

Manual Valves - Flow Coefficients

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Introduction

Manual valves are used for different purposes like isolation, throttling, control, pressurization, depressurization, venting, draining and purging, etc. Type of valve is generally selected based on service, size, frequency of operation, required tightness (leakage rate), and valve pressure drop and cost. Regardless of purpose and type of manual valve, a process engineer may be asked to carry out following activities which need valve flow coefficient (Cv):

1. Calculating the flow rate that valve can pass. Some examples are:

- Calculating the maximum flow through control valve manual bypass where downstream relief valve is going to be sized for control valve failure + fully open bypass valve.
- Calculating the maximum drain flow rate from a depressurized process vessel to closed drain drum, in order to check the capacity of closed drain drum pump (to prevent closed drain drum overflow).
- Calculating the draining time of process vessel to the drain system through drain valve after vessel is completely depressurized which may be interesting for operator.

2. Selecting the size of valve suitable for a particular application. For example:

- Selecting the size of control valve bypass based on control valve Cv. Some guidelines state that control valve bypass size should be selected so that the valve Cv is higher than control valve Cv and less than double of control valve Cv.
- Selecting the size of pressurization or depressurization valve when the required flow rate has been calculated or limited to a specific value. Selecting the valve of right type and size which ensures flow rate not higher than required flow eliminates the need for installing a flow limiting element (such as restriction orifice) upstream/downstream of valve.

In this note, I present a comprehensive list of manual valve Cv for different types of valves. Though valve Cv can be different from manufacturer to manufacturer, but the difference between valve Cv from different manufactures is not generally much unless it is manufactured for a specific need (as specialty item). Therefore in absence of vendor data, the following data can be used.

Manual Valve Flow Coefficient

1. Full Bore Ball Valve

Body Size (in)	Rating						
	150#	300#	400#	600#	900#	1500#	2500#
¾	52	52	46	46	42	42	29
1	115	113	99	99	91	91	53
1 1/2	300	300	265	265	236	236	160
2	520	476	448	413	369	369	334
3	1405	1188	1140	1062	1023	924	835
4	2627	2276	1975	1924	1858	1700	1527
6	5549	5499	4959	4664	4460	4154	3645
8	10855	11364	9551	9062	8574	8075	7270
10	18043	17483	16058	14866	14398	13278	11690
12	27187	26373	24285	23216	21587	19907	17819
14	33297	31566	30344	29224	27187	24591	-
16	45210	43072	41545	39610	37166	33602	-
18	59262	57429	55596	52847	-	-	-
20	76878	73925	71481	67205	-	-	-
24	115062	111193	106916	121986	-	-	-
28	156500	150600	147100	140850	-	-	-
30	187900	181250	174100	114900	-	-	-
34	242000	230500	220000	211000	-	-	-
36	275000	269000	248000	236500	-	-	-

All flow coefficients are in gal/minutes.

2. Reduced Bore Ball Valve

Body Size (in)	Bore size (in)	Rating						
		150#	300#	400#	600#	900#	1500#	2500#
1	3/4	26	26	28	28	28	27	21
1 1/2	1	46	46	45	45	48	48	31
2	1 1/2	115	129	140	140	142	142	105
3	2	190	200	189	183	192	177	229
4	3	567	548	543	539	589	524	589
6	4	815	778	764	760	774	742	806
8	6	2021	2031	2296	2276	2118	2312	2368
10	8	4205	4205	4184	4368	4705	4664	4700
12	10	7348	7450	7317	7664	8103	9420	9328
14	12	13879	14094	14186	14396	13070	13564	-
16	12	14100	14250	14484	14530	13120	13320	-
16	14	15053	15308	14920	14829	14662	14464	-
18	16	21176	21227	21687	22656	-	-	-
20	16	23546	23810	24020	24150	-	-	-
20	18	28371	28473	29290	30514	-	-	-
24	20	27351	27351	27657	28473	-	-	-
30	28	82600	82500	84500	88800	-	-	-
36	30	62800	63800	65500	70100	-	-	-
36	34	130000	129200	134300	139800	-	-	-

3. Full Bore 150# Ball Valve at Different Opening Angle

Body Size (in)	Valve Opening Angle											
	15°	20°	30°	40°	50°	60°	65°	70°	75°	80°	85°	90°
3/4	-	-	0.8	1.8	3.6	6.1	8.1	11	14	21	36	46
1	-	-	1.4	3.3	6.4	11	15	19	25	39	64	103
1.5	-	0.9	3.4	8	16	28	39	54	74	108	166	250
2	-	1.3	4.9	12	23	40	58	84	118	183	297	465
3	1.4	5	17	36	65	106	147	211	294	444	719	1100
4	2.5	8.8	30	64	115	191	277	403	563	848	1373	2100
6	12	29	84	169	291	502	728	1060	1480	2190	3520	5300
8	30	65	165	315	531	946	1360	1970	2760	4000	6400	9500
10	55	113	272	513	861	1560	2230	3240	4540	6520	10460	15500
12	77	159	383	720	1210	2220	3230	4680	6560	9420	15110	22400
14	107	216	497	917	1530	2850	4110	5940	8330	11860	19000	28000
16	140	282	647	1200	1990	3750	5430	7850	11000	15680	25110	37000
18	157	327	786	1480	2480	4610	6760	9820	13760	19770	31710	47000
20	256	483	1060	1950	3090	6110	8790	12600	17660	24960	39930	58500
24	373	703	1650	2850	4700	8880	12770	18300	25660	36270	58000	85000

4. Globe Valve

Body Size (in)	Rating			
	150#	300#	600#	900#
1/2	5	5	5	-
3/4	7	7	7	-
1	12.7	12.7	12.7	7.2
1 1/2	25	25	25	17.5
2	45	45	45	35
2 1/2	70	70	70	60
3	100	100	100	90
4	185	185	185	170
6	440	440	440	400

8	810	810	780	710
10	1260	1260	1200	-
12	1890	1890	1810	-

5. Gate Valve

Body Size (in)	Rating			
	150#	300#	600#	900#
1 1/2	165	165	-	-
2	310	310	310	270
2 1/2	490	490	490	400
3	710	710	710	620
4	1300	1300	1300	1150
6	3100	3100	3100	2680
8	5720	5720	5540	4700
10	8940	8940	8500	7850
12	13350	13350	12800	11480
14	16280	16220	15370	13910
16	21560	21560	20170	18150
18	28720	27890	26270	23910
20	35760	34840	32140	29500
24	52170	51050	46710	-

6. Knife Gate Valve

Body Size (in)	Metal Seat	Soft Seat	Bi- Direction
1 1/2	-	-	-
2	210	-	195
2 1/2	360	-	320
3	560	627	500
4	1200	1380	1100
6	3500	4000	3200
8	5700	6510	5400
10	8600	9300	7900
12	11700	12400	10700
14	14700	15600	13800
16	18000	18900	17000
18	21600	22500	20000
20	25400	26000	24000
24	32800	34000	31000

7. Butterfly Valve

Body Size (in)	Rating		
	150#	300#	600#
1 1/2	73	-	-
2	102	100	93
2 1/2	146	143	133
3	228	223	28
4	451	435	387
6	1103	1041	979
8	2064	1911	1788
10	3517	3194	2747
12	4837	4428	3891
14	6857	5705	4873
16	9287	8243	6424
18	11400	9712	-
20	14420	10658	-
24	22050	16205	-

30	34388	28245	-
36	47160	-	-
42	64190	-	-

8. 150# Butterfly Valve at Different Opening Angle

Valve size (in)	Disc Angles								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
2	0.06	3	7	14	25	36	51	70	76
2 1/2	0.1	5	12	24	45	64	90	125	135
3	0.2	8	20	37	65	98	144	204	220
4	0.3	12	22	39	70	116	183	275	302
6	0.8	29	61	133	237	392	620	930	1022
8	2	45	95	205	366	605	958	1437	1579
10	3	89	188	408	727	1202	1903	2854	3136

9. Plug Valve

Valve size (in)	Port Area (sq in)	Plug Position								
		10°	20°	30°	40°	50°	60°	70°	80°	100°
1	0.86	1	2	3	6	9	13	21	32	37
2	1.6	5	7	12	23	38	52	85	131	150
2 1/2	7.4	8	12	20	37	62	84	135	210	240
3	7.4	10	16	26	50	83	112	180	280	320
4	12.7	18	28	47	89	147	199	322	498	570
6	24.6	38	59	100	187	309	419	678	1048	1200
8	42.3	65	102	170	323	534	723	1170	1808	2070
10	66.8	103	160	268	510	838	1130	1840	2840	3250
12	97.1	150	233	392	740	1220	1660	2680	4150	4750
14	119	194	300	510	960	1580	2150	3470	5370	6150
16	158	250	400	665	1250	2070	2810	4540	7030	8050
18	193	325	500	840	1590	2620	3565	5755	8910	10200
20	240	400	620	1040	1960	3240	4400	7100	11000	12600
24	352	570	890	1500	2820	4650	6320	10200	15800	18100
30	507	890	1390	2340	4410	7270	9900	16000	24700	28300
36	732	1280	2000	3360	6340	10450	14200	23000	35000	40700

Contact

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