Red Valve®

CONTROL VALVE
Sizing Guide

Red Valve®

Sizing Control Valves

Sizing the system control valves to provide desirable operating parameters rank among the most important factors in determining the stability and longevity of a process system. This handbook addresses the key points in that process. Red Valve is committed to providing the utmost in quality equipment to achieve that goal.

Red Valve and its staff of experienced valve specialists are also dedicated to taking the extra step to ensure the selection of the control valves meets the needs of the application. Our specialists have experience with control valves in systems ranging from wastewater, mining, chemical, and bulk handling applications. We have computerized the selection process to evaluate multiple system parameters and valve configurations to provide you with an optimized solution for the application. Red Valve evaluates the flow conditions and potential for cavitation and will recommend a pinch valve and actuator. Our experience and computer systems are here to support your projects.

The first step in engaging Red Valve's services is to contact us. We will request the data needed to complete the Control Valve Data Sheet, the next to last page in the brochure, and a simple sketch or description of the system layout. We will evaluate the conditions and discuss the results, then recommend solutions for you to review.

We are committed to achieving your satisfaction.

Red Valve Company, Inc.
600 North Bell Avenue
Carnegie, PA 15106
ph: 412.279.0044
fax: 412-279-7878
support@redvalve.com

Red Valve produces products and systems that improve air and water quality in our communities. Through mass customization we will tailor our products and systems for our clients' individual and particular needs. This commitment is an evolutionary and dynamic process of continuous improvement.

Flow Data

Data Required for Sizing:

- Pipe diameter
- Flow Q Maximum in gallons per minute GPM
- Flow Q Minimum in gallons per minute GPM
- Flow Q Normal in gallons per minute GPM
- P_1 Inlet Pressure PSIG at Minimum, Maximum and Normal flow.
- ΔP Pressure Drop through the valve at Minimum, Maximum and Normal Flow
- G Specific Gravity of fluid at operating temperatures
- P_V Vapor Pressure, PSIA of fluid at operating temperatures

The basic equation for sizing Red Valve's Control Pinch Valves for non-compressible fluids and liquids is as follows:

$$C_V = Q\sqrt{\frac{G}{\Delta P}}$$

Where: Q = Flow rate in GPM

G = Specific Gravity

ΔP = Pressure Drop = $P_1 - P_2$

P_1 = Inlet pressure in PSIG

P_2 = Outlet pressure in PSIG

Flow Coefficient

Valve flow coefficient indicates capacity. It is the flow in GPM of 60°F water through the valve with 1 psi pressure drop, at a stated upstream pressure.

Leakage

Leakage references the allowable quantity of fluid passing through a valve when fully closed. This leakage rate is defined by ANSI standard B16.104.

Flow Characteristics

Flow Characteristics of the valve refer to the relationship between the flow through the valve and the rated travel or opening, as the latter is varied from 0 to 100%.

Rangeability

Rangeability refers to the ratio of maximum to minimum flows to be controlled.

Differential Pressure Drop

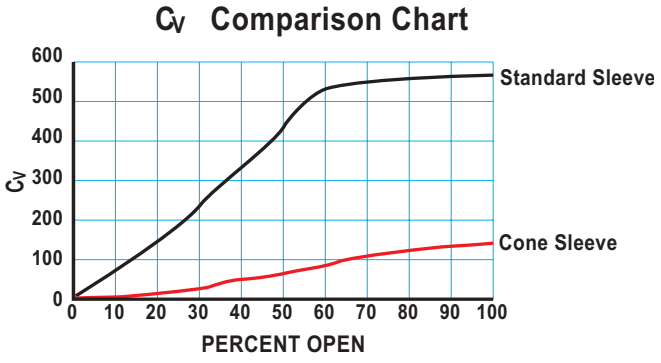
A point of confusion regarding control valve sizing is the difference between the assigned ΔP and the actual ΔP.

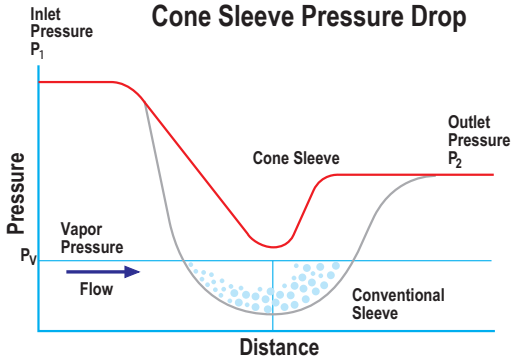
Assigned ΔP is actually the pressure drop added to the system resistance during design to assure that sufficient ΔP is available to permit the control valve to perform its function. This is considered a theoretical value and has no meaning under actual operating conditions. It is needed during the design stage for tasks such as estimating pump size.

The actual ΔP is the difference between the control valve inlet pressure and control valve outlet pressure for a given flow. A control valve does not dictate the ΔP in a system. Rather, the fluid system dictates what the ΔP across a control valve is for a given flow.

Cone Sleeve Benefits

The Cone Sleeve maintains a smooth streamline flow pattern when modulating slurry fluids. It has a maximum allowable pressure drop of 20% to 25% higher than the standard sleeve trim. The Cone Sleeve offers a high rangeability for modulating service. It has th highest rangeability and pressure recovery factor of all the Red Valve sleeve trims and provides accurate, repeatable control over a wide range of flow conditions.





Red Valve®

Control Valve Sizing

The illustration below is the mathematical calculation used in correctly sizing a Control Valve. All of the information necessary to calculate valve size is listed on the following pages. Designers can also submit a sizing request using the Control Valve Order Entry data sheet form on page 27 or online at www.redvalve.com.

Sizing of Control Pinch Valves is now made easier by using Red Valve Company's Kwiksize Control Valve Sizing Software.

Example:

Line Size:	3" diameter 125# ANSI flanged
Flow:	137 gallons per minute GPM max
	125 gallons per minute GPM min
P_1:	25 PSIG max
	20 PSIG min
T_1:	120°F
ΔP:	12 PSI max
	7.5 PSI min
G:	1.2 Specific Gravity
Viscosity:	50 SSU

Process media is lime slurry, throttling service.

- Solve for C_{VMAX}: $C_{VMAX} = Q_{MAX}\sqrt{\frac{G}{\Delta P}}$

$$C_{VMAX} = 137\sqrt{\frac{1.2}{7.5}}$$

$C_{VMAX} = 54.8$

- Solve for C_{VMIN}: $C_{VMIN} = Q_{MIN}\sqrt{\frac{G}{\Delta P}}$

$$C_{VMIN} = 125\sqrt{\frac{1.2}{12}}$$

$C_{VMIN} = 39.5$

- Select the Control Pinch Valve size.
  If there is a 3" line and a 54.8 C_{VMAX} and a 39.5 C_{VMIN} is required for this application, review the C_V Charts to determine the appropriate sleeve trim selection. This selection dictates the valve size.

Note: A 3" x 1-1/2" Cone Sleeve has a maximum C_V of 58. This would be the best selection, as maximum valve C_V equals 58. Control would be between 56% open and 80% open.

- Solve for ΔP Allowable:

ΔP Allowable = $F_L^2 \times (P_1 + 14.7 - rc \times P_V)$

ΔP Allowable	=	Maximum allowable pressure drop
F_L	=	Pressure Recovery Factor (see C_V table for F_L factor)
P_1	=	Inlet Pressure PSIG
14.7	=	Conversion to PSIA
rc	=	Critical Pressure Ratio (.94 constant)
P_V	=	Vapor Pressure at Flow Temperature (see Vapor Pressure table)

ΔP Allowable = $.70^2 \times (25 + 14.7 - .94 \times 1.69)$
ΔP Allowable = 18.7 PSI
Note: Actual Max ΔP = 12 PSI

When the Actual ΔP is smaller than the ΔP Allowable, cavitation will not occur.

- Solve for Reynold's Number:

$$Re = 3160 \times \frac{Q}{d \times k}$$

Re	=	Reynold's Number
Q	=	Flow GPM
d	=	Internal Diameter Square Inches
k	=	Viscosity Centistokes (see Viscosity Conversion table)

$$Re = 3160 \times \frac{137}{(3 \times 7.4)}$$

$Re = 19501$

Note: The Reynold's Number is much higher than 3500, no correction to the C_V is required.

Generally, if the calculated Reynold's Number is 3500 or greater, no correction to the C_V is required.

- Solve for Valve Inlet Velocity:

$$V = \frac{Q}{3.12 \times A}$$

V	=	Velocity
Q	=	Flow GPM
A	=	Valve Inlet Cross Section Area Sq. In.

$$V = \frac{137}{(3.12 \times 7)}$$

$V = 6.3$ Feet per Second

Note: Velocity is below 14 feet per second which is ideal. Velocity should not exceed 22 feet per second.

- Choose appropriate accessories, ie: limit switches, positioners, solenoids, etc.

Pressure Recovery Factor - F_L

Liquid Pressure Recovery Factor F_L

The critical flow factor F_L is a dimensionless expression of the pressure recovery ratio in a control valve. F_L is an ISA nomenclature.

$$F_L = \sqrt{\frac{P_1 - P_2}{P_1 - P_{VC}}}$$

F_L = Valve critical flow factor
P_1 = Inlet pressure PSIA
P_2 = Outlet pressure PSIA
P_{VC} = Pressure at Vena Contracta

F_L Cone Sleeve – Series 5200

VALVE SIZE (")		PORT SIZE (")	% OF TOTAL TRAVEL									
			10	20	30	40	50	60	70	80	90	100
1	x	1/3	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
1	x	1/2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
1	x	3/4	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
1-1/2	x	1/2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
1-1/2	x	1/4	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
1-1/2	x	1	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
2	x	3/4	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
2	x	1	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
2	x	1-1/2	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
2-1/2	x	1	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
2-1/2	x	1-1/2	.66	.66	.66	.65	.68	.66	.64	.62	.60	.58
2-1/2	x	2	.45	.45	.47	.50	.60	.62	.62	.61	.61	.60
3	x	1	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
3	x	1-1/2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
3	x	2	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
4	x	1-1/2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
4	x	2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
4	x	3	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
6	x	3	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
6	x	4	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
6	x	5	.43	.43	.44	.47	.50	.60	.61	.62	.61	.61
8	x	4	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
8	x	5	.63	.63	.63	.63	.65	.66	.64	.62	.60	.58
8	x	6	.49	.49	.51	.53	.58	.62	.63	.62	.61	.60
10	x	5	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
10	x	6	.66	.66	.66	.65	.68	.66	.64	.62	.60	.58
10	x	8	.45	.45	.46	.49	.54	.61	.62	.62	.61	.61
12	x	6	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
12	x	8	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
12	x	10	.43	.43	.45	.47	.50	.60	.61	.62	.61	.61
14	x	8	.74	.74	.74	.72	.72	.68	.65	.62	.60	.58
14	x	10	.52	.52	.53	.54	.60	.63	.63	.62	.61	.60
14	x	12	.42	.42	.43	.44	.47	.54	.59	.61	.62	.61
16	x	8	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
16	x	12	.49	.49	.50	.52	.57	.62	.63	.62	.61	.60
16	x	14	.41	.41	.42	.45	.47	.56	.60	.61	.62	.61
18	x	12	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
18	x	14	.47	.47	.49	.50	.56	.61	.62	.62	.61	.61
18	x	16	.40	.40	.41	.44	.46	.55	.60	.61	.61	.61
20	x	14	.52	.52	.53	.55	.62	.63	.63	.61	.60	.59
20	x	16	.45	.45	.46	.49	.54	.61	.62	.62	.61	.61
20	x	18	.40	.40	.41	.43	.46	.54	.60	.61	.61	.61
24	x	16	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
24	x	18	.49	.49	.51	.53	.59	.62	.62	.62	.61	.60
24	x	20	.43	.43	.45	.47	.51	.60	.61	.62	.61	.61
30	x	18	.66	.66	.66	.65	.68	.66	.64	.62	.60	.58
30	x	20	.57	.57	.58	.58	.64	.64	.63	61	.60	.59
30	x	24	.45	.45	.46	.49	.54	.61	.62	.62	.61	.61

For larger sizes up to 72", consult factory.

F_L Standard and Double-Wall Sleeve

% OF TOTAL TRAVEL	Series 5200 1/2" – 4"	Series 5200 6" – 36"	Series 5400 All Sizes
10	.360	.360	.360
20	.360	.360	.360
30	.390	.363	.390
40	.430	.384	.430
50	.560	.410	.560
60	.600	.456	.600
70	.610	.547	.610
80	.610	.584	.610
90	.610	.603	.610
100	.610	.610	.610

For larger sizes up to 72", consult factory.

F_L Cone Sleeve – Series 5400

VALVE SIZE (")		PORT SIZE (")	% OF TOTAL TRAVEL									
			10	20	30	40	50	60	70	80	90	100
4	x	1-1/2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
4	x	2	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
4	x	3	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
6	x	3	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
6	x	4	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
6	x	5	.43	.43	.46	.48	.59	.61	.62	.61	.61	.60
8	x	4	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
8	x	5	.63	.63	.63	.63	.65	.66	.64	.62	.60	.58
8	x	6	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
10	x	5	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
10	x	6	.66	.66	.66	.65	.68	.66	.64	.62	.60	.58
10	x	8	.45	.45	.47	.50	.60	.60	.62	.61	.61	.60
12	x	6	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
12	x	8	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
12	x	10	.43	.43	.46	.48	.59	.61	.62	.61	.61	.60
14	x	8	.74	.74	.74	.72	.72	.68	.65	.62	.60	.58
14	x	10	.52	.52	.53	.55	.62	.63	.63	.61	.60	.59
14	x	12	.42	.42	.44	.47	.58	.61	.62	.61	.61	.60
16	x	8	.86	.86	.84	.80	.76	.70	.66	.62	.59	.56
16	x	12	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
16	x	14	.41	.41	.44	.47	.58	.61	.62	.61	.61	.60
18	x	12	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
18	x	14	.47	.47	.49	.51	.60	.62	.62	.61	.61	.60
18	x	16	.40	.40	.43	.46	.58	.61	.61	.61	.61	.61
20	x	14	.52	.52	.53	.55	.62	.63	.63	.61	.60	.59
20	x	16	.45	.45	.47	.50	.60	.62	.62	.61	.61	.60
20	x	18	.40	.40	.43	.46	.58	.61	.61	.61	.61	.61
24	x	16	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
24	x	18	.49	.49	.51	.53	.61	.63	.62	.61	.60	.60
24	x	20	.43	.43	.46	.48	.59	.61	.62	.61	.61	.60
30	x	18	.66	.66	.66	.65	.68	.66	.64	.62	.60	.58
30	x	20	.57	.57	.58	.58	.64	.64	.63	.61	.60	.59
30	x	24	.45	.45	.47	.50	.60	.60	.62	.61	.61	.60

For larger sizes up to 72", consult factory.

Red Valve®

Cv = Flow Coefficient

Valve flow coefficient – C_V – indicates valve capacity. It is the flow in gallons per minute of water at 60°F through the valve with 1 psi pressure drop at a stated upstream pressure. In most on/off valve applications, a high C_V is important. The high C_V of a full-port sleeve results in low pressure losses through the valve, which increases capacity and reduces pumping costs. High C_V is a disadvantage in throttling or control applications, however, where the valve is used to absorb pressure.

To maintain a pressure drop across a full-port sleeve, the valve must be positioned in a partially closed position. This results in increased sleeve wear and reduces the control range of the sleeve. If the valve has to be positioned at 50% open to obtain the correct pressure drop at maximum flow, the control range is cut in half, as the valve position above 50% is useless. Red Valve Cone Sleeves solve this problem with a flow restriction that is designed into the sleeve. This allows the valve to operate at positions closer to 100% open.

How To Use The Flow Coefficient – C_V – Charts:

- From the example on page 17, note line size. In the example on page 17 line size is 3".
- Select proper valve size from the lefthand column of the C_V charts below. In the example, valve size is 3"; from the lefthand column locate valve size 3".
- Note calculated C_V. From the example, calculated C_V is 54.8.
- Locate from among the three charts, under 100% open, the closest value to calculated C_V. Closest value for the example is 58.
- Use this value to determine sleeve trim. In the example, 58 is the C_V value for a 3" x 1-$^1/_2$" Cone Sleeve.

Note: For modulating service select C_V values between 20% and 80% to allow for good control.

Cv Standard and Double-Wall Sleeve – Series 5200

VALVE	VALVE OPENING-% OF TOTAL TRAVEL									
SIZE (")	10	20	30	40	50	60	70	80	90	100
1	9	18	28	41	50	61	64	65	66	67
1-1/2	19	40	62	91	112	137	143	145	147	148
2	34	70	109	159	196	240	252	255	257	260
2-1/2	53	108	169	247	304	372	390	395	398	402
3	74	152	237	347	427	523	548	554	560	565
4	110	235	389	532	656	759	791	803	811	817
6	160	358	601	941	1214	1417	1513	1567	1609	1643
8	284	635	1065	1670	2155	2514	2682	2779	2853	2913
10	444	993	1666	2613	3370	3931	4168	4345	4460	4552
12	724	1619	2716	4260	5494	6411	6841	7085	7272	7422
14	967	2163	3629	5691	7340	8565	9142	9464	9710	9911
16	1263	2824	4740	7433	9587	11186	11939	12360	12682	12944
18	1611	3604	6049	9485	12234	14275	15236	15773	16184	16519
20	2384	5332	8949	14033	18100	21119	22542	23337	23944	24440
24	2951	6601	11079	17373	22407	26145	27906	28890	29641	30255

For larger sizes up to 72", consult factory.

Cv Standard and Double-Wall Sleeve – Series 5400

VALVE	VALVE OPENING-% OF TOTAL TRAVEL									
SIZE (")	10	20	30	40	50	60	70	80	90	100
4	110	235	389	532	656	759	791	803	811	817
6	229	552	1038	1390	1527	1594	1643	1670	1691	1700
8	405	979	1843	2466	2706	2827	2913	2961	2998	3014
10	634	1531	2883	3856	4233	4420	4552	4629	4686	4710
12	1034	2496	4701	6288	6902	7207	7422	7548	7641	7680
14	1381	3335	6280	8400	9224	9624	9911	10083	10209	10260
16	1804	4355	8202	10971	12047	12569	12944	13170	13333	13400
18	2302	5558	10467	14000	15373	16040	16519	16806	17015	17100
20	3405	8223	15486	20713	22745	23731	24440	24865	25174	25300
24	4215	10180	19171	25642	28157	29378	30255	30781	31164	31320
30	6737	16270	30641	40983	45003	46954	48356	49197	49809	50058
36	9882	23866	44945	60116	66013	68875	70931	72164	73062	73428
42	15103	36477	68694	91881	100893	105268	108411	110296	111668	112227
48	23457	56654	106690	142703	156699	163494	168375	171302	173434	174302
54	34423	83137	156564	209411	229951	239922	247084	251380	254508	255782

For larger sizes up to 72", consult factory.

Cv = Flow Coefficient (cont.)

Cv Cone Sleeve – Series 5200

VALVE SIZE (")		PORT SIZE (")	VALVE OPENING-% OF TOTAL TRAVEL									
			10	20	30	40	50	60	70	80	90	100
1	x	1/3	.10	.44	.88	1.52	1.92	2.46	2.80	3.00	3.24	3.44
1	x	1/2	.2	.9	1.8	3.1	3.9	5	5.7	6.1	6.6	7
1	x	3/4	1.1	2.8	5.6	7.7	11.7	14.5	17	18.9	21	23.3
1-1/2	x	1/2	.31	1.56	2.49	3.74	4.67	4.98	5.60	6.23	6.54	6.85
1-1/2	x	1/4	1	5	8	12	15	16	18	20	21	22
1-1/2	x	1	3	6	10	16	20	28	32	36	37	38
2	x	3/4	.50	2.00	4.00	7.00	9.00	11.50	13.00	14.00	15.00	16.00
2	x	1	1	4	8	14	18	23	26	28	30	32
2	x	1-1/2	4	7	15	26	43	57	65	72	78	84
2-1/2	x	1	.74	1.29	2.78	4.81	7.92	10.53	11.98	13.30	14.38	15.50
2-1/2	x	1-1/2	2.2	3.8	8.2	14.2	23.4	31.1	35.4	39.3	42.5	45.8
2-1/2	x	2	10.7	24	49.3	63.4	79.7	93	118	132	137	153
3	x	1	.89	1.78	3.56	6.52	10.38	12.46	14.83	16.01	16.61	17.20
3	x	1-1/2	3	6	12	22	35	42	50	54	56	58
3	x	2	8	17	32	51	70	92	118	131	143	152
4	x	1-1/2	1.47	2.94	5.88	10.30	19.61	25.99	30.89	34.33	37.76	40.70
4	x	2	3	6	12	21	40	53	63	70	77	83
4	x	3	15	32	63	131	159	197	231	253	286	315
6	x	3	10	17	35	79	101	115	134	148	170	187
6	x	4	23	41	85	190	242	277	322	357	410	450
6	x	5	46	94	174	311	484	618	748	862	948	1028
8	x	4	14	27	54	95	180	239	284	315	347	374
8	x	5	32	57	121	216	346	453	517	573	624	673
8	x	6	58	143	280	396	578	747	884	998	1102	1215
10	x	5	22	38	80	178	226	259	301	334	384	421
10	x	6	34	59	127	220	363	482	549	609	659	710
10	x	8	123	271	523	741	914	1091	1263	1514	1709	1787
12	x	6	25	51	101	177	337	447	532	590	649	700
12	x	8	86	153	317	709	904	1034	1202	1333	1531	1680
12	x	10	144	296	548	975	1519	1942	2349	2707	2979	3229
14	x	8	67	142	267	426	585	768	985	1094	1194	1269
14	x	10	144	303	553	877	1216	1589	2019	2378	2604	2803
14	x	12	193	397	693	1156	1940	2548	3107	3637	4109	4431
16	x	8	54	114	215	343	470	618	793	880	961	1021
16	x	12	205	433	778	1226	1713	2228	2817	3438	3771	4078
16	x	14	271	558	1003	1731	2819	3619	4394	5103	5695	6138
18	x	12	146	260	539	1205	1536	1757	2043	2265	2602	2855
18	x	14	283	596	1082	1712	2381	3181	4040	4707	5158	5567
18	x	16	454	949	1640	2674	4243	5232	6435	7671	8731	9431
20	x	14	305	646	1213	1936	2657	3493	4478	4972	5427	5768
20	x	16	504	1060	1900	2995	4189	5536	7124	8446	9264	10019
20	x	18	480	987	1735	2919	4865	6347	7730	9030	10186	10964
24	x	16	381	678	1405	3142	4007	4583	5327	5908	6786	7446
24	x	18	543	1152	2213	4433	5792	7058	8340	9318	1030	11447
24	x	20	692	1452	2553	4002	5644	7333	9596	11507	12840	13915
30	x	18	440	934	1754	2800	3840	5280	6472	7188	7845	8337
30	x	20	611	1088	2254	5041	6428	7352	8546	9478	10886	11945
30	x	24	1646	3647	7058	9946	12278	14638	17024	29760	22934	23903
36	x	20	511	1081	2030	3239	4446	5843	7490	8318	9079	9649.2
36	x	24	894	1592	3299	7379	9408	10761	12509	13873	15933	17484
36	x	30	1906	3929	7291	13012	20185	25795	31189	35919	39471	42799

For larger sizes up to 72", consult factory.

Cv = Flow Coefficient (cont.)

Cv Cone Sleeve – Series 5400

VALVE SIZE (")		PORT SIZE (")	VALVE OPENING-% OF TOTAL TRAVEL									
			10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
4	x	1-1/2	1.47	2.94	5.88	10.3	19.61	25.99	30.89	34.33	37.76	40.7
4	x	2	3	6	12	21	40	53	63	70	77	83
4	x	3	15	32	63	131	159	197	231	253	286	315
6	x	3	9.56	17.04	35.32	78.96	100.56	115.11	133.81	148.35	170.38	187.00
6	x	4	23	41	85	190	242	277	322	357	410	450
6	x	5	54.5	113	231	452	612	766	899	987	1089	1210
8	x	4	13.5	27	54	94.6	180	239	284	315	347	374
8	x	5	32	57	121	216	346	453	517	573	624	673
8	x	6	62	156	311	427	653	810	948	1055	1173	1300
10	x	5	22	38	80	178	226	259	301	334	384	421
10	x	6	33.8	59.2	127	220	363	482	549	609	659	710
10	x	8	140	315	648	834	1047	1222	1547	1732	1805	2010
12	x	6	25	51	101	177	337	447	532	590	649	700
12	x	8	85.9	153	317	709	904	1034	1202	1333	1531	1680
12	x	10	171	355	726	1418	1923	2407	2824	3101	3420	3800
14	x	8	67.18	142.16	266.98	426.03	584.66	768.42	985.12	1093.91	1194.02	1269.00
14	x	10	155	328	616	983	1349	1773	2273	2524	2755	2928
14	x	12	250	520	1063	2077	2816	3525	4136	4541	5008	5565
16	x	8	53.95	114.43	214.85	342.82	470.33	618.16	792.61	880.18	960.75	1021.00
16	x	12	231	490	920	1468	2014	2647	3394	3769	4114	4372
16	x	14	336	699	1428	2791	3784	4737	5558	6102	6730	7478
18	x	12	146	260	539	1205	1536	1757	2043	2265	2602	2855
18	x	14	310	658	1236	1973	2708	3721	4561	5065	5528	5875
18	x	16	573	1218	2343	4324	5534	7195	8619	9503	10562	11437
20	x	14	305	646	1213	1936	2657	3493	4478	4972	5427	5768
20	x	16	570	1209	2271	3626	4973	6838	8382	9308	10159	10797
20	x	18	614	1277	2609	5100	6915	8656	10156	1151	12298	13665
24	x	16	381	678	1405	3142	4007	4583	5327	5908	6786	7446
24	x	18	575	1226	2415	5022	6095	7552	8856	9699	10964	12076
24	x	20	818	1735	3260	5204	7138	9815	12031	13360	14581	15497
30	x	18	440	934	1754	2800	3840	5280	6472	7188	7845	8337
30	x	20	611	1088	2254	5041	6428	7352	8546	9478	10886	11945
30	x	24	1869	4204	8649	11132	13975	16310	20648	23117	24092	26828
36	x	20	511	1081	2030	3239	4446	5843	7490	8318	9079	9649
36	x	24	894	1592	3299	7379	9408	10761	12509	13873	15933	17484
36	x	30	2259	4689	9590	18731	25402	31795	37304	40963	45176	50196
42	x	24	766	1622	3046	4860	6670	8766	11238	12479	13622	14477
42	x	30	1665	3522	6615	10557	14487	19040	24410	27105	29586	31444
42	x	36	3781	7865	16078	31414	42592	53315	62557	68682	75745	84170
48	x	30	1215	2132	4558	8125	13023	17055	19460	21586	23485	25347
48	x	36	2705	5739	10775	17193	23587	31001	39749	44141	48181	51203
48	x	42	6527	13578	27738	54213	73502	92013	107961	118527	130726	130726
54	x	36	2066	3681	7626	17056	21747	24874	28916	32067	36831	40415
54	x	42	4102	8708	16356	26109	35809	49241	60357	67027	73154	77746
54	x	48	10407	22122	42556	78537	100514	130682	156546	172602	191837	191837

For larger sizes up to 72", consult factory.

Viscosity

C_V is useful in sizing for water flow or the flow of liquids that behave like water. However, when the liquid is extremely viscous, particular attention must be paid to the effects the viscosity may have on the size of the valve that is controlling the process fluid.

Although the majority of the valve applications have Reynold's Numbers above 5000 and will involve fluids where viscosity corrections can be ignored or where the corrections are relatively small, fluid viscosity should be considered with each valve selection.

Calculating Reynold's Number:

$$Re = 3160 \times \frac{Q}{d \times K}$$

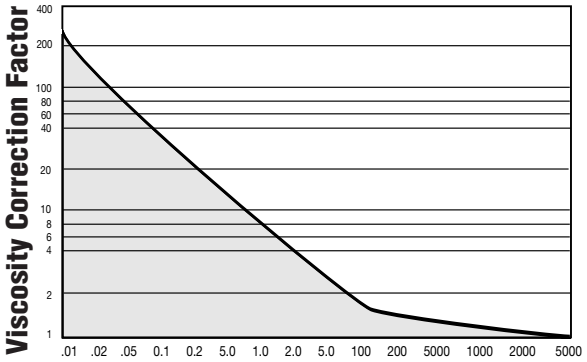
Re = Reynold's Number
Q = Flow GPM
d = Internal diameter in inches
K = Viscosity, centistokes

If the calculated Reynold's Number is lower than 3500, then the flow is considered laminar and the viscosity must be corrected according to the Viscosity Conversion Table. This correction factor should be multiplied by the original C_V value to arrive at the "corrected" C_V that accounts for viscosity.

Viscosity Conversion Table

Kinematic Viscosity Centistokes	Seconds Saybolt Universal	Seconds Saybolt Furol
1.00	31	
2.56	35	
4.30	40	
5.90	45	
7.40	50	
8.83	55	
10.20	60	
11.53	65	
12.83	70	12.95
14.10	75	13.33
15.35	80	13.70
16.58	85	14.10
17.80	90	14.44
19.00	95	14.85
20.20	100	15.24
31.80	150	19.3
43.10	200	23.5
54.30	250	28.0
65.40	300	32.5
76.50	350	35.1
87.60	400	41.9
98.60	450	46.8
110.00	500	56.6
121.00	550	56.6
132.00	600	61.4
143.00	650	66.2
154.00	700	71.1
165.00	750	76.0
176.00	800	81.0
187.00	850	86.0
198.00	990	91.0
209.00	950	95.8
220.00	1000	100.7
330.00	1500	150.0
440.00	2000	200.0
550.00	2500	250.0
660.00	3000	300.0
770.00	3500	350.0
880.00	4000	400.0
990.00	4500	450.0
1100.00	5000	500.0
1210.00	5500	550.0
1320.00	6000	600.0
1430.00	6500	650.0
1540.00	7000	700.0
1650.00	7500	750.0
1760.00	8000	800.0
1870.00	8500	850.0
1980.00	9000	900.0
2090.00	9500	950.0
2200.00	10000	1000.0

Viscosity Correction Table



Vapor Pressure/Water

°F	Vapor Pressure (lbs/in² asb)	°F	Vapor Pressure (lbs/in² asb)
32	0.08859	59	0.24713
33	0.09223	60	0.25611
34	0.09600	62	0.27494
35	0.09991	64	0.29479
36	0.010395	66	0.31626
37	0.10815	68	0.33889
38	0.11249	70	0.36292
39	0.11698	75	0.42964
40	0.12163	80	0.50683
41	0.12645	85	0.59683
42	0.13143	90	0.69813
43	0.13659	95	0.81534
44	0.14192	100	0.94924
45	0.14744	110	1.2750
46	0.15314	120	1.6927
47	0.15904	130	2.2230
48	0.16514	140	2.8892
49	0.17144	150	3.7184
50	0.17796	160	4.7414
51	0.18469	170	5.9926
52	0.19165	180	7.5110
53	0.19883	190	9.340
54	0.20625	200	11.526
55	0.21332	210	14.123
56	0.22183	220	17.186
57	0.23000	230	20.779
58	0.23843	240	24.968

Red Valve®

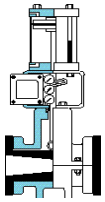
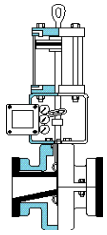
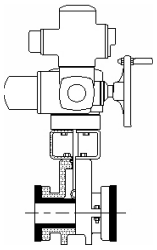
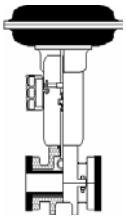
Velocity

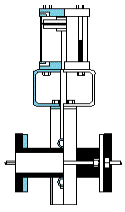
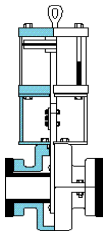
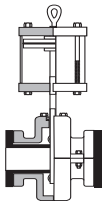
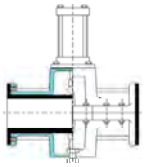
Velocity and Pressure Drop Through Schedule 40 Pipe

Discharge		Pressure Drop Per 100 Feet and Velocity in Schedule 40 Pipe For Water at 60° F																	
Gallons per Minute	Cubic Ft. per Second	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch	Velocity Feet per second	Press. Drop Lbs./Sq. Inch		
		1/2″																	
.3	0.000668	0.317	0.061																
.4	0.000891	0.422	0.086		3/4″														
.5	0.00111	0.528	0.167	0.301	0.333														
.6	0.00134	0.633	0.240	0.361	0.041														
.8	0.00178	0.844	0.408	0.481	0.102		1″												
1	0.00223	1.060	0.600	0.602	0.155	0.371	0.048												
2	0.00446	2.110	2.100	1.200	0.526	0.743	0.164												
3	0.00668	3.170	4.330	1.810	1.090	1.114	0.336		1-1/2″										
4	0.00891	4.220	7.420	2.410	1.830	1.490	0.565	0.630	0.071										
5	0.0111	5.280	11.20	3.010	2.750	1.860	0.835	0.788	0.104		2″								
6	0.0134	6.330	15.80	3.610	3.840	2.230	1.170	0.946	0.145	0.574	0.044								
8	0.0178	8.450	27.70	4.810	6.600	2.970	1.990	1.260	0.241	0.765	0.073		2-1/2″						
10	0.0223	10.56	42.40	6.020	9.990	3.710	2.990	1.580	0.361	0.959	0.108	0.670	0.046						
15	0.0334			9.030	21.60	5.570	6.360	2.370	0.755	1.430	0.224	1.01	0.094		3″				
20	0.0446			12.03	37.80	7.430	10.90	3.160	1.280	1.910	0.375	1.34	0.156	0.868	0.056				
25	0.0557					9.280	16.70	3.940	1.930	2.390	0.561	1.68	0.234	1.09	0.083				
30	0.0668					11.14	23.80	4.730	2.720	2.870	0.786	2.01	0.327	1.30	0.114		4″		
35	0.0780					12.99	32.20	5.520	3.640	3.350	1.05	2.35	0.436	1.52	0.151	0.882	0.041		
40	0.0891					14.85	41.50	6.300	4.650	3.830	1.35	2.68	0.556	1.74	0.192	1.01	0.052		
45	0.100							7.090	5.850	4.300	1.67	3.02	0.668	1.95	0.239	1.13	0.064		
50	0.11							7.880	7.150	4.780	2.03	3.35	0.839	2.17	0.288	1.26	0.076		
60	0.13		5″					9.470	10.21	5.740	2.87	4.02	1.18	2.60	0.406	1.51	0.107		
70	0.16	1.12	0.047					11.05	13.71	6.700	3.84	4.69	1.59	3.04	0.540	1.76	0.143		
80	0.18	1.28	0.060					12.62	17.59	7.650	4.97	5.36	2.03	3.47	0.687	2.02	0.180		
90	0.20	1.44	0.074		6″			14.20	22.00	8.600	6.20	6.03	2.53	3.91	0.861	2.27	0.224		
100	0.22	1.60	0.090	1.11	0.036			15.78	26.90	9.560	7.59	6.70	3.09	4.34	1.05	2.52	0.272		
125	0.28	2.01	0.135	1.39	0.055			19.72	41.40	11.97	11.76	8.38	4.71	5.43	1.61	3.15	0.415		
150	0.33	2.41	0.190	1.67	0.077					14.36	16.70	10.05	6.69	6.51	2.24	3.78	0.580		
175	0.39	2.81	0.253	1.94	0.102					16.75	22.3	11.73	8.97	7.60	3.00	4.41	0.774		
200	0.45	3.21	0.323	2.22	0.130		8″			19.14	28.8	13.42	11.68	8.68	3.87	5.04	0.985		
225	0.50	3.61	0.401	2.50	0.162	1.44	0.043					15.09	14.63	9.77	4.83	5.67	1.23		
250	0.56	4.01	0.495	2.78	0.195	1.60	0.051							10.85	5.93	6.30	1.46		
175	0.61	4.41	0.583	3.05	0.234	1.76	0.061							11.94	7.14	6.93	1.79		
300	0.67	4.81	0.683	3.33	0.275	1.92	0.072							13.00	8.36	7.56	2.11		
325	0.72	5.21	0.797	3.61	0.320	2.08	0.083							14.12	9.89	8.19	2.47		
350	0.78	5.62	0.919	3.89	0.367	2.24	0.095									8.82	2.84		
375	0.84	6.02	1.05	4.16	0.416	2.40	0.108									9.45	3.25		
400	0.89	6.42	1.19	4.44	0.471	2.56	0.121									10.08	3.68		
425	0.95	6.82	1.33	4.72	0.529	2.73	0.136									10.71	4.12		
450	1.00	7.22	1.48	5.00	0.590	2.89	0.151		10″							11.34	4.60		
475	1.06	7.62	1.64	5.27	0.653	3.04	0.166	1.93	0.054							11.97	5.12		
500	1.11	8.02	1.81	5.55	0.720	3.21	0.182	2.03	0.059							12.60	5.65		
550	1.23	8.82	2.17	6.11	0.861	3.53	0.219	2.24	0.071							13.85	6.79		
600	1.34	9.63	2.55	6.66	1.02	3.85	0.258	2.44	0.083							15.12	8.04		
650	1.45	10.43	2.98	7.22	1.18	4.17	0.301	2.64	0.097		12″								
700	1.56	11.23	3.43	7.78	1.35	4.49	0.343	2.85	0.112	2.01	0.047								
750	1.67	12.03	3.92	8.33	1.55	4.81	0.392	3.05	0.127	2.15	0.054								
800	1.78	12.83	4.43	8.88	1.75	5.13	0.443	3.25	0.143	2.29	0.061		14″						
850	1.89	13.64	5.00	9.44	1.96	5.45	0.497	3.46	0.160	2.44	0.068	2.02	0.042						
900	2.01	14.44	5.58	9.9	2.18	5.77	0.554	3.66	0.179	2.59	0.075	2.13	0.047						
950	2.12	15.24	6.21	10.55	2.42	6.09	0.613	3.86	0.198	2.72	0.083	2.25	0.052						
1000	2.23	16.04	6.84	11.10	2.68	6.41	0.675	4.07	0.218	2.87	0.091	2.37	0.057						
1100	2.45	17.65	8.23	12.22	3.22	7.05	0.807	4.48	0.260	3.15	0.110	2.61	0.068		16″				
1200	2.67			13.33	3.81	7.70	0.948	4.88	0.306	3.44	0.128	2.85	0.080	2.18	0.042				
1300	2.90			14.43	4.45	8.33	1.11	5.29	0.355	3.73	0.150	3.08	0.093	2.36	0.048				
1400	3.12			15.55	5.13	8.98	1.28	5.70	0.409	4.01	0.170	3.32	0.107	2.54	0.055				
1500	3.34			16.66	5.85	9.62	1.46	6.10	0.466	4.30	0.195	3.56	0.122	2.72	0.063				
1600	3.57			17.77	6.61	10.26	1.65	6.51	0.527	4.59	0.219	3.79	0.138	2.90	0.071		18″		
1800	4.01			19.99	8.37	11.54	2.08	7.32	0.663	5.16	0.276	4.27	0.172	3.27	0.088	2.58	0.050		
2000	4.46			22.21	10.3	12.82	2.55	8.14	0.808	5.73	0.339	4.74	0.209	3.69	0.107	2.87	0.060		
2500	5.57		20″			16.03	3.94	10.17	1.24	7.17	0.515	5.93	0.312	4.54	0.163	3.59	0.091		
3000	6.68	3.46	0.075			19.24	5.59	12.20	1.76	8.60	0.731	7.11	0.451	5.45	0.232	4.30	0.129		
3500	7.80	4.04	0.101		24″	22.44	7.56	14.24	2.38	10.03	0.982	8.30	0.607	6.35	0.312	5.02	0.173		
4000	8.91	4.62	0.129	3.19	0.052	25.65	9.80	16.27	3.08	11.47	1.27	9.48	0.787	7.26	0.401	5.70	0.222		
4500	10.03	5.20	0.162	3.59	0.065	28.87	12.2	18.31	3.87	12.90	1.60	10.67	0.990	8.17	0.503	6.46	0.280		
5000	11.14	5.77	0.199	3.99	0.079			20.35	4.71	14.33	1.95	11.85	1.21	9.08	0.617	7.17	0.340		
6000	13.37	6.93	0.280	4.79	0.111			24.41	6.74	17.20	2.77	14.23	1.71	10.89	0.877	8.61	0.483		
7000	15.60	8.08	0.376	5.59	0.150			28.49	9.11	20.07	3.74	16.60	2.31	12.71	1.18	10.04	0.652		
8000	17.82	9.23	0.488	6.38	0.192					22.93	4.84	18.96	2.99	14.52	1.51	11.47	0.839		
9000	20.05	10.39	0.608	7.18	0.242					25.79	6.09	21.34	3.76	16.34	1.90	12.91	1.05		
10000	22.28	11.54	0.739	7.98	0.294					28.66	7.46	23.71	4.61	18.15	2.34	14.34	1.28		
12000	26.74	13.85	1.06	9.58	0.416					34.30	10.7	28.45	6.59	21.79	3.33	17.21	1.83		
14000	31.19	16.16	1.43	11.17	0.562							33.19	8.89	25.42	4.49	20.08	2.45		
16000	35.65	18.47	1.85	12.77	0.723									29.05	5.83	22.95	3.18		
18000	40.10	20.77	2.32	14.36	0.907									32.68	7.31	25.82	4.03		
20000	44.56	23.08	2.86	15.96	1.12									36.61	9.03	28.69	4.93		

Control Valve Styles

Click on Valve Photos to View Data Sheets

BODY STYLE	 Series 5200	 Series 5200 D-Port	 Series 5200E Electrically Actuated	 Series 5200 Diaphragm Actuated
Sizes	1" - 4"	6" - 48"	1" - 48"	1" - 3"
Flange Drilling	ANSI B16.1 Class 125 ANSI B16.5 Class 150	ANSI B16.1 Class 125 ANSI B16.5 Class 150	ANSI B16.1 Class 125 ANSI B16.5 Class 150	ANSI B16.1 Class 125 ANSI B16.5 Class 150
Body Materials	Ductile Iron A536-65-45-12	Ductile Iron A536-65-45-12	Ductile Iron A536-65-45-12	Ductile Iron A536-65-45-12
Class of Shutoff*	Class V	Class V	Class V	Class V
Actuator	ATO/ATC ATO/FCS ATC/FOS	ATO/ATC ATO/FCS ATC/FOS	Pneumatic Hydraulic Electric Modulating	ATO/ATC ATO/FCS ATC/FOS
Cv	Pre-pinched	Pre-pinched	Pre-pinched	Pre-pinched

BODY STYLE	 Series 5300	 Series 5400	 Series 5700	 Series 9000
Sizes	2" - 48"	4" - 48"	2" - 48"	1" - 12"
Flange Drilling	ANSI B16.1 Class 125 ANSI B16.5 Class 150	ANSI B16.1 Class 125 ANSI B16.5 Class 150	ANSI B16.1 Class 125 ANSI B16.5 Class 150	ANSI B16.1 Class 125 ANSI B16.5 Class 150
Body Materials	Steel, fabricated Stainless Steel fabricated	Ductile Iron A536-65-45-12	Ductile Iron A536-65-45-12	Ductile Iron A536-65-45-12
Class of Shutoff*	Class V	Class V	Class V	Class IV
Actuator	Pneumatic Hydraulic Electric Modulating	Pneumatic Hydraulic Electric	Pneumatic Hydraulic Electric Modulating	Manual Hydraulic Electric Modulating
Cv	Pre-pinched	Centerline pinch	Centerline pinch	Pre-pinched

* See following page for leakage class information

Red Valve®

Control Valve Data Sheet

Email Your Inquiry to support@redvalve.com

DOWNLOAD FORM >>

To complete the Control Valve Data Sheet electronically, please click on the Download Form button. You will be hyperlinked to a fillable pdf of the form. Be sure to include as much information as possible. Shaded areas are required. Email completed form to support@redvalve.com.

CUSTOMER			PHONE	
CONTACT PERSON			EMAIL	
PROJECT REFERENCE	DELIVERY REQUIRED			DRAWING APPROVAL
LINE SIZE	BODY MATERIAL			FLANGE CLASS DRILLING
PIPE SCH.				
MODEL	SLEEVE MATERIAL			FLOW MEDIUM (describe):

FLOW DATA	**MINIMUM FLOW TO BE CONTROLLED**	**NORMAL FLOW TO BE CONTROLLED**	**MAXIMUM FLOW TO BE CONTROLLED**	**SHUTOFF** ☐ YES ☐ NO
Q (Flow Rate in U.S. GPM)				**ANSI/FCI LEAKAGE CLASS**
P1 (Inlet Pressure at Controlled Flow Rate) psig				
P2 (Outlet Pressure at Controlled Flow Rate) psig				
SPECIFIC GRAVITY				According to ANSI/FCI Spec 70-2.
INLET TEMPERATURE (ºF)				
Cv (Flow Coeff.)				The information on classifications can be found on next page.
ΔP MAX (calculated)				
MAX ALLOWABLE APPROACH VELOCITY (fps)				

SLEEVE STYLE		
ACTUATOR	TYPE	FUNCTION
TYPE SPECIFICATION Plant Air Supply:_____ psi min. Voltage:_____V Frequency:_____ Hz Phase:_____ Hydraulic Pressure: _____ psi min.	AIR TO:	
	AIR FAILS, VALVE TO:	

Please use separate form for each control valve.

PREPARED BY: _____ **DATE:** _____

CUSTOMER APPROVAL: _____ **DATE:** _____

05 May 2017

Red Valve Company • 600 North Bell Avenue • Carnegie, PA 15106 • ph: 412.279.0044 • fax: 412.279.7878 • support@redvalve.com

Red Valve®

Control Valve Seat Leakage Classifications

Per Information in ANSI/FCI 70-2-2006

TABLE 1				
Leakage Class	**Maximum Seat Leakage**	**Test Medium**	**Test Pressure**	**Test Procedure**
I	- - -	- - -	- - -	By agreement between user and seller, no test required
II	0.5% of rated capacity	Air or water at 50-125 °F (10-51 °C)	45-60 psig or max operating differential, whichever is lower	Type A
III	0.1% of rated capacity	Air or water at 50-125 °F (10-51 °C)	45-60 psig or max operating differential, whichever is lower	Type A
IV	0.01% of rated capacity	Air or water at 50-125 °F (10-51 °C)	45-60 psig or max operating differential, whichever is lower	Type A
V	0.0005 ml per minute of water per inch of port diameter per psi differential	Water at 50-125 °F (10-51 °C)	Max service pressure drop across valve plug; not to exceed ANSI body rating	Type B
VI	Not to exceed amounts in Table 2	Air or nitrogen at 50-125 °F (10-51 °C)	50 psig or max rated differential pressure across valve plug, whichever is lower	Type C

Type A: Leakage flow and pressure data accurate to +/- 10% of reading; pressure applied to valve inlet with outlet open to atmosphere or connected to low head loss measuring device; full normal closing thrust from actuator

Type B: Leakage flow and pressure data accurate to +/- 10% of reading after letting leakage flow stabilize; pressure applied to valve inlet after filling entire body cavity and connected plumbing and stroking valve plug closed; net actuator thrust to be specified max;

Type C: Pressure applied to inlet with outlet connected to suitable measuring device; actuator adjusted to operating conditions specified with full normal closing thrust; allow sufficient time for leakage flow to stabilize

TABLE 2* *directly from ANSI/FCI 70-2-2006, p. 3		
Nominal Seat Diameter		
Millimeters (Inches)	**ml per Minute**	**Bubbles per Minute**
≤ 25 (≤ 1)	0.15	1
38 (1.5)	0.30	2
51 (2)	0.45	3
64 (2.5)	0.60	4
76 (3)	0.90	6
102 (4)	1.70	11
152 (6)	4.00	27
203 (8)	6.75	45
250 (10)	11.1	- - -
300 (12)	16.0	- - -
350 (14)	21.6	- - -
400 (16)	28.4	- - -