterweights may be needed. Manufacturers that state that a check valve can be placed in a vertical pipeline are referring only to the springs or counterweights and ignoring the danger of deposited grit and solids, which can (and will) jam the valve.

The designer's responsibility is the selection of a valve that will give good service in keeping with the pump selection, hydraulics, and size of the system. The first decision is whether a check valve will serve, or whether a more sophisticated pump-control valve is necessary to limit surges. Some insights for this decision are contained in Chapters 6, 7, and 26 as well as in Parmakian [12], but only a sophisticated mathematical model of the system solved by means of a computer can provide a rational analysis. Unfortunately, such modeling is too time consuming and expensive for common use.

Valve Slam

Check valves can be divided into two broad classifications: (1) those that are closed by the static pressure of water above the valve (mechanical checks) and (2) those held shut by an external actuator (pump control or controlled check valves). The latter do not slam, but swing checks do if, before the valve is fully closed, any substantial reverse velocity catches the valve disc and accelerates it until it strikes the body seat abruptly. The sudden stop of disc, lever, and counterweight (if there is one) plus the violent impact of the disc on the body seat (especially if the contact is metal to metal) causes an explosive noise and vibrations that shake the pipe and may shake the whole building. The real problem is the water hammer that results if the water column is flowing backward at a significant velocity when the valve closes. However, valve slam can occur without water hammer and vice versa.

At worst, valve slam can rupture water lines and pump casings. At best, it is annoying. In between, it pounds the system, can overstress pipes and joints, and may well result in eventual leaks and greatly increased maintenance. It is difficult to give advice on the best kinds of valves to specify because valve slam depends on many interrelated factors in addition to valve design. Other factors that are just as important include static head, friction head, the inertia and spin-down characteristics of the impeller and motor, size of pipe, and velocity of flow. Generally, valve slam is caused or aggravated in the following ways.

Low flywheel effect. The principal cause of valve slam is quick deceleration of the pump due to low angular momentum of the impeller, the driver, and the water within the casing. With enough inertia, valve slam can be prevented, but the necessary flywheels may be large and costly.

High proportion of static head. If the headloss is 70% static and 30% dynamic (due to friction), valves slam worse than if the headloss is 50% static and 50% dynamic. A simple vertical lift (e.g., into an adjacent elevated tank) is especially prone to valve slam.

Frequency of valve slam. Valve slam may stress material beyond yield strengths and cause permanent deformations. A few deformations of a given intensity may be acceptable, but numerous deformations eventually cause leakage or rupture. Even a single slam, if severe, is dangerous.

Table 5-3. Recommendations for Use of Check Valves[a]

Type of valve	Water		Wastewater		
	Raw	Clean	Raw	Treated	Sludge
Ball	E	E	E	E	E
Ball lift	F–G	F–G	F–G	F–G	G
Center-post guided	P	F	X	X	X
Double door	X	G	X	X	X
Flap	—	—	G	—	—
Foot	F	G	—	—	—
Swing					
No outside lever	P	P	P	P	P
Outside lever and counterweight	F–G	F–G	F–G	F–G	G
Outside lever and spring	F–G	F–G	F–G	F–G	F
Outside lever and air cushioned	F	F	F	F	P
Outside lever and oil cushioned	G	G	G	G	G
Slanting disc	G	G	X	F	X

[a] E, excellent; G, good; F, fair; P, poor; X, do not use; —, use is unlikely.

Ball Lift Check Valves

A ball lift check valve contains a ball in the flow path within the body. The body contains a short length or guide piece in which the ball moves away from the seat to allow the passage of fluid. Upon reverse fluid flow, the ball rests against an elastomeric seat.

These valves are often encountered in pumping stations in sizes of 50 to 150 mm (2 to 6 in.) or smaller for pump seal water or for wash water supply piping. They have also been successfully used by at least one major pump manufacturer for raw wastewater pump discharge piping up to 600 mm (24 in.). Except for small sizes, bodies are made of ductile iron. The ball is hollow with an external rubber coating resistant to grease and dilute concentrations of petroleum products, acids, and alkalies. The specific gravity of the balls can be adjusted to suit a wide range of operating conditions.

The valves are said to be self-cleaning, rugged, reliable, nonclogging and to be able to withstand repeated cycling, because each time the ball is reseated, a different part of the surface rests on the seat. In larger sizes (100 mm [4 in.] or more) for sludge pumping service, ball lift checks are part of the mechanism in plunger (piston) sludge pumps.

As check valves for wastewater pump discharge piping, the valves have these advantages: (1) the headloss is lower than it is for other types; (2) there are no external penetrations and no leakage to the outside (although good swing check valves properly set up do not leak either); and (3) stringy materials have nothing to wrap around and do not foul the valve. On the other hand, the standard valve (unlike swing check valves) gives no indication of whether water is flowing—a serious disadvantage. Ball lift check valves are, however, available with ball position indicator-proximity switches.

Decisions to use a ball lift check valve instead of, say, the faster-closing swing check valve with a spring-loaded lever should be based on a computer-aided dynamic hydraulic analysis of the system.

Center-Post Guided Check Valves

Center-post guided check valves are low cost and are called "silent check valves" by some manufacturers. They close more rapidly than any other check valve. As shown in Figure 5-13, the disc is held closed by a spring until the pump is started. The spring selection is very critical; it is the differential pressure across the valve (difference between static head and TDH) that must be specified and not the safety pressure rating of the system. An incorrect specification results in valve slam.

Three disadvantages of this valve type are that (1) the operating mechanism is enclosed so the valve must be removed for servicing, (2) there is no external indicator of the position of the disc, and (3) the headloss is high.

Double Leaf Check Valves

Double leaf (also double door, double disc, or split disc) check valves contain two hinged half-discs in a short body. The two half-discs are hinged in the middle and contain a spring that forces them closed. This type of valve has no connecting flanges of its own.

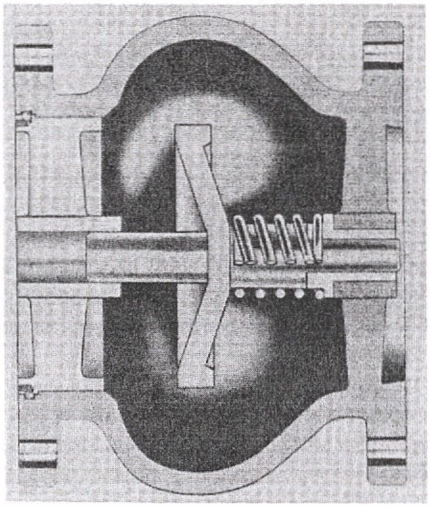


Figure 5-13. Center-post guided "silent" check valve. Courtesy of APCO Valve & Primer Corp.

Instead, it is inserted between two adjacent pipe flanges. It can be installed in either the horizontal or vertical position.

These valves should never be used in sewage or sludge service or in abrasive conditions because the hinge and discs can catch solids and the seat and discs would wear in abrasive service. Double leaf check valves are small, light, and inexpensive and have a short laying length. They close very quickly but they cannot be adjusted from the outside, nor can they be cushioned, so a sudden flow reversal can cause slam and water hammer. Shut-off is not leakproof. Other disadvantages are (1) the valve must be removed to service the mechanism, (2) there is no external indication of whether the valve is open or closed, and (3) they are subject to a fluttering motion caused by vortex shedding as the fluid moves past the valve plates. If the fluid velocity is less than 3.4 m/s (11 ft/s) and the valve is at least eight pipe diameters downstream from any source of flow disturbance such as a pump or a fitting, the problem is reduced [13].

Foot Valves

A foot valve is a special design of a lift check valve. It is used in the suction line of a sump pump to prevent loss of prime. It is designed for upflow and is attached to the bottom of a pump suction pipe.

Foot valves are prone to leakage, especially when used in fluids containing abrasives and solids, and they are difficult to service. Foot valves decrease the net positive suction head available ($NPSH_A$, see Section 10-4). In a raw sewage pumping station, a better choice would be to use a self-priming pump if a conventional wet well–dry well pumping station cannot be used or is not feasible.

Lift Check Valves

The body of a lift check valve is similar to that of a globe valve. A plug or stem moving within a guide lifts upward and allows fluid to pass through the valve. The plug seats when the flow reverses.

A lift check valve does not provide a tight shutoff. It cannot be used in fluids containing solids or abrasives, and gum-forming fluids can cause the stem to stick. Sudden flow reversal can cause water hammer.

This type of valve is normally encountered in pumping stations only in sizes 50 mm (2 in.) and smaller and in services such as utility water and compressed air.

Swing Check Valves

A swing check valve (Figure 5-12) contains a hinged clapper or disc that rests on a seat and prevents fluid from flowing backward through the body. A disadvantage of metal-to-metal design is the lack of a tight seal when the disc is seated, so a rubber seat is better. The disc is usually affixed to a hinge pin by means of an arm. The pin and arm allow the disc to move up and out of the flow path in the direction of fluid flow.

Swing check valves can be installed in both horizontal and vertical positions. In a horizontal position, the valve bonnet must be upright. In a vertical pipe, the valve must be installed so that fluid flow is in the upward direction, but never install swing check valves in vertical pipes in sewage, sludge, or slurry service because rags, debris, and grit would settle against the disc and eventually prevent functioning. Clearing the valve in this position is a messy, disagreeable task.

Slamming when a pump stops and the fluid reverses direction is a significant problem when using swing check valves of some designs. In general, swing check valves larger than 150 mm (6 in.) should have an outside lever and spring to close the disc quickly before the fluid can reverse direction. Note, however, that a commonly used check valve standard, AWWA C508, does not cover the outside lever and spring design. A disadvantage of this type of valve is that the outside lever and spring or counterweight can prevent the disc from opening fully, especially at low flow velocities—less than about 3 m/s (10 ft/s)—with a consequent increase of headloss. The swing check valve in Figure 5-12 is fully ported when open 20°, but most designs require a swing of 60° to open fully.

Swing check valves without cover plates. In wastewater service, the lack of a cover plate means that the entire valve must be removed to extract debris, so require removable cover plates.

Other Aspects of Valves

Improper location. Location is often critical for any type of valve. Never allow swing checks or gate valves in a vertical pipe carrying raw sewage or grit-laden raw water. When the flow stops, grit settles and clogs the valve (or the valve bonnet of a gate valve), and the valve will eventually fail. If valves must be placed on a vertical pipe carrying dirty water, use only eccentric plug, ball, cone, or pinch valves. Never install butterfly valves near (within 2 pipe diameters of) elbows or pumps because the curved streamlines may cause so much torque on the vane that the valve actuator will not function. Never install valves in a wet well.

Air- and vacuum-release valves in sewage service. Go to any lengths to avoid using air-release and vacuum-relief valves for sewage service. Relocate the force main or the pumping station. Dig deep trenches or tunnel. If the use of such valves is unavoidable, realize that they are high-maintenance items, that they frequently clog, and that they are unreliable in wastewater service. Specify them in pairs to provide a backup, and specify sewage types with stainless-steel trim and flushing connections. Require not less than monthly cleaning in the O&M manual. Removal of all internal parts and shop cleaning is more effective than field flushing.

Throttling. Except for slow starts and stops to control water hammer, seek methods other than throttling to control flow (such as variable speed, spillage, a bypass, or a smaller impeller) because throttling wastes energy. Gate valves should not be throttled for extended periods because they are quickly ruined by vibration. Low velocity through a throttling valve results in poor control, so if throttling is unavoidable, consider using a reducer, a smaller valve, and an expander.

Nearly all butterfly valves are unsuitable for severe throttling service (as in pump-control valves). AWWA C504 specifications alone are insufficient to ensure the adequacy of valve seats. Some (but not all) replaceable body seats are satisfactory. Some manufacturers of pump-control systems who either use top-of-the-line makes or buy customized valves of special design may be able to offer advice.

Air-release valves in transmission and force mains. Air-release valves can cause water hammer (see Section 7-4) unless appropriately sized.

Vacuum-relief valve danger. Be extremely wary of using vacuum-relief valves in a pipeline if the pump valve is of the slow-closing type. If the water column reverses its direction and the velocity increases while the check valve is still mostly open (and unable to prevent high velocities), an explosive force can be produced that is sufficient to throw slabs of concrete into the air. Hydraulic analyses amd consultation with the vacuum-relief valve manufacturers are necessary to determine whether such a problem can occur.

Air in piping. Preferably, arrange piping so that air is automatically expelled as the wet well or sump fills. Air entrapped between the pump inlet and a check valve can air bind the pump, so install manual or automatic (or both in sewage service) air-release valves at all possible points of air entrapment, such as the volutes of horizontal pumps, pressure gauges, suction piping, and both upstream and downstream from the check valve. A manual air release should have, say, a 12- or 19-mm (1/2- or 3/4-in.) gate valve (for water) or a ball valve (for water or sewage) followed by an air break and drainpipe to the floor sump.

Natural rubber seats. Because natural rubber in wastewater valves is attacked by petroleum products, specify a resistant synthetic elastomer.

Thin elastomer seats. Elastomers may be cut by grit in slurry service, so thick layers should be specified. Urethane is preferable to either natural or synthetic rubber.

Zinc and aluminum bronze. Avoid zinc and untempered aluminum bronze in valves for waters that cause dezincification (see C508-93, 2.2.2.4 and C504, Foreword 111.7 and main text 2.2.11.2).

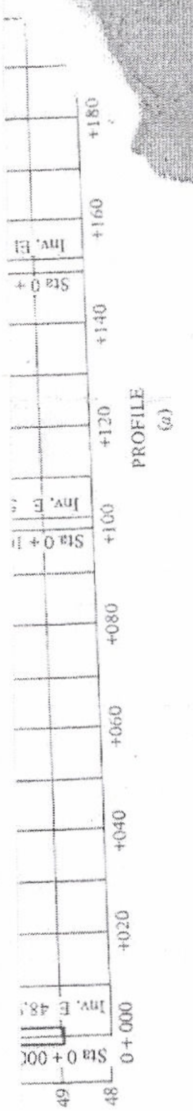
Valve handles. Chain wheels in sewage wet wells are an explosion hazard. Hand wheels should be placed within easy reach and away from walls or other knuckle-cracking obstructions. Use either hand wheels or chain wheels with worm gears instead of levers on plug valves 150 mm (6 in.) or larger.

Valve stems protruding into walkways. Protruding valve stems constitute a safety hazard in walkways, so relocate them.

Power-actuated valves without manual actuators. The valve cannot be moved if the power actuator does not work. Always specify an auxiliary manual closure.

Power actuators not designed for continuous throttling service. Valves designed for throttling should have actuators that are specified accordingly; otherwise, maintenance is excessive.

Hand wheel with nonstandard direction. Valves should either open when the hand wheel is turned counterclockwise or the hand wheel should be permanently marked with the direction for opening.



WASTEWATER ENGINEERING: COLLECTION AND PUMPING OF WASTEWATER

METCALF & EDDY, INC.

Written and edited by

GEORGE TCHOBANOGLOUS

Professor of Civil Engineering
University of California, Davis

McGraw-Hill Book Company

New York St. Louis San Francisco Auckland Bogotá Hamburg
Johannesburg London Madrid Mexico Montreal New Delhi
Panama Paris São Paulo Singapore Sydney Tokyo Toronto

Table 9-4 Types of check valves

Type of valve	Description	Installation
Swing check valve	Available in sizes up to 0.75 m (30 in). Used on all systems except those that require a different valve for waterhammer control or a size over 0.75 m. Should have an outside weight and level with the weight adjusted to assist closing.	Should be installed horizontally. If installed vertically, debris can settle out on top of the clapper when the pump is not operating. This debris would enter the bonnet of the valve when the pump starts to operate and would prevent the valve from opening fully.
Cone valve	Used on systems requiring valves larger than 0.75 m in size or if timed opening and closing are required to control waterhammer. Operated by a hydraulic cylinder. The use of cone valves for waterhammer control is discussed further in Secs. 9-4 and 9-5.	The valves and the hydraulic control system are expensive and are only installed where absolutely necessary. In the open position, the cone valve has a smooth pipe passageway; therefore, to reduce costs, the cone valve is normally the same size as the pump nozzle, or even smaller if space is available for both a decreaser and an increaser.
Tilting-disk check valve	Available in sizes up to 1.8 m (72 in). Used only if the right size of swing check valve is not available. Has a shaft that passes through the flow passage of the body.	Rags and other debris can wrap around the shaft and prevent the valve from operating properly. Should be installed only when a large size is necessary and when the screenings are removed by mechanically cleaned screens with openings no larger than 25 mm (1 in) or have been comminuted.
Butterfly valve	Like the tilting-disk valve, operated by a hydraulic cylinder and has a shaft passing through the flow passage of the body. Used only in large sizes for waterhammer control.	Should be installed only when the screenings have been removed or comminuted.

Note: mm × 0.03937 = in.

Valve selection handbook By Peter Smith, R. W. Zappe

downflow.

Swing Check Valves

Conventional swing check valves are provided with a disc-like closure member that swings about a hinge outside the seat, as in the valves shown in Figure 4-8 and Figure 4-9. Travel of the disc from the fully open to the closed position is greater than in most lift check valves. On the other hand, dirt and viscous fluids cannot easily hinder the rotation of the disc around the hinge. In the valve shown in Figure 4-9, the closure member is an integral part of the rubber gasket between the valve body halves. It is steel-reinforced, and opens and closes by bending a rubber strip connecting the closure member and the gasket.

As the size of swing check valves increases, weight and travel of the disc eventually become excessive for satisfactory valve operation. For this reason, swing check valves larger than about DN600 (NPS 24) are frequently designed as multi-disc swing check valves, and have a number of conventional swing discs mounted on a multi-seat diaphragm across the flow passage in the valve.

Swing check valves should be mounted in the horizontal position, but may also be mounted in the vertical position, provided the disc is prevented from reaching the stalling position. In the latter case, however, the closing moment of the disc, due to its weight, is very small in the fully open position, so the valve will tend to close late. To overcome slow response to retarding flow, the disc may be provided with a lever-mounted weight or spring loaded.

Bryant, Larry [DNR]

From: Bryant, Larry [DNR]
Sent: Tuesday, July 21, 2009 3:18 PM
To: 'Randy Krutzfield'
Cc: Michael Hart
Subject: RE: vertical check valve
Attachments: Sanks p. 125.pdf; Urbana Phase I CP.pdf

Thanks Randy.

I'm not sure I completely follow the logic of the manufacturer's common header statement. Certainly the downstream valve(s) on a common header would tend accumulate settled solids at a faster rate than the upstream valves due to the extra exposure, but won't all of the check valves be exposed to settled solids from the vertical water column above the valve every time the respective pump associated with that valve shuts off? So, the common header is more of a problem in that downstream valves would tend to plug faster than the upstream valves?

The manufacturer's experience with vertical installed swing check valves and lack of problems reported to them is noted, but anecdotal at this point and not as comforting as it would be if the Sanks text warning against vertical installation was less emphatic (see the attached other section where vertical installation of swing checks is discussed).

I went ahead and issued the construction permit (also attached) this morning with a condition regarding the check valves and pending variance decision.

Larry Bryant
IDNR Wastewater Engineering Section
502 E. 9th Street
Des Moines, IA 50319-0034
515/281-6759
larry.bryant@dnr.iowa.gov

From: Randy Krutzfield [mailto:RKrutzfield@hart-frederick.com]
Sent: Tuesday, July 21, 2009 12:24 PM
To: Bryant, Larry [DNR]
Cc: Michael Hart
Subject: vertical check valve

Larry,

See below for mfr's response regarding concerns over solids with vertical swing check valve spec'd for Urbana Project.

Randy Krutzfield, P.E.
Hart-Frederick Consultants P.C.
510 East State St
P.O. Box 560
Tiffin, IA 52340
Ph (319) 545-7215
Fax (319) 545-7220
rkrutzfield@hart-frederick.com

From: Sales [mailto:sales@apcovalves.com]
Sent: Tuesday, July 21, 2009 12:20 PM

To: Randy Krutzfield
Subject: Re: Website enquiry APCOVALVES.com

The APCO Series 6000 with any of the optional Closure Assist features, Outside Lever and Weight, Lever and Spring, Air Cushion, Bottom Mounted Buffer, or Side Mounted Oil Cushion and the APCO SERIES 100, Rubber Flapper Swing Valve, have been installed in Vertical Installation for over 40 years without any problem with settling solids that we have been made aware of. These valves are designed for a "crack open" pressure of 1/4 to 1/2 psi pressure differential. The valve will continue to open further with velocity of flow. One scenario that may cause this problem: Two or more pumps in a row pumping through a common header. If one pump is running and pumping across the direction of the other valves where the pumps are not running, when that pump shuts down, there is a possibility that enough solids could settle in one or more of the other check valves to create a problem. We are not aware of any installations where this has happened.

Ross Toney
Inside Technical Sales

APCO WILLAMETTE Valve and Primer, Corp.
800-478-7458
Office: 949-361-9900
Fax: 949-361- 3414

----- Original Message -----
From: sales@apcovalves.com
To: sales@apcovalves.com
Sent: Tuesday, July 21, 2009 8:00 AM
Subject: Website enquiry APCOVALVES.com

Dear **Sir / Ma'am**,

I have submitted my request for an information regarding the products.
Name : : Randy Krutzfield
Company : : Hart-Frederick Consultants
Title : : Engineer
Address : : PO Box 560

City : : Tiffin
State : : IA
Zip code : : 52340
Country : : USA
Email : : rkrutzfield@hart-frederick.com
Phone : : 319-545-7215
Fax : : 319-545-7220
Comments : : Your literature states the swing check valve can be installed vertically, but some design manuals for wastewater pumping recommend only horizontal installation due to risk of solids settling and interfering with valve operation. Are there specific features of your swing check valves which would prevent this from happ ening when installed vertically for raw sewage applications?

Thanks

Bryant, Larry [DNR]

From: Bryant, Larry [DNR]
Sent: Tuesday, July 21, 2009 4:17 PM
To: 'Randy Krutzfield'
Cc: Michael Hart
Subject: RE: vertical check valve
Attachments: Sanks p. 121.pdf

Here is another excerpt from the Sanks book regarding solids deposition.

Larry

From: Randy Krutzfield [mailto:RKrutzfield@hart-frederick.com]
Sent: Tuesday, July 21, 2009 12:24 PM
To: Bryant, Larry [DNR]
Cc: Michael Hart
Subject: vertical check valve

Larry,

See below for mfr's response regarding concerns over solids with vertical swing check valve spec'd for Urbana Project.

Randy Krutzfield, P.E.
Hart-Frederick Consultants P.C.
510 East State St
P.O. Box 560
Tiffin, IA 52340
Ph (319) 545-7215
Fax (319) 545-7220
rkrutzfield@hart-frederick.com

From: Sales [mailto:sales@apcovalves.com]
Sent: Tuesday, July 21, 2009 12:20 PM
To: Randy Krutzfield
Subject: Re: Website enquiry APCOVALVES.com

The APCO Series 6000 with any of the optional Closure Assist features, Outside Lever and Weight, Lever and Spring, Air Cushion, Bottom Mounted Buffer, or Side Mounted Oil Cushion and the APCO SERIES 100, Rubber Flapper Swing Valve, have been installed in Vertical Installation for over 40 years without any problem with settling solids that we have been made aware of. These valves are designed for a "crack open" pressure of 1/4 to 1/2 psi pressure differential. The valve will continue to open further with velocity of flow. One scenario that may cause this problem: Two or more pumps in a row pumping through a common header. If one pump is running and pumping across the direction of the other valves where the pumps are not running, when that pump shuts down, there is a possibility that enough solids could settle in one or more of the other check valves to create a problem. We are not aware of any installations where this has happened.

Ross Toney
Inside Technical Sales

APCO WILLAMETTE Valve and Primer, Corp.
800-478-7458

Office: 949-361-9900
Fax: 949-361- 3414

----- Original Message -----
From: sales@apcovalves.com
To: sales@apcovalves.com
Sent: Tuesday, July 21, 2009 8:00 AM
Subject: Website enquiry APCOVALVES.com

Dear **Sir / Ma'am**,

I have submitted my request for an information regarding the products.
Name : : Randy Krutzfield
Company : : Hart-Frederick Consultants
Title : : Engineer
Address : : PO Box 560

City : : Tiffin
State : : IA
Zip code : : 52340
Country : : USA
Email : : rkrutzfield@hart-frederick.com
Phone : : 319-545-7215
Fax : : 319-545-7220
Comments : : Your literature states the swing check valve can be installed vertically, but some design manuals for wastewater pumping recommend only horizontal installation due to risk of solids settling and interfering with valve operation. Are there specific features of your swing check valves which would prevent this from happ ening when installed vertically for raw sewage applications?

Thanks

HFC HART-FREDERICK CONSULTANTS P.C. www.hart-frederick.com

RECEIVED
JUL 07 2009
Director's Office

July 2, 2009

Richard Leopold, Director
Iowa Department of Natural Resources
502 E. 9th Street
Des Moines, IA 50319-0034

Note: GC
561 - 10.9
Contents of petition

RE: City of Urbana 2009 Wastewater Conveyance and Treatment Rehabilitation Project: Petition for variance to Iowa Wastewater Facilities Design Standards

Dear Mr. Leopold:

561 IAC 10
(1)✓ (2)✓ (3)✓ (4)✓ (5)N/A (6)✓ (7)N/A (8)N/A (9)✓ (10)N/A

I am respectfully filing, on behalf of the City of Urbana (906 W Main St, Urbana, IA 52345, 319-443-2400) this petition for variance to the requirement for check valves to be placed on the horizontal portion of discharge piping of wastewater pumping stations as called for in Item 13.5.2 of the Iowa Wastewater Facilities Design Standards.

The proposed design includes check valves of the swing check type located on the vertical upward flow section of discharge piping for each of a total of seven pumps at 3 separate pumping stations. The valves will be located above the floor of the proposed control building in a separate room from the pump controls. This arrangement of valves and piping will allow for easy access for inspecting and maintaining the valves while decreasing the area needed for housing the valves compared to that required for horizontally installed check valves.

According to the manufacturer's literature and recommendations, the specified check valve works equally well in either the vertical upward flow or horizontal position.

It is my understanding the IDNR has allowed this type of check valve installation for other recent projects including wastewater pump stations in the communities of Zearing, Mineola and Hiawatha.

Please contact Mike Hart or me if you have any questions.

Sincerely,

Randy Krutzfield

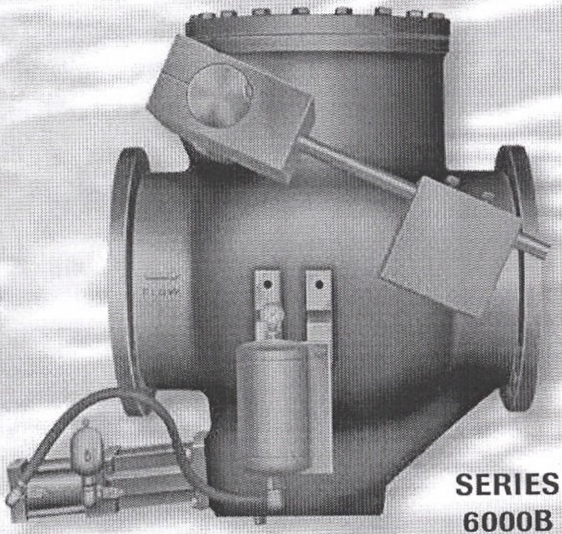
Randy Krutzfield, P.E.
Hart-Frederick Consultants P.C.

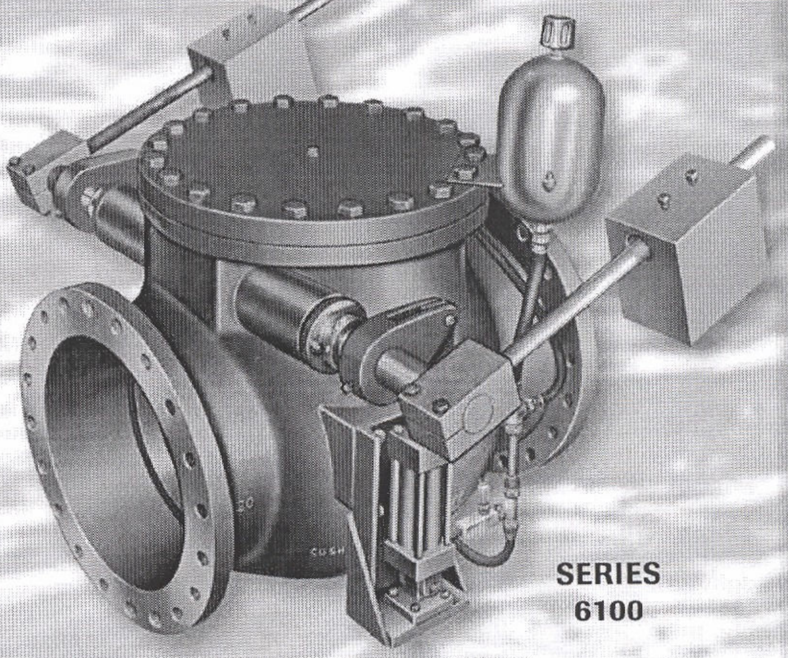
Cc: Larry Bryant, IDNR Project Manager; Chris Justice, Urbana City Clerk

510 E. State Street • P.O. Box 560 • Tiffin, IA 52340-0560 • 319-545-7215 • Fax: 319-545-7220
Engineering • Surveying • Planning

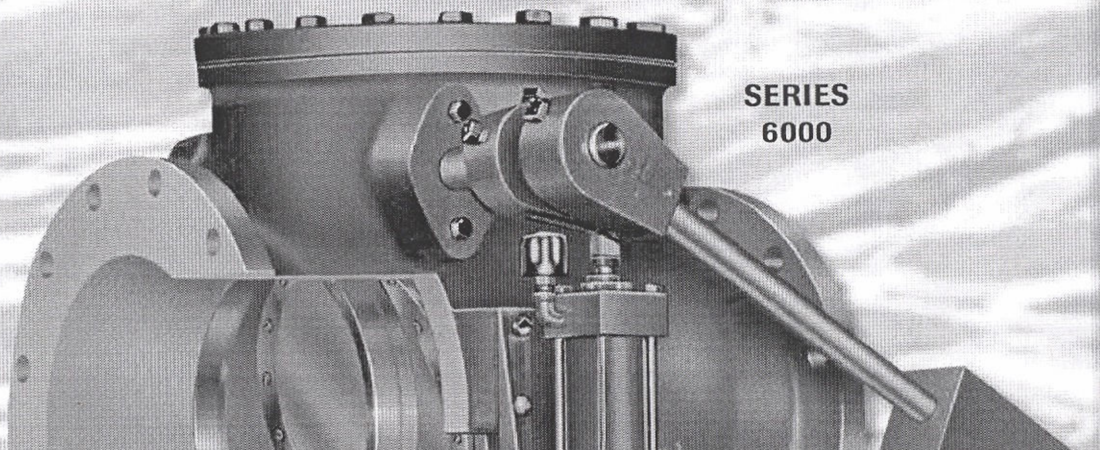
APCO®

SWING CHECK VALVES
Air Cushioned/Oil Controlled

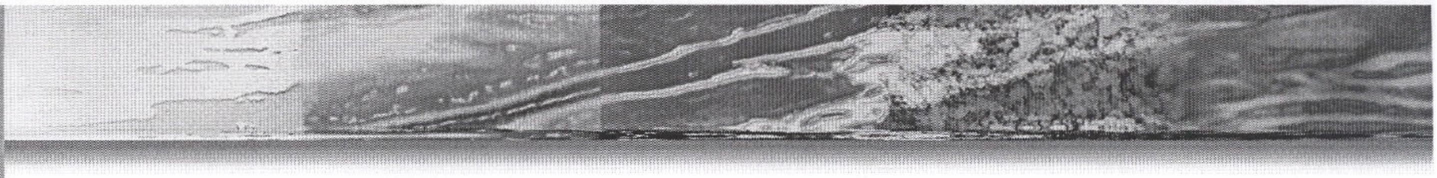




**for
Sewage
or
Water**



VALVE & PRIMER CORPORATION
1420 WRIGHT BLVD. • SCHAUMBURG, IL 60193-4599
847.524.9000 • FAX:847.524.9007 • 800.323.6969
website: www.apcovalves.com • e-mail: factory@apcovalves.com



APCO® SWING CHECK VALVES

PLAIN TALK ABOUT PLAIN SWING CHECK VALVES

The advantage "COMMON" Variety Plain Swing Check Valves offer is a fully unobstructed flow through area. This advantage is accomplished in design by locating the pivot point of the disc well outside its periphery, thus it is possible for the entire disc to lift clear of the flow area. This is a very desirable feature when pumping raw sewage. However, there are better performing check valves.

Many years ago, pumping flow rates of 3 feet per second and pressures of 25 PSI were common. Today, these low flow and pressure conditions are rare. Therefore, a Plain Swing Check is often misapplied, not adequate and may slam.

REQUEST BROCHURE #769, "WHICH CHECK VALVE SHOULD I USE?"

APCO CUSHIONED SWING CHECK VALVES...

APCO Air Cushion Checks have the full unobstructed flow advantage of the Plain Swing Check, but here similarity ends. The Air Cushion Check is a much heavier valve that is designed to withstand shock. The Air Cushion Check Valve utilizes a **totally enclosed** Cushion Cylinder externally mounted to the side of the main valve body. In addition, it is designed with a heavy outside lever, positively clamped to an extra large diameter pivot shaft. The weight can be easily moved to various positions on the lever to change the closing time.

It is the outside lever and weight which forces the disc to close immediately upon pump shut down and BEFORE reverse flow takes place. In so doing, the weighted lever drives the Piston into the Cushion Chamber, compressing the trapped air creating the cushion during valve closure.

CAUTION: Air is infinitely compressible and due to this phenomenon, when pumping conditions result in rapid flow reversal at pump shut-off, the high closing speed of the disc may diminish the effectiveness of the air cushioning. Oil control check valves should then be considered.

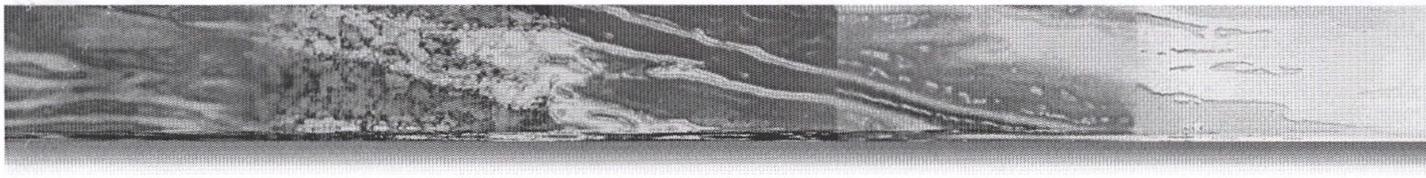
HOW CUSHIONED SWING CHECK VALVES WORK

1. Discharge velocity head from the pump against disc **(#10)** opens the disc and raises the weighted lever **(#29)** outside of the valve upwards. At the same time the piston inside the cushion cylinder **(#20)** is pulled upwards, drawing free air into the cushion cylinder through the "one way" control check valve **(#30)**.

2. When reverse flow occurs against the backside of the disc **(#10)** pressure forces the disc toward the shut-off position against the seat **(#5)** at the same time forcing the cushion cylinder downwards. Moving downwards, the piston compresses the air in the cushion cylinder because the air cannot readily escape through the "one way" control check valve. By restricting the air escape through the adjustable control check **(#30)** air cushioned closing is accomplished.

   NOTE: Because air is infinitely compressible the disc swings to shut-off with minimal resistance. Therefore the Air Cushion Check Valve is rated one speed fast closing, less than two seconds.

3. Air Cushioning is "Field Adjustable", starting when the valve disc is approximately 90% closed. Therefore, the disc closes very fast through 90% of its swing. Then, air compression develops to cushion close the remaining 10% of valve shut-off. Factory start-up service is available but not essential.



AIR CUSHION/SIDE MOUNTED
SERIES 6000

EASILY ADJUSTED TO OPERATING CONDITIONS • AIR CUSHION CHECK

The totally enclosed external air cushion cylinder is adjustable as follows:

Primary control is in the cushion cylinder, by adjusting the flow control valve (#30)

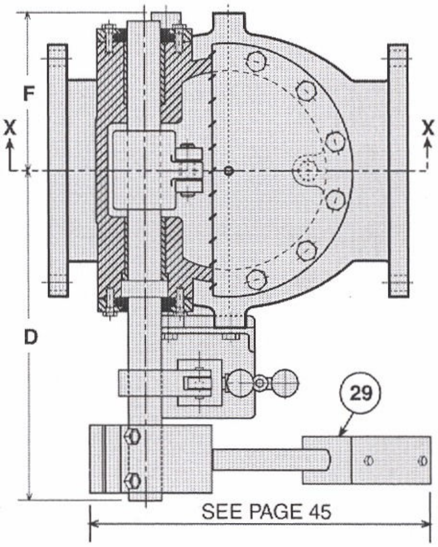
Increased cushioning – screw in (clockwise) control valve (#30)

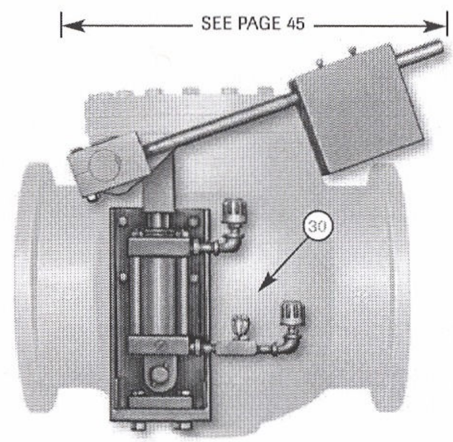
Decreased cushioning – screw out (counter clockwise) control valve (#30)

For more rapid disc closure – move the weight towards outer end of the lever.

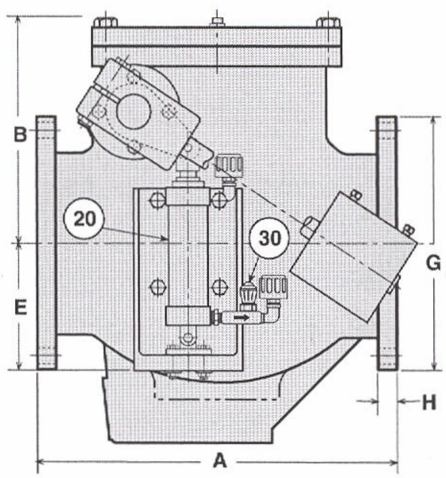
For less rapid disc closure – move the weight towards pivot shaft.

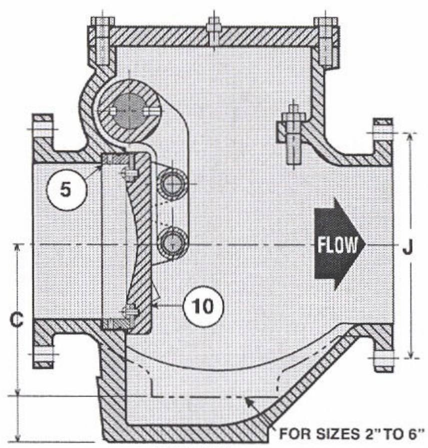
WARNING: *Many Check Valves including Air Cushion Check Valves can experience problems when a Surge/Pressure Tank is being installed on the pipeline in close proximity to the check valves. Contact **APCO**'s Engineering Department for Check Valve recommendations.*





FAST CLOSING WITH CUSHION AT SHUT-OFF





SEC. X-X

FEATURES BY APCO®

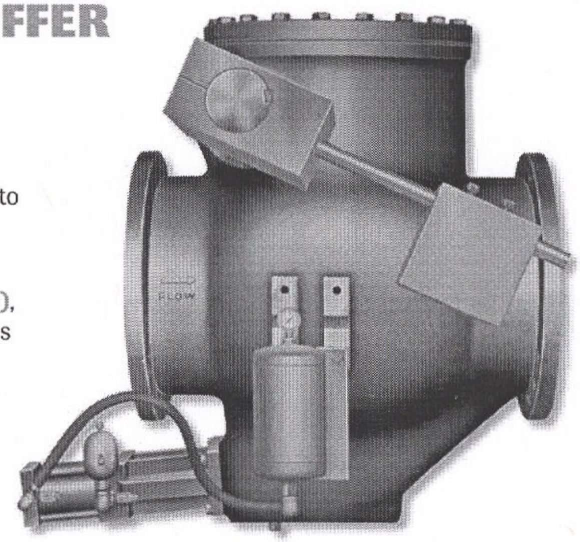
1. **Totally enclosed** air cylinders are protected from the elements.
2. Micrometer air control valve-coded for ease of adjustment to achieve air cushion closure.
3. Double Clevis, self aligning disc.
4. Convertible valves can be retrofitted in the field to oil control.
5. Centrifugally cast aluminum bronze tough wearing body seat.
6. All internal parts can be easily replaced, including the body seat, in the field!
7. Through shafts to avoid internal axial forces.

All the above can be done without removing valve from the line.

CLASS	VALVE SIZE	2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"	54"	60"	66"
125 & 250 LB. CLASS	MODEL NO.	6002	6002½	6003	6004	6006	6008	6010	6012	6014	6016	6018	6020	6024	6030	6036	6042	6048	6054	6060	6066
	A	9	12	12	13	17½	18	23	28	33	36	40	40	48	56	63	70	78	87	97	108
	B	6	7	7	7½	10	12	14¼	16	19⅝	21	24	26	30	38	45	56	50	63	66	68
	C	10⅜	10¼	10⅜	10⅜	10½	10¼	14	16	18	22	22	24½	26	31	36	39	41	52	58	64
	D	13⅜	13½	13⅜	14	17	16⅝	21	22	26	27½	29	32	33½	38½	41½	49	60	65	70	76
	E	10⅜	9⅜	10	9	10⅜	8⅝	8½	8⅞	10⅜	9½	8⅛	8⅜	5¼	9¼	5	1	6	16	27	39
	F	5	5¼	5½	6	8⅜	8½	10	11½	13⅜	14½	16	17½	20	24	27	33	38	43	46	50½
	NO. OF CWT. ARM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	NO. OF CYLINDER	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
125 LB. CLASS	G	6	7	7½	9	11	13½	16	19	21	23½	25	27½	32	38⅜	46	53	59½	66¼	73	80
	H	⅝	11/16	¾	15/16	1	1⅛	1 3/16	1¼	1⅜	1 7/16	1 9/16	1 11/16	1⅞	2⅛	2⅜	2⅜	2¾	3	3¼	3 7/16
	J	4¾	5½	6	7½	9½	11¾	14¼	17	18¾	21¼	22¾	25	29½	36	42¾	49½	56	62¾	69¼	76
	DIA. OF HOLES	⅝	⅝	⅝	¾	⅞	⅞	1	1	1⅛	1⅛	1¼	1¼	1⅜	1⅜	1⅝	1⅝	1⅝	2	2	2
	NO. OF HOLES	4	4	4	8	8	8	12	12	12	16	16	20	20	28	32	36	44	44	52	52
250 LB. CLASS	G	6½	7½	8¼	10	12½	15	17½	20½	23	25½	28	30½	36	43	50	57	65	TO BE SUPPLIED BY CUSTOMER		
	H	⅞	1	1⅛	1¼	1 7/16	1⅝	1⅞	2	2⅛	2¼	2⅜	2½	2¾	3	3⅜	3 11/16	4			
	J	5	5⅞	6⅝	7⅞	10⅝	13	15¼	17¾	20¼	22½	24¾	27	32	39¼	46	52¾	60¾			
	DIA. OF HOLES	¾	⅞	¾	⅞	⅞	1	1⅛	1¼	1¼	1⅜	1⅜	1⅝	1⅝	2	2¼	2½	2¾			
	NO. OF HOLES	8	8	8	8	12	12	16	16	20	20	24	24	24	28	32	36	40			

OIL CONTROL/BOTTOM BUFFER

SERIES 6000B

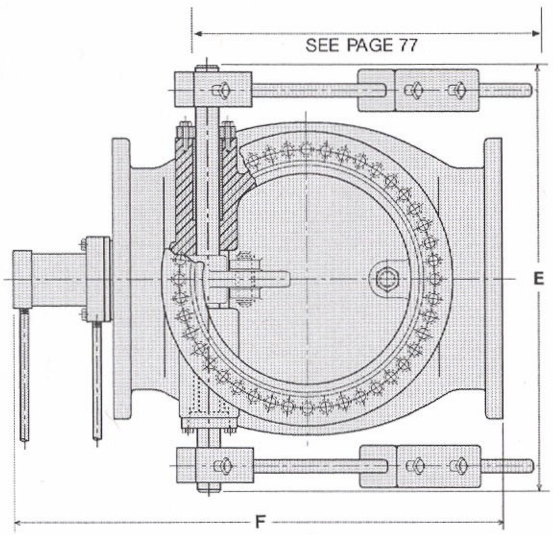


HOW 6000B SERIES OIL CONTROL/BOTTOM BUFFER VALVES WORK

1. Discharge velocity head from the pump causes the disc (#10) to open and raises the outside weighted lever (#29).
NOTE: The disc freely swings open!!

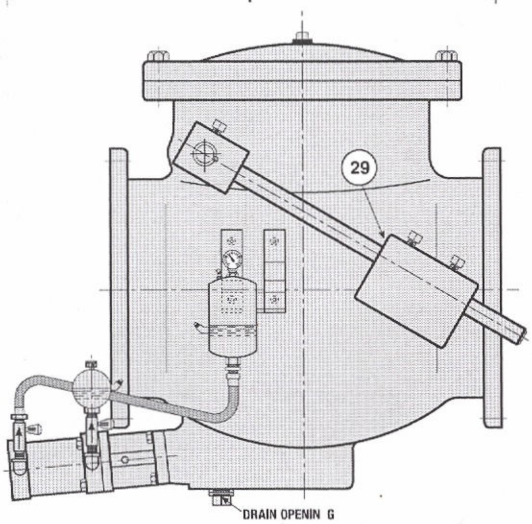
2. Conversely when pumping stops the outside weighted lever (#29), together with the reversing flow, forces the disc (#10) downwards towards shut off rapidly and freely until the disc tail comes in contact with the buffer rod. Controlled closure takes place during the final (approximately) 10% of disc movement.

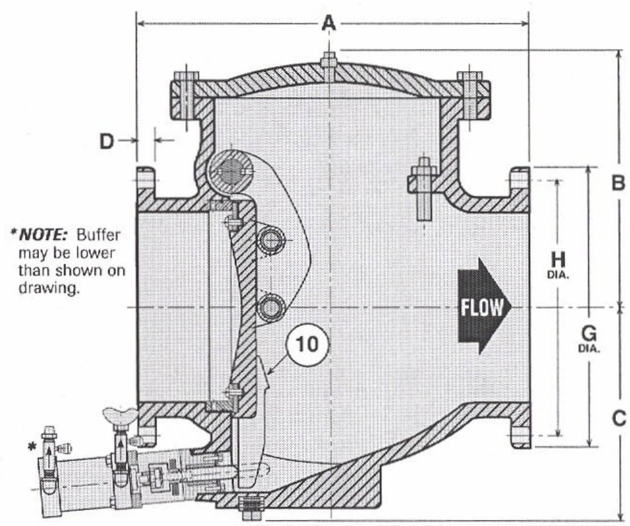
The bottom buffer principal of control closure has been used for decades on slanting disc check valves...
IT WORKS, IT'S RELIABLE...



Class	VALVE SIZE	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"	54"	60"	66"
125 LB. & 250 LB. CLASS	MODEL No.	6008B	6010B	6012B	6014B	6016B	6018B	6020B	6024B	6030B	6036B	6042B	6048B	6054B	6060B	6066B
	A	18	23	28	33	36	40	40	48	56	63	70	78	87	97	108
	B	12	14¼	16	19¾	24	24	26	30	37⅞	45	56	50	63	66	68
	C	10¼	13¾	17½	21	21¼	22	24	26	31	36	39	41	52	58	64
	E	25	30	31½	46	46	58	64	67	77	83	98	115	130	140	152
	F	28	33½	42	48	50	56	60	65	76	86	95	108	120	130	140
125 LB. CLASS	G	14	16	19	21	23½	25	27½	32	38¾	46	53	59½	66¼	73	80
	H	11¾	14¼	17	18¾	21¼	22¾	25	29½	36	42¾	49½	56	62¾	69¼	76
	D	1⅛	1³⁄₁₆	1¼	1⅜	1⁷⁄₁₆	1⁹⁄₁₆	1¹¹⁄₁₆	1⅞	2⅛	2⅜	2⅝	2¾	3	3⅛	3⁷⁄₁₆
	DIA. OF HOLES	⅞	1	1	1⅛	1⅛	1¼	1¼	1⅜	1⅜	1⅝	1⅝	1⅝	2	2	2
	NO. OF HOLES	8	12	12	12	16	16	20	20	28	32	36	44	44	52	52
250 LB. CLASS	G	15	17½	20½	23	25½	28	30½	36	43	50	57	65	TO BE SUPPLIED BY CUSTOMER		
	H	13	15¼	17¾	20¾	22½	24¾	27	32	39¼	46	52¾	60¾			
	D	1⅞	1⅞	2	2⅛	2¼	2⅜	2½	2¾	3	3⅜	3¹¹⁄₁₆	4			
	DIA. OF HOLES	1	1⅛	1¼	1¼	1⅜	1⅜	1⅜	1⅝	2	2¼	2¼	2¼			
	NO. OF HOLES	12	16	16	20	20	24	24	24	28	32	36	40			

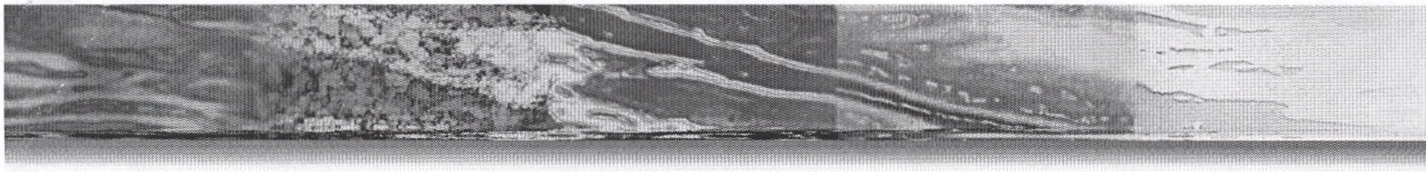
NOTE: 1. SIZES 8", 10" AND 12" HAVE ONLY ONE COUNTERWEIGHT. (RIGHT SIDE)
2. LEVER ARM EXTENDS BEYOND OUTLET FLANGE ON SOME SIZES.
3. SPECIFY IF OTHER THAN HORIZONTAL INSTALLATION. BECAUSE ANGLE OF WEIGHT LEVER AND OIL RESERVOIR MUST BE CHANGED.
4. WE RECOMMEND THE BOTTOM MOUNT FOR VERTICAL FLOW UP INSTALLATIONS.
5. THE BOTTOM MOUNT IS FAR SUPERIOR TO THE SIDE MOUNT IN LARGER SIZED VALVES AND MAINTAINS A FULL ANSI RATING.





NOTE: VENTURI ACTION AUTOMATICALLY CLEANS THE BUFFER AREA

ADDITIONAL INFORMATION: APCO 6000B FOUND ON PAGE 76



OIL CONTROL/SIDE MOUNTED

SERIES 6100 (125# Class)

HOW 6100 SERIES VALVES WORK

1. OPENING Discharge velocity head from the pump causes the disc (#10) to open and raises the outside weighted lever. (#29) Except for frictional resistance, the disc is free opening.

2. THREE STAGES OF CONTROLLED CLOSURE
The Cylinders provide two stages and a third stage is developed by the Timing Valve (#45). The Timing Valve is most important because it allows very fast closure of the disc from full open to any degree of closure. This feature greatly reduces the volume of backflow and flow reversal that occurs with only 2 stage closure valves (by others) on the market.

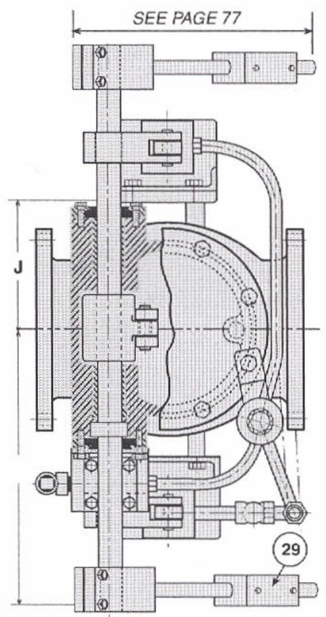
The three-stage closure function is as follows:

1st STAGE: Rapid closure from full open to any degree of closing. (#45- Timing Valve)
2nd STAGE: Variable speed towards final closure. (#30- Flow Control Valve)
3rd STAGE: Variable speed closure to shut-off. (#20- Internal Cushion Adjustment of the Cylinder)

Each stage is independently adjustable. Additional closing adjustments:
Faster disc closing – move weight towards outer end of lever.
Slower disc closing – move weight towards pivot shaft.

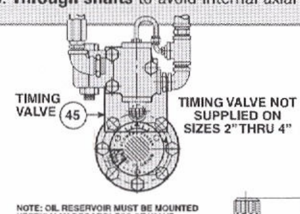
VALVE SIZE		2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"
MODEL #		6102	6102½	6103	6104	6106	6108	6110	6112	6114	6116	6118	6120
A		9	12	12	13	17½	18	23	28	33	36	40	40
B		5¾	6⅞	7	7½	10	12	14¼	16	19⅝	22	24	26
C		3½	4	4⅛	5	6½	10¼	14	16	18	22	22	24½
D		13¼	13½	13¾	14	17	16¾	21	22	26	27½	30	32
E		19	20½	21	21	22½	24	28	29½	33	35½	44	46
F		10¾	10¼	10	10½	14	12½	12	12	14¼	15½	16½	17
G		6	7	7½	9	11	13½	16	19	21	23½	25	27½
H		⅝	11/16	¾	1 15/16	1	1⅛	1 3/16	1¼	1⅜	1 7/16	1 9/16	1 11/16
FLG. HOLES	No.	4	4	4	8	8	8	12	12	12	16	16	20
FLG. HOLES	Dia.	¾	¾	¾	¾	⅞	⅞	1	1	1⅛	1⅛	1¼	1¼
FLG. HOLES	B.C.D.	4¾	5½	6	7½	9½	11¾	14¼	17	18¾	21¼	22¾	25
No. of C'WT. ARM		1	1	1	1	1	1	2	2	2	2	2	2
No. of CYLINDER		1	1	1	1	1	1	2	2	2	2	2	2
J		5	5½	5¾	6¼	8¾	8¾	–	–	–	–	–	–

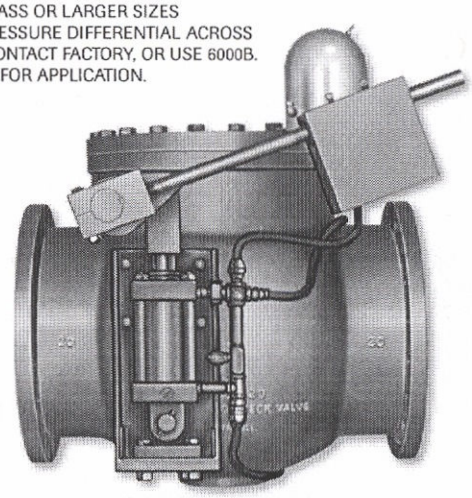
NOTE: FOR 250# CLASS OR LARGER SIZES DEPENDING ON PRESSURE DIFFERENTIAL ACROSS DISC AND FLOW, CONTACT FACTORY, OR USE 6000B. CONTACT FACTORY FOR APPLICATION.



FEATURES by APCO

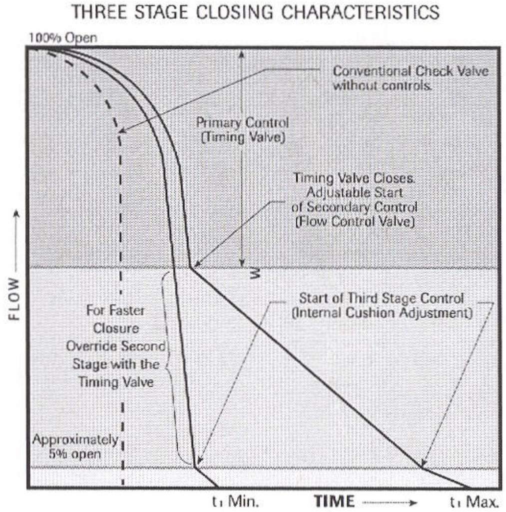
1. **Three stage closure** with fail safe oil accumulator system
2. **Totally enclosed** oil cylinders protected from the elements.
3. **Timing valve**
4. Centrifugally cast aluminum bronze tough non-wearing body seat.
5. **Double clevis** self aligning disc.
6. All internal parts can be easily replaced, including body seat, in the field without removing the valve from the line.
7. **Through shafts** to avoid internal axial forces.

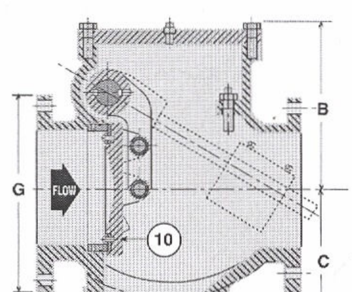


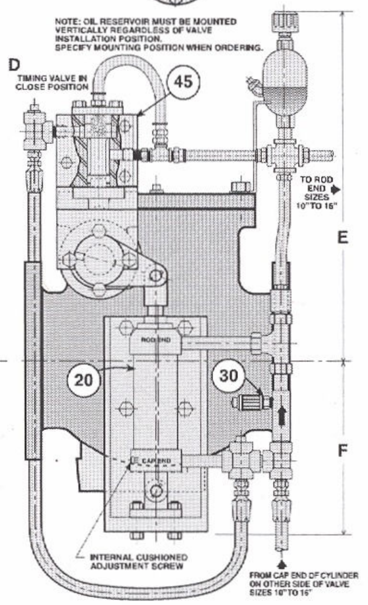


SERIES 6100

THREE STAGE CLOSING CHARACTERISTICS







CONTROL CLOSING is achieved by the Oil Dashpot/Timing Valve System. This will minimize damaging water hammer. Adjusting the Timing Valve/Oil Dashpot System is easily accomplished to suit each application.
The graph shows flow rate as a function of closing time and illustrates clearly the superiority of the APCO three stage Oil Control Check Valves.

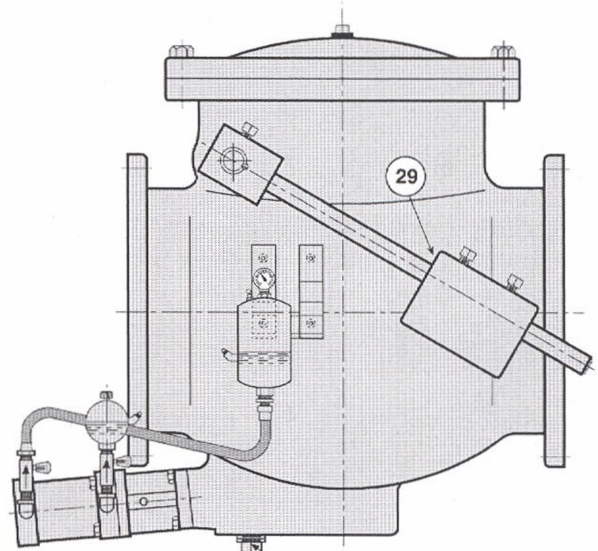
ADDITIONAL INFORMATION:

BOTTOM MOUNTED BUFFER
(FREE OPENING AND CONTROLLED CLOSING)

This unique buffer arrangement allows the valve disc (#10) to open fully without interference and to close freely for approximately 90% of its stroke. After the disc is 90% closed, it then comes in contact with the buffer rod (#33). At this point, speed of closing of the last 10% is established.

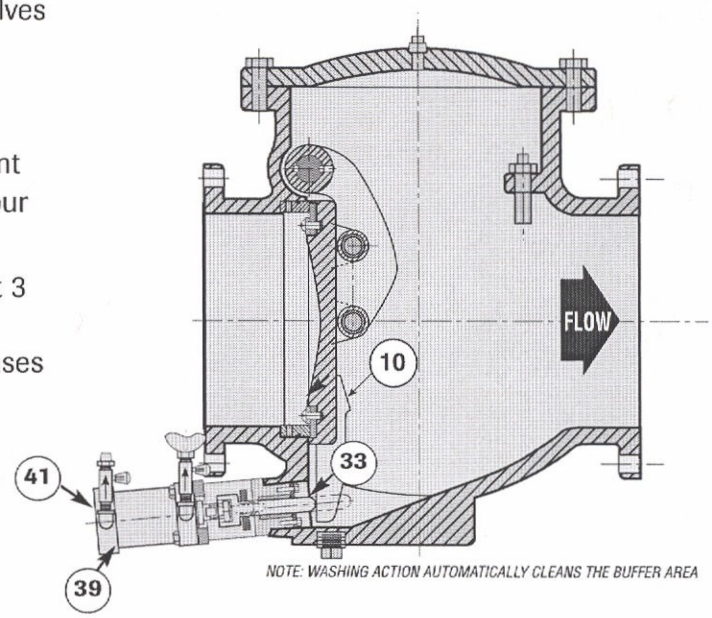
The flow control valve (#41) on the cylinder (#39) is easily adjusted to allow a closing time adjustment to suit pipeline flow conditions. Slamming is prevented and pipeline pressure surges are greatly reduced.

- We recommend the Bottom Mounted Buffer for vertical upward flow installations and whenever there is a hydro pneumatic surge tank in close proximity to the pump discharge.
- Bottom Mounted Buffer is far superior to side mounted oil control for larger sized valves. With the Bottom Mounted Buffer the larger size valves still maintain a full ANSI rating.



Did you know?

- Any APCO (convertible) controlled movement valve can be modified in the field to meet your specific conditions.
- Good pump station design suggests at least 3 pipe diameters of straight pipe on the down stream side of a check valve and in some cases the upstream side.
- The APCO buffer may be added to a convertible check valve in the field.
- APCO offers factory trained engineers for field start up.

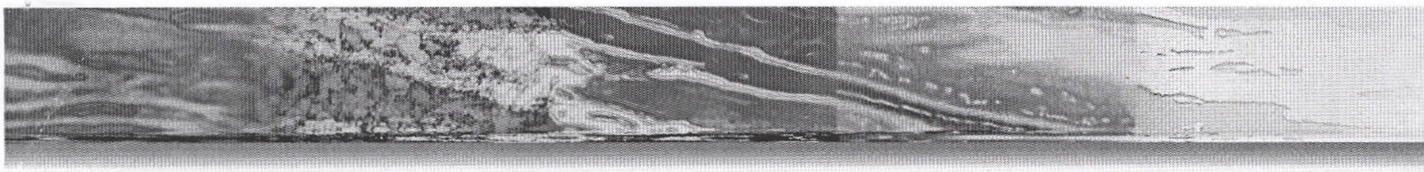


NOTE: WASHING ACTION AUTOMATICALLY CLEANS THE BUFFER AREA

About the buffer

Bottom Mounted Buffers have been used successfully for decades to eliminate slamming of the valve disc and resultant water hammer.

Recommended where instantaneous flow reversal caused by a Hydro-pneumatic Surge Tank or Open Line Discharge is so fast a free closing check valve cannot shut prior to reverse flow and therefore slams. With the Buffer, the disc will stop at approximately 90% (adjustable) of closure and closure is controlled to shut-off without slamming and with minimal pressure rise.

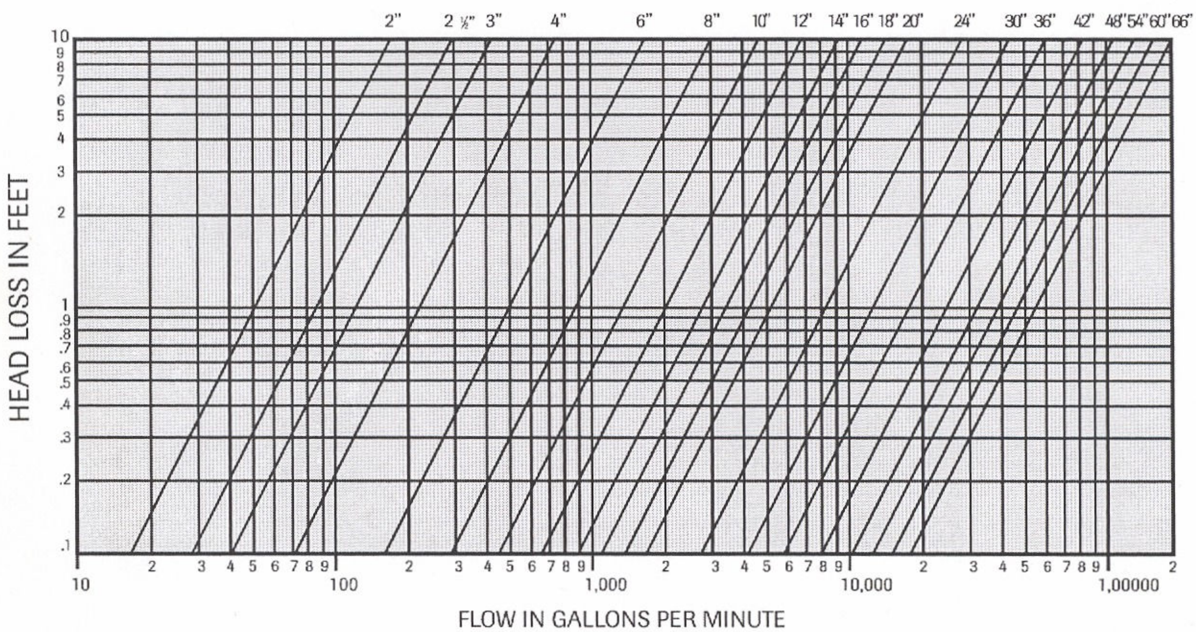


VALVE SIZE		2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"	54"	60"	66"
SHAFT DIAMETER		1"	1"	1"	1⅛"	1⅜"	1¾"	2⅛"	2½"	3"	3½"	3¾"	4"	3"	3¾"	4"	5"	5½"	5½"	6"	6"
MODEL NO. 6000	SHAFT MATERIAL	STAINLESS STEEL T303																			
6000B	SHAFT MATERIAL	NOT AVAILABLE					STAINLESS STEEL T303														
6100	SHAFT MATERIAL	STAINLESS STEEL 17-4PH										FOR FULL ANSI RATING USE SERIES 6000B									

YIELD STRENGTH: STAINLESS STEEL 17-4PH = 165,000 PSI; STAINLESS STEEL T303 = 40,000 PSI

NOTE: Above shaft diameters and materials are designed for maximum torque. A superior grade 17-4PH Stainless Steel shaft material is used on Oil Control Check Valves. This material is 4 times stronger than T303, T304 or T316 stainless steel.

Head loss characteristics for Swing Check Valves



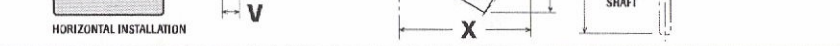
HOW TO INSTALL

APCO Cushion Swing Check Valves may be installed horizontally or vertically on the discharge side of the pump to suit available space in the pump station.

The lever weight arm is fitted with a movable weight No. 29. This weight acts as the force to hold the disc No. 10 against the seat to keep the valve closed. Occasionally the weight is not required and can be removed (or additional weights may be required at minimum cost).

Each valve comes with installation instructions fixed to the weight.

NOTE: ALL SWING CHECKS ARE RECOMMENDED FOR RAW SEWAGE.



SIZE	2"	2½"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"	54"	60"	66"
V	4½	3¼	3¼	2¾	7⅛	7	7¾	7⅛	7¼	7	8¼	8¼	10	5	2	15	17	18	8½	3½
W	9	9½	9½	10¾	16½	18	20¼	25	29	30¾	35	36	43¾	48	51	65	75	84	88½	91
X	9½	8¼	8½	8	14½	13	13½	18	20	20	24½	23½	28	24	21	41	47½	50½	46	43
Y	6	4	4	4½	10	10	9¼	11	13½	14	15	15	18	15½	15	26	29¼	39½	41	33½
Z	32	33	34	35	43	43	52	56	66	71	75	82	88	102	111	132	159	174	187	204

APCO AIR CUSHION OR OIL CONTROL CHECK VALVES OPERATE EQUALLY WELL IN THE VERTICAL POSITION. FOR VERTICAL INSTALLATION THE ANGLE OF THE LEVER MUST BE CHANGED.

SPECIFICATIONS

SERIES 6000 CUSHION SWING CHECK VALVE - AIR CUSHION SIDE MOUNTED

Air Cushion Swing Check Valve body shall be cast iron per AWWA C508 having integral (not Wafer) flanges.
The seat shall be centrifugally cast bronze with an o-ring seal and be locked in place with stainless steel lock screws and be field replaceable, without the use of special tools.

The shaft shall be single and continuous stainless steel, **extending both sides of the body** with a lever and weight, using an air cushion cylinder side mounted.
The air cushion cylinder shall be constructed of corrosion-resistant material and the piston shall be **totally enclosed** within the cylinder and not open at one end.
The cushion cylinder assembly shall be externally attached to either or both sides of the valve body and will permit adjustability to cushion the closure of the valve. Cushioning shall be air trapped in the cushion cylinder which shall be fitted with a one way adjustable control check valve to cushion disc contact to the seat at the shut-off point. The bottom cylinder head shall be **swivel mounted** and not rigid to follow the change of force angles as the lever raises or lowers to open or close the check valve.

This valve shall prevent backflow of the media on normal pump shut-off or power failure, and be water tight.
The disc shall be cast iron utilizing a **double clevis** connected to a Ductile iron disc arm. The disc arm assembly shall be suspended from a stainless steel shaft which passes through a seal retainer on both sides of the valve body. (Specify if other than horizontal installation.)
Valve exterior to be painted with Universal Metal Primer Paint as accepted by the FDA for use in contact with Potable Water.

Materials shall be certified to the following A.S.T.M. specifications:

Body, cover, disc	Cast iron	ASTM A126 GR.B
Disc arm	Ductile iron	ASTM A536
Seat	Aluminum bronze or	ASTM B148
	Stainless steel	ASTM A276
Disc seat	Buna-N or metal	To suit
Cylinder	Corrosion-resistant material	Commercial

Valve to be APCO Series 6000 Cushion Swing Check Valve - Air Cushion Side Mounted as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.

SERIES 6000B SWING CHECK VALVE - OIL CONTROLLED BOTTOM BUFFER

The Oil Control Bottom Buffer Swing Check Valve body shall be cast iron per AWWA C508 having integral flanges (not Wafer) and have a centrifugally cast bronze body seat. The body shall have a flush and drain hole. The seat shall be locked in place with stainless steel lock screws and be field replaceable without the use of special tools. The shaft shall be (1) piece T303 steel, extending through both sides of the body with a lever and weight mounted on each side. Except 8", 10", and 12".
The disc shall be Ductile iron, utilizing a double clevis, and be connected to a Ductile iron disc arm. The disc seat shall be Buna-N (replaceable) to provide water tight shut-off. The disc arm assembly shall be suspended from the stainless steel shaft.
The valve must have a bottom hydraulic buffer to permit free open and positive non-slam control closure of the disc. The hydraulic buffer shall make contact with the disc during the last 10% of closure, to instantly control the valve disc until shut-off in a manner to prevent slam and water hammer. The last 10% of closure shall be externally adjustable and variable to suit operating conditions. The hydraulic buffer and oil system shall be separate from the main line media.
(Specify if other than horizontal installation)
Materials shall be certified to the following A.S.T.M. specifications:

Body/cover	Cast iron	ASTM A126, GR.B
Disc arm/disc	Ductile iron	ASTM A536
Seat	Aluminum bronze or Stainless steel	ASTM B148 or ASTM A276 (Engineer select one)
Shaft	Stainless steel	ASTM A582 T303
Disc seat	Buna-N or metal	To suit
Buffer cylinder	Steel	Per N.F.P.A. Standards
Buffer rod	Stainless steel	ASTM A582 T303
Exterior paint	Universal Metal Primer	FDA Approved For Potable Water Contact

Valve to be APCO Series 6000B Swing Check Valve - Oil Control Bottom Buffer, as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.

SERIES 6100 SWING CHECK VALVE - OIL CONTROL SIDE MOUNTED

The Oil Controlled Swing Check Valve body shall be cast iron per AWWA C508 with integral flanges (not Wafer) and have a centrifugally cast bronze body seat. The seat shall be locked in place with stainless steel lock screws and be field replaceable without the use of special tools.
The shaft shall be one piece hi-strength Type 17-4PH stainless, **extending through both sides of the valve body.**
Oil Control side mounted hydraulic cylinders shall provide **three stage control closing** for the prevention of surge and water hammer. The cylinder must have two stages of control during the closing cycle and a third stage by means of a **timing valve** to permit rapid closure of the disc from full open to any degree of closure on pump stop.
Typically as follows:

1st stage: rapid closure to any degree
2nd stage: variable slow closure towards final closure
3rd stage: variable closure to shut-off

Each stage shall be independently adjustable and the oil system self-contained and separate from the main line media.
The valve shall control close while flow reverses in the pipeline during normal pump shut-off or power failure in a time sequence to prevent or minimize water hammer. Each stage closure shall be field adjustable. (Specify if other than horizontal installation)
The disc shall have a **double clevis** connected to a Ductile iron disc arm. The disc arm assembly shall be suspended from the stainless steel shaft. The disc seat shall be Buna-N (replaceable) to provide water tight shut-off.
Materials shall be certified to the following A.S.T.M. specifications:

Body & cover	Cast iron	ASTM A126, GR.B
Disc	Cast or ductile iron	ASTM A126, GR.B or ASTM A536
Disc arm	Ductile iron	ASTM A536
Body seat ring	Aluminum bronze or Stainless Steel	ASTM A148 or ASTM A226 (Engineer to select one)
Disc seat	Buna-N or metal	to suit
Dashpot cylinder	Steel	Per N.F.P.A. Standards
Pivot shaft	Stainless steel	Type 17-4PH
Exterior paint	Universal Metal Primer	FDA Approved For Potable Water Contact

Valve to be APCO Series 6100 Cushion Swing Check Valve - Oil Control Side Mounted, as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.

APCO VALVE & PRIMER CORPORATION
1420 WRIGHT BLVD. • SCHAUMBURG, IL 60193-4599
847.524.9000 • FAX:847.524.9007 • 800.323.6969
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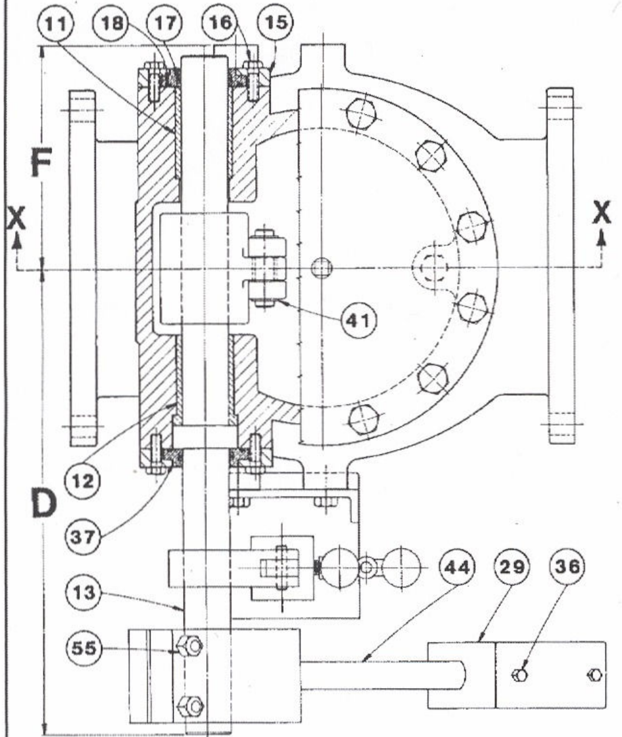
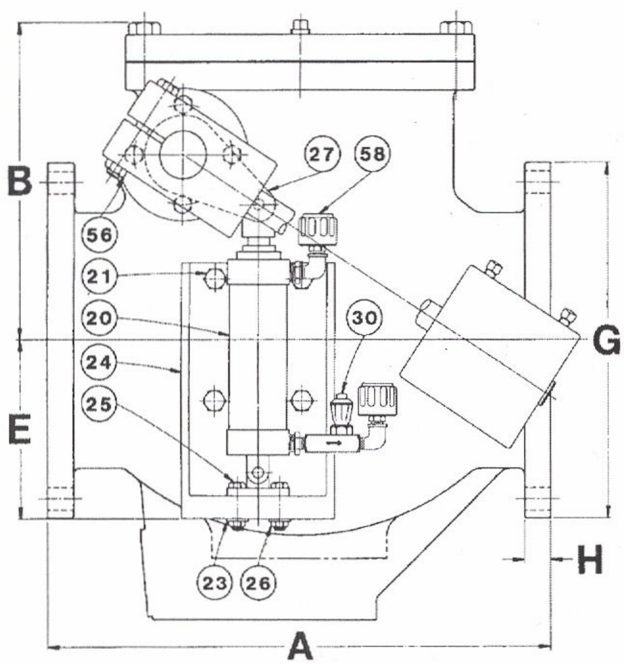
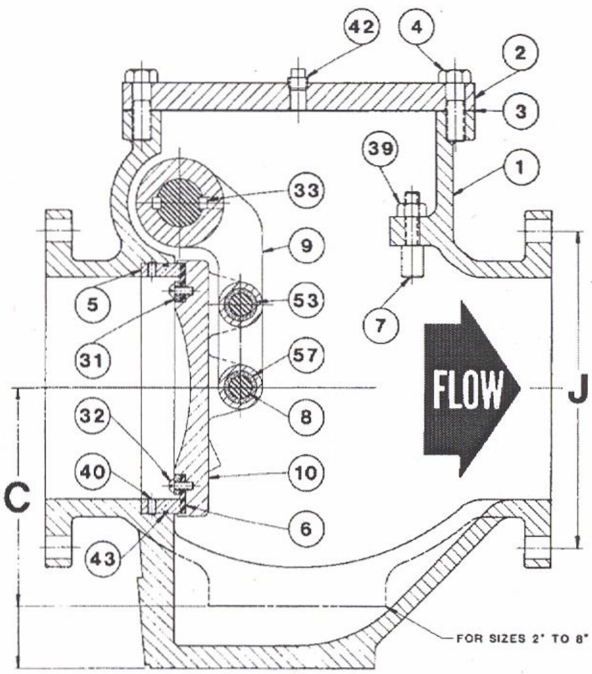
CUSHIONED SWING CHECK VALVE
AIR CUSHIONED SIDE MOUNTED



Class	VALVE SIZE	2"	2 1/2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	42"	48"	54"	60"	66"
125 & 250 LB. CLASS	A	9	12	12	13	17 1/2	18	23	28	33	36	40	40	48	56	63	70	78	87	97	108
	B	6	7	7	7 1/2	10	12	14 1/4	16	19 5/8	21	24	26	30	38	45	56	50	63	66	68
	C	10 1/4	10 1/4	10 1/4	10 1/2	10 1/2	9	14	16	18	22	22	24 1/2	26	31	36	39	41	52	58	64
	D	13 1/4	13 1/2	13 3/4	14	17	16 3/4	21	22	26	27 1/2	29	32	33 1/2	38 1/2	41 1/2	49	60	65	70	76
	E	10 3/4	9 5/8	10	9	10 3/8	8 3/4	8 1/2	8 3/4	10 3/4	9 1/2	8 1/8	8 3/4	5 7/8	9 1/4	5	1	6	16	27	39
	F	5	5 1/4	5 1/2	6	8 3/8	8 1/2	10	11 1/2	13 3/4	14 1/2	16	17 1/2	20	24	27	33	38	43	46	50 1/2
	NO. OF C'WT. ARM	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
	NO. OF CYLINDER	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2
125 LB. CLASS	MODEL NO.	6002	6002 1/2	6003	6004	6006	6008	6010	6012	6014	6016	6018	6020	6024	6030	6036	6042	6048	6054	6060	6066
	G	6	7	7 1/2	9	11	13 1/2	16	19	21	23 1/2	25	27 1/2	32	38 3/4	46	53	59 1/2	66 1/4	73	80
	H	5/8	11/16	3/4	15/16	1	1 1/8	1 3/16	1 1/4	1 3/8	1 7/16	1 9/16	1 11/16	1 7/8	2 1/8	2 3/8	2 5/8	2 3/4	3	3 1/8	3 7/8
	J	4 3/4	5 1/2	6	7 1/2	9 1/2	11 3/4	14 1/4	17	18 3/4	21 1/4	22 3/4	25	29 1/2	36	42 3/4	49 1/2	56	62 3/4	69 1/4	76
	DIA. OF HOLES	3/4	3/4	3/4	3/4	7/8	7/8	1	1	1 1/8	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 5/8	1 5/8	1 5/8	2	2	2
	NO. OF HOLES	4	4	4	8	8	8	12	12	12	16	16	20	20	28	32	36	44	44	52	52
250 LB. CLASS	MODEL NO.	6302	6302 1/2	6303	6304	6306	6308	6310	6312	6314	6316	6318	6320	6324	6330	6336	6342	6348	6354	6360	6366
	G	6 1/2	7 1/2	8 1/4	10	12 1/2	15	17 1/2	20 1/2	23	25 1/2	28	30 1/2	36	43	50	57	65	TO BE SUPPLIED BY CUSTOMER		
	H	7/8	1	1 1/8	1 1/4	1 7/16	1 5/8	1 7/8	2	2 1/8	2 1/4	2 3/8	2 1/2	2 3/4	3	3 3/8	3 11/16	4			
	J	5	5 7/8	6 5/8	7 7/8	10 5/8	13	15 1/4	17 3/4	20 1/4	22 1/2	24 3/4	27	32	39 1/4	46	52 3/4	60 3/4			
	DIA. OF HOLES	3/4	7/8	7/8	7/8	7/8	1	1 1/8	1 1/4	1 1/4	1 3/8	1 3/8	1 3/8	1 5/8	2	2 1/4	2 1/4	2 1/4			
	NO. OF HOLES	8	8	8	8	12	12	16	16	20	20	24	24	24	28	32	36	40			

DET.	DESCRIPTION	MATERIAL	DET.	DESCRIPTION	MATERIAL
1	BODY	CAST IRON ASTM A126 Gr. B	25	EYE BRACKET MOUNTING BOLT	STEEL ASTM A307 Gr. B
2	COVER	CAST IRON ASTM A126 Gr. B	26	EYE BRACKET BOLT NUT	STEEL ASTM A307 Gr. B
3	COVER GASKET	LEXIDE (NON-ASBESTOS)	27	CYLINDER LEVER	DUCTILE IRON ASTM A536
4	COVER BOLT	STEEL ASTM A307 Gr. B	29	COUNTERWEIGHT	CAST IRON ASTM A48 Cl. 30
5	BODY SEAT RING	ALUMINIUM BRONZE ASTM B148	30	FLOW CONTROL VALVE	BRASS
6	DISC SEAT	BUNA-N	31	SEAT RETAINING RING	ALUMINIUM BRONZE ASTM B148
7	DISC STOP	STAINLESS STEEL T303	32	SEAT RETAINING RING SCREW	STAINLESS STEEL 18-8
8	DISC PIN	STAINLESS STEEL T303	33	PIVOT SHAFT KEY	STAINLESS STEEL 18-8
9	DISC ARM	DUCTILE IRON ASTM A536	36	COUNTERWEIGHT ARM SET SCREW	ALLOY STEEL HT
10	DISC	CAST IRON ASTM A126 Cl. B	37	PIVOT SHAFT SEAL RETAINER	BRONZE ASTM B584
11	PIVOT SHAFT STRAIGHT BUSHING	BRONZE ASTM B584	39	DISC STOP LOCK NUT	STAINLESS STEEL 18-8
12	PIVOT SHAFT FLANGED BUSHING	BRONZE ASTM B584	40	SEAT RETAINING SET SCREW	STAINLESS STEEL 18-8
13	PIVOT SHAFT	STAINLESS STEEL T303	41	DISC PIN RETAINING RING	STAINLESS STEEL
15	PIVOT SHAFT COVER	CAST IRON ASTM A48 CL 30	42	COVER PIPE PLUG	MALLEABLE IRON
16	PIVOT SHAFT COVER BOLT	STEEL ASTM A307 Gr. B	43	BODY SEAT SEAL	BUNA-N
17	PIVOT SHAFT SEAL	BUNA-N	44	COUNTERWEIGHT ARM ASSEMBLY	DUCTILE IRON/STEEL
18	PIVOT SHAFT COVER SEAL	BUNA-N	53	PIVOT SLEEVE BEARING	BRONZE ASTM B584
20	PNEUMATIC CYLINDER	ALUMINIUM	55	LEVER ARM BOLT	ALLOY STEEL HT
21	CYLINDER BRACKET MOUNTING BOLT	STEEL ASTM A307 Gr. B	56	LEVER ARM BOLT NUT	STEEL
23	EYE BRACKET LOCK WASHER	STEEL	57	DISC ARM SLEEVE	BRONZE ASTM B584
24	CYLINDER BRACKET	STEEL	58	AIR BREATHER	STEEL





SEC. X-X

CERTIFIED BY: ______ DATE: ______

DATE		DRWG. NO.
09-01-03	APCO Willamette. VALVE AND PRIMER CORPORATION	S-6000

SPECIFICATIONS OTHER SIDE

September 1, 2003

APCO® SPECIFICATIONS

SERIES 6000 CUSHION SWING CHECK VALVE - AIR CUSHION SIDE MOUNTED

Air Cushion Swing Check Valve body shall be cast iron per AWWA C5O8 having integral (not Wafer) flanges.

The seat shall be centrifugally cast aluminum bronze with an 0-ring seal and be locked in place with stainless steel lock screws and be field replaceable without the use of special tools.

The shaft shall be single and continuous stainless steel, extending both sides of the body with a lever and weight, using an air cushion cylinder side mounted.

The air cushion cylinder shall be constructed of corrosion-resistant material and the piston shall be totally enclosed within the cylinder and not open at one end.

The cushion cylinder assembly shall be externally attached to the right side of the valve body looking downstream and be adjustable to cushion the closure of the valve. Cushioning shall be by air trapped in the cushion cylinder which shall be fitted with a one way adjustable control check valve to cushion disc contact to the seat at the shut-off point. The bottom cylinder head shall be swivel mounted and not rigid to follow the change of angular force as the lever rises or lowers to open or close the check valve.

This valve shall prevent back-flow of the media on normal pump shut-off or power failure at zero velocity and be water tight.

The disc shall be cast iron, utilizing a double clevis hinge connected to a Ductile iron disc arm. The disc arm assembly shall be suspended from a stainless steel shaft which passes thru a seal retainer on both sides of the valve body.

Valve exterior to be painted with Universal Primer Paint as accepted by the FDA for use in contact with Potable Water.

Materials shall be certified to the following A.S.T.M. specifications:

Body, cover, disc	Cast iron	ASTM A126 Gr. B
Disc arm	Ductile iron	ASTM A536
Seat	Aluminum bronze	ASTM B148
Disc seat	Buna-N	
Cushion cylinder	Hard coated aluminum	Commercial

Valve to be APCO Series 6000 Cushion Swing Check Valve - Air Cushion Side Mounted, as manufactured by Valve & Primer Corporation, Schaumburg, Illinois, U.S.A.

APCO Willamette
VALVE AND PRIMER CORPORATION

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