Flowserve – Anchor Darling
Check Valve Selection Guide

Check Valve Selection Guide

Introduction

Check valves are defined as automatic valves which open with forward flow and close against reverse flow. Although most check valves are relatively simple in design and, if constructed correctly, quite rugged, it is critical that the proper type of check valve gets selected. Use of the wrong type of check valve can result in operability problems and/or continual requirements for valve maintenance. This guide is intended to assist the user in the sizing and selection of the best check valve for a given application.

Instructions for Using this On-Line Guide

The first step in selecting a valve is to fully define the design requirements and operating parameters for the valve. These include temperature, pressure, fluid media, minimum and maximum flow rates, allowable pressure drop through the valve, rate of flow reversal, isolation requirements, space limitations, and location and orientation of the valve in the piping system.

This information should then be used in conjunction with the table below to identify a tentative valve selection. The adequacy of the tentative selection can then be verified by consulting the referenced appendix.

Valve Type	Swing Check	Tilting Disc Check	Lift Check
Reference Appendix	A	B	C
Service Requirements			
Fast Opening or Fast Closing	3	1	1
Variable Flow Conditions	3	2	1
Ease of Maintenance	1	3	2
Low Pressure Drop	1	2	3
Isolation	1*	2*	2*
Slurries and Fluids Containing Particulates	2	3	3

1 = Excellent
2 = Fair to Good
3 = Not Recommended

** With dual seats; dual seats are usually recommended for isolation service where service temperatures do not exceed 500°F.*

Appendix A: Swing Check Valves Applications

Where tight sealing is required – The flat seats of a swing check valve provide tighter shutoff than other types of check valves. Anchor/Darling swing check valves have flexible connections between the disc and seat to accommodate any minor misalignment, thus maintaining tight shutoff. When fitted with an elastomeric dual seat, a swing check can provide tight shutoff at both low and high differential pressures.

Where pressure drop must be kept to a minimum – The basically straight-through design and clear waterway of a swing check keeps pressure drop to a minimum.

Where water hammer occurrence does not present a problem – Water hammer is the result of an excessively high surge pressure when a check valve closes. Swing check valves in general do not provide protection from water hammer. The disc in a swing check valve must travel a relatively large distance in going from the fully open to the fully closed position. The amount of time that it takes for the disc to move to the closed position may

permit a significant reverse flow velocity to develop. When the disc seats under this condition, water hammer occurs.

Where flow is relatively constant – Swing check valves are usually not the best selection for service involving low or pulsating flow rates or rapid flow reversal. Since swing checks usually involve several moving parts and bolted connections, they tend to be less rugged than other types of check valves. In addition, the relatively large amount of disc travel can result in high disc velocities and correspondingly high impact loads during sudden opening and closing.

Can be installed in horizontal as well as vertical lines – Anchor/Darling swing check valves can be installed in horizontal lines as well as in vertical lines. If installed in a vertical line, the normal flow must be upward in order for gravity to assist in disc closure. A swing check should always be installed with the hinge pin horizontal.

Ease of maintenance – Due to their flat seating surfaces and simple construction, swing check valves are the easiest check valves to maintain. For special applications, such as where ALARA is a consideration, Flowserve Anchor/Darling can provide designs which reduce the required time for disassembly and maintenance to an absolute minimum.

Sizing

Swing check valves should be sized such that the flow velocity in the line is sufficient to hold the disc in the fully open position. For most Anchor/Darling swing check valves, the minimum line velocity for full disc lift can be approximated from the following formula:

Minimum Line Velocity (ft/s) = 75 √v
where v = Specific Volume of the Fluid (ft^3/lb)

Appendix B: Tilting Disc Check Valves

Applications

Where fast opening or closing is required – The center of gravity of an Anchor/Darling TDC disc is very close to the axis of rotation, thus the disc can open or close very quickly without damage to the body, disc or seat. Since the valve closes quickly upon flow reversal significant fluid velocities are not developed in the reverse direction, therefore minimizing the effects of water hammer.

Stable at low and pulsating flows – The TDC valve has greater stability at low flow rates and in pulsating service when compared to a swing check valve.

Moderate pressure drop – The pressure drop across a TDC will usually be much less than for an equivalent lift check valve. Although a TDC valve will restrict flow slightly more than a swing check, the straight-through flow path provides a minimal pressure drop.

Designs available for installation in vertical as well as horizontal lines – Flowserve Anchor/Darling Valves offers TDC valves for installation in horizontal lines and for vertical lines with flow upward. The location of the disc center of gravity relative to its pivot point is the key to a well-designed TDC. Since it is necessary to adjust this relationship for the installed orientation, Anchor/Darling furnishes different disc designs for horizontal and vertical installations. TDC valves should always be installed with the hinge pins horizontal.

Where tight sealing is required – TDC valves have moderate sealing capability and can provide tight shutoff if the differential pressure across the disc is relatively large. For tight shutoff at lower differential pressure (less than approximately 100 psi) an elastomeric dual seat is recommended.

Sizing

Although operation in the fully open position is preferred, Anchor/Darling TDC valves are designed to open and maintain a stable disc position at relatively low fluid velocities. The minimum recommended line velocity for TDC valves can be determined from the following formula:

Minimum Recommended Line Velocity(ft/s) = 24 √v
where v = Specific Volume of the Fluid (ft^3/lbm)

Check Valve Selection Guide

For most TDC valves the minimum line velocity to fully open the valve can be approximated from the following formula:
Minimum Line Velocity to Fully Open the Valve(ft/s) = 135√v

Appendix C: Globe Lift Check Valves Applications

Where rapid flow reversal may occur – Lift check valves are excellent selections for services where rapid flow reversal may occur. The travel of a lift check valve is the shortest of all the check valves, thus travel to and from the seat is faster. In addition, the lift check is inherently rugged by design, having no hinge pins, bushings, or bolted connections which are subject to impact loads when the valve seats.

Excellent for low or pulsating flows – As described above, the lift check has the shortest stroke and fewest number of parts subject to impact loads and wear. This makes the lift check an excellent selection for services where low or pulsating flows are expected. For some services a lift check with a special lightweight disc should be considered. The lightweight disc minimizes pressure drop at low flow conditions, and except for extremely low flow rates, eliminates the possibility of "chugging" or "simmering" (repeated seating and unseating).

Pressure drop – Pressure drop for a lift check will generally be higher than for a swing or tilting disc check, however, the pressure drop differential can often be minimized by using a Y-lift check or by using an angle lift check in lieu of an elbow in the piping system.

Where systems are free of particles – Lift check valves have relatively small clearances between the body and disc and thus are not generally a good selection for applications where the system fluid may contain particles.

Where tight sealing is required – Lift check valves have moderate sealing capability and can provide tight shutoff if the differential pressure across the disc is relatively large. For tight shutoff at lower differential pressure (less than approximately 100 psi) an elastomeric dual seat is recommended.

Installation Orientation

For optimum performance, lift check valves should be installed with the neck of the valve upright and vertical. When installed in this position, the force, due to the weight of the disc, acts along the centerline of the neck and the seat, thus helping to center the disc and reducing wear due to disc drag on the body and seat.

Sizing

Although operation in the fully open position is preferred, globe lift check valves are acceptable for operation at relatively low flow rates and with the disc in a partially open position. The minimum recommended line velocity can be determined from the following formula:

Minimum Recommended Line Velocity(ft/s) = 12√v
where v = Specific Volume of the Fluid (ft^3/lbm)

For most lift check valves, the velocity to fully open the valve can be approximated from the following formula:

Minimum Line Velocity to Fully Open the Valve (ft/s)
= 32√v for T-Globe Lift Check Valves
= 113√v for Y and Angle Globe Lift Check Valves

Check Valve Selection Guide

Swing Check Valves

Pressure Class	Size											
	2.5	3	4	6	8	10	12	14	16	18	20	24
End to End (in.)												
150	8.5	9.5	11.5	14	19.5	24.5	27.5	31	34	38.5	38.5	44
300	11.5	12.5	14	17.5	21	24.5	28	33	34	38.5	40	44
600	8.5	10	12	18	23	28	32	35	39	43	47	55
900	10	12	14	20	26	31	36	39	43	46	50	59
1500	10	12	16	22	28	34	39	42	47	53	58	68
2500	13	14.5	18	24	30	36	41	42	47	53	58	68
Pipe Centerline to Top (in.)												
150	6	6	6.5	8.5	11	12.5	13.5	15	16	18	21.5	25
300	6	6.5	7.5	9.5	12	14.5	15.5	16.5	18	20	23.5	28
600	5	7	9	13	14	18	20	23	24	25	31	36
900	6.5	6.5	9.5	12	13.5	15	20	24	19	22.5	25.5	29.5
1500	6.5	9	10	12	18	22	26	30	36	42	47	57
2500	7	9.5	11	13	19	23	27	31	37	43	49	59
Weight (lb.)												
150	35	75	90	145	280	430	625	820	1120	1260	1635	2475
300	50	100	120	280	330	590	780	990	1245	1880	2325	3290
600	35	45	115	295	575	705	1145	1630	2255	2875	3495	3915
900	50	65	145	375	600	860	1670	1985	2415	3145	4105	6380
1500	76	95	240	500	1085	1415	2175	2960	3985	4715	7665	8380
2500	60	85	290	650	1300	1800	2900	4000	5500	6400	8500	11100
C_v Values												
150	175	275	525	1225	2225	3600	5250	6500	8750	11375	14425	21400
300	175	275	525	1225	2225	3600	5250	6500	8750	11050	14050	20950

Check Valve Selection Guide

Tilting Disc Check Valves

Pressure Class	Size											
	2.5	3	4	6	8	10	12	14	16	18	20	24
End to End (in.)												
150	8.5	9.5	11.5	14	19.5	24.5	27.5	31	34	38.5	38.5	44
300	11.5	12.5	14	17.5	21	24.5	28	33	34	38.5	40	44
600	8.5	10	12	18	23	28	32	35	39	43	47	55
900	10	12	14	20	26	31	36	39	43	46	50	59
1500	10	12	16	22	28	34	39	42	47	53	58	68
2500	13	14.5	18	24	30	36	41	42	47	53	58	68
Pipe Centerline to Top (in.)												
150	6.5	7	7.5	9	10	12.5	13.5	15	17.5	18	21	23
300	6.5	7	7.5	10	11.5	13.5	17.5	18	18	20	21.5	23
600	6	6	7	9	11	12	13.5	15	17	21	26	27.5
900	6	7	7	12	12	13	15	16	21	22.5	26	28
1500	6	7	8	10	12	15	17	17	18.5	22	24	29.5
2500	6	7	8	10.5	12.5	16	18	18	20	23	26	31
Weight (lb.)												
150	55	75	110	200	305	590	625	945	1210	1675	2440	2920
300	70	90	190	375	440	690	905	1350	1560	1930	2635	3730
600	50	65	85	125	295	475	820	1615	2000	2700	2900	3100
900	55	70	160	290	525	990	1675	2040	2400	3390	5250	9600
1500	75	80	280	370	950	1130	2080	2820	3750	4350	8510	11600
2500	85	160	300	700	1140	2080	3500	4100	4400	7800	10900	14000
C_v Values												
150	175	275	500	1175	2200	3525	5175	6400	8625	11200	14075	20850
300	175	275	500	1175	2200	3525	5175	6400	8625	10875	13700	20425

Check Valve Selection Guide

Globe Lift Check Valves*

Pressure Class	Size											
	2.5	3	4	6	8	10	12	14	16	18	20	24
End to End (in.)												
150	8.5	9.5	11.5	16	19.5	24.5	31	38	36	50	50	56
300	11.5	12.5	14	17.5	22	24.5	31	38	47	50	54	58
600	8.5	14	17	22	26	31	33	35	39	43	50	58
900	13	12	18	20	26	31	36	40.5	43	48	52	58
1500	13	15	18	24	29	34	38	40	45	51	58	68
2500	20	22.75	26.5	36	40.25	50	56	42	47	53	60	70
Pipe Centerline to Top (in.)												
150	6	8	8.5	11.5	12.5	16	17.5	18.5	20.5	22	23.5	26
300	6	8	9.5	12	14.5	16	18.5	20.5	22	25	28	32
600	7	8	10.5	14	16	18	19.5	21.5	24.5	29	32.5	36
900	9	9	11.5	16	19	20	20.5	24	27	32	37	42
1500	9	10	12	16	18	19.5	24	29	34	39	44	50
2500	10	11	12.5	16	20	25	30	36	42	48	54	60
Weight (lb.)												
150	46	95	150	248	390	680	840	1100	1450	1820	2500	3300
300	50	100	250	400	600	900	1200	1850	2500	3100	3800	4700
600	60	120	300	500	1000	1300	1700	2200	2900	3800	4800	5800
900	70	150	350	650	1200	1600	2100	2700	3500	4500	5600	6700
1500	120	200	375	800	1400	1900	2500	3200	4100	5200	6400	7600
2500	180	260	500	900	1600	2200	2900	3700	4700	5900	7200	8500
C_v Values												
150	74	100	173	390	674	1060	1636	2139	2497	3790	4396	6150
300	90	119	196	414	730	1060	1636	2139	2975	3719	4548	6159
600	71	129	221	479	798	1195	1669	1960	2529	3267	4125	5853
900	84	107	217	421	745	1133	1644	2021	2515	3296	4002	5492
1500	84	119	201	435	733	1102	1552	1813	2345	3097	3929	5567
2500	70	97	156	347	583	865	1240	1481	1913	2530	3127	4439

** Information listed relates to "T" type valves. Contact Flowserve for information on "Y" and angle-type valves.*

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing, selection, installation, operation and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

While the information and specifications contained in this literature are believed to be accurate, they are supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because Flowserve is continually improving and upgrading its product design, the specifications, dimensions and information contained herein are subject to change without notice. Should any question arise concerning these provisions, the purchaser/user should contact Flowserve Corporation at any one of its world-wide operations or offices.

For more information about Flowserve Corporation, contact www.Flowserve.com or call USA 1-800-225-6989

Flowserve Corporation
Flow Control Division
Edward & Anchor/Darling Valves
1900 South Saunders St
Raleigh, NC 27603 USA

Toll – Free Telephone Service
(U.S. and Canada)
Day: 1-800-225-6989

After Hours Customer Service
1-800-543-3927

U.S. Sales Office
Phone: 919-832-0525
Fax: 919-831-3369

Website:
www.Flowserve.com

 ADAMS8007-00,