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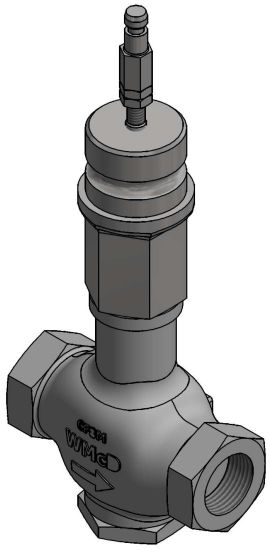
Technical Instructions

Document No. FED-2000

May 26, 2026

HFV Series

HFV… Control Valves



Description

HFV… control valves are used to throttle and shut off the flow of water or steam.

Features

- Up to 150 psi differential across the valve when modulating
- High close-off pressure
- Stainless steel body, stem, and plug
- Sizes available from 1/2” to 4”
- Linear or equal percentage flow characteristic
- ANSI Class IV or Class VI shutoff
- Fail closed
- Conforms to ASME B16.34 standards

Application

HFV… control valves are ideal for boiler feedwater or steam flow applications. Each valve is to be used with an SKB/C/D… electronic actuator. A controller sensing the controlled variable provides a signal to the actuator to obtain the desired valve position. Upon loss of power or control signal, all HFV… control valves fail closed via spring return.

Product Part Numbers

The part number structure for HFV… series control valves is shown below. Not all possible part number combinations are available.

HFV - 2 L N - 100 - X

High Pressure Feedwater Valve

Valve Type

2 = 2-way, Class IV shutoff
3 = 3-way, Class IV shutoff
4 = 2-way, Class VI shutoff

Flow Characteristic

L = Linear
E = Equal percentage (2-way valves only)

Valve Connection

N = NPT (1/2" to 2" valves only)
1 = 150# flanged
3 = 300# flanged

Pipe Size

050R = 1/2" reduced port (2-way valves only)
050 = 1/2" full port
075 = 3/4"
100 = 1"
150 = 1-1/2"
200 = 2"
250 = 2-1/2"
300 = 3"
400 = 4"

Cavitation Adapter (2-way 1/2" to 2-1/2" valves only)[1]

X = None (must be selected for 3" and 4" 2-way valves and all 3-way valves
1 = Cavitation adapter option 1
2 = Cavitation adapter option 2
3 = Cavitation adapter option 3

[1] Use pages 7-8 to determine if a cavitation adapter is required. If one is required, the proper valve and cavitation adapter combination must be determined using the valve sizing tool at:
https://scccombustion.com/products/modulating-water-level-control-system/hfv-control-valves

Product Part Numbers (continued)

Before selecting a valve, use pages 7-8 to determine if a cavitation adapter is required for the application. The part numbers for HFV… series control valves without cavitation adapters are tabulated below. If a cavitation adapter is required for the application, the proper valve part number must be determined using the valve sizing tool found at:

https://scccombustion.com/products/modulating-water-level-control-system/hfv-control-valves

Table 1 lists all the 2-way Class IV valves with a linear flow characteristic.
Table 2 lists all the 2-way Class IV valves with an equal percentage flow characteristic.
Table 3 lists all the 2-way Class VI valves with a linear flow characteristic.
Table 4 lists all the 2-way Class VI valves with an equal percentage flow characteristic.
Table 5 lists all the 3-way valves which all have a linear flow characteristic.

Table 1: 2-way Class IV Linear HFV… Valve Part Numbers

Valve Size[1]	Cv	Valve Connection		
		NPT	150# Flanged	300# Flanged
1/2" Reduced	3.5	HFV-2LN-050R-X	HFV-2L1-050R-X	HFV-2L3-050R-X
1/2"	5	HFV-2LN-050-X	HFV-2L1-050-X	HFV-2L3-050-X
3/4"	6.5	HFV-2LN-075-X	HFV-2L1-075-X	HFV-2L3-075-X
1"	10	HFV-2LN-100-X	HFV-2L1-100-X	HFV-2L3-100-X
1-1/2"	22	HFV-2LN-150-X	HFV-2L1-150-X	HFV-2L3-150-X
2"	42	HFV-2LN-200-X	HFV-2L1-200-X	HFV-2L3-200-X
2-1/2"	70	-	HFV-2L1-250-X	HFV-2L3-250-X
3"	110	-	HFV-2L1-300-X	HFV-2L3-300-X
4"	170	-	HFV-2L1-400-X	HFV-2L3-400-X

Table 2: 2-way Class IV Equal Percentage HFV… Valve Part Numbers

Valve Size[1]	Cv	Valve Connection		
		NPT	150# Flanged	300# Flanged
1/2" Reduced	3.5	HFV-2EN-050R-X	HFV-2E1-050R-X	HFV-2E3-050R-X
1/2"	5	HFV-2EN-050-X	HFV-2E1-050-X	HFV-2E3-050-X
3/4"	6.5	HFV-2EN-075-X	HFV-2E1-075-X	HFV-2E3-075-X
1"	10	HFV-2EN-100-X	HFV-2E1-100-X	HFV-2E3-100-X
1-1/2"	22	HFV-2EN-150-X	HFV-2E1-150-X	HFV-2E3-150-X
2"	42	HFV-2EN-200-X	HFV-2E1-200-X	HFV-2E3-200-X
2-1/2"	70	-	HFV-2E1-250-X	HFV-2E3-250-X
3"	110	-	HFV-2E1-300-X	HFV-2E3-300-X
4"	170	-	HFV-2E1-400-X	HFV-2E3-400-X

Product Part Numbers (continued)

Table 3: 2-way Class VI Linear HFV… Valve Part Numbers

Valve Size[1]	Cv	Valve Connection		
		NPT	150# Flanged	300# Flanged
1/2" Reduced	3.5	HFV-4LN-050R-X	HFV-4L1-050R-X	HFV-4L3-050R-X
1/2"	5	HFV-4LN-050-X	HFV-4L1-050-X	HFV-4L3-050-X
3/4"	6.5	HFV-4LN-075-X	HFV-4L1-075-X	HFV-4L3-075-X
1"	10	HFV-4LN-100-X	HFV-4L1-100-X	HFV-4L3-100-X
1-1/2"	22	HFV-4LN-150-X	HFV-4L1-150-X	HFV-4L3-150-X
2"	42	HFV-4LN-200-X	HFV-4L1-200-X	HFV-4L3-200-X
2-1/2"	70	-	HFV-4L1-250-X	HFV-4L3-250-X
3"	110	-	HFV-4L1-300-X	HFV-4L3-300-X
4"	170	-	HFV-4L1-400-X	HFV-4L3-400-X

Table 4: 2-way Class VI Equal Percentage HFV… Valve Part Numbers

Valve Size[1]	Cv	Valve Connection		
		NPT	150# Flanged	300# Flanged
1/2" Reduced	3.5	HFV-4EN-050R-X	HFV-4E1-050R-X	HFV-4E3-050R-X
1/2"	5	HFV-4EN-050-X	HFV-4E1-050-X	HFV-4E3-050-X
3/4"	6.5	HFV-4EN-075-X	HFV-4E1-075-X	HFV-4E3-075-X
1"	10	HFV-4EN-100-X	HFV-4E1-100-X	HFV-4E3-100-X
1-1/2"	22	HFV-4EN-150-X	HFV-4E1-150-X	HFV-4E3-150-X
2"	42	HFV-4EN-200-X	HFV-4E1-200-X	HFV-4E3-200-X
2-1/2"	70	-	HFV-4E1-250-X	HFV-4E3-250-X
3"	110	-	HFV-4E1-300-X	HFV-4E3-300-X
4"	170	-	HFV-4E1-400-X	HFV-4E3-400-X

Table 5: 3-way Linear HFV… Valve Part Numbers

Valve Size[1]	Cv	Valve Connection		
		NPT	150# Flanged	300# Flanged
1/2"	5	HFV-3LN-050-X	HFV-3L1-050-X	HFV-3L3-050-X
3/4"	6.5	HFV-3LN-075-X	HFV-3L1-075-X	HFV-3L3-075-X
1"	10	HFV-3LN-100-X	HFV-3L1-100-X	HFV-3L3-100-X
1-1/2"	22	HFV-3LN-150-X	HFV-3L1-150-X	HFV-3L3-150-X
2"	42	HFV-3LN-200-X	HFV-3L1-200-X	HFV-3L3-200-X
2-1/2"	70	-	HFV-3L1-250-X	HFV-3L3-250-X
3"	110	-	HFV-3L1-300-X	HFV-3L3-300-X
4"	170	-	HFV-3L1-400-X	HFV-3L3-400-X

[1] All 2-1/2” to 4” HFV… valves have a 1-1/8” valve stroke and must be used with an SKC… electronic actuator.

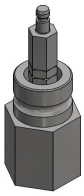
Accessories

HFV-SBA-050-200



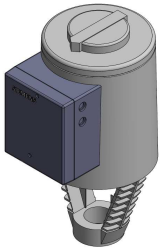
Stem and bonnet adapters for mounting any 1/2” through 2” HFV… valve to an SKB/C/D… electronic actuator. Stem and bonnet adapters are provided with all HFV… valves. Only required if the stem or bonnet adapter that came with the valve was lost or damaged.

HFV-SBA-250-400



Stem and bonnet adapters for mounting any 2-1/2” through 4” HFV… valve to an SKC… electronic actuator. Stem and bonnet adapters are provided with all HFV… valves. Only required if the stem or bonnet adapter that came with the valve was lost or damaged.

SKB/C/D… Electronic Actuators



Electronic actuators designed to work with all HFV… controls valves. Part numbers for ordering are listed below. See Table 11 for close-off pressures for each actuator based on the valve size being used.

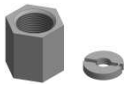
SKB62UA – 3/4” stroke, 629 lb_f opening force, 120 sec. opening time, 15 sec. closing time
SKC62UA – 1-1/2” stroke, 629 lb_f opening force, 60 (90) sec. opening time for 3/4” (1-1/8”) stroke valves, 10 (15) sec. closing time for 3/4” (1-1/8”) stroke valves
SKD62UA – 3/4” stroke, 225 lb_f opening force, 30 sec. opening time, 15 sec. closing time

ASC9.3



Auxiliary switch for SKB/C/D… electronic actuators. The switching point is adjustable from 0 – 100% stroke.

599-10048



Spare 10mm stem nut and washer for mounting an SKB… or SKC… actuator to any HFV… control valve. One nut and washer come with each SKB… or SKC… actuator. Only to be ordered if nut or washer are lost or damaged.

Packing Kits / Rebuild Kits

See “Spare Parts” section later in this document.

Materials

Table 6: HFV… Valve Materials

Item	Description	Material	
		1/2" – 2" Valves	2-1/2" – 4" Valves
1	Body	316 Stainless Steel	
2	Valve Plug	Class IV: Hardened 17-4 PH Stainless Steel Class VI: PTFE Seat with 303 Stainless Steel Retainer and Plug Profile	
3	Body Plug	316 Stainless Steel	
4	Body Gasket	303 Stainless Steel	PTFE
5	Stem	316 Stainless Steel	
6	Lower Seal Bushing	303 Stainless Steel	N/A
7	Packing Gland Nut	303 Stainless Steel	303 Stainless Steel (x2)
8	Stem Seal Spring	302 Stainless Steel	
9	Guide Bushing	Rulon 641 (x2)	PTFE (x2)
10	Packing Washer	303 Stainless Steel	
11	V-ring Packing Set	PTFE	
12	Staking Ball	440 Stainless Steel	N/A
13	Stem O-ring	Aflas	Aflas (x2)
14	Bonnet Adapter	316 Stainless Steel	303 Stainless Steel
15	Stem Adapter	303 Stainless Steel	
16	Hex Jam Nut	316 Stainless Steel (x2) (5/16"-24 thread)	316 Stainless Steel (x2) (1/2"-20 thread)
17	5/8"-11 Hex Bolt	N/A	304 Stainless Steel (x4)

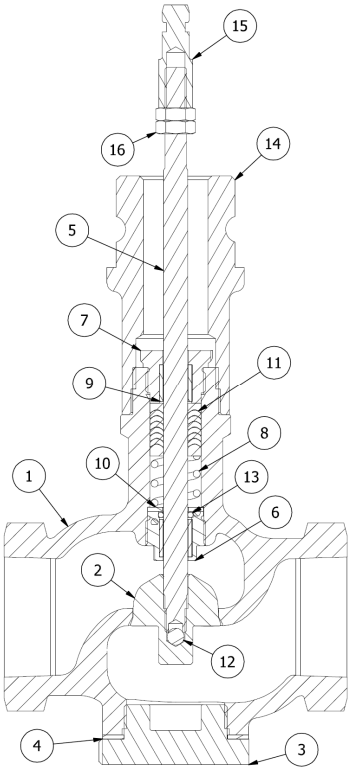


Figure 1: 1/2" to 2" Valve Materials

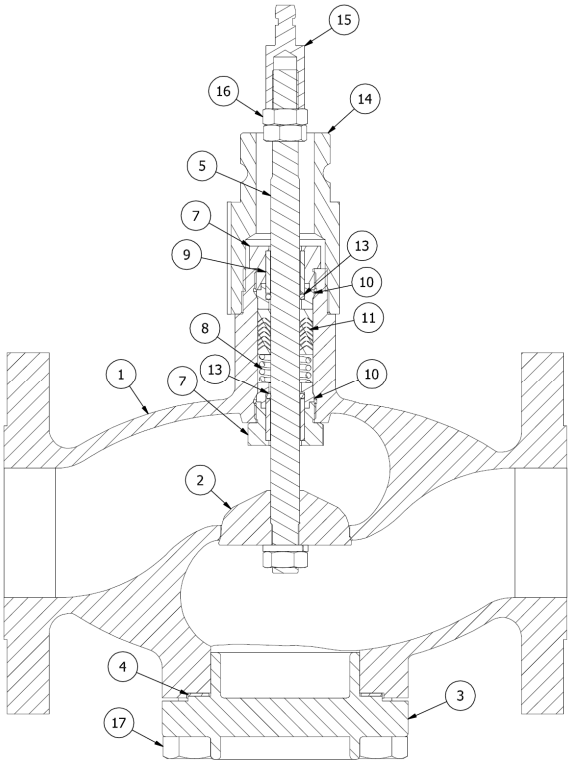


Figure 2: 2-1/2" to 4" Valve Materials

Flow Data

Cavitation Adapters

Before sizing a valve for water flow applications, valve cavitation is something that must be considered. For steam flow applications, cavitation is not a concern, and the valve can be sized using Table 9 or the valve sizing tool available at:

https://scccombustion.com/products/modulating-water-level-control-system/hfv-control-valves

To determine if the valve will experience cavitation and require a cavitation adapter, three variables must be known:

- Inlet pressure to the valve (psig)
- Outlet pressure from the valve (psig)
- Water temperature at the valve (°F)

The three charts provided below can be used to determine if the valve will experience cavitation. Each chart displays the inlet pressure vs. outlet pressure at a different water temperature (60°F, 230°F, and 280°F).

Use the chart for the water temperature of the application. Find the point on the chart that lines up with the inlet pressure and outlet pressure for the application. If this point falls inside the zone labeled “Possible Cavitation,” a cavitation adapter is required, and the valve must be sized using the valve sizing tool available at the SCC website listed above. If the point falls inside the zone labeled “No Cavitation,” no cavitation adapter is required, and the valve can be sized using Tables 7 and 8 or the valve sizing tool available at the SCC website listed above. Please note that cavitation adapters are available exclusively for 1/2” to 2-1/2” 2-way valves and are not offered for 3-way valves or for 3” or 4” 2-way valves.

For water temperatures other than 60°F, 230°F, or 280°F, additional guidance is provided in Appendix A to determine if a cavitation adapter is required.

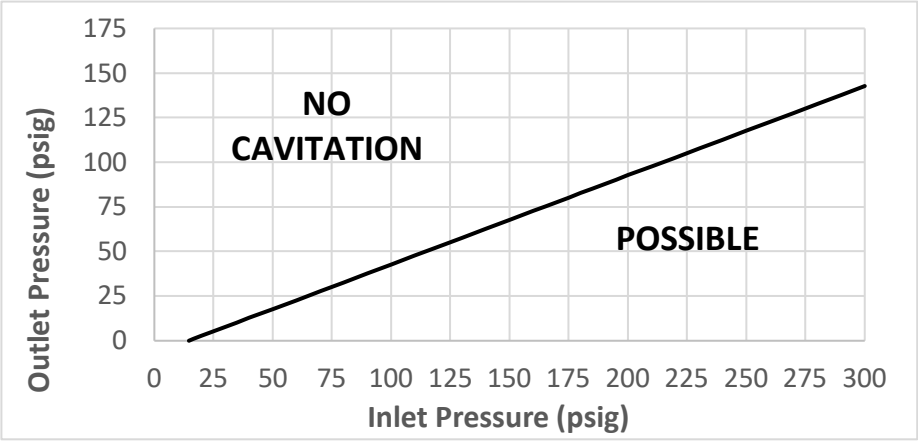


Figure 3: Cavitation Chart at 60°F Water Temperature

Flow Data (continued)

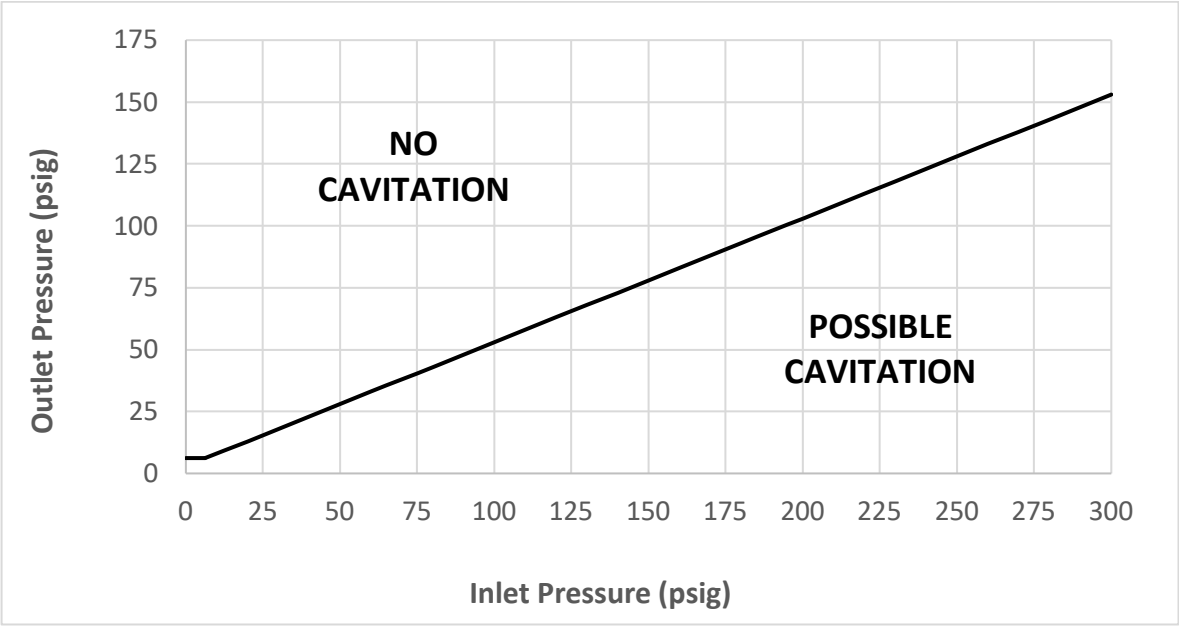


Figure 4: Cavitation Chart at 230°F Water Temperature

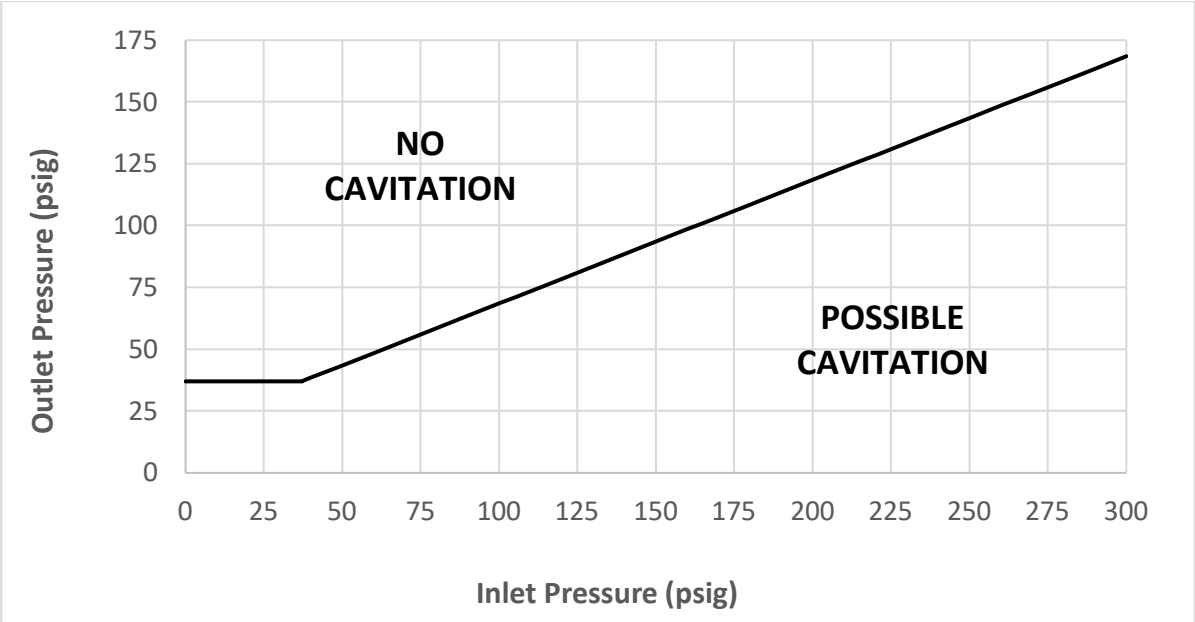


Figure 5: Cavitation Chart at 280°F Water Temperature

Flow Data (continued)

Valve Sizing for Water Flow

For applications that do not require a cavitation adapter, full open flow through the valve body is tabulated below at common differential pressures. There are tables below to size the valve based on required water flow (gpm) or boiler horsepower (BHP). If a cavitation adapter is required for the application, the proper valve part number must be determined using the valve sizing tool found at:

https://scccombustion.com/products/modulating-water-level-control-system/hfv-control-valves

The water flow equations used to make Tables 7 and 8 are given in Appendix A. These equations can be used to calculate maximum water capacity at water temperatures other than 230°F. If necessary, additional guidance is also provided in Appendix A to help determine how much water flow is required for deaerator makeup water applications.

Table 7: Maximum Water Capacity (gpm)[1]

Valve Size		1/2" Reduced	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"	3"	4"
Cv		3.5	5	6.5	10	22	42	70	110	170
Differential Pressure (PSI)	1	4	5	7	11	23	44	74	116	179
	5	8	12	15	24	52	99	165	259	400
	10	12	17	22	33	73	140	233	366	566
	15	14	20	26	41	90	171	285	448	693
	20	16	24	31	47	104	198	330	518	800
	25	18	26	34	53	116	221	368	579	895
	30	20	29	37	58	127	242	404	634	980
	40	23	33	43	67	146	280	466	732	1132
	50	26	37	48	74	164	313	521	819	1265
	60	29	41	53	82	179	342	571	897	1386
	70	31	44	57	88	194	370	616	969	1497
	80	33	47	61	94	207	395	659	1036	1601
	90	35	50	65	100	220	419	699	1098	1698
	100	37	53	68	105	232	442	737	1158	1789
	125	41	59	76	118	259	494	824	1295	2001
	150	45	64	84	129	284	541	902	1418	2192

[1] Water capacities based on 230°F water (specific gravity = 0.95).

Flow Data (continued)

Table 8: Maximum Water Capacity (BHP)[1]

Valve Size		1/2" Reduced	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"	3"	4"
Cv		3.5	5	6.5	10	22	42	70	110	170
Differential Pressure (PSI)	1	44	62	81	125	275	524	874	1373	2122
	5	98	140	181	279	614	1172	1953	3070	4744
	10	138	197	257	395	868	1658	2763	4341	6709
	15	169	242	314	483	1063	2030	3383	5317	8217
	20	195	279	363	558	1228	2344	3907	6139	9488
	25	218	312	406	624	1373	2621	4368	6864	10608
	30	239	342	444	684	1504	2871	4785	7519	11621
	40	276	395	513	789	1736	3315	5525	8682	13418
	50	309	441	574	882	1941	3706	6177	9707	15002
	60	338	483	628	967	2127	4060	6767	10634	16434
	70	365	522	679	1044	2297	4385	7309	11486	17751
	80	391	558	726	1116	2456	4688	7814	12279	18976
	90	414	592	770	1184	2605	4973	8288	13024	20128
	100	437	624	811	1248	2746	5242	8736	13728	21216
	125	488	698	907	1395	3070	5860	9767	15349	23721
	150	535	764	994	1529	3363	6420	10700	16814	25985

[1] Water capacities based on 230°F water (specific gravity = 0.95).

Flow Data (continued)

Valve Sizing for Steam Flow

Full open flow through the valve body is tabulated below at common inlet pressures and differential pressures.

The steam flow equation used to make Table 9 is given in Appendix A. This equation can be used to calculate maximum steam capacity at inlet pressures and differential pressures other than those provided in the chart.

Table 9: Maximum Steam Capacity (lb/hr)

Valve Size				1/2" Reduced	1/2"	3/4"	1"	1-1/2"	2"	2-1/2"	3"	4"
Cv				3.5	5	6.5	10	22	42	70	110	170
Inlet Pressure (PSIG)	5	Differential Pressure (PSI)	2	66	95	123	189	416	795	1325	2082	3217
			5	96	137	178	274	604	1153	1921	3019	4666
	10		2	74	106	137	211	465	887	1478	2323	3590
			5	109	156	203	312	687	1311	2185	3434	5307
			10	137	195	254	390	858	1639	2731	4292	6633
	15		5	121	173	225	347	763	1456	2427	3814	5895
			10	155	222	289	444	977	1864	3107	4883	7547
			15	170	243	316	487	1071	2044	3407	5354	8274
	20		5	133	190	247	380	836	1596	2659	4179	6458
			10	173	247	321	494	1087	2076	3460	5437	8402
			15	193	276	359	553	1216	2321	3869	6079	9395
	30		5	152	217	282	434	954	1822	3036	4771	7373
			15	231	330	429	659	1451	2770	4616	7254	11211
			25	257	366	476	733	1613	3079	5131	8063	12461
	50		10	250	356	463	713	1568	2994	4990	7842	12120
			20	322	461	599	921	2026	3869	6448	10132	15659
			40	370	528	687	1056	2324	4437	7395	11620	17958
	100		20	457	653	849	1307	2874	5488	9146	14372	22212
			40	583	833	1083	1666	3665	6996	11660	18323	28317
			60	636	909	1181	1817	3998	7632	12719	19988	30890
	150		20	561	802	1042	1603	3527	6734	11224	17637	27257
			50	799	1141	1483	2282	5020	9583	15972	25099	38790
			100	920	1315	1709	2630	5785	11045	18408	28927	44705
	200		25	712	1017	1322	2034	4475	8543	14238	22374	34577
			50	943	1347	1751	2693	5925	11311	18852	29625	45784
			100	1152	1645	2139	3290	7239	13820	23033	36194	55936
	250		30	864	1234	1604	2468	5430	10366	17277	27149	41957
			80	1265	1807	2349	3614	7952	15181	25301	39759	61446
			150	1453	2076	2699	4152	9135	17439	29065	45673	70586
	300		100	1529	2184	2839	4367	9608	18343	30572	48042	74247
			150	1689	2413	3137	4826	10618	20271	33785	53091	82050
			200	1739	2485	3230	4970	10933	20873	34788	54667	84485

Specifications

Physical characteristics	Valve body rating	ANSI/ASME Class 150/300
	Weight	See "Weights"
	Leakage rate	
	-HFV-2… and HFV-3…	Class IV (0.01% of C_v)
	-HFV-4…	Class VI
	Rangeability	50:1
	Valve stroke	
	1/2" to 2" valves	3/4"
	2-1/2" to 4" valves	1-1/8"
Operating environment	Controlled media	Water or steam
	Media temperature	-20 to 450°F [-29 to 232°C]
	Ambient temperature	-20 to 280°F [-29 to 138°C]
	Maximum operating pressure	
	Water	See Table 10
	Steam – NPT or 300# flanged	408 psig [28.1 bar]
	Steam – 150# flanged	See Table 10
	Close-off pressure	See Table 11
	Maximum differential pressure for modulating service	150 psig [10.3 bar]

Table 10: Valve Pressure-Temperature Rating

Temperature (°F)	Pressure (psig)	
	150# Flanged	NPT or 300# Flanged
100	275	720
200	230	600
300	205	540
400	190	495
450	180	480

Actuator Selection

Table 11 lists the close-off pressure for the SKB/C/D… series electronic actuators based on the valve size being used. Valves larger than 2” have a 1-1/8” valve stroke and must be used with an SKC… electronic actuator.

Table 11: SKB/C/D… Actuator Close-off Pressure (psig)

Valve Size	SKD62UA	SKB62UA	SKC62UA[1]
1/2”	290	720	720
3/4”	290	720	720
1”	290	720	720
1-1/2”	150	450	450
2”	75	230	230
2-1/2”	-	-	109
3”	-	-	80
4”	-	-	43

[1] SKC… actuators open twice as fast as SKB… actuators and offer a better response for water level control applications.

Weights

Table 12: HFV… Valve Weights in lb [kg][1]

Valve Size	2-Way Valves			3-Way Valves		
	NPT	150# Flanged	300# Flanged	NPT	150# Flanged	300# Flanged
1/2”	3.5 [1.6]	6.0 [2.7]	7.0 [3.2]	4.0 [1.8]	8.5 [3.9]	9.0 [4.1]
3/4”	3.5 [1.6]	7.0 [3.2]	9.0 [4.1]	4.0 [1.8]	8.5 [3.9]	9.0 [4.1]
1”	5.5 [2.5]	10 [4.5]	13 [5.9]	5.5 [2.5]	12 [5.4]	13 [5.9]
1-1/2”	6.8 [3.1]	14 [6.4]	19 [8.6]	7.0 [3.2]	19 [8.6]	22 [10]
2”	10 [4.5]	21 [9.5]	25 [11]	11 [5.0]	26 [12]	35 [16]
2-1/2”	-	41 [19]	46 [21]	-	50 [23]	58 [26]
3”	-	65 [29]	74 [34]	-	74 [34]	88 [40]
4”	-	92 [42]	112 [51]	-	106 [48]	136 [62]

[1] Weights listed are for valves without a cavitation adapter.

Spare Parts

Two types of spare parts kits are available for each HFV… valve: a packing kit and a rebuild kit.

Packing kits are available to repair a valve that is leaking either around the valve stem or out of the bottom plug. Each packing kit contains the components shown below in Figure 6.

Table 13: HFV… Valve Packing Kits

Valve Size	Part Number
1/2", 3/4", 1"	HFV-PK-050-100
1-1/2"	HFV-PK-150
2"	HFV-PK-200
2-1/2"	HFV-PK-250
3"	HFV-PK-300
4"	HFV-PK-400

Item	Description	Quantity
4	Body Gasket	1
6	Lower Seal Bushing	1
7	Packing Gland Nut	1
8	Stem Seal Spring	1
9	Guide Bushing	2
10	Packing Washer	1
11	V-ring Packing Set	1
13	Stem O-ring	1

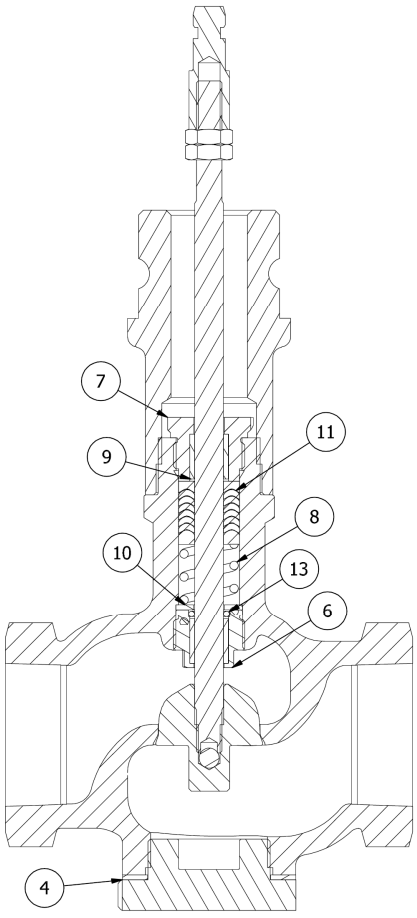


Figure 6: Components Included with Packing Kits

Spare Parts (continued)

Rebuild kits are available to repair a valve that is leaking by the valve seat and no longer seals correctly when fully closed. Each rebuild kit contains the components shown below in Figure 7.

Table 14: Class IV HFV… Valve Rebuild Kits

Valve Size	2-way Linear	2-way Equal Percentage	3-way Linear
1/2" Reduced	HFV-RK-2L-050R	HFV-RK-2E-050R	-
1/2" Full, 3/4", 1"	HFV-RK-2L-050-100	HFV-RK-2E-050-100	HFV-RK-3L-050-100
1-1/2"	HFV-RK-2L-150	HFV-RK-2E-150	HFV-RK-3L-150
2"	HFV-RK-2L-200	HFV-RK-2E-200	HFV-RK-3L-200
2-1/2"	HFV-RK-2L-250	HFV-RK-2E-250	HFV-RK-3L-250
3"	HFV-RK-2L-300	HFV-RK-2E-300	HFV-RK-3L-300
4"	HFV-RK-2L-400	HFV-RK-2E-400	HFV-RK-3L-400

Table 15: Class VI HFV… Valve Rebuild Kits

Valve Size	2-way Linear	2-way Equal Percentage
1/2" Reduced	HFV-RK-4L-0.5R	HFV-RK-4E-0.5R
1/2", 3/4", 1"	HFV-RK-4L-0.5-1.0	HFV-RK-4E-0.5-1.0
1-1/2"	HFV-RK-4L-1.5	HFV-RK-4E-1.5
2"	HFV-RK-4L-2.0	HFV-RK-4E-2.0
2-1/2"	HFV-RK-4L-2.5	HFV-RK-4E-2.5
3"	HFV-RK-4L-3.0	HFV-RK-4E-3.0
4"	HFV-RK-4L-4.0	HFV-RK-4E-4.0

Item	Description	Quantity
2, 5	Stem and Plug Assembly	1
4	Body Gasket	1
6	Lower Seal Bushing	1
7	Packing Gland Nut	1
8	Stem Seal Spring	1
9	Guide Bushing	2
10	Packing Washer	1
11	V-ring Packing Set	1
13	Stem O-ring	1

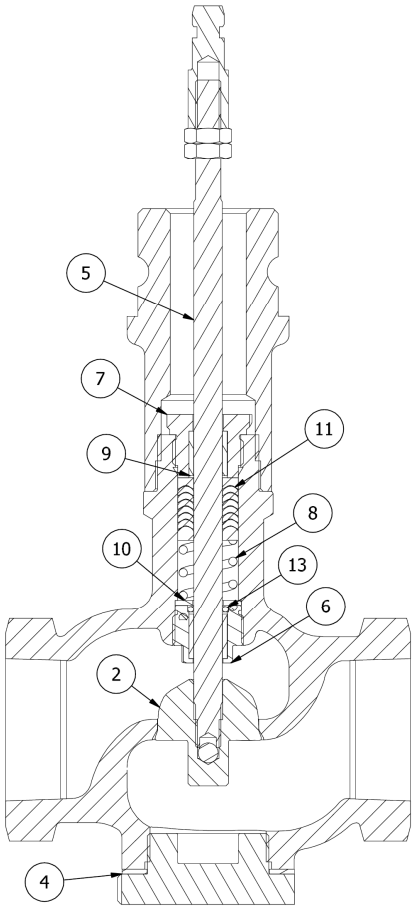


Figure 7: Components Included with Rebuild Kits

Installation

- The valve can be mounted in horizontal or vertical pipe. The SKB/C/D… actuator must be mounted in an upright or horizontal position.
- Install the valve with the flow arrow on the side of the body pointing in the direction of fluid flow.
- Insulation may be applied to the valve body if desired. Do not insulate the bonnet or the actuator.
- An upstream strainer is required to avoid scale entering the valve. It is recommended to use a 20-mesh strainer with 1/2” through 2” valves and a 45-mesh strainer with 2-1/2” through 4” valves.
- Be sure to clean and remove any scale or debris in piping prior to installation of the valve.
- Appropriate thread sealant should be applied to all NPT threaded pipe connections.
- To ease maintenance procedures, it is recommended to have isolation valves installed with unions or flanged connections before and after the valve.
- An optional bypass line can be installed parallel to the control valve to enable the valve to be serviced while a boiler or deaerator are still in operation.

Maintenance

HFV… valves do not require any maintenance. However, if the valve exhibits a leak, it can be disassembled to install a new packing kit or rebuild kit. On Class IV shutoff valves, it can also be disassembled to lap the valve seat and plug to fix minor leaks through the valve seat. The following procedures can be used to properly disassemble and reassemble any HFV… valve.

Valve Disassembly

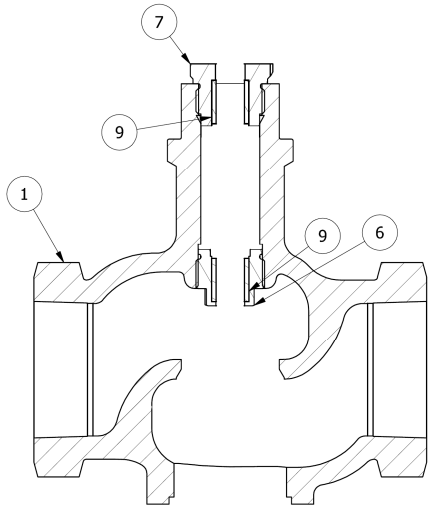
1. Make sure fluid supply to the valve is safely shut off and allow sufficient time for the valve to cool down if necessary.
2. Remove the actuator from the valve.
3. Remove the stem adapter, bonnet adapter, and jam nuts from the top of the valve.
4. Remove the body plug and body gasket from the bottom of the valve. Sometimes the body gasket will remain adhered to the bottom of the valve body. If this happens, it is okay to leave the body gasket in place unless it is being replaced.
5. Loosen and remove the packing gland nut on the top of the valve. Inside the packing gland nut should be one of the guide bushings.
6. Push down on the valve stem to remove the stem and plug assembly from the valve.
7. Remove the V-ring packing set and the stem seal spring from the top of the valve. Re-inserting the valve stem back through the packing may help to push the packing out of the valve if necessary.
8. Through the bottom of the valve, use a socket with extension to remove the lower seal bushing. On 1/2” through 2” valves, use a 9/16” socket. On 2-1/2” through 4” valves, use a 1-3/8” socket. The packing washer and stem O-ring should drop out with the lower seal bushing. Inside the lower seal bushing is the other guide bushing.
9. Inspect the guide bushings in the packing gland nut and the lower seal bushing. Replace as required.
10. Replace the stem O-ring as required. Be sure to lubricate the O-ring prior to installation. A recommended lubricant is Dow Corning High Vacuum Grease or equivalent.
11. Clean all the surfaces of the seat, stem, and plug. If the stem or plug is corroded, worn, or marred in any way, it should be replaced.

Maintenance (continued)

Lapping the Seat and Plug (Class IV Shutoff Valves Only)

Over time, high pressure water flowing between the seat and plug may create small grooves in the seat or plug. This can increase the fully closed leakage rate beyond the valve's ANSI Class IV shutoff rating. Lapping reduces or eliminates these grooves and thus reduces the fully closed leakage rate. Lapping is the process of polishing the mating surfaces of the seat and plug together so that imperfections in the seat or plug are removed and the two pieces wear into each other to create a better seal.

1. With the valve disassembled according to the instructions above, reinstall the packing gland nut into the top of the valve with the guide bushing installed. Then reinstall the lower seal bushing into the bottom of the valve with the other guide bushing installed. These components are installed simply to function as a guide for the valve stem during the lapping procedure. The rest of the components, including the V-ring packing set, stem seal spring, stem O-ring, and packing washer should remain out of the valve during this procedure. A cutaway of what the valve should look like at this point is shown below.
2. Apply a thin amount of lapping compound around the plug at the taper near the bottom. A recommended lapping compound is Hyperion Diamond Compound SJK-5 mixed with a small amount of light machine oil.
3. Slide the stem through the packing until the plug rests on the seat.
4. Pulling up on the stem and/or pushing up on the plug, apply light pressure to the plug on the seat and rotate the stem back and forth. Rotation should not exceed 90 degrees.
5. Lift the plug away from the seat and rotate 90 degrees.
6. Repeat steps 4 and 5 several times to ensure a proper seat. Then remove the stem and plug from the valve and clean any excess lapping compound off the parts.
7. Remove the packing gland nut from the top of the valve and the lower seal bushing from the bottom of the valve.

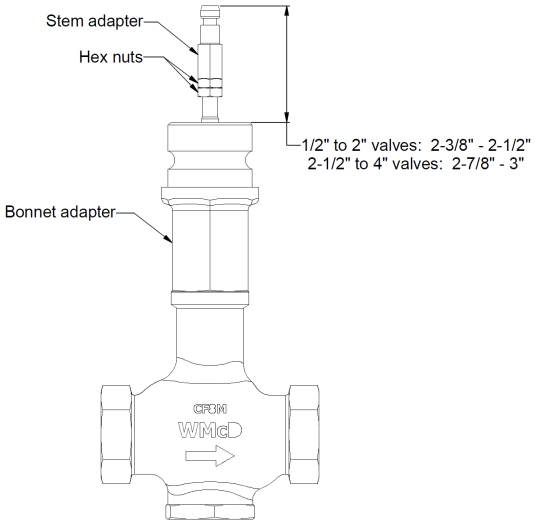


Item	Description	Quantity
1	Body	1
6	Lower Seal Bushing	1
7	Packing Gland Nut	1
9	Guide Bushing	2

Maintenance (continued)

Valve Assembly

1. Install the packing washer, stem O-ring, and lower seal bushing with guide bushing installed into the bottom of the valve body. Be sure to lubricate the O-ring prior to installation. A recommended lubricant is Dow Corning High Vacuum Grease or equivalent.
2. Insert the stem seal spring into the top of the valve body.
3. Slide the stem and plug assembly up through the bottom of the valve.
4. Install the V-ring packing set onto the stem and lower it into the packing cavity in the top of the valve. Make sure that the point of the V is aimed up towards the actuator. The V-rings must be carefully installed over the stem threads to avoid snagging on the threads. A sharp edge on the V-rings is critical for a proper seal.
5. Install and tighten the packing gland nut onto the top of the valve. The other guide bushing should be installed inside the packing gland nut.
6. Verify that the stem slides through the packing without any binding or extreme sticking.
7. Install the body plug and body gasket onto the bottom of the valve.
8. A leak test may be performed to verify all components have been properly installed and tightened prior to actuator installation.
9. Install the bonnet adapter until it bottoms out on the top of the valve.
10. Thread the jam nuts onto the valve stem.
11. Thread the stem adapter onto the valve stem until the distance from the top of the stem adapter to the top of the bonnet adapter is approximately 2-1/2” (+0, -1/8”) for 1/2” through 2” valves, or approximately 3” (+0, -1/8”) for 2-1/2” through 4” valves, as shown below. Getting this measurement as accurate as possible is critical. If the stem adapter is not threaded far enough onto the valve stem, the valve will not completely close when the SKB/C/D… actuator ram is fully retracted. Conversely, if the stem adapter is threaded too far onto the valve stem, full open flow will never be achieved.



12. Install the actuator onto the valve.

Dimensions

Dimensions in inches; millimeters in brackets

2-Way HFV… Valves without a Cavitation Adapter

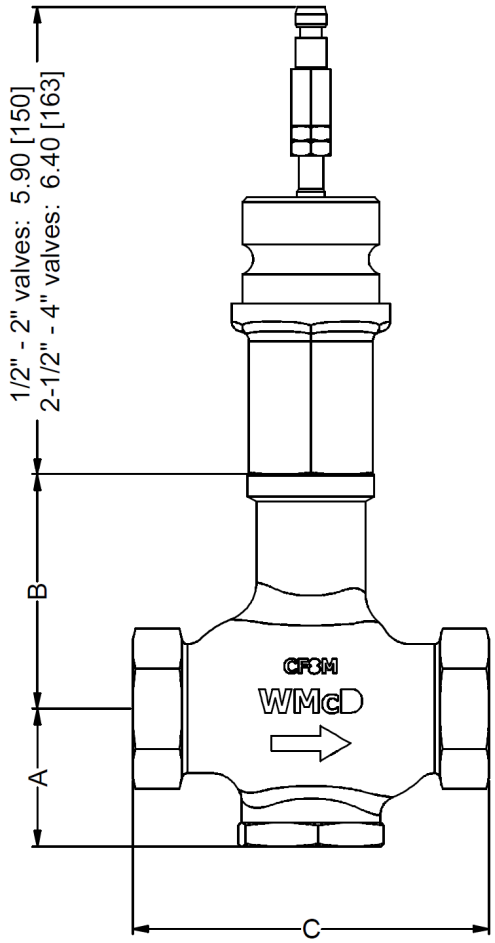


Table 16: Dimensions of 2-Way HFV… Valves without a Cavitation Adapter

Size	A	B	C		
			NPT	150#	300#
1/2”	1.76 [45]	2.95 [75]	4.50 [114]	7.25 [184]	7.75 [197]
3/4”	1.76 [45]	2.95 [75]	4.50 [114]	7.25 [184]	7.75 [197]
1”	1.74 [44]	2.95 [75]	4.50 [114]	7.25 [184]	7.75 [197]
1-1/2”	2.15 [55]	2.95 [75]	5.00 [127]	8.75 [222]	9.25 [235]
2”	2.31 [59]	2.95 [75]	6.00 [152]	10.00 [254]	10.50 [267]
2-1/2”	4.38 [111]	4.25 [108]	-	10.88 [276]	11.50 [292]
3”	5.56 [141]	4.25 [108]	-	11.75 [298]	12.50 [318]
4”	6.19 [157]	4.25 [108]	-	13.88 [353]	14.50 [368]

Dimensions

Dimensions in inches; millimeters in brackets

2-Way HFV… Valves with a Cavitation Adapter

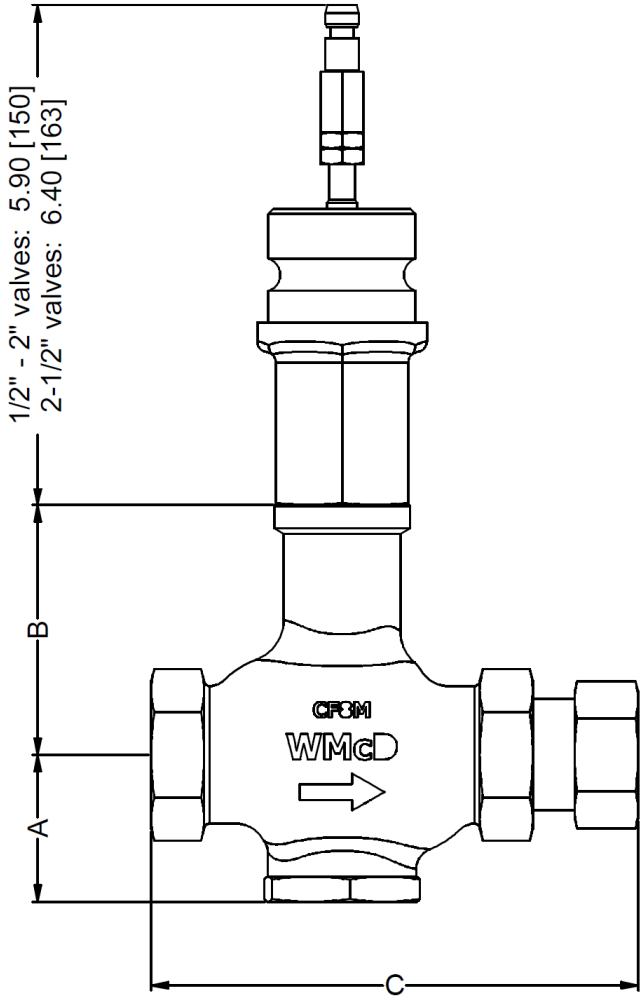


Table 17: Dimensions of 2-Way HFV… Valves with a Cavitation Adapter

Size	A	B	C		
			NPT	150#	300#
1/2”	1.76 [45]	2.95 [75]	5.61 [142]	7.25 [184]	7.75 [197]
3/4”	1.76 [45]	2.95 [75]	5.66 [144]	7.25 [184]	7.75 [197]
1”	1.74 [44]	2.95 [75]	5.74 [146]	7.25 [184]	7.75 [197]
1-1/2”	2.15 [55]	2.95 [75]	6.14 [156]	8.75 [222]	9.25 [235]
2”	2.31 [59]	2.95 [75]	7.23 [184]	10.00 [254]	10.50 [267]
2-1/2”	4.38 [111]	4.25 [108]	-	10.88 [276]	11.50 [292]

Dimensions (continued)

Dimensions in inches; millimeters in brackets

3-Way HFV… Valves

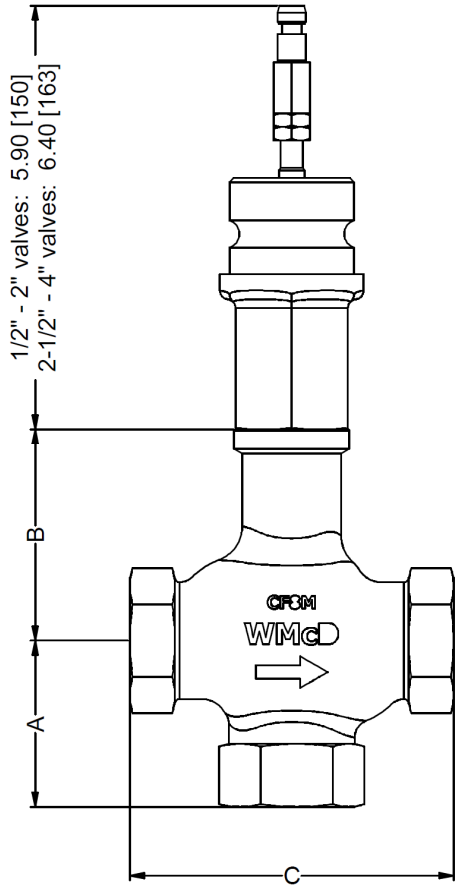


Table 18: Dimensions of 3-Way HFV… Valves

Size	A			B	C		
	NPT	150#	300#		NPT	150#	300#
1/2”	2.31 [59]	4.00 [102]	4.00 [102]	2.95 [75]	4.50 [114]	7.25 [184]	7.75 [197]
3/4”	2.31 [59]	4.00 [102]	4.00 [102]	2.95 [75]	4.50 [114]	7.25 [184]	7.75 [197]
1”	2.31 [59]	4.00 [102]	4.00 [102]	2.95 [75]	4.50 [114]	7.25 [184]	7.75 [197]
1-1/2”	2.84 [72]	4.30 [109]	4.30 [109]	2.95 [75]	5.00 [127]	8.75 [222]	9.25 [235]
2”	3.19 [81]	5.00 [127]	5.00 [127]	2.95 [75]	6.00 [152]	10.00 [254]	10.50 [267]
2-1/2”	-	7.13 [181]	7.38 [187]	4.25 [108]	-	10.88 [276]	11.50 [292]
3”	-	8.32 [211]	8.50 [216]	4.25 [108]	-	11.75 [298]	12.50 [318]
4”	-	9.19 [233]	9.50 [241]	4.25 [108]	-	13.88 [353]	14.50 [368]

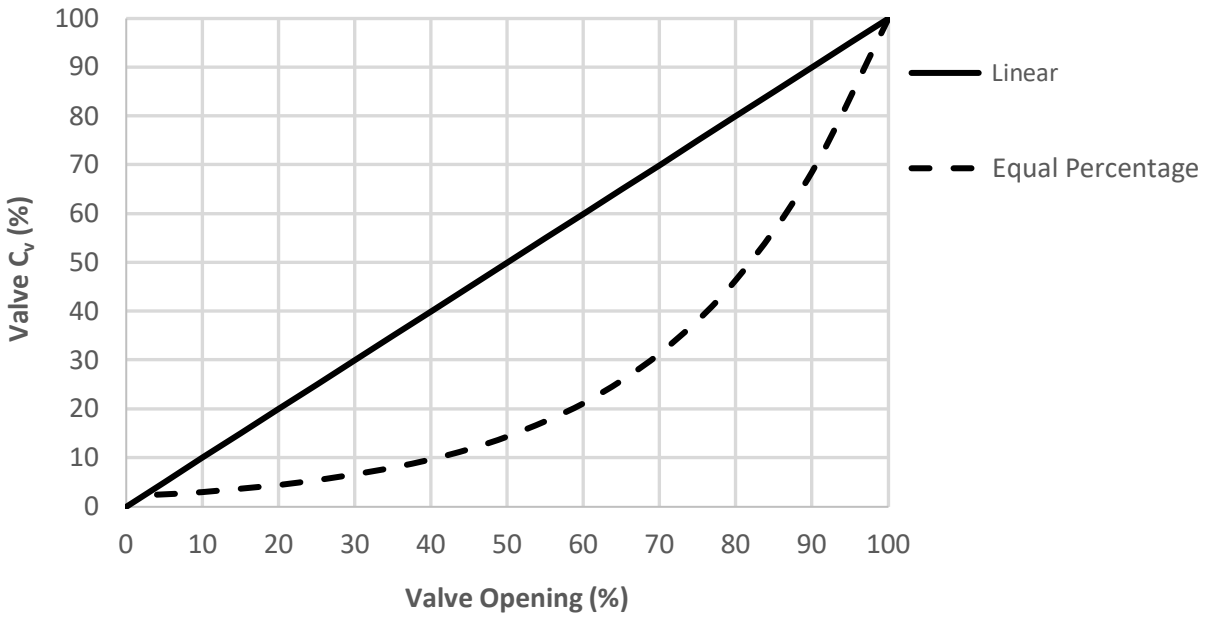
Appendix A

Valve Characteristic

HFV… control valves have two available flow characteristics: linear and equal percentage.

When using a linear valve, the flow capacity increases linearly with the valve opening. For example, if the valve is 50% open, the valve will flow 50% of its maximum capacity.

When using an equal percentage valve, the flow capacity increases exponentially with the valve opening. Equal increments of valve opening result in an equal percentage change in the flow capacity. For example, consider when a valve with a C_v of 100 experiences a 10% incremental increase in the valve opening from 50% to 60%. In this case, the valve C_v increases from 14.4 to 21.2 for an increase of 47%. Now, consider the same valve experiences another 10% incremental increase in valve opening from 60% to 70%. The valve C_v increases by 47% again, from 21.2 to 31.2.



Linear valves are preferred when the pressure drop across the valve remains constant or near constant with increases in flow rate. Equal percentage valves should be used when the pressure differential across the valve decreases significantly with increases in flow rate.

Appendix A (continued)

Valve Sizing for Water Flow

For valves without a cavitation adapter, water flow through the valve body can be calculated using the equation below and the C_v values from Tables 1-5.

$$(\boldsymbol{Eq.1}) \quad Q = C_v \times \sqrt{\frac{\Delta P}{G}}$$

…where…

C_v = Flow coefficient (see Tables 1-5)
G = Specific gravity of water (see Table 20)
ΔP = Differential pressure across valve in psi
Q = Water flow in gpm

Valve Sizing for Steam Flow

Steam flow through the valve body can be calculated using the equation below and the C_v values from Tables 1-5.

$$(\boldsymbol{Eq.2}) \quad W = C_v \times 63.3 \times \left(1 - \frac{\Delta P}{1.944 \times P_1}\right) \times \sqrt{\Delta P \times \rho_1}$$

…where…

C_v = Flow coefficient (see Tables 1-5)
ΔP = Differential pressure across valve in psi
ρ_1 = Density of steam at inlet pressure P_1 (see Table 20)
P_1 = Absolute inlet pressure in psia (psig + 14.7)
W = Steam flow in lb/hr

Appendix A (continued)

Cavitation Index

The cavitation index for a given application can be calculated using the equation below. If the cavitation index is greater than 2.0, the valve will not experience cavitation. If the cavitation index is below or equal to 2.0, the valve may experience cavitation, and a cavitation adapter is required.

$$(\boldsymbol{Eq.3}) \quad Cavitation\ index = \frac{P_1 - P_v}{P_1 - P_2}$$

…where…

P_1 = Inlet pressure to valve in psig
P_2 = Outlet pressure from valve in psig
P_v = Vapor pressure of water at application water temperature in psig (see Table 20)

Leakage Rate Classification

HFV… control valves have two available leakage rate classes: Class IV and Class VI.

A valve with a Class IV leakage rate has a metal-to-metal seat. By definition, a Class IV valve flows less than 0.01% of the full open Cv when the valve is fully closed. For example, on a 1" Class IV valve with a full open Cv of 10, the full closed Cv would be 0.001 or less. A valve with a Class IV shutoff is the most commonly used valve for feedwater applications.

A valve with a Class VI leakage rate has a soft seat. Either the valve seat or valve plug (or both) is made from a soft material. On Class VI HFV… valves, the portion of the plug that seals off flow is made from Teflon (PTFE). The acceptable leakage rate of a Class VI valve varies by valve size but is less than the leakage rate of a Class IV valve.

Appendix A (continued)

Determining Required Water Flow for Boiler Feedwater Applications

To determine the required water flow for boiler feedwater applications, the following values must be identified:

- Maximum boiler output in HP
- Maximum boiler operating pressure in psi
- Water temperature at the valve in °F

Using the maximum boiler operating pressure and Table 20 in Appendix A, determine the steam enthalpy. Similarly, using the water temperature at the valve and Table 20 in Appendix A, determine the water enthalpy and water density. With these values known, the following equations can be used to calculate the required water flow for the application.

First, use Equation 4 below to determine the maximum steam output of the boiler:

$$(\boldsymbol{Eq.4})\quad \boldsymbol{Steam\ Flow}\left(\frac{\boldsymbol{lb}}{\boldsymbol{hr}}\right) = \frac{Boiler\ Horsepower\ (HP) \times 970.3\ \left(\frac{BTU}{lb}\right) \times 34.5\ \left(\frac{lb}{hr \cdot HP}\right)}{Steam\ Enthalpy\ \left(\frac{BTU}{lb}\right) - Water\ Enthalpy\ \left(\frac{BTU}{lb}\right)}$$

Now that the maximum steam flow is known, the maximum amount of water flow needed through the valve can be calculated using Equation 5 below:

$$(\boldsymbol{Eq.5})\quad \boldsymbol{Water\ Flow\ (gpm)} = \frac{1.15\ \times Steam\ Flow\left(\frac{lb}{hr}\right)}{Water\ Density\left(\frac{lb}{gal}\right) \times 60\ \left(\frac{min}{hr}\right)}$$

Appendix A (continued)

Determining Required Water Flow for Deaerator Makeup Water Applications

To determine the required water flow for deaerator makeup water applications, the following values must be identified:

- Deaerator rating in lb/hr
- Percentage of makeup water in %
- Makeup water temperature in °F

Using the makeup water temperature at the valve and Table 20 in Appendix A, determine the makeup water density. With this value known, Equation 6 can be used to calculate the required water flow.

$$(\boldsymbol{Eq.6}) \qquad \boldsymbol{Water\ Flow\ (gpm)} = \frac{Deaerator\ Rating\left(\frac{lb}{hr}\right) \times \frac{Makeup\ Water\ Percentage}{100}}{Makeup\ Water\ Density\left(\frac{lb}{gal}\right) \times 60\left(\frac{min}{hr}\right)}$$

Appendix A (continued)

Steam Tables

Table 20: Steam Table Values

Water Temperature	Water Enthalpy	Water Density	Water Specific Gravity	Steam Pressure / Vapor Pressure		Steam Enthalpy	Steam Density
°F	Btu / lb	lb / gal	-	psig	psia	Btu / lb	lb / ft^3
32	-0.018	8.34	1.000	-14.611	0.089	1075.5	0.0004
36	4.008	8.35	1.001	-14.596	0.104	1077.2	0.0004
40	8.027	8.35	1.001	-14.578	0.122	1079.0	0.0005
44	12.041	8.34	1.000	-14.558	0.142	1080.7	0.0005
48	16.051	8.34	1.000	-14.535	0.165	1082.5	0.0006
52	20.057	8.34	1.000	-14.508	0.192	1084.2	0.0006
56	24.059	8.34	1.000	-14.478	0.222	1086.0	0.0007
60	28.060	8.34	1.000	-14.444	0.256	1087.7	0.0008
64	32.058	8.34	1.000	-14.405	0.295	1089.5	0.0009
68	36.054	8.33	0.999	-14.361	0.339	1091.2	0.0010
72	40.049	8.33	0.999	-14.312	0.388	1093.0	0.0012
76	44.043	8.32	0.998	-14.256	0.444	1094.7	0.0014
80	48.037	8.32	0.998	-14.193	0.507	1096.4	0.0016
84	52.029	8.31	0.996	-14.123	0.577	1098.2	0.0018
88	56.022	8.31	0.996	-14.044	0.656	1099.9	0.0020
92	60.014	8.30	0.995	-13.957	0.743	1101.6	0.0023
96	64.006	8.29	0.994	-13.859	0.841	1103.3	0.0025
100	67.999	8.29	0.994	-13.751	0.949	1105.1	0.0029
104	71.992	8.28	0.993	-13.63	1.07	1106.8	0.0032
108	75.98	8.27	0.992	-13.50	1.20	1108.5	0.0036
112	79.98	8.27	0.992	-13.35	1.35	1110.2	0.0040
116	83.97	8.26	0.990	-13.19	1.51	1111.9	0.0045
120	87.97	8.25	0.989	-13.01	1.69	1113.6	0.0050
124	91.96	8.24	0.988	-12.81	1.89	1115.3	0.0055
128	95.96	8.23	0.987	-12.59	2.11	1117.0	0.0061
132	99.95	8.22	0.986	-12.36	2.34	1118.6	0.0067
136	103.95	8.21	0.984	-12.10	2.60	1120.3	0.0074
140	107.95	8.21	0.984	-11.81	2.89	1122.0	0.0081
144	111.95	8.20	0.983	-11.50	3.20	1123.6	0.0090
148	115.95	8.19	0.982	-11.16	3.54	1125.3	0.0098
152	119.95	8.18	0.981	-10.79	3.91	1126.9	0.0108
156	123.95	8.16	0.978	-10.39	4.31	1128.6	0.0118
160	127.96	8.15	0.977	-9.96	4.74	1130.2	0.0130
164	131.96	8.14	0.976	-9.49	5.21	1131.8	0.0142

Appendix A (continued)

Table 20: Steam Table Values (continued)

Water Temperature	Water Enthalpy	Water Density	Water Specific Gravity	Steam Pressure / Vapor Pressure		Steam Enthalpy	Steam Density
°F	Btu / lb	lb / gal	-	psig	psia	Btu / lb	lb / ft^3
168	135.97	8.13	0.975	-8.98	5.72	1133.4	0.0154
172	139.98	8.12	0.974	-8.43	6.27	1135.0	0.0168
176	143.99	8.11	0.972	-7.83	6.87	1136.6	0.0183
180	148.00	8.10	0.971	-7.19	7.51	1138.2	0.0199
184	152.01	8.09	0.970	-6.50	8.20	1139.8	0.0216
188	156.03	8.07	0.968	-5.75	8.95	1141.3	0.0235
192	160.05	8.06	0.966	-4.95	9.75	1142.9	0.0254
196	164.06	8.05	0.965	-4.1	10.6	1144.4	0.0275
200	168.09	8.04	0.964	-3.2	11.5	1146.0	0.0298
204	172.11	8.02	0.962	-2.2	12.5	1147.5	0.0321
208	176.14	8.01	0.960	-1.1	13.6	1149.0	0.0347
212	180.17	8.00	0.959	0.0	14.7	1150.5	0.0373
216	184.20	7.98	0.957	1.2	15.9	1152.0	0.0402
220	188.23	7.97	0.956	2.5	17.2	1153.4	0.0432
224	192.27	7.96	0.954	3.9	18.6	1154.9	0.0464
228	196.31	7.94	0.952	5.3	20.0	1156.3	0.0498
232	200.35	7.93	0.951	6.9	21.6	1157.8	0.0535
236	204.40	7.91	0.948	8.5	23.2	1159.2	0.0573
240	208.45	7.90	0.947	10.3	25.0	1160.6	0.0613
244	212.50	7.89	0.946	12.1	26.8	1162.0	0.0656
248	216.56	7.87	0.944	14.1	28.8	1163.4	0.0700
252	220.62	7.86	0.942	16.2	30.9	1164.7	0.0748
256	224.69	7.84	0.940	18.4	33.1	1166.1	0.0798
260	228.76	7.82	0.938	20.7	35.4	1167.4	0.0850
264	232.83	7.81	0.936	23.2	37.9	1168.7	0.0906
268	236.91	7.79	0.934	25.8	40.5	1170.0	0.0964
272	240.99	7.78	0.933	28.5	43.2	1171.3	0.103
276	245.08	7.76	0.930	31.4	46.1	1172.5	0.109
280	249.17	7.74	0.928	34.5	49.2	1173.8	0.116
284	253.3	7.73	0.927	37.7	52.4	1175.0	0.123
288	257.4	7.71	0.924	41.1	55.8	1176.2	0.130
292	261.5	7.69	0.922	44.7	59.4	1177.4	0.138
296	265.6	7.68	0.921	48.4	63.1	1178.6	0.146
300	269.7	7.66	0.918	52.3	67.0	1179.7	0.155
304	273.8	7.64	0.916	56.4	71.1	1180.9	0.164
308	278.0	7.62	0.914	60.7	75.4	1182.0	0.173

Appendix A (continued)

Table 20: Steam Table Values (continued)

Water Temperature	Water Enthalpy	Water Density	Water Specific Gravity	Steam Pressure / Vapor Pressure		Steam Enthalpy	Steam Density
°F	Btu / lb	lb / gal	-	psig	psia	Btu / lb	lb / ft^3
312	282.1	7.61	0.912	65.3	80.0	1183.1	0.183
316	286.3	7.59	0.910	70.0	84.7	1184.1	0.193
320	290.4	7.57	0.908	74.9	89.6	1185.2	0.203
324	294.6	7.55	0.905	80.1	94.8	1186.2	0.215
328	298.7	7.53	0.903	85.5	100.2	1187.2	0.226
332	302.9	7.52	0.902	91.2	105.9	1188.2	0.238
336	307.1	7.50	0.899	97.1	111.8	1189.1	0.251
340	311.3	7.48	0.897	103.3	118.0	1190.1	0.264
344	315.5	7.46	0.894	109.7	124.4	1191.0	0.278
348	319.7	7.44	0.892	116.4	131.1	1191.9	0.292
352	323.9	7.42	0.890	123.4	138.1	1192.7	0.307
356	328.1	7.40	0.887	130.7	145.4	1193.6	0.322
360	332.3	7.38	0.885	138.3	153.0	1194.4	0.338
364	336.5	7.36	0.882	146.2	160.9	1195.2	0.355
368	340.8	7.34	0.880	154.4	169.1	1195.9	0.372
372	345.0	7.32	0.878	162.9	177.6	1196.7	0.390
376	349.3	7.30	0.875	171.8	186.5	1197.4	0.409
380	353.6	7.28	0.873	181.0	195.7	1198.0	0.428
384	357.9	7.26	0.871	190.6	205.3	1198.7	0.448
388	362.2	7.24	0.868	200.5	215.2	1199.3	0.469
392	366.5	7.22	0.866	210.8	225.5	1199.9	0.491
396	370.8	7.20	0.863	221.5	236.2	1200.4	0.513
400	375.1	7.18	0.861	232.6	247.3	1201.0	0.537
404	379.4	7.15	0.857	244.0	258.7	1201.5	0.561
408	383.8	7.13	0.855	255.9	270.6	1201.9	0.586
412	388.1	7.11	0.853	268.2	282.9	1202.4	0.612
416	392.5	7.09	0.850	280.9	295.6	1202.8	0.639
420	396.9	7.06	0.847	294.1	308.8	1203.1	0.666

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