Introduction

For any given port diameter and valve plug travel, the tables in this section show the maximum **allowable** pressure drop at shutoff for each actuator, facilitating proper actuator sizing for many control applications. Some selections have been further limited due to valve flowing pressure drop limitations.

Additional actuator constructions can be selected by using a more complicated and more exact force method found in Section B of this catalog.

These pressure drop tables provide sizing information for actuators used on the general valve construction and application conditions described below. (The Fisher® GX control valve and actuator follow a different actuator selection process than other Fisher sliding-stem products. Please refer to the following section entitled, "Fisher GX").

1. Normal flow direction (determined from individual valve bulletins) and push-down-to-close valve plug action.

2. Pressure drop (ΔP) is equal to maximum inlet pressure.

3. Single PTFE packing.

4. Metal seating surfaces for all but Fisher ET valves with Class V shutoff.

5. Shutoff classes per ANSI/FCI 70-2 and IEC 60534-4.

6. Shutoff pressure drops not exceeding 6000 psi.

7. Pressure and temperature limitations determined by the specific valve body and trim materials.

8. For piston and spring-biased piston actuators, the tables list supply pressures for either 3 to 15 or 6 to 30 psig signal ranges. For spring-and-diaphragm actuators, an available supply pressure of 0 to 18 psig is assumed with a 3 to 15 psig signal range, and a 0 to 33 psig supply pressure is assumed with a 6 to 30 psig signal range.

9. Except where indicated, standard seat loading by shutoff class is used per Catalog 14 Section B.

10. No dynamic instability due to negative gradients.

These tables are arranged by unbalanced or balanced valve construction and then by increasing port diameter for each actuator type. (The trim parts in a balanced design minimize the net fluid flow forces creating static unbalance, making possible the selection of a smaller actuator.)

The valve designs included in this section are listed in the following table.

Fisher GX

The standard GX control valve and actuator system requires no actuator sizing. Each GX has a pre-selected actuator size based on valve size and port diameter. The standard supply pressure range to the GX actuator will be 4 to 6 barg (58 to 87 psi). In addition to these base constructions, the GX actuator has several optional features.

- 3BAR -- changes actuator spring configuration to allow for 3 to 4 bar (44 to 58 psi) of actuator supply pressure
- 2BAR -- changes actuator spring configuration to allow for 2 to 3 bar (28 to 44 psi) of actuator supply pressure
- 750ACT -- replaces size 225 actuator for added pressure drop capability

Each of the above options should be applied to base GX selections which may impact the maximum pressure drop and shutoff class. Please reference the Fisher GX Bulletin Supplement, 51.1:GX(S1), D103209X012 for further details.

1. The GX is offered as a flow-up construction only.

2. The GX is available in Class IV, V, and VI shutoff constructions. These will all be tested using 50 psig air at the factory. Reference the Fisher GX Bulletin Supplement for shutoff availability.

3. The maximum allowable pressure drops are equal to the maximum inlet pressure. The allowable pressure drops are the maximum pressure differentials at which the actuator can still close the valve.

4. Unlike the easy-e™ and other sliding-stem valves, the GX does not use Group 1 actuator mounting. Instead, the GX uses a trapped bonnet that is clamped between the actuator and the valve body. The GX actuator is not used on any other sliding-stem valve.

5. In the case of alloy constructions, the maximum allowable air supply pressure to the actuator has been limited in certain cases. When supplied with a 3582i I/P positioner, maximum allowable air supply is 3.44 barg (50 psig). This will require a lower supply option to a base FS number, which may be further limited in the case of alloy constructions.

Sizing Procedure

1. Locate the appropriate tables for the desired actuator type. The tables are appropriate for the balanced or unbalanced valve body designs listed above.

2. Enter the table for the given port diameter and travel.

3. For all designs, find the yoke boss diameter that matches the yoke boss on the given valve body.

4. Begin with the smallest actuator size listed in the actuator size column, and read from left to right to find an actuator construction that will allow the required pressure drop. Proceed to larger actuator sizes or to a greater air supply pressure as necessary.

5. To order the actuator, specify the construction details in Fisher FIRST 2.

Balanced and Unbalanced Valves

Style	Valve	ANSI Shutoff Class
Balanced	ED and EWD (CL125 thru 2500)	Class II
	ET and EWT (CL125 thru 2500)	Class IV—metal seats Class V—PTFE seats
Unbalanced	D ES and EWS EZ	Class IV

Major topics covered in Section A are:

Actuator Selection **Page**

Maximum Allowable Pressure Drops (ΔP)

Travel, Inch	Yoke Boss Size, Inch	Actuator Size	50 ΔP, Psi	60 ΔP, Psi	80 ΔP, Psi	100 ΔP, Psi
1 Inch Port						
1.125	3-9/16	60	2925	3562	4834	6000
1.5 Inch Port						
1.125	3-9/16	60	1262	1544	2108	2673
2 Inch Port						
1.125	3-9/16	60	691	850	1168	1486
2.3125 Inch Port						
1.125	3-9/16	60	507	626	864	1102
2.5 Inch Port						
1.5	3-9/16	60 68	429 731	531 894	734 - - -	938 - - -
2.875 Inch Port						
1.5	3-9/16	60 68	317 546	394 669	548 - - -	702 - - -
3 Inch Port						
1.5	3-9/16	60 68	289 499	360 612	501 - - -	642 - - -
3.4375 Inch Port						
1.5	3-9/16	60 68	214 374	267 460	375 - - -	483 - - -
4 Inch Port						
1.5	3-9/16	60 68	152 270	192 334	271 - - -	357 - - -
2	3-9/16	60 68	152 270	192 334	271 - - -	357 - - -
2	5	80(1) 100(2) 130(2)	268 417 743	332 511 902	458 697 - - -	585 884 - - -
4.375 Inch Port						
2	3-9/16	60 68	124 223	157 276	224 - - -	290 - - -
2	5	80(1) 100(2) 130(2)	221 346 618	274 424 751	380 580 - - -	486 736 - - -

Air to Cylinder, Psig: 50, 60, 80, 100

1. 1-inch stem.
2. 1-1/4 inch stem.

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Maximum Allowable Pressure Drops (ΔP)

5.375 Inch Port						
Air to Cylinder, Psig			**50**	**60**	**80**	**100**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
2	3-9/16	60	48	70	114	158
		68	114	149	219	289
2 and 3	5	80[1]	114	149	219	289
		100[2]	197	249	352	456
		130[2]	378	465	641	817
6 Inch Port						
2	3-9/16	60	31	49	83	118
		68	83	110	---	---
	5	80[1]	82	110	165	220
		100[2]	147	188	269	351
		130[2]	289	358	---	---
7 Inch Port						
2	3-9/16	60	17	30	56	82
		68	55	76	117	158
	5	80[1]	55	75	117	158
		100[2]	103	134	195	256
		130[2]	210	261	---	---
8 Inch Port						
2	3-9/16	60	8	18	38	57
		68	37	53	---	---
	5	80[1]	37	53	84	116
		100[2]	74	97	144	191
		130[2]	155	195	---	---

1. 1-inch stem.
2. 1-1/4 inch stem.

Maximum Allowable Pressure Drops (ΔP)

2.875 Inch Port (ED, Class II Leakage)						
Air to Cylinder, Psig			50	60	80	100
Travel Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
1.5	3-9/16	60 80	6000 6000	6000 6000	6000 - - -	6000 - - -
2.875 Inch Port (ET, Class IV Leakage)						
1.5	3-9/16	60 80	6000 6000	6000 6000	6000 - - -	6000 - - -
3.4375 Inch Port (ED, Class II Leakage)						
1.5	3-9/16	60 68	5516 6000	6000 6000	6000 - - -	6000 - - -
3.4375 Inch Port (ET, Class IV Leakage)						
1.5	3-9/16	60 68	4976 6000	6000 6000	6000 - - -	6000 - - -
4.375 Inch Port (ED, Class II Leakage)						
2	3-9/16	60 68	4211 6000	5190 6000	6000 - - -	6000 - - -
	5	80(1) 100(2) 130(2)	6000 6000 6000	6000 6000 6000	6000 6000 - - -	6000 6000 - - -
4.375 Inch Port (ET, Class IV Leakage)						
2	3-9/16	60 68	3672 6000	4652 6000	6000 - - -	6000 - - -
	5	80(1) 100(2) 130(2)	6000 6000 6000	6000 6000 6000	6000 6000 - - -	6000 6000 - - -
4.375 Inch Port (ET, Class V Leakage) Soft Seat Only						
2	3-9/16	60	1440	1440	1440	1440
5.375 Inch Port (ED, Class II Leakage)						
2	3-9/16	60 68	3349 5706	4142 6000	5727 6000	7313 6000
2 and 3	5	80(1) 100(2) 130(2)	5706 6000 6000	6000 6000 6000	6000 6000 6000	6000 6000 6000
5.375 Inch Port (ET, Class IV Leakage)						
2	3-9/16	60 68	1740 4097	2533 5362	4119 6000	5704 6000
2 and 3	5	80(1) 100(2) 130(2)	4097 6000 6000	5362 6000 6000	6000 6000 6000	6000 6000 6000

1. 1-inch stem.
2. 1-1/4 inch stem.

Maximum Allowable Pressure Drops (ΔP)

5.375 Inch Port (ET, Class V Leakage) Soft Seat Only						
Air to Cylinder			50	60	80	100
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	3-9/16	60	1440	1440	1440	1440
2 and 3	5	80(1)	1440	1440	1440	1440
7 Inch Port (ED, Class II Leakage)						
2	3-9/16	60 68	2447 4280	3064 5264	4297 - - -	5530 - - -
	5	80(1) 100(2) 130(2)	4250 6000 6000	5233 6000 6000	6000 6000 - - -	6000 6000 - - -
7 Inch Port (ET, Class IV Leakage)						
2	3-9/16	60 68	817 2651	1434 3634	2667 - - -	3901 - - -
	5	80(1) 100(2) 130(2)	2620 4929 6000	3603 6000 6000	5570 6000 - - -	6000 6000 - - -
7 Inch Port (ET, Class V Leakage) Soft Seat Only						
2	5	60	1440	1440	1440	1440
8 Inch Port (ED, Class II Leakage)						
2	3-9/16	60 68	2232 3959	2813 4885	3974 - - -	5136 - - -
	5	80(1) 100(2) 130(2)	3930 6000 6000	4856 6000 6000	6000 6000 - - -	6000 6000 - - -
8 Inch Port (ET, Class IV Leakage)						
2	3-9/16	60 68	479 2206	1060 3132	2222 - - -	3383 - - -
	5	80(1) 100(2) 130(2)	2177 4351 6000	3103 5717 6000	4955 6000 - - -	6000 6000 - - -
8 Inch Port (ET, Class V Leakage) Soft Seat Only						
2	3-9/16	60	1440	1440	1440	1440

1. 1-inch stem.
2. 1-1/4 inch stem.

Maximum Allowable Pressure Drops (∆P)

0.25 Inch Port								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	∆P, Psi	∆P, Psi	∆P, Psi	∆P, Psi	∆P, Psi	∆P, Psi
0.75	2-1/8	30, 30i	1410	5165(2)	6000(3)	1410	5165	6000
		34, 34i	2818	6000(2)	6000(3)	2818	6000	6000
	2-13/16	40, 40i	2563	6000(2)	6000(3)	2563	6000	6000
		45, 45i	4767	6000	6000	4767	6000	6000
	3-9/16	50, 50i	4257	6000	6000	4257	6000	6000
		60, 60i	6000	6000	6000	6000	6000	6000
0.375 Inch Port								
0.75	2-1/8	30, 30i	485	2158(2)	2995(3)	485	2158	3831
		34, 34i	1113	3622(2)	4876(3)	1113	3622	6000
	2-13/16	40, 40i	999	3508(2)	4763(3)	999	3508	6000
		45, 45i	1981	4845	6000	1981	5799	6000
	3-9/16	50, 50i	1754	4617	6000	1754	5572	6000
		60, 60i	3145	6000	6000	3145	6000	6000
0.5 Inch Port								
0.75	2-1/8	30, 30i	192	1131(2)	1600(3)	192	1131	2070
		34, 34i	544	1952(2)	2656(3)	544	1952	3360
	2-13/16	40, 40i	480	1888(2)	2592(3)	480	1888	3297
		45, 45i	1031	2638	3710	1031	3174	5317
	3-9/16	50, 50i	904	2511	3582	904	3047	5189
		60, 60i	1684	4702	5664	1684	4868	6000

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3 - 11 psig range.
3. 3 - 9 psig range.

Maximum Allowable Pressure Drops (ΔP)

0.75 Inch Port								
Air to Diaphragm, Psig			**0-18**(1)			**0-33**(1)		
Bench Set, Psig			**3-15**	**3-12**	**3-10**	**6-30**	**6-26**	**6-22**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
0.75	2-1/8	30, 30i	14	431(2)	640(3)	14	431	848
		34, 34i	170	796(2)	1109(3)	170	796	1422
	2-13/16	40, 40i	142	768(2)	1081(3)	142	768	1394
		45, 45i	387	1101	1577	387	1339	2292
	3-9/16	50, 50i	330	1044	1521	330	1283	2235
		60, 60i	677	1738	2446	677	2092	3507
1 Inch Port								
0.75	2-1/8	30, 30i	- - -	202(2)	261(3)	- - -	202	437
		34, 34i	56	408(2)	495(3)	56	408	759
	2-13/16	40, 40i	40	392(2)	479(3)	40	392	743
		45, 45i	178	579	846	178	713	1248
	3-9/16	50, 50i	146	547	815	146	681	1216
		60, 60i	341	937	1334	341	1136	1930
1.125	2-13/16	40, 40i	40	392	479	40	392	743
		45, 45i	178	579	846	178	713	1248
1.25 Inch Port								
0.75	2-1/8	30, 30i	- - -	104(2)	178(3)	- - -	104	253
		34, 34i	10	234(2)	347(3)	10	234	459
	2-13/16	40, 40i	- - -	168(2)	280(3)	- - -	224	449
		45, 45i	88	344	514	88	429	771
	3-9/16	50, 50i	67	323	494	67	409	750
		60, 60i	192	572	826	192	699	1206

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range
3. 3-9 psig range

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Maximum Allowable Pressure Drops (ΔP)

1.3125 Inch Port								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30, 30i	- - -	89(2)	157(3)	- - -	89	225
		34, 34i	4	208(2)	310(3)	4	208	412
	2-13/16	40, 40i	- - -	148(2)	250(3)	- - -	199	403
		45, 45i	74	308	463	74	385	696
	3-9/16	50, 50i	56	289	445	56	367	678
		60, 60i	169	516	747	169	631	1093
1.5 Inch Port								
0.75	2-1/8	30, 30i	- - -	54(2)	106(3)	- - -	54	158
		34, 34i	- - -	145(2)	224(3)	- - -	145	302
	2-13/16	40, 40i	- - -	138(2)	216(3)	- - -	138	295
		45, 45i	43	221	340	43	280	518
	3-9/16	50, 50i	29	207	326	29	266	504
		60, 60i	116	380	556	116	468	821
1.125	2-13/16	40, 40i	- - -	99	177	- - -	138	333(4)
		45, 45i	43	221	340	43	281	518
1.875 Inch Port								
0.75	2-1/8	30, 30i	- - -	18(2)	51(3)	- - -	18	84
		34, 34i	- - -	76(2)	126(3)	- - -	76	176
	2-13/16	40, 40i	- - -	71(2)	121(3)	- - -	71	171
		45, 45i	10	124	200	10	162	315
	3-9/16	50, 50i	1	115	191	1	153	306
		60, 60i	57	226	339	57	283	509

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range
3. 3-9 psig range
4. 6-21 psig range

Maximum Allowable Pressure Drops (ΔP)

2 Inch Port								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30, 30i	- - -	10(2)	40(3)	- - -	10	69
		34, 34i	- - -	62(2)	106(3)	- - -	62	150
	2-13/16	40, 40i	- - -	57(2)	102(3)	- - -	57	146
		45, 45i	4	104	171	4	138	272
	3-9/16	50, 50i	- - -	96	163	- - -	130	264
		60, 60i	45	194	293	45	243	442
1.125	2-13/16	40, 40i	- - -	36	79	- - -	57	167(4)
		45, 45i	4	104	171	4	138	272
2.3125 Inch Port								
1.125	2-13/16	40, 40i	- - -	17	50	- - -	34	123(4)
		45, 45i	- - -	69	119	- - -	94	194
2.5 Inch Port								
1.5	2-13/16	40, 40i	- - -	24(2)	52(3)	- - -	24	- - -
		45, 45i	- - -	54	97	- - -	75	161
	3-9/16	50, 50i	- - -	49	91	- - -	70	156
		60, 60i	16	111	206(3)	16	143	270
		70, 70i	55	189	- - -	55	- - -	413
2.875 Inch Port								
1.5	2-13/16	40, 40i	- - -	11(2)	32(3)	- - -	11	- - -
		45, 45i	- - -	33	66	- - -	49	114
	3-9/16	50, 50i	- - -	29	62	- - -	46	110
		60, 60i	5	77	125	5	101	197
		70, 70i	34	136	- - -	34	- - -	305

1. The pressure drops as shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig.
3. 3-9 psig range.
4. 6-21 psig range.

Maximum Allowable Pressure Drops (ΔP)

3 Inch Port								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
1.5	2-13/16	40, 40i	- - -	8(2)	27(3)	- - -	8	- - -
		45, 45i	- - -	28	58	- - -	43	103
	3-9/16	50. 50i	- - -	25	55	- - -	40	99
		60, 60i	2	68	134(3)	2	90	178
		70, 70i	29	122	- - -	29	- - -	278
3.4375 Inch Port								
1.5	2-13/16	40, 40i	- - -	- - -	15(3)	- - -	- - -	- - -
		45, 45i	- - -	16	38	- - -	27	72
	3-9/16	50, 50i	- - -	13	35	- - -	24	69
		60, 60i	- - -	46	96(3)	- - -	63	130
		70, 70i	16	87	- - -	16	- - -	206
4 Inch Port								
1.5	3-9/16	50, 50i	- - -	4	20	- - -	12	46
		60, 60i	- - -	28	65(3)	- - -	41	90
		70, 70i	6	59	- - -	6	- - -	146
2	2-13/16	45, 45i	- - -	6	31(3)	- - -	14	47
	3-9/16	50, 50i	- - -	4	29(3)	- - -	12	45
		60, 60i	- - -	40(2)	65(3)	- - -	40	90
		70, 70i	6	- - -	94	6	76	146
	5	87	4	- - -	92	4	74	144
		80	19	- - -	132	19	- - -	200

1. The pressure drops as shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig.
3. 3-9 psig range.

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Maximum Allowable Pressure Drops (ΔP)

4.375 Inch Port								
Air to Diaphragm, Psig			**0-18(1)**			**0-33(1)**		
Bench Set, Psig			**3-15**	**3-12**	**3-10**	**6-30**	**6-26**	**6-22**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
2	2-13/16	45, 45i	- - -	2	16	- - -	9	37
	3-9/16	50, 50i	- - -	- - -	21(3)	- - -	7	35
		60, 60i	- - -	31(2)	51(3)	- - -	31	72
		70, 70i	2	- - -	75	2	61	119
	5	87	- - -	- - -	73	- - -	59	117
		80	13	- - -	107	13	- - -	164
5.375 Inch Port								
2	3-9/16	60, 60i	- - -	- - -	- - -	- - -	- - -	14
		70, 70i	- - -	- - -	16	- - -	6	45
	5	87	- - -	- - -	16	- - -	6	45
		80	- - -	- - -	38	- - -	- - -	76
3	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	45
	5	87	- - -	- - -	- - -	- - -	- - -	45
		80	- - -	- - -	- - -	- - -	22	- - -
6 Inch Port								
2	3-9/16	60, 60i	- - -	- - -	- - -	- - -	- - -	4
		70, 70i	- - -	- - -	6	- - -	- - -	29
	5	87	- - -	- - -	5	- - -	- - -	28
		80	- - -	- - -	23	- - -	- - -	52
7 Inch Port								
2	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	15
	5	87	- - -	- - -	- - -	- - -	- - -	14
		80	- - -	- - -	10	- - -	- - -	32
8 Inch Port								
2	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	6
	5	87	- - -	- - -	- - -	- - -	- - -	6
		80	- - -	- - -	3	- - -	- - -	20

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)

1.3125 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30, 30i	113	1263(2)	1838(3)	113	1263	2413
		34, 34i	544	2269(2)	3132(3)	544	2269	3994
	2-13/16	40, 40i	466	2191(2)	3054(3)	466	2191	3916
		45, 45i	1141	3110	4423	1141	3766	6000
	3-9/16	50, 50i	985	2954	4266	985	3610	6000
		60, 60i	1941	4866	6000	1941	5841	6000
1.3125 Inch Port (ET, Class IV Leakage)								
0.75	2-1/8	30, 30i	- - -	748(2)	1323(3)	- - -	748	1898
		34, 34i	29	1754(2)	2617(3)	29	1754	3479
	2-13/16	40, 40i	- - -	1676(2)	2539(3)	- - -	1676	3401
		45, 45i	626	2595	3908	626	3251	5876
	3-9/16	50, 50i	470	2439	3751	470	3095	5720
		60, 60i	1426	4351	6000	1426	5326	6000
1.3125 Inch Port (ET, Class V Leakage) Soft Seat Only								
0.75	2-1/8	30, 30i	- - -	750(2)	1184(3)	- - -	750	1440
		34, 34i	207	1440(2)	1440(3)	207	1440	1440
	2-13/16	40, 40i	- - -	1440(2)	1440(3)	- - -	1440	1440
	3-9/16	50, 50i	542	1440	1440	542	1440	1440

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.

Maximum Allowable Pressure Drops (ΔP)

1.875 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30, 30i	- - -	758[2]	1176[3]	- - -	758	1594
		34, 34i	235	1490[2]	2117[3]	235	1490	2744
	2-13/16	40, 40i	178	1433[2]	2060[3]	178	1433	2687
		45, 45i	669	2101	3055	669	2578	4487
	3-9/16	50, 50i	555	1987	2942	555	2465	4374
		60, 60i	1251	3378	4796	1251	4087	6000
1.875 Inch Port (ET, Class IV Leakage)								
0.75	2-1/8	30, 30i	- - -	222[2]	640[3]	- - -	222	1059
		34, 34i	- - -	954[2]	1581[3]	- - -	954	2209
	2-13/16	40, 40i	- - -	897[2]	1525[3]	- - -	897	2152
		45, 45i	134	1565	2520	134	2043	3952
	3-9/16	50, 50i	20	1452	2406	20	1929	3838
		60, 60i	715	2843	4261	715	3552	6000
1.875 Inch Port (ET, Class V Leakage) Soft Seat Only								
0.75	2-1/8	30, 30i	- - -	361[2]	673[3]	- - -	361	986
		34, 34i	- - -	908[2]	1378[3]	- - -	908	1440
	2-13/16	40, 40i	- - -	867[2]	1337[3]	- - -	867	1440
		45, 45i	296	1367	1440	296	1440	1440
	3-9/16	50, 50i	211	1282	1440	211	1440	1440

1. The pressure drops as shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig.
3. 3-9 psig range.

Maximum Allowable Pressure Drops (ΔP)

Travel, Inch	Yoke Boss Size, Inch	Actuator Size	3-15	3-12	3-10	6-30	6-26	6-22
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
			ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2.3125 Inch Port (ED, Class II Leakage)								
1.125	2-13/16	40, 40i	43	810	1321	43	1066	2343(4)
		45, 45i	444	1610	2388	444	1999	3555
2.3125 Inch Port (ET, Class IV Leakage)								
1.125	2-13/16	40, 40i	- - -	273	784	- - -	528	1805(4)
		45, 45i	- - -	1073	1850	- - -	1461	3017
2.3125 Inch Port (ET, Class V Leakage) Soft Seat Only								
1.125	2-13/16	40, 40i	- - -	402	784	- - -	593	1548(4)
		45, 45i	127	1000	1440	127	1291	1440
2.875 Inch Port (ED, Class II Leakage)								
1.5	2-13/16	40, 40i	- - -	742(2)	1148(3)	- - -	742	- - -
		45, 45i	248	1175	1792	248	1484	2719
	3-9/16	50, 50i	175	1101	1719	175	1410	2645
		60, 60i	625	2001	3378(3)	625	2460	4295
		70, 70i	1189	3131	- - -	1189	- - -	6000
2.875 Inch Port (ET, Class IV Leakage)								
1.5	2-13/16	40, 40i	- - -	211(2)	617(3)	- - -	211	- - -
		45, 45i	- - -	643	1261	- - -	952	2187
	3-9/16	50, 50i	- - -	570	1188	- - -	878	2114
		60, 60i	94	1470	2846(3)	94	1929	3764
		70, 70i	658	2599	- - -	658	- - -	5835
2.875 Inch Port (ET, Class V Leakage) Soft Seat Only								
1.5	2-13/16	40, 40i	- - -	355(2)	659(3)	- - -	355	- - -
		45, 45i	- - -	678	1141	- - -	910	1440
	3-9/16	50, 50i	- - -	623	1086	- - -	855	1440
		60, 60i	267	1297	1440(3)	267	1440	1440

1. The pressure drops as shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig.
3. 3-9 psig range.
4. 6-21 psig range.

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EMERSON Process Management

Maximum Allowable Pressure Drops (ΔP)

3.4375 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
1.5	2-13/16	40, 40i	- - -	542(2)	887(3)	- - -	542	- - -
		45, 45i	122	910	1435	122	1172	2222
	3-9/16	50, 50i	60	847	1372	60	1110	2160
		60, 60i	505	1612	2782(3)	505	2002	3562
		70, 70i	922	2572	- - -	922	- - -	5322
3.4375 Inch Port (ET, Class IV Leakage)								
1.5	2-13/16	40, 40i	- - -	- - -	347(3)	- - -	- - -	- - -
		45, 45i	- - -	370	895	- - -	632	1682
	3-9/16	50, 50i	- - -	307	832	- - -	570	1620
		60, 60i	- - -	1072	2242(3)	- - -	1462	3022
		70, 70i	382	2032	- - -	382	- - -	4782
3.4375 Inch Port (ET, Class V Leakage) Soft Seat Only								
1.5	2-13/16	40, 40i	- - -	201(2)	459(3)	- - -	201	- - -
		45, 45i	- - -	475	868	- - -	672	1440
	3-9/16	50, 50i	- - -	429	821	- - -	625	1408
		60, 60i	127	1000	1440(3)	127	1291	1440

1. The pressure drops shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. A positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)

4.375 Inch Port (ET, Class II Leakage)								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	2-13/16	45, 45i	- - -	598	1216(3)	- - -	804	1628
	3-9/16	50, 50i	- - -	549	1167(3)	- - -	755	1579
		60, 60i	232	1455(2)	2067(3)	232	1455	2679
		70, 70i	608	- - -	2765	608	2334	4059
	5	87	559	- - -	2716	559	2285	4010
		80	936	- - -	3720	936	3163	- - -
4.375 Inch Port (ET, Class IV Leakage)								
2	2-13/16	45, 45i	- - -	60	677(3)	- - -	265	1089
	3-9/16	50, 50i	- - -	11	628(3)	- - -	216	1040
		60, 60i	- - -	916(2)	1528(3)	- - -	916	2140
		70, 70i	69	- - -	2226	69	1795	3520
	5	87	20	- - -	2177	20	1746	3471
		80	397	- - -	3181	397	2624	- - -
4.375 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	2-13/16	45, 45i	- - -	243	705(3)	- - -	397	1013
	3-9/16	50, 50i	- - -	207	669(3)	- - -	361	977
		60, 60i	- - -	884(2)	1342(3)	- - -	884	1799
		70, 70i	251	- - -	1440	251	1440	1440
	5	87	214	- - -	1440	214	1440	1440

1. The pressure drops shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. A positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.

Maximum Allowable Pressure Drops (ΔP)

5.375 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			**0-18[1]**			**0-33[1]**		
Bench Set, Psig			**3-15**	**3-12**	**3-10**	**6-30**	**6-26**	**6-22**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
2	3-9/16	50, 50i	- - -	384	884[3]	- - -	551	1218
		60, 60i	127	1118[2]	1613[3]	127	1118	2108
		70, 70i	432	- - -	2178	432	1829	3226
	5	87	432	- - -	2178	432	1829	3226
		80	737	- - -	2991	737	- - -	4343
3	3-9/16	70, 70i	432	- - -	- - -	432	- - -	3226
	5	87	432	- - -	- - -	432	- - -	3226
		80	684	- - -	- - -	684	2418	- - -
5.375 Inch Port (ET, Class IV Leakage)								
2	3-9/16	60, 60i	- - -	- - -	4[3]	- - -	- - -	500
		70, 70i	- - -	- - -	570	- - -	220	1617
	5	87	- - -	- - -	570	- - -	220	1617
		80	- - -	- - -	1382	- - -	- - -	2735
3	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	1617
	5	87	- - -	- - -	- - -	- - -	- - -	1617
		80	- - -	- - -	- - -	- - -	809	- - -
5.375 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	3-9/16	50, 50i	- - -	56	430[3]	- - -	180	679
		60, 60i	- - -	605[2]	975[3]	- - -	604	1345
		70, 70i	91	- - -	1398	91	1136	1440
	5	87	62	- - -	1368	62	1106	1440
		80	382	- - -	1440	382	- - -	1440
3	3-9/16	70, 70i	91	- - -	- - -	91	- - -	1440
	5	87	62	- - -	- - -	62	- - -	1440
		80	382	- - -	- - -	382	1440	- - -

1. The pressure drops shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. A positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)

7-Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	2-13/16	45, 45i	- - -	173	562[3]	- - -	302	821
	3-9/16	50, 50i	- - -	142	531[3]	- - -	272	790
		60, 60i	- - -	712[2]	1098[3]	- - -	712	1483
		70, 70i	179	- - -	1537	179	1265	2352
	5	87	148	- - -	1506	148	1235	2321
		80	385	- - -	2138	385	- - -	3190
7-Inch Port (ET, Class IV Leakage)								
2	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	722
	5	87	- - -	- - -	- - -	- - -	- - -	691
		80	- - -	- - -	509	- - -	- - -	1560
7-Inch Port (ET, Class V Leakage) Soft Seat Only								
2	2-13/16	45, 45i	- - -	- - -	215[3]	- - -	22	409
	3-9/16	50, 50i	- - -	- - -	192[3]	- - -	- - -	386
		60, 60i	- - -	328[2]	615[3]	- - -	328	902
		70, 70i	- - -	- - -	943	- - -	740	1440
	5	87	- - -	- - -	920	- - -	717	1440
		80	156	- - -	1440	156	- - -	1440

1. The pressure drops shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. A positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.

Maximum Allowable Pressure Drops (∆P)

8 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	3-12	3-10	6-30	6-26	6-22
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	∆P, Psi	∆P, Psi	∆P, Psi	∆P, Psi	∆P, Psi	∆P, Psi
2	2-13/16	45, 45i	- - -	90	456[3]	- - -	212	700
	3-9/16	50, 50i	- - -	61	427[3]	- - -	183	671
		60, 60i	- - -	598[2]	961[3]	- - -	598	1324
		70, 70i	96	- - -	1119[2]	352[5]	1119	2398[7]
	5	87	67	- - -	1090[2]	323[5]	1090	2369[7]
		80	290	- - -	1941	290	- - -	2932
3	3-9/16	70, 70i	96	- - -	- - -	352[5]	- - -	1887[6]
	5	87	67	- - -	- - -	323[5]	- - -	1857[6]
		80	252	- - -	- - -	252	1521	- - -
8 Inch Port (ET, Class IV Leakage)								
2	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	645[7]
	5	87	- - -	- - -	- - -	- - -	- - -	616[7]
		80	- - -	- - -	188	- - -	- - -	1179
3	3-9/16	70, 70i	- - -	- - -	- - -	- - -	- - -	133[6]
	5	87	- - -	- - -	- - -	- - -	- - -	104[6]
		80	- - -	- - -	- - -	- - -	- - -	- - -
8 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	2-13/16	45, 45i	- - -	- - -	133[3]	- - -	- - -	313
	3-9/16	50, 50i	- - -	- - -	111[3]	- - -	- - -	291
		60, 60i	- - -	237[2]	504[3]	- - -	237	771
		70, 70i	- - -	- - -	621[2]	56[5]	621	1440[7]
	5	87	- - -	- - -	599[2]	34[5]	599	1440[7]
		80	10	- - -	1226	10	- - -	1440
3	3-9/16	70, 70i	- - -	- - -	- - -	56[5]	- - -	1186[6]
	5	87	- - -	- - -	- - -	34[5]	- - -	1164[6]
		80	- - -	- - -	- - -	- - -	917	- - -

1. The pressure drops shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. A positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 3-11 psig range.
3. 3-9 psig range.
4. 3-4 psig range.
5. 6-29 psig range.
6. 6-23 psig range.
7. 6-21 psig range.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)

0.25 Inch Port								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set. Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30/30i	1414	5169(2)	6000(3)	4230	6000	6000
		34/34i	2822	6000(2)	6000(3)	6000	6000	6000
	2-13/16	40/40i	2567	6000(2)	6000(3)	6000	6000	6000
		45/45i	4771	6000	6000	6000	6000	6000
	3-9/16	50	4261	6000	6000	6000	6000	6000
		60	6000	6000	6000	6000	6000	6000
0.375 Inch Port								
0.75	2-1/8	30/30i	485	2157(2)	2994(3)	1739	3412	5085
		34/34i	1112	3621(2)	4875(3)	2994	5503	6000
	2-13/16	40/40i	998	3507(2)	4762(3)	2880	5389	6000
		45/45i	1980	4844	6000	4844	6000	6000
	3-9/16	50	1753	4616	6000	4616	6000	6000
		60	3144	6000	6000	6000	6000	6000
0.5 Inch Port								
0.75	2-1/8	30/30i	192	1131(2)	1600(3)	896	1836	2774
		34/34i	544	1952(2)	2656(3)	1600	1835	4416
	2-13/16	40/40i	480	1888(2)	2592(3)	1536	2945	4353
		45/45i	1031	2638	3710	2638	4781	6000
	3-9/16	50	904	2511	3582	2511	4654	6000
		60	1684	4072	5664	4072	6000	6000

1. The pressure drops shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. A positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7-15 psig range.
3. 9-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

0.75 Inch Port								
Air to Diaphragm, Psig			**0-18**(1)			**0-33**(1)		
Bench Set, Psig			**3-15**	**6-15**	**8-15**	**6-30**	**10-30**	**14-30**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
0.75	2-1/8	30/30i	13	431(2)	639(3)	326	744	1161
		34/34i	170	796(2)	1109(3)	639	1265	1891
	2-13/16	40/40i	142	767(2)	1080(3)	611	1237	1863
		45/45i	386	1101	1577	1101	2053	3006
	3-9/16	50	330	1044	1520	1044	1996	2949
		60	677	1738	2445	1738	3153	4568
1 Inch Port								
0.75	2-1/8	30/30i	- - -	202(2)	319(3)	143	378	612
		34/34i	56	407(2)	583(3)	319	671	1022
	2-13/16	40/40i	40	391(2)	567(3)	303	655	1006
		45/45i	177	578	846	578	1113	1649
	3-9/16	50	145	547	814	547	1082	1617
		60	340	936	1334	936	1731	2526
1.125	2-13/16	40/40i	40	303	479	303	671	- - -
		45/45i	177	578	846	578	1113	1649
1.25 Inch Port								
0.75	2-1/8	30/30i	- - -	103(2)	178(3)	66	215	365
		34/34i	10	234(2)	346(3)	178	402	627
	2-13/16	40/40i	- - -	224(2)	336(3)	168	392	617
		45/45i	87	343	514	343	685	1026
	3-9/16	50	67	323	494	323	665	1006
		60	191	572	825	572	1079	1586

1. The pressure drops sown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7-15 psig range.
3. 9-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

1.3125 Inch Port								
Air to Diaphragm, Psig			**0-18(1)**			**0-33(1)**		
Bench Set, Psig			**3-15**	**6-15**	**8-15**	**6-30**	**10-30**	**14-30**
Travel, Inch	**Yoke Boss Size, Inch**	**Actator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
0.75	2-1/8	30/30i	- - -	88(2)	156(3)	54	190	327
		34/34i	3	208(2)	310(3)	156	361	565
	2-13/16	40/40i	- - -	198(2)	300(3)	147	352	556
		45/45i	74	307	463	307	618	929
	3-9/16	50	55	289	444	289	600	911
		60	169	515	746	515	977	1440
1.5 Inch Port								
0.75	2-1/8	30/30i	- - -	54(2)	106(3)	28	132	236
		34/34i	- - -	144(2)	223(3)	106	262	418
	2-13/16	40/40i	- - -	138(2)	216(3)	99	255	411
		45/45i	43	221	340	221	459	696
	3-9/16	50	29	207	326	207	444	682
		60	116	380	556	380	733	1085
1.125	2-13/16	40/40i	- - -	99	177	99	255	- - -
		45/45i	43	221	340	221	459	696

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7-15 psig range.
3. 9-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

1.875 Inch Port								
Air to Diaphragm, Psig			**0-18(1)**			**0-33(1)**		
Bench Set, Psig			**3-15**	**6-15**	**8-15**	**6-30**	**10-30**	**14-30**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
0.75	2-1/8	30/30i	- - -	18(2)	51(3)	1	68	135
		34/34i	- - -	76(2)	126(3)	51	151	251
	2-13/16	40/40i	- - -	71(2)	121(3)	46	146	246
		45/45i	10	124	200	124	277	429
	3-9/16	50	1	115	191	115	268	420
		60	57	226	339	226	452	678
2 Inch Port								
0.75	2-1/8	30/30i	- - -	10(2)	40(3)	- - -	54	113
		34/34i	- - -	61(2)	105(3)	40	127	215
	2-13/16	40/40i	- - -	58(2)	101(3)	36	123	211
		45/45i	4	104	171	104	238	372
	3-9/16	50	- - -	96	163	96	230	364
		60	45	194	293	194	393	591
1.125	2-13/16	40/40i	- - -	36	79	36	123	- - -
		45/45i	4	104	171	104	238	372
2.3125 Inch Port								
1.125	2-13/16	40/40i	- - -	17	50	17	83	- - -
		45/45i	- - -	63	113	63	163	263
2.5 Inch Port								
1.5	2-13/16	40/40i	- - -	24(2)	- - -	10	- - -	- - -
		45/45i	- - -	54	97	54	139	225
	3-9/16	50	- - -	49	91	49	134	220
		60	16	111	- - -	111	238	- - -
		70	55	189	- - -	189	- - -	548

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7 - 15 psig range.
3. 9 - 15 psig range.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)

2.875 Inch Port								
Air to Diaphragm, Psig			**0-18[1]**			**0-33[1]**		
Bench Set, Psig			**3-15**	**6-15**	**8-15**	**6-30**	**10-30**	**14-30**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
1.5	2-13/16	40/40i	- - -	11[2]	- - -	- - -	- - -	- - -
		45/45i	- - -	33	66	33	98	163
	3-9/16	50	- - -	29	62	29	94	159
		60	5	77	- - -	77	173	- - -
		70	34	136	- - -	136	- - -	407
3 Inch Port								
1.5	2-13/16	40/40i	- - -	7[2]	- - -	- - -	- - -	- - -
		45/45i	- - -	28	58	28	88	147
	3-9/16	50	- - -	25	54	25	84	144
		60	2	68	- - -	68	156	- - -
		70	29	122	- - -	122	- - -	371
3.4375 Inch Port								
1.5	2-13/16	45/45i	- - -	16	38	16	61	106
	3-9/16	50	- - -	13	35	13	58	103
		60	- - -	46	- - -	46	113	- - -
		70	16	87	- - -	87	- - -	227
4 Inch Port								
1.5	3-9/16	50	- - -	4	20	4	37	71
		60	- - -	28	- - -	28	78	- - -
		70	6	59	- - -	59	- - -	199
2	2-13/16	45/45i	- - -	6	- - -	6	39	- - -
	3-9/16	50	- - -	4	- - -	4	37	- - -
		70	6	- - -	94	59	129	199
	5	87	4	- - -	92	57	127	197
		80	19	- - -	132	87	- - -	268

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

4.375 Inch Port								
Air to Diaphragm, Psig			**0-18(1)**			**0-33(1)**		
Bench Set, Psig			**3-15**	**6-15**	**8-15**	**6-30**	**10-30**	**14-30**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
2	2-13/16	45/45i	- - -	2	- - -	2	30	- - -
	3-9/16	50	- - -	- - -	- - -	- - -	28	- - -
		70	2	- - -	75	46	104	163
	5	87	- - -	- - -	73	44	103	161
		80	13	- - -	108	70	- - -	221
5.375 Inch Port								
2	3-9/16	70	- - -	- - -	16	- - -	35	74
	5	87	- - -	- - -	16	- - -	35	74
		80	- - -	- - -	48	20	- - -	130
3	5	80	- - -	- - -	- - -	20	- - -	- - -
6 Inch Port								
2	3-9/16	70	- - -	- - -	6	- - -	21	52
	5	87	- - -	- - -	5	- - -	20	51
		80	- - -	- - -	23	3	- - -	82
7 Inch Port								
2	3-9/16	70	- - -	- - -	- - -	- - -	9	32
	5	87	- - -	- - -	- - -	- - -	8	31
		80	- - -	- - -	10	- - -	- - -	55
8 Inch Port								
2	3-9/16	70	- - -	- - -	- - -	- - -	2	19
	5	87	- - -	- - -	- - -	- - -	1	19
		80	- - -	- - -	3	- - -	- - -	37

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)

1.3125 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30/30i	113	1263(2)	1838(3)	976	2126	3276
		34/34i	544	2269(2)	3132(3)	1838	3563	5288
	2-13/16	40/40i	466	2191(2)	3054(3)	1760	3485	5210
		45/45i	1141	3110	4423	3110	5735	6000
	3-9/16	50	985	2954	4266	2954	5579	6000
		60	1941	4866	6000	4866	6000	6000
1.3125 Inch Port (ET, Class IV Leakage)								
0.75	2-1/8	30/30i	- - -	748(2)	1323(3)	461	1611	2761
		34/34i	29	1754(2)	2617(3)	1323	3048	4773
	2-13/16	40/40i	- - -	1767(2)	2539(3)	1245	2970	4695
		45/45i	626	2595	3908	2595	5220	6000
	3-9/16	50	470	2439	3751	2439	5064	6000
		60	1426	4351	6000	4351	6000	6000
1.3125 Inch Port (ET, Class V Leakage) Soft Seat Only								
0.75	2-1/8	30/30i	- - -	750(2)	1184(3)	533	1401	1440
		34/34i	207	1440(2)	1440(3)	1184	1440	1440
	2-13/16	40/40i	151	1440(2)	1440(3)	1127	1440	1440
	3-9/16	50	542	1440	1440	1440	1440	1440

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7-15 psig range.
3. 9-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

1.875 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
0.75	2-1/8	30/30i	- - -	758[2]	1176[3]	549	1385	2221
		34/34i	235	1490[2]	2117[3]	1176	2430	3685
	2-13/16	40/40i	178	1433[2]	2060[3]	1119	2374	3628
		45/45i	669	2101	3055	2101	4010	5919
	3-9/16	50	555	1987	2942	1987	3896	5805
		60	1251	3378	4796	3378	6000	6000
1.875 Inch Port (ET, Class IV Leakage)								
0.75	2-1/8	30/30i	- - -	222[2]	640[3]	18	850	1686
		34/34i	- - -	954[2]	1581[3]	640	1895	3150
	2-13/16	40/40i	- - -	897[2]	1525[3]	584	1838	3093
		45/45i	134	1565	2520	1565	3475	5384
	3-9/16	50	28	1452	2406	1452	3361	5220
		60	715	2843	4261	2843	5679	6000
1.875 Inch Port (ET, Class V Leakage) Soft Seat Only								
0.75	2-1/8	30/30i	- - -	360[2]	673[3]	204	830	1440
		34/34i	- - -	908[2]	1377[3]	673	1440	1440
	2-13/16	40/40i	- - -	867[2]	1337[3]	633	1440	1440
		45/45i	295	1367	1440	1367	1440	1440
	3-9/16	50	211	1282	1440	1282	1440	1440

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate extended range.
2. 7-15 psig range.
3. 9-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

2.3125 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
1.125	2-13/16	40/40i	44	810	1321	810	1833	- - -
		45/45i	444	1610	2388	1610	3166	4721
2.3125 Inch Port (ET, Class IV Leakage)								
1.125	2-13/16	40/40i	- - -	273	784	273	1295	- - -
		45/45i	- - -	1073	1850	1073	2628	4184
2.3125 Inch Port (ET, Class V Leakage) Soft Seal Only								
1.125	2-13/16	40/40i	- - -	402	784	402	1166	- - -
		45/45i	127	1000	1440	1000	1440	1440
2.875 Inch Port (ED, Class II Leakage)								
1.5	2-13/16	40/40i	- - -	742[2]	- - -	539	- - -	- - -
		45/45i	248	1175	1792	1175	2410	3645
	3-9/16	50	175	1101	1719	1101	2336	3572
		60	625	2001	- - -	2001	3836	- - -
		70	1189	3131	- - -	3131	- - -	6000
2.875 Inch Port (ET, Class IV Leakage)								
1.5	2-13/16	40/40i	- - -	211[2]	- - -	8	- - -	- - -
		45/45i	- - -	644	1261	644	1879	3114
	3-9/16	50	- - -	570	1188	570	1805	3041
		60	94	1470	- - -	1470	3305	- - -
		70	658	2599	- - -	2599	- - -	6000
2.875 Inch Port (ET, Class V Leakage) Soft Seal Only								
1.5	2-13/16	40/40i	- - -	355[2]	- - -	202	- - -	- - -
		45/45i	- - -	678	1141	678	1440	1440
	3-9/16	50	- - -	623	1086	623	1440	1440
		60	266	1297	- - -	1297	1440	- - -
		70	689	1440	- - -	1440	- - -	1440

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate extended range.
2. 7-15 psig range.
3. 9-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

3.4375 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			**0-18(1)**			**0-33(1)**		
Bench Set, Psig			**3-15**	**6-15**	**8-15**	**6-30**	**10-30**	**14-30**
Travel, Inch	**Yoke Boss Size, Inch**	**Actuator Size**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**	**ΔP, Psi**
1.5	2-13/16	40/40i	- - -	370(2)	- - -	370	- - -	- - -
		45/45i	122	910	1435	910	1960	3010
	3-9/16	50	60	847	1372	847	1897	2947
		60	442	1612	- - -	1612	3172	- - -
		70	922	2572	- - -	2572	- - -	6000
3.4375 Inch Port (ET, Class IV Leakage)								
1.5	2-13/16	40/40i	- - -	- - -	- - -	- - -	- - -	- - -
		45/45i	- - -	370	865	370	1420	2470
	3-9/16	50	- - -	307	832	307	1357	2407
		60	- - -	1072	- - -	1072	2632	- - -
		70	382	2032	- - -	2032	- - -	6000
3.4375 Inch Port (ET, Class V Leakage) Soft Seat Only								
1.5	2-13/16	40/40i	- - -	201(2)	- - -	72	- - -	- - -
		45/45i	- - -	475	868	475	1259	1440
	3-9/16	50	- - -	429	821	429	1213	1440
		60	127	1000	- - -	1000	1440	- - -
		70	485	1440	- - -	1440	- - -	1440

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 7-15 psig range.

Maximum Allowable Pressure Drops (ΔP)

4.375 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	2-13/16	45/45i	- - -	598	- - -	598	1422	- - -
	3-9/16	50	- - -	549	- - -	549	1373	- - -
		60	231	- - -	- - -	1149	- - -	- - -
		70	608	- - -	2765	1902	3628	5353
	5	87	559	- - -	2716	1853	3579	5304
		80	936	- - -	3720	2606	- - -	6000
4.375 Inch Port (ET, Class IV Leakage)								
2	2-13/16	45/45i	- - -	60	- - -	60	883	- - -
	3-9/16	50	- - -	10	- - -	10	834	- - -
		60	- - -	- - -	- - -	610	- - -	- - -
		70	69	- - -	2226	1364	3089	4815
	5	87	20	- - -	2177	1315	3040	4765
		80	397	- - -	3181	2067	- - -	6000
4.375 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	2-13/16	45/45i	- - -	243	- - -	243	859	- - -
	3-9/16	50	- - -	207	- - -	207	823	- - -
		60	- - -	- - -	- - -	655	- - -	- - -
		70	250	- - -	1440	1218	1440	1440
	5	87	214	- - -	1440	1182	1440	1440

1. The pressure drops shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Maximum Allowable Pressure Drops (ΔP)

5.375 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	3-9/16	50	- - -	384	- - -	384	1051	- - -
		60	127	- - -	- - -	870	- - -	- - -
		70	432	- - -	2178	1480	2876	4273
	5	87	432	- - -	2178	1480	2876	4273
		80	861	- - -	3320	2337	- - -	6000
3	3-9/16	70	432	- - -	- - -	1480	- - -	- - -
	5	87	432	- - -	- - -	1480	- - -	- - -
		80	861	- - -	- - -	2337	- - -	- - -
5.375 Inch Port (ET, Class IV Leakage)								
2	3-9/16	70	- - -	- - -	570	- - -	1268	2665
	5	87	- - -	- - -	570	- - -	1268	2665
		80	- - -	- - -	1712	728	- - -	4665
3	5	80	- - -	- - -	- - -	728	- - -	- - -
5.375 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	3-9/16	50	- - -	56	- - -	56	555	- - -
		60	- - -	- - -	- - -	419	- - -	- - -
		70	91	- - -	1398	875	1440	1440
	5	87	62	- - -	1368	845	1440	1440
		80	382	- - -	1440	1440	- - -	1440
3	3-9/16	70	91	- - -	- - -	875	- - -	- - -
	5	87	62	- - -	- - -	845	- - -	- - -
		80	382	- - -	- - -	1440	- - -	- - -

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

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Maximum Allowable Pressure Drops (ΔP)

7 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18[1]			0-33[1]		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	2-13/16	45/45i	- - -	173	- - -	173	691	- - -
	3-9/16	50	- - -	142	- - -	142	660	- - -
		70	179	- - -	1537	994	2080	3167
	5	87	148	- - -	1506	963	2049	3136
		80	385	- - -	2138	1437	- - -	4242
7 Inch Port (ET, Class IV Leakage)								
2	2-13/16	45/45i	- - -	- - -	- - -	- - -	- - -	- - -
	3-9/16	50	- - -	- - -	- - -	- - -	- - -	- - -
		70	- - -	- - -	- - -	- - -	451	1537
	5	87	- - -	- - -	- - -	- - -	420	1506
		80	- - -	- - -	509	- - -	- - -	2612
7 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	2-13/16	45/45i	- - -	- - -	- - -	- - -	312	- - -
	3-9/16	50	- - -	- - -	- - -	- - -	289	- - -
		70	- - -	- - -	943	538	1348	1440
	5	87	- - -	- - -	920	515	1325	1440
		80	155	- - -	1440	1012	- - -	1440

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Maximum Allowable Pressure Drops (ΔP)

8 Inch Port (ED, Class II Leakage)								
Air to Diaphragm, Psig			0-18(1)			0-33(1)		
Bench Set, Psig			3-15	6-15	8-15	6-30	10-30	14-30
Travel, Inch	Yoke Boss Size, Inch	Actuator Size	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi	ΔP, Psi
2	3-9/16	76	- - -	- - -	- - -	- - -	961(2)	1868
		70	96	- - -	1375	863	1887	2910
	5	87	67	- - -	1346	834	1857	2881
		80	402	- - -	2239	1504	2974	4443
3	3-9/16	70	96	- - -	- - -	863	- - -	2910(3)
	5	87	67	- - -	- - -	834	- - -	2881(3)
		80	402	- - -	- - -	1504	2606(4)	- - -
8 Inch Port (ET, Class IV Leakage)								
2	3-9/16	76	- - -	- - -	- - -	- - -	- - -	115
		70	- - -	- - -	- - -	- - -	133	1157
	5	87	- - -	- - -	- - -	- - -	104	1127
		80	- - -	- - -	486	- - -	1220	2690
3	3-9/16	70	- - -	- - -	- - -	- - -	- - -	1157(3)
	5	87	- - -	- - -	- - -	- - -	- - -	1128(3)
		80	- - -	- - -	- - -	- - -	853(4)	- - -
8 Inch Port (ET, Class V Leakage) Soft Seat Only								
2	3-9/16	76	- - -	- - -	- - -	- - -	504(2)	1172
		70	96	- - -	621	432	1886	1440
	5	87	- - -	- - -	788	411	1164	1440
		80	92	- - -	1440	904	1440	1440
3	3-9/16	70	- - -	- - -	- - -	432	- - -	1440(3)
	5	87	- - -	- - -	- - -	411	- - -	1440(3)
		80	92	- - -	- - -	904	1440(4)	- - -

1. The pressure drops shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 9-30 psig range.
3. 14-26 psig range for 667-4 without handjack.
4. 9-29 psig range.

Table of Contents

Introduction

The information provided in this section enables the user to determine the force requirements of a sliding-stem valve and match this force to an available actuator. Additional sliding-stem actuator sizing information using only the valve pressure drop as a base can be found in section A of this catalog.

The table of contents provides page number references to specific information for sizing the various valve body and actuator constructions. The major subsections of this section enable the user to:

1. Determine valve body force requirements under given service conditions.

2. Match the valve body force requirements with an appropriate actuator from the actuator tables, in which most constructions are covered, and

3. Perform calculations to select an actuator for other specific conditions, such as reverse flow direction or non-standard travel.

Figures and tables within each division provide data as needed for each step in the actuator sizing procedure. In addition, the actuator selection division includes necessary ordering information.

The sample calculations illustrate fully, and provide a rationale for, the actuator sizing techniques. This third major division clarifies the techniques used and presents a sizing method which can be applied to those non-standard conditions or applications (for example, a non-standard travel requirement) that cannot be picked directly from the actuator tables.

Basic Valve Body Force Requirements

The force required to operate a control valve must include:

A. Force to overcome static unbalance of the valve plug

B. Force to provide seat load

C. Force to overcome packing friction

D. Additional forces required for certain specific applications or constructions.

Total force required = A + B + C + D

Calculate the forces which must be included in the base equation from each of the following four major sections.

A. Force to Overcome Static Unbalance

(1) Use table 1 to determine if the valve construction is balanced or unbalanced. (The trim parts in a balanced design minimize the net fluid flow forces creating static unbalance, making possible the selection of a smaller actuator.)

Table 1. Balanced and Unbalanced Valves

Balanced Valves	Unbalanced Valves
CAV4 CHPD & CHPT EAD & EAT ED & EDR EHD & EDT ET, ETR, & ET-C EWD, EWT, & EWT-C EWND & EWNT HPD, HPT, & HPT-C	461 D & DA EHS ES EWS EZ & EZ-C HPS HPS-C

(2) Use figures 1 and 2 to determine if the valve is a pressure-tends-to-open or pressure-tends-to-close construction.

(3) Use the applicable equation below to calculate the force required to overcome static unbalance. The terms used in the equations are:

Force A = Force to overcome static unbalance, lb
P_1 = Upstream pressure, psig
P_2 = Downstream pressure, psig
A_{port} = Port area, inch^2 (from table 2, 2A, or 2C)
A_{stem} = Stem area, inch^2 (from table 4)
A_{unb} = Unbalance area, inch^2 (from table 2)

Pressure-Tends-To-Open

Unbalanced Valve Plug

- Flow up (PDTC)

Force A = $[(P_1 - P_2)\,A_{port} + P_2\,A_{stem}]$

- Flow down (PDTO)

Force A = $[(P_1 - P_2)\,A_{port} - P_1\,A_{stem}]$

Balanced Valve Plug

- Flow down (PDTC)

Force A = $[(P_1 - P_2)\,A_{unb} + P_2\,A_{stem}]$

- Flow up (PDTO)

Force A = $[(P_1 - P_2)\,A_{unb} - P_2\,A_{stem}]$

Figure 1. Pressure-Tends-To-Open

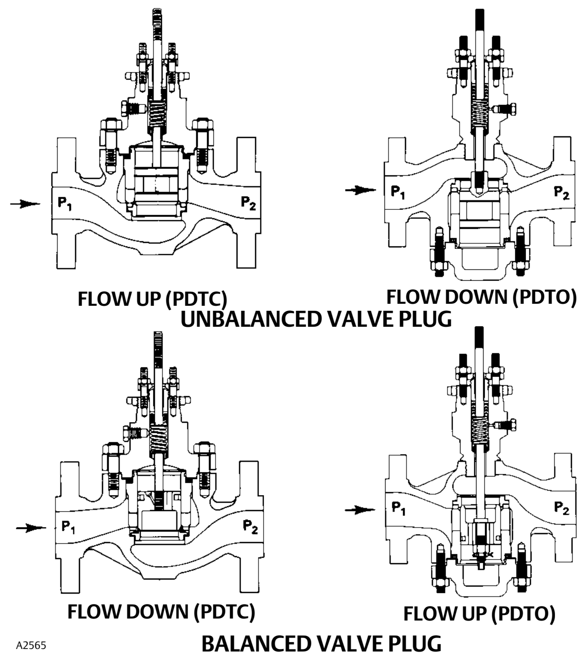
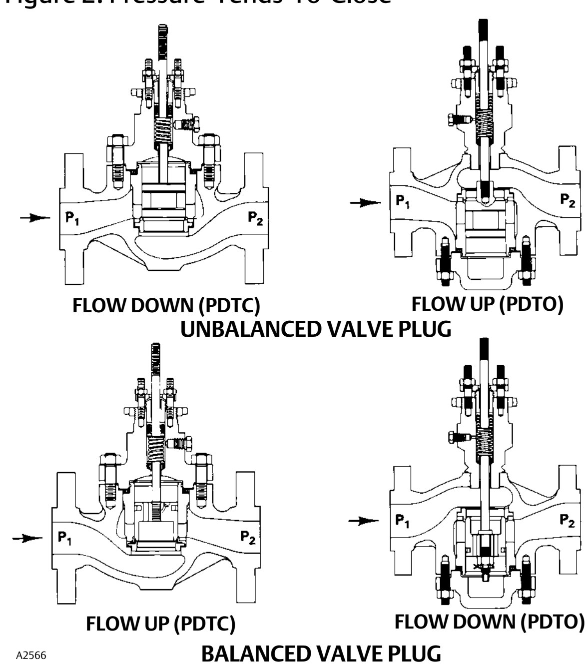


Figure 2. Pressure-Tends-To-Close



Pressure-Tends-To-Close

Note

Since pressure tends to close the valve in these constructions, a negative sign has been placed in front of the brackets of these equations. This indicates that pressure is assisting, rather than opposing the actuator in closing the valve.

Because the A value is negative, while B, C, and D are positive, the force required to close the valve will be smaller than for pressure-tends-to-open constructions.

However, when calculating the force required to open the valve, A, C, and D all oppose the actuator. Since seat loading is not considered when opening the valve, B is now zero.

For this reason, the total force required (equation on page B-1) must be calculated for both opening and closing the valve. For all but the Fisher® 585C actuators, the larger of these force requirements is then used to size the actuator. For 585C actuators, both the opening and closing forces are used in the sizing procedure.

To calculate the closing force, solve the equation given on page B-1 using the A value as determined by the appropriate equation below. To calculate the opening force, drop the negative sign from the A value determined below, and add C and D.

Unbalanced Valve Plug

- Flow down (PDTC)

$$\text{Force A} = -[(P_1 - P_2)\,A_{port} - P_1\,A_{stem}]$$

- Flow up (PDTO)

$$\text{Force A} = -[(P_1 - P_2)\,A_{port} + P_2\,A_{stem}]$$

Balanced Valve Plug

- Flow up (PDTC)

$$\text{Force A} = -[(P_1 - P_2)\,A_{unb} - P_1\,A_{stem}]$$

- Flow down (PDTO)

$$\text{Force A} = -[(P_1 - P_2)\,A_{unb} + P_1\,A_{stem}]$$

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Table 2. Port Data for Single-Port Valves (See Separate Tables for Fisher EH and HP Valves; See Bulletin 51.1:FB for Fisher FB Valves)

Port Diameter (Inches)	Port Circumference, (Inches)	Port Area (Sq. Inches)	Unbalance Area(1) (Balanced Plug), Sq. Inches
0.1875	0.59	0.028	---
0.25	0.78	0.049	---
0.375	1.18	0.110	---
0.5	1.57	0.196	---
0.625	1.96	0.307	---
0.75	2.36	0.441	---
0.875	2.75	0.601	---
1	3.14	0.785	---
1.125	3.53	0.994	---
1.25	3.93	1.23	---
1.3125	4.12	1.35	0.04 (ET Class V Shutoff—Metal Seats) 0.16 (ED, EDR, ET, ETR)
1.375	4.32	1.48	---
1.5	4.71	1.77	0.17 (CAV4)
1.625	5.11	2.07	---
1.75	5.50	2.41	---
1.875	5.89	2.76	0.062 (ET Class V Shutoff—Metal Seats) 0.22 (ED, EDR, ET, ETR)
2	6.28	3.14	---
2.3125	7.26	4.20	0.27 (ED, EDR, ET, ETR, EWD, EWT) 0.074 (ET, EWT Class V Shutoff—Metal Seats)
2.5	7.85	4.91	---
2.75	8.64	5.94	0.32 (CAV4 Seal Ring Construction)
2.875	9.03	6.49	0.098 (ET, EWT Class V Shutoff—Metal Seats) 0.17(2) (C-seal trim, high-temperature, Class V Shutoff) 0.34 (ED, EDR, ET, ETR)
3	9.42	7.07	---
3.25	10.2	8.30	---
3.4375	10.8	9.28	0.118 (ET, EWT Class V Shutoff or ET-C—Metal Seats) 0.21(2) (C-seal trim, high-temperature, Class V Shutoff) 0.40 (ED, EDR, ET, ETR)

1. Unbalance area is the annular area between the cage inside diameter and the seat line. It does not include the stem area. See the following footnote.
2. Unbalance area for the C-seal trim is the annular area between the upper seat diameter and the lower seat diameter.

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Table 2. Port Data for Single-Port Valves (See Separate Tables for Fisher EH and HP Valves; See Bulletin 51.1:FB for Fisher FB Valves) (continued)

Port Diameter (Inches)	Port Circumference, (Inches)	Port Area (Sq. Inches)	Unbalance Area[1] (Balanced Plug), Sq. Inches
3.5 3.625	11.0 11.39	9.62 10.32	--- 0.21[2] (C-seal trim, high-temperature, Class V Shutoff)
4	12.57	12.57	---
4.375	13.74	15.03	0.154 (ET, EWT Class V Shutoff, ET-C, EWT-C — Metal Seats) 0.25[2] (C-seal trim, high-temperature, Class V Shutoff) 0.51 (CAV4, ED, EDR, ET, ETR, EWD, EWT)
4.9375 5	15.5 15.7	19.15 19.64	--- ---
5.375	16.89	22.69	0.63 (ED, ET, EWND, EWNT) 0.206 (CHPD, CHPT, ET, EWT Class V Shutoff, ET-C, EWT-C — Metal Seats) 0.37 (CHPD-Bore Seal) 0.37[2] (C-seal trim, high-temperature, Class V Shutoff)
6 6.75	18.85 21.21	28.3 35.78	--- 3.79 (EWND, EWNT)
7	22.0	38.48	0.30 (ET, EWT Class V Shutoff, ET-C, EWT-C — Metal Seats) 0.47[2] (C-seal trim, high-temperature, Class V Shutoff) 0.81 (ED, ET, ETR, EWD, EWT)
7.75	24.35	47.17	4.33 (EWND, EWNT)
8	25.13	50.24	0.35 (ET, EWT Class V Shutoff, ET-C, EWT-C — Metal Seats) 0.60[2] (C-seal trim, high-temperature, Class V Shutoff) 0.86 (ED, ET, ETR, EWD, EWT)
9.5	29.83	70.85	1.62 ED-J, ET-J except Cavitrol III 0.57 ET-J Cavitrol III
10 10.125 11.00 14.75	31.42 31.81 34.56 46.43	78.5 80.5 95.0 170.9	0.57 (ET and ED Whisper Trim™ III Level D) 1.24 (EWND, EWNT) 0.49 1.87 (ED-J, ET-J except Cavitrol III) 0.66 (ET-J Cavitrol III) 0.65 2.51 (ED-J, ET-J except Cavitrol III) 0.89 (ET-J Cavitrol III)
16.25 18.25 19.75 24 26	51.05 57.33 62.05 75.40 81.68	207.5 261.6 306.6 452.4 530.9	0.72 (ET/EWT Whisper Trim III Level A, B, and C) 0.81 0.87 (ET/EWT Whisper Trim III Level A, B, and C) 0.96 1.02 (ET Whisper Trim III Levels A, B, and C)

1. Unbalance area is the annular area between the cage inside diameter and the seat line. It does not include the stem area. See footnote 2 here for definition of unbalance area of C-seal trim.
2. Unbalance area for the C-seal trim is the annular area between the upper seat diameter and the lower seat diameter.

Table 2A. Port Data for Fisher D Valves

Port Diameter (Inches)	Seat Radius (Inches)	Plug Angle (Degrees)	Shutoff Diameter (Inches)	Unbalance Area (Inches^2)		
				Port	Shutoff	% Difference
0.25	1/4	60	0.317	0.049	0.079	161%
0.375	1/4	60	0.442	0.110	0.153	139%
0.5	1/4	60	0.567	0.196	0.252	129%
0.75	1/4	60	0.817	0.442	0.524	119%
1	1/4	60	1.067	0.785	0.894	114%
1.25	1/4	60	1.317	1.227	1.362	111%

Table 2B. Additional Port Data for Fisher D Valves

PORT DIAMETER		STANDARD TRIM				VTC (CERAMIC)			
		Circumference		Area		Circumference		Area	
mm	Inches	mm	Inches	mm^2	$Inches^2$	mm	Inches	mm^2	$Inches^2$
6.4	0.25	25.29	0.996	50.91	0.0789	19.95	0.785	31.67	0.0491
9.5	0.38	35.27	1.389	98.99	0.1534	29.92	1.178	71.26	0.1104
12.7	0.50	45.24	1.781	162.9	0.2525	39.90	1.571	126.7	0.1963
19.1	0.75	65.19	2.567	338.2	0.5242	59.85	2.356	285.0	0.4418
25.4	1.00	85.14	3.352	576.9	0.8941	79.80	3.142	506.7	0.7854
31.8	1.25	105.09	4.137	878.9	1.3622	99.75	3.927	791.7	1.2272

Table 2C. Port Data for Fisher EH & HP Valves

Port Diameter (Inches)	Port Circumference, (Inches)	Port Area (Sq. Inches)	Unbalance Area(1) (Balanced Plug), Sq. Inches
0.25	0.78	0.049	---
0.375	1.18	0.110	---
0.5	1.57	0.196	---
0.625	1.96	0.307	---
0.75	2.36	0.441	---
0.875	2.75	0.601	---
1	3.14	0.785	---
1.25	3.93	1.23	0.02 (EHT, HPT)
1.5	4.71	1.77	0.051 (EHD, EHT)
1.875	5.89	2.76	0.062 (EHD, EHT, HPD, HPT)
2.3125	7.26	4.20	0.074 (EHD, EHT)
2.875	9.03	6.49	0.17(2) (High-temperature C-seal trim with Class V Shutoff) 0.098 (EHD, EHT, HPD, HPT)
3.25	10.2	8.30	---
3.4375	10.8	9.28	0.21(2) (High-temperature C-seal trim with Class V Shutoff)
3.625	11.39	10.32	0.128 (EHD, EHT, HPD, HPT, HPT-C) 0.21(2) (High-temperature C-seal trim with Class V Shutoff)
4.375	13.74	15.03	0.154 (EHD, EHT, HPD, HPT) 0.25(2) (High-temperature C-seal trim with Class V Shutoff)
4.9375	15.5	19.15	---
5.375	16.89	22.69	0.206 (EHD, EHT, HPD, HPT, HPT-C) 0.37(2) (High-temperature Bore Seal trim with Class V Shutoff)
7	22.0	38.48	0.30 (EHD, EHT) 0.47(2) (High-temperature Bore Seal trim with Class V Shutoff)
8	25.13	50.24	0.60(2) (High-temperature Bore Seal trim with Class V Shutoff)
10	31.42	78.5	0.540 (EHD, EHT)

1. Unbalance area is the annular area between the cage inside diameter and the seat line. It does not include the stem area. See footnote 2 here for definition of unbalance area of C-seal trim.
2. Unbalance area for the C-seal trim is the annular area between the upper seat diameter and the lower seat diameter.

Table 2D. Port Data for Fisher ET and EWT Valves with Cavitrol™ III One-Stage Trim

VALVE RATING AND DESIGN	VALVE SIZE, NPS	PORT DIAMETER[1]		UNBALANCE AREA		PORT CIRCUMFERENCE	
		mm	Inch	cm^2	$Inch^2$	mm	Inch
CL125 through 600 ET	1	33.3	1.3125	0.13	0.02	104.6	4.12
	1-1/2	47.6	1.875	0.20	0.031	149.6	5.89
	2	58.7	2.3125	0.25	0.038	184.4	7.26
	2-1/2	73.0	2.875	0.30	0.047	229.4	9.03
	3	87.3	3.4375	0.36	0.056	274.3	10.80
	4	111.1	4.375	0.50	0.077	349.0	13.74
	6	177.8	7	0.84	0.13	558.5	21.99
	8	203.2	8	0.97	0.15	638.3	25.13
CL600 EWT	4x2	58.7	2.3125	0.25	0.038	184.4	7.26
	6x4 or 8x4	111.1	4.375	0.50	0.077	349.0	13.74
	8x6 or 12x6	177.8	7	0.84	0.13	558.5	21.99
	10x8 or 12x8	203.2	8	0.97	0.15	638.3	25.13
CL150 through 600 ET	12	279	11	1.24	0.49	877.8	34.56
	14	279	11	1.24	0.49	877.8	34.56
	16	375	14.75	1.65	0.65	1177.0	46.34
	18	375	14.75	1.65	0.65	1177.0	46.34
	20	464	18.25	5.29	0.81	1456.3	57.33
	30	- - -	- - -	- - -	- - -	- - -	- - -
CL150 through 600 EWT	16x12	279	11	1.24	0.49	877.8	34.56
	20x16	375	14.75	1.65	0.65	1177.0	46.34
	24x16	375	14.75	1.65	0.65	1177.0	46.34
	24x20	464	18.25	5.29	0.81	1456.3	57.33

1. Same as ET or EWT port diameter. Also listed in valve bulletin.

Table 2E. Port Data for Fisher ET, EWT, EHT, HPAS, HPAT, HPS, HPT with Cavitrol III 2-Stage and 2-Stage DST Trim

VALVE BODY RATING AND DESIGN	VALVE SIZE, NPS	PORT DIAMETER		UNBALANCE AREA		PORT CIRCUMFERENCE	
		mm	Inch	cm	Inch	mm	Inch
CL600 ET	1	25.4	1	0.13	0.02	79.8	3.14
	1-1/2	33.3	1.3125	0.13	0.02	104.6	4.12
	2	47.6	1.875	0.20	0.031	149.6	5.89
	2-1/2	58.7	2.3125	0.25	0.038	184.4	7.26
	3	73.0	2.875	0.30	0.047	229.4	9.03
	4	73.0	2.875	0.30	0.047	229.4	9.03
	6	136.5	5.375	0.65	0.10	429.0	16.89
	8	177.8	7	0.84	0.13	558.5	21.99
CL600(1, 3) EWT	4 x 2	47.6	1.875	0.20	0.031	149.6	5.89
	6 x 4	73.0	2.875	0.30	0.047	229.4	9.03
	8 x 4	73.0	2.875	0.30	0.047	229.4	9.03
	8 x 6	136.5	5.375	0.65	0.10	429.0	16.89
	12 x 6	136.5	5.375	0.65	0.10	429.0	16.89
	12 x 8	177.8	7	0.84	0.13	558.5	21.99
CL2500 EHT	3, 4 x 3	47.6	1.875	0.20	0.031	149.6	5.89
	4, 6 x 4	73.0	2.875	0.30	0.047	229.4	9.03
	6, 8 x 6	111.1	4.375	0.50	0.077	349.0	13.74
CL900 and 1500 HPAS and HPAT(2)	1	22.2	0.875	3.88	0.601	69.9	2.75
	2, 3	44.5	1.75	0.19	0.029	139.7	5.50
	4	63.5	2.500	0.26	0.041	199.4	7.85
	6	87.3	3.438	0.31	0.056	274.3	10.80
	8	113.4	5.250	0.59	0.092	418.9	16.49
CL900 and 1500 HPS and HPT(2)	1	22.2	0.875	3.88	0.601	69.9	2.75
	2	44.5	1.75	0.19	0.029	139.7	5.50
	3	63.5	2.5	0.26	0.041	199.4	7.85
	4	87.3	3.4375	0.31	0.056	274.3	10.80
	6	133.4	5.25	0.59	0.092	418.9	16.49

1. Values for CL900 NPS 8 x 6 and 12 x 8 EWT available in two-stage trim same as CL600 NPS 8 x 6 and 12 x 8 EWT.
2. Cavitrol III trim in the CL1500 and 2500, NPS 1, two-stage and in the NPS 2, three-stage valve uses unbalanced valve plugs. These sizes and constructions are Fisher HPS/HPAS valves; other valves in this section of the table are HPT/HPAT valves.
3. For larger sizes, consult your Emerson Automation Solutions sales office.

Table 2F. Port Data for Fisher EHT, HPAS, HPAT, HPS, HPT with Cavitrol III 3-Stage and 3-Stage DST Trim

VALVE BODY RATING AND DESIGN	VALVE SIZE, NPS	PORT DIAMETER		UNBALANCE AREA		PORT CIRCUMFERENCE	
		mm	Inch	cm	Inch	mm	Inch
CL2500 EHT	3, 4 x 3	33.3	1.3125	0.13	0.02	104.6	4.12
	4, 6 x 4	58.7	2.3125	0.25	0.038	184.4	7.26
	6, 8 x 6	111.1	4.375	0.50	0.077	349.0	13.74
CL900 and 1500 HPAS and HPAT(1)	2	25.4	1	5.06	0.785	79.8	3.14
	4	47.6	1.875	0.20	0.031	149.6	5.89
	6	73.0	2.875	0.30	0.047	229.4	9.03
	8	115.9	4.5625	0.52	0.080	364.0	14.33
CL900 and 1500 HPS and HPT(1)	2	25.4	1	5.06	0.785	79.8	3.14
	3	47.6	1.875	0.20	0.031	149.6	5.89
	4	73.0	2.875	0.30	0.047	229.4	9.03
	6	115.9	4.5625	0.52	0.080	364.0	14.33

1. Cavitrol III trim in the CL1500 and 2500, NPS 1, two-stage and in the NPS 2, three-stage valve uses unbalanced valve plugs. These sizes and constructions are Fisher HPS/HPAS valves; other valves in this section of the table are HPT/HPAT valves.

Table 2G. Port Data for Fisher EHT, HPT Valves with Protected Inside Seat with Cavitrol III 2-Stage and 3-Stage Trim

CAVITROL III STAGE	PRESSURE RATING	VALVE SIZE	PORT DIAMETER				UNBALANCE AREA		PORT CIRCUMFERENCE	
			Standard Seat		Inside Seat					
Number		NPS	mm	Inch	mm	Inch	cm^2	$Inch^2$	mm	Inch
2	CL900 and 1500	2	44.5	1.75	29.5	1.16	5.38	0.834	92.5	3.64
		3	63.5	2.5	48.5	1.91	7.77	1.205	152.4	6.00
		4	87.3	3.438	72.4	2.85	10.76	1.668	227.3	8.95
		6	133.4	5.25	118.4	4.66	16.54	2.563	371.9	14.64
	CL2500	3, 4x3	47.6	1.875	32.5	1.28	5.78	0.896	102.1	4.02
		4, 6x4	73.0	2.875	57.9	2.28	8.97	1.390	181.9	7.16
		6, 8x6	111.1	4.375	96.0	3.78	13.75	2.131	301.8	11.88
3	CL900 and 1500	3	47.6	1.875	32.5	1.28	5.78	0.896	102.1	4.02
		4	73.0	2.875	57.9	2.28	8.97	1.390	181.9	7.16
		6	115.9	4.562	100.8	3.97	14.34	2.223	316.7	12.47
	CL2500	3, 4x3	33.3	1.312	18.3	0.72	3.99	0.618	57.4	2.26
		4, 6x4	58.7	2.312	43.7	1.72	7.17	1.112	137.2	5.40
		6, 8x6	111.1	4.375	96.0	3.78	13.75	2.131	301.8	11.88

Table 2H. Port Data for Fisher NotchFlo™ DST Valves

VALVE BODY RATING AND DESIGN	VALVE SIZE, NPS	PORT DIAMETER		UNBALANCE AREA		PORT CIRCUMFERENCE	
		mm	Inch	cm^2	$Inch^2$	mm	Inch
CL600 3-Stage	1(2)	25.4	1.00	0.1	0.02	79.8	3.14
	2(2)	38.1	1.50	0.3	0.05	119.7	4.71
	3(2)	55.6	2.19	0.5	0.07	174.7	6.88
	4(2)	73.2	2.88	0.4	0.06	230.0	9.05
	6(2)	111.1	4.38	0.5	0.08	349.0	13.76
	8(2)	136.5	5.38	0.6	0.09	428.8	16.90
CL900/CL1500 4-Stage	1(1)	17.8	0.70	2.5	0.39	55.9	2.20
	1-1/2(1)	25.4	1.00	5.1	0.79	79.8	3.14
	2(2)	38.1	1.50	0.3	0.05	119.7	4.71
	3(2)	55.6	2.19	0.5	0.07	174.7	6.88
	4(2)	73.2	2.88	0.4	0.06	230.0	9.05
	6(2)	111.1	4.38	0.6	0.09	349.0	13.76
	8(2)	136.5	5.38	0.6	0.10	428.8	16.90
CL2500 6-Stage	1(1)	17.8	0.70	2.5	0.39	55.9	2.20
	2(2)	38.1	1.50	0.3	0.05	119.7	4.71
	3(2)	55.6	2.19	0.5	0.07	174.7	6.88
	4(2)	73.2	2.88	0.4	0.06	230.0	9.05
	6(2)	111.1	4.38	0.6	0.09	349.0	13.76

1. Unbalanced trim, PTTO (pressure tends to open).
2. Balanced trim, PTTC (pressure tends to close).

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Table 3. Valve Stem Area

Valve Stem Diameter		Area	
mm	Inches	mm^2	$Inches^2$
7.9	5/16	51.6	0.08
9.5	3/8	71	0.11
12.7	1/2	129	0.20
19	3/4	284	0.44
25.4	1	510	0.79
32	1-1/4	794	1.23
38	1-1/2	1142	1.77
51	2	2026	3.14
70	2-3/4	3832	5.94

B. Force to Provide Seat Load

Seat load is usually expressed as a force applied to the seat to provide sufficient load to meet the required shutoff classification. This force is calculated by using a factor multiplied by the lineal port circumference as defined by the shutoff requirements.

Use the following guidelines to determine the seat load required to meet the factory acceptance tests for ANSI/FCI 70-2 and IEC 60534-4 leak classes II through VI. *Because of differences in the severity of service conditions, do not construe these leak classifications and corresponding leakage rates as indicators of field performance. Also, shutoff performance does not fall under Emerson Process Management warranty terms.*

To prolong seat life and shutoff capabilities, Emerson Process Management suggests the use of a higher than recommended seat load. See table 4 for suggested seat loads. If tight shutoff is not a prime consideration, use a lower leak class. Please note that high seat loads may cause valve stem load issues. See page B-99 for calculations to determine acceptable stem loads to prevent buckling. Changes in stem size may impact valve body and actuator construction.

Standard and Optional Leakage Classes with corresponding minimum seat load requirements for Fisher Sliding-Stem Valves

The following tables indicate the leak classes provided with the various Fisher designs in accordance with ANSI/FCI 70-2 (IEC 60534-4). Optional leak classes indicated can be provided for an extra charge. The optional TSO (Tight Shutoff) leakage class (flow down only) uses ANSI/FCI 70-2 water test methods, with an Emerson Process Management defined acceptance criteria. See Section 2 of Catalog 12 for additional information on these ANSI/FCI 70-2 leak classes.

For recommended seat loads, please see the following chart and match the construction being used with the appropriate seat load equation. Note that class V shutoff can be achieved using the standard class V equation from the seat load equation column. Testing has shown that Class V shutoff life can be significantly extended with the use of 800lbs/lineal inch of port circumference.

Table 4. Leak Class and Seat Loads

TYPE	CONSTRUCTION	Port Size, Inch	LEAK CLASS Standard	Seat load Equation	LEAK CLASS Optional	Seat load Equation
A, AR (double port)	Metal Seat	All	II	20*PC	III	40*PC
Bore Seal or C-Seal	Metal Seat	4.375 or Less	V	(210+0.122ΔPshutoff)*PC	IV	150*PC
	Metal Seat	Greater than 4.375	V	(210+0.122ΔPshutoff)*PC	IV	190*PC
CAV4	Soft Metal-to-Metal Seat	All	V/VI(2)	(100+0.122ΔPshutoff)*PC	IV	(100+.05ΔPshutoff)*PC
Cavitrol™ III 1-stage	Metal to Metal	All	IV	(100+0.05ΔPshutoff)*PC	V	(100+0.122ΔPshutoff)*PC
Cavitrol III 2-stage through 5-stage	Metal to Metal	All	V	(100+0.122ΔPshutoff)*PC	---	---
CHPD	Metal Seat	5.375	II	20*PC	---	---
CHPT	Metal Seat	5.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
D, DA	Metal Seat	All	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
D2T, D3, D4	Metal Seat	All	IV	40*PC	---	---
DST, NotchFlo DST	Metal Seat	All	V	(100+0.122ΔPshutoff)*PC	III(3)	(100+0.122ΔPshutoff)*PC
DST-G	Metal Seat	All	V	(100+0.122ΔPshutoff)*PC	III(3)	(100+0.122ΔPshutoff)*PC
ED, EAD, EWD, EDR	Metal Seat	1.3125-18.25	II	20*PC	III	40*PC
	Metal Seat	4.375 or less	IV	40*PC	---	40*PC
	Metal Seat	Greater than 4.375	IV	80*PC	---	80*PC
ED-J	Metal Seat	All	II	20*PC	III	40*PC
					IV	80*PC
EHAD & EHD	Metal Seat	1.875 or smaller	II	20*PC	---	---
	Metal Seat	2.3125-3.625	II	20*PC	III	40*PC
	Metal Seat	Greater than 4.375	III	40*PC	IV	80*PC
EHAS, EHS EHAT, & EHT	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
ES, EAS, ESR, & EWS	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
	Soft Metal-to-Metal	All	VI	300*PC	---	---
	Composition Seat(1)	All	VI	(A*ΔPshutoff)+B	---	---
ET, EAT, ETR	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
	Soft Metal-to-Metal	All	VI	300*PC	---	---
	Composition Seat(1)	All	V (Air)	(A*ΔPshutoff)+B	VI	(A*ΔPshutoff)+B
ET-C, EWT-C	Soft Metal-to-Metal	4.375 or Less	IV	40*PC	V (Air)	300*PC
	Soft Metal-to-Metal	Greater than 4.375	IV	80*PC	V (Air)	300*PC
	Composition Seat(1)	All	V (Air)	(A*ΔPshutoff)+B	VI	(A*ΔPshutoff)+B
ET-J	Metal Seat	All	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
	Composition (Soft) Seat	All	V	(150+0.122ΔPshutoff)*PC	---	---
EWND	Metal Seat	All	III	40*PC	IV	80*PC
	Metal Seat	10.125	II	20*PC	III	40*PC
EWT, EWNT	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
	Soft Metal-to Metal (EWT only)	8 or less	VI	300*PC	---	---
	Composition Seat(1)	All	V (Air)	(A*ΔPshutoff)+B	---	---
EZ, EHZ, HPZ	Metal Seat	All	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Composition Seat(1)	All	VI	(A*ΔPshutoff)+B	---	---
	Soft Metal-to-Metal Seat	All	VI	300*PC	---	---
EZ-C	Soft Metal-to-Metal Seat	All	IV	40*PC	VI	300*PC
FBD	Metal Seat	All	II	20*PC	---	---
FBT	Metal Seat	All	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
GX	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
	Composition Seat(1)	All	VI	(A*ΔPshutoff)+B	---	---

-continued-

Table 4. Leak Class and Seat Loads (continued)

TYPE	CONSTRUCTION	Port Size, Inch	LEAK CLASS Standard	Seat load Equation	LEAK CLASS Optional	Seat load Equation
HPAD, HPD	Metal Seat	1.875 or smaller	II	20*PC	---	---
	Metal Seat	2.3125 - 3.625	II	20*PC	III	40*PC
	Metal Seat	Greater than 4.375	III	40*PC	IV	80*PC
HPAS, HPAT, HPS, HPT	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
HPT-C, HPS-C	Soft Metal-to-Metal Seat	4.375 or Less	IV	40*PC	V (Air)	300*PC
	Soft Metal-to-Metal Seat	Greater than 4.375	IV	80*PC	V (Air)	300*PC
M-Flat Anti-Cavitation	Metal Seat	All	V	(100+0.122ΔPshutoff)*PC	---	---
Protected Inside Seat	Metal Seat	All	V	800*PC	---	---
RSS	Composition Seat	All	VI	(4)	---	---
TBX	Metal Seat	All	V	(210+0.122ΔPshutoff)*PC	---	---
TSO Trim	TSO	All	TSO	(100+0.122ΔPshutoff)*PC	---	---
Y, YY	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC
	Composition Seat(1)	All	VI	(A*ΔPshutoff)+B	---	---
YD	Low Temp Metal Seat	All	IV	40*PC	---	---
	High Temp Metal Seat	All	II	20*PC	---	---
YS	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	---	---
461	Metal Seat	4.375 or Less	IV	40*PC	V	(100+0.122ΔPshutoff)*PC
	Metal Seat	Greater than 4.375	IV	80*PC	V	(100+0.122ΔPshutoff)*PC

1. For valves with composition seat constructions, port size 1.3125 inches and greater, see table 5 for A & B factor. For port size less than 1.3125 inches use 40 pounds per lineal inch of port circumference.
2. Cav4 is standard with dual Class V & Class VI shutoff. Seat Load to correspond to Class V as this is more stringent.
3. Class III offered for high temperature service only. Class V seat loads are used to achieve Class III leakage rates.
4. Sizing for this construction requires special factors inclusive of seat load and friction factors. Contact your local Emerson Process Management sales office for assistance.
PC = Lineal Port Circumference (inches) = Π * Port Diameter (inches)
ΔPshutoff is defined in (psi).

Table 5. Seat Load Factors for Composition Seat Constructions

PORT DIAMETER		PTFE OR CTFE SEAT(1)		SYNTHETIC RUBBER SEAT(2)				POLYURETHANE SEAT(3)			
		Flow Up or Down		Flow Down		Flow Up		Flow Down		Flow Up	
mm	Inches	A	B	A	B	A	B	A	B	A	B
For EZ Valves											
38	1.5	.059	141	---	---	---	---	---	---	---	---
51	2	.079	189	---	---	---	---	---	---	---	---
76	3	.118	283	---	---	---	---	---	---	---	---
102	4	.157	377	---	---	---	---	---	---	---	---
For All Other Valves											
33.3	1.3125	.052	125	.209	88	.078	31	.146	125	.042	63
47.6	1.875	.074	178	.297	125	.111	45	.208	178	.059	89
58.7	2.3125	.091	219	.366	154	.137	55	.256	219	.073	110
73	2.875	.114	272	.454	191	.170	68	.318	272	.091	136
87.3	3.4375	.136	325	.542	228	.203	81	.379	325	.110	163
111.1	4.375	.172	414	.690	290	.259	103	.482	414	.148	207
136.5(4)	5.375(4)	.211	507	---	---	---	---	---	---	---	---
177.8	7	.276	661	1.102	463	.413	165	.771	661	.220	331
203.2(5)	8(5)	.308	740	1.234	518	.463	185	.863	740	.247	370

1. PTFE seat max. ΔP = 1440 psi.
2. Synthetic rubber seat max. ΔP = 400 psi.
3. Polyurethane seat max. ΔP = 1000 psi.
4. Available only with ET and EWT with Whisper Trim™ III.
5. Available only with ES, EWS, ET, or EWT globe-style valves.

For other constructions not listed in table 4 or 5, please use the following:

- Class I: As required by customer specification, no factory leak test required.
- Class II: 20 pounds per lineal inch of port circumference
- Class III: 40 pounds per lineal inch of port circumference
- Class IV:

  Metal Seat. 40 pounds per lineal inch of port circumference (up through a 4.375 inch diameter port)
  Metal Seat. 80 pounds per lineal inch of port circumference (larger than 4.375 inch diameter port)

- Class V: Metal Seat: (100+0.122ΔPshutoff)*PC
- Metal Seat in Water Services or other low viscous fluids. Improved performance and extended life achieved at 800 lb/in seating force.
- Class VI: Seat load dependent on actual construction. Please consult your local Emerson Process Management Sales office for further details.

When sizing an actuator for valves that use the ENVIRO-SEAL™ bellows seal bonnet, use the bellows seal effective area instead of the stem area to calculate static unbalance. Simply substitute the effective area on this page for the stem area in the equations on Catalog 14 page B-2 and B-3. Also add these effective areas to table 3 on page B-11.

Bellows Effective Area

NPS 1/2 through 2 Valves: 0.353 square inches

NPS 3, 4, 6, and 8 Valves: 1.340 square inches

The bellows spring rate is negligible for actuator sizing purposes.

When sizing actuators for valves that use ENVIRO-SEAL or HIGH-SEAL packing, use the packing friction from tables 6A, 6B, or 6C rather than those shown in table 6 on page B-18.

Table 6A. Packing Friction with ENVIRO-SEAL Packing

VALVE STEM DIAMETER		PTFE OR DUPLEX PACKING	GRAPHITE ULF PACKING	H2 DUPLEX PACKING
mm	Inches	Newtons		
7.9	5/16	265	N/A	N/A
9.5	3/8	555	935	N/A
12.7	1/2	755	1250	1510
15.9	5/8	930	1680	N/A
19.1	3/4	1110	2350	2220
25.4	1	1515	3740	3030
31.8	1-1/4	1890	4800	3780
50.8	2	3220	6000	N/A
mm	Inches	Pounds (Force)		
7.9	5/16	60	N/A	N/A
9.5	3/8	125	210	N/A
12.7	1/2	170	280	340
15.9	5/8	210	380	N/A
19.1	3/4	250	530	500
25.4	1	340	840	680
31.8	1-1/4	425	1100	850
50.8	2	725	1350	N/A

Table 6B. Packing Friction with HIGH-SEAL Graphite ULF Packing(1)

VALVE STEM DIAMETER		GRAPHITE ULF PACKING
mm	Inches	Newtons
9.5	3/8	935
12.7	1/2	1250
15.9	5/8	1680
19.1	3/4	2350
25.4	1	3740
31.8	1-1/4	4800
50.8	2	6000
mm	Inches	Pounds (Force)
9.5	3/8	210
12.7	1/2	280
15.9	5/8	380
19.1	3/4	530
25.4	1	840
31.8	1-1/4	1100
50.8	2	1350

1. HIGH-SEAL packing systems are intended for applications with pressure limits up to 290 bar (4200 psig), except for 9.5 mm (3/8 inch) stem size, which is restricted to 110 bar (1600 psig).

Table 6C. Packing Friction with HIGH-SEAL Graphite Packing(1)

VALVE STEM DIAMETER		GRAPHITE PACKING
mm	Inches	Newtons
9.5	3/8	1870
12.7	1/2	5030
19.1	3/4	9430
25.4	1	15,080
31.8	1-1/4	18,860
50.8	2	30,200
mm	Inches	Pounds (Force)
9.5	3/8	420
12.7	1/2	1130
19.1	3/4	2120
25.4	1	3390
31.8	1-1/4	4240
50.8	2	6790

1. HIGH-SEAL packing systems are intended for applications with pressure limits up to 290 bar (4200 psig), except for 9.5 mm (3/8 inch) stem size, which is restricted to 110 bar (1600 psig).

C. Force to Overcome Packing Friction

From table 6, select the force that is appropriate for the stem size and type of packing to be used.

D. Additional Forces

- For EHD and HPD Valves

A force to overcome friction due to graphite piston rings should be included in determining the actuator force required. This force to overcome graphite piston ring friction corresponding to any given pressure drop can be determined directly from figure 4. The HPD valve plugs for 1.875, 2.875, and 3.625 inch port diameters use two piston rings. All others use three piston rings.

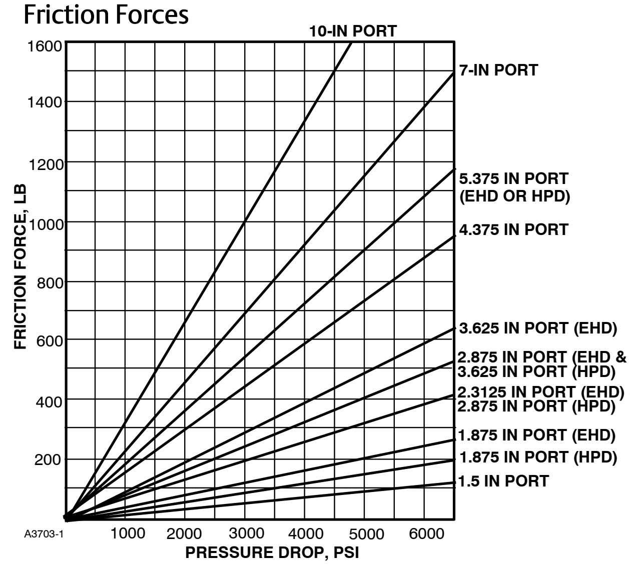
- For ET-C/EWT-C and ET/EWT Leak Class VI Valves

The force to overcome friction due to the UHMWPE/R30003 cryogenic seal ring can be determined as follows:

Port sizes less than 8-inches--28 pounds per lineal inch of port circumference.

Port sizes equal to or greater than 8-inches--34 pounds per lineal inch of port circumference.

Figure 4. Fisher EHD & HPD Graphite Piston Ring Friction Forces



Actuator Selection

After a valve has been selected to meet given service conditions, the valve must be matched with an appropriate actuator to achieve maximum efficiency.

Although unusual service conditions may necessitate selecting an oversized actuator, the actuator may be selected from the tables in the following actuator selection information. Using the standard size actuator as a starting point prevents needless calculations on actuators too small or too large for given conditions.

Table 6D. Packing Friction with ISO-Seal Packing

STEM DIAMETER		ANSI/FCI VALVE PRESSURE CLASS	ISO-Seal PTFE		ISO-Seal Graphite	
mm	Inches		Newtons	Pounds (force)	Newtons	Pounds (force)
9.5	3/8	Up to CL600	400	90	1300	290
		CL900-1500	590	130	1900	430
		CL2500	790	180	2070	470
12.7	1/2	Up to CL600	530	120	1700	380
		CL900-1500	790	180	2500	560
		CL2500	1060	240	2760	620
19.1	3/4	Up to CL600	1050	240	3300	740
		CL900-1500	1570	350	4700	1060
		CL2500	2100	470	5300	1190
25.4	1	Up to CL600	1670	380	5200	1170
		CL900-1500	2500	560	7500	1690
		CL2500	3330	750	8440	1900
31.8	1-1/4	Up to CL600	2080	470	6500	1460
		CL900-1500	3120	700	9400	2110
		CL2500	4160	940	10550	2370

Table 6. Packing Friction,(1, 2) Pounds

STEM DIAMETER, INCH	ANSI/FCI VALVE PRESSURE CLASS	PACKING ARRANGEMENT			
		PTFE		PTFE/ Composition	Ribbon/ Filament
		Single	Double		
5/16	All	20	30	- - -	- - -
3/8	125	38	56	63	- - -
	150			63	125
	250			95	- - -
	300			95	190
	600			125	250
	900			160	320
	1500			190	380
1/2	125	50	75	90	- - -
	150			90	180
	250			115	- - -
	300			115	230
	600			160	320
	900			205	410
	1500			250	500
	2500			295	590
5/8	125	63	95	109	- - -
	150			109	218
	250			145	- - -
	300			145	290
	600			200	400
3/4	125	75	112.5	175	- - -
	150			175	350
	250			220	- - -
	300			220	440
	600			330	660
	900			440	880
	1500			550	1100
	2500			660	1320
1	300	100	150	305	610
	600			425	850
	900			530	1060
	1500			650	1300
	2500			770	1540
1-1/4	300	120	180	400	800
	600			550	1100
	900			700	1400
	1500			850	1700
	2500			1020	2040
2	300	200	300	613	1225
	600			862.5	1725
	900			1125	2250
	1500			1375	2750
	2500			1623	3245

1. Values shown are frictional forces typically encountered when using standard packing flange bolt torquing procedures.
2. Packing friction on intermediate classes is the same as the next lower standard class, i.e. for CL1876, use CL1500, or for CL3273, use CL2500.

585C Spring-Biased Piston Actuators with Push-Down-to-Close Valves Only

Use the following procedure to select and size a 585C spring-biased piston actuator. This procedure uses equations and forces designated by letters (A, B, C, and D). The equation and forces are described in the Basic Valve Body Requirements procedure at the beginning of this section (page B-1) of the catalog.

Another description of this procedure is given in the section: 585C Actuator Sizing Guidelines. The procedure described in the Guidelines is the same as the one below except it is a word description of the steps required. It does not use equations or letters to designate forces. Use these guidelines if you understand the procedure below, but just need a reminder of the forces that must be considered.

1. For direct-acting (push-down-to-close) valves, select either for a fail-open or fail-closed application.

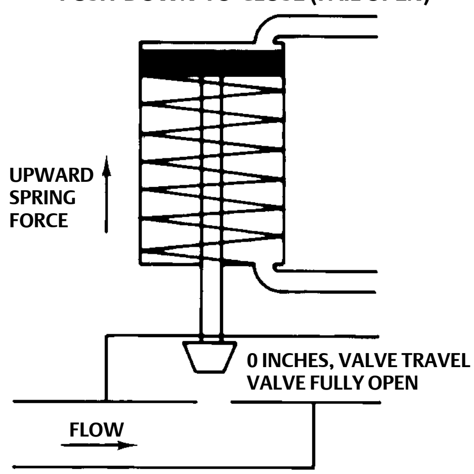
2. Match the valve stem connection and the valve body yoke boss diameter with one of the following selections:

- 3/8-inch valve stem connection and 2-1/8 inch yoke boss diameter: size 25 actuator
- 1/2-inch valve stem connection and 2-13/16 inch yoke boss diameter: size 25 or 50 actuator
- 3/4-inch valve stem connection and 3-9/16 inch yoke boss diameter: size 50 actuator

3. Use the following data and proceed to step 4:

- Size 25 cylinder area is 26.0 square inches: $A_c = 26.0$
- Size 50 cylinder area is 47.0 square inches: $A_c = 47.0$

Fisher 585C—Upward Spring Force (Spring Retracts Actuator Rod)



FLOW TENDS TO OPEN VALVE

- Calculated valve body force requirements (as defined previously in this section)
- Spring forces as shown in the actuator spring force table

4. Select a spring for the actuator using the appropriate procedures below.

For the 585C Actuator—Spring Retracts Actuator Rod (Fail-Open):

Note

For fail-open: Valve travel is measured from the fully open position.

Find a spring (from the following 585C spring force table) with the lightest spring rate that is strong enough to move the valve plug off the seat ring and strong enough to drive the valve plug to the full-open position:

a. Refer to the 585C spring force table. On the left side of the table, find the travel (from fully open) of the valve you are going to use. Then, using the spring with the lowest possible spring rate, find the upward spring force that equals or is greater than the valve body force requirements below:

Upward Spring Force at Given Travel(1)	$\geq$	*C+D-A for pressure tends to open valves* *C+D+A for pressure tends to close valves*

Note

For pressure-tends-to-open valves the unbalance force (A) helps the spring open the valve. Therefore, this force is subtracted from the other forces, as shown in the equation.

You have selected a spring that has sufficient upward force to begin to stroke the valve open from the fully closed position, overcoming packing friction (C), unbalance force (A), and any additional valve forces (D).

b. Again refer to the 585C spring force table. In the row of entries for 0 inches valve travel (from fully open), check the spring selected to be sure it has an upward spring force that equals or is greater than the valve body force requirements below:

Upward Spring Force at 0 Travel(1)	$\geq$	*C+D*

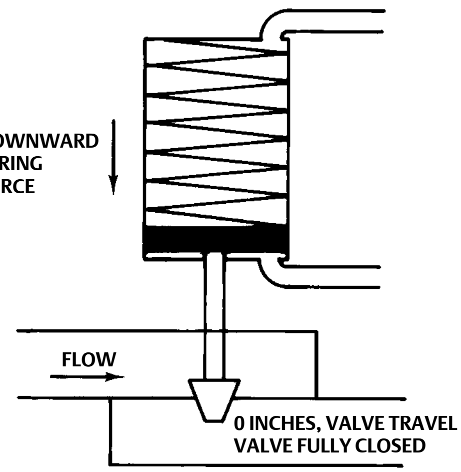
You have verified that the spring will still have sufficient upward force to continue to stroke the valve to the fully open position. After the valve is off its seat, the unbalance force is no longer a consideration.

For the 585C Actuator—Spring Extends Actuator Rod (Fail-Closed):

Note

For fail-closed: Valve travel is measured from the fully closed position.

Fisher 585C—Downward Spring Force (Spring Extends Actuator Rod)



Find a spring (from the 585C spring force table) with the lightest spring rate that is strong enough to move the valve plug to the closed position.

a. Refer to the 585C spring force table. In the row of entries for 0 inches valve travel (from fully closed), find the spring with the lowest possible spring rate. Then find the downward spring force that equals or is greater than the valve body force requirements below:

Downward Spring Force at 0 Travel(2)	$\geq$	*B+C+D+A for pressure tends to open valves* *B+C+D-A for pressure tends to close valves*

Note

For pressure-tends-to-close valves the unbalance force (A) helps the spring close the valve. Therefore, this force is subtracted from the other forces, as shown in the equation. When calculating A for this check, use the lowest expected pressure drop.

You have selected a spring that has sufficient downward force to overcome unbalance force (A), packing friction (C), and any additional valve forces (D), plus provide the required seating force (B).

1. Valve travel from fully open.
2. Valve travel from fully closed.

EMERSON. Process Management

Fisher 585C Actuator Spring Force, Pounds(1)

VALVE TRAVEL, INCHES(2)	SIZE 25				
	Spring Part Number and Spring Rates				
	13B9260X012	13B9261X012	13B9259X012	13B9259X012 13B9260X012	13B9259X012 13B9261X012
	200 lb/in	400 lb/in	500 lb/in	700 lb/in	900 lb/in
0(3)	200	400	500	700	900
0.5625	315	625	780	1095	1405
0.75	350	700	875	1225	1575
0.875	375	750	940	1315	1690
1.125	425	850	1065	1490	1915
	SIZE 50				
	18A0621X012	14B7136X012	14B7136X012 18A0621X012	14B7137X012	14B7137X012 18A0621X012
	330 lb/in	600 lb/in	930 lb/in	1550 lb/in	1880 lb/in
0(3)	330	600	930	1550	1880
0.75	580	1050	1630	2713	3290
0.875	620	1125	1745	2905	3525
1.125	700	1275	1975	3295	3995
1.5	825	1500	2325	3875	4700
2	990	1800	2790	4650	5640

1. Upward spring force for a 585C actuator (spring retracts actuator rod), downward spring force for a 585C actuator (spring extends actuator rod).
2. Valve travel is from fully open position for a 585C actuator (spring retracts actuator rod), and from a fully closed position for a 585C actuator (spring extends actuator rod).
3. For 585C actuator, at 0 inches of valve travel the valve is fully open and the actuator piston is at the top of the actuator cylinder. For 585CR actuator, at 0 inches of valve travel the valve is fully closed and the actuator piston is at the bottom of the actuator cylinder.

a. Again, refer to the 585C spring force table. In the row of entries for 0 inches valve travel (from fully closed), check the spring selected to be sure it has a downward spring force that equals or is greater than the valve body force requirements below:

$$\text{Downward Spring Force at 0 Travel}^{(2)} \geq C+D$$

You have verified that the spring will have sufficient downward force to stroke the valve when it is off the seat and the unbalance force is not a factor.

1. Check that the available air supply (P_s) to the unit (either the actuator alone or the actuator and positioner) will operate the valve:

For the 585C Actuator (spring retracts actuator rod): Refer to the 585C spring force table for the spring selected in step 4 at the given valve travel (from fully open). The force produced by the air supply minus the 585C upward spring force must be equal to or greater than the following valve body force requirements:

$$(P_s \ X \ A_c) - \text{(Upward Spring Force at Given Travel}^{(1)}) \geq \begin{cases} A+B+C+D & \text{for pressure tends to open valves} \\ B+C+D-A & \text{for pressure tends to close valves} \end{cases}$$

Note

Be sure the valve body force requirements used in the above formula are the forces required to close the valve. Use the worst case value for the unbalance force when making this check. For a pressure tends to open valve, use the unbalance force at the highest expected pressure drop. For a pressure tends to close valve, use the unbalance force at the lowest expected pressure drop.

1. Valve travel from fully open.
2. Valve travel from fully closed.

For the 585C Actuator (spring extends actuator rod): Refer to the 585C spring force table for the downward spring force of the spring selected in step 4 at the given valve travel (from fully closed). The force provided by the air supply minus the 585C downward spring force must be equal to or greater than the following valve body force requirements:

$$(P_s \times A_c) - \left(\text{Downward Spring Force at Given Travel}^{(2)}\right) \geq C+D$$

2. If step 5 indicates the air supply will not operate the valve, increase the air supply, and repeat step 5.

3. If the air supply cannot be increased, or if the increased air supply will not operate the valve, select a larger actuator. As shown in step 2, a larger actuator may require that the valve body have a larger yoke boss diameter. If the larger yoke boss diameter can be selected, repeat steps 4 and 5. If the larger yoke boss diameter cannot be selected, use another actuator type.

4. Check that the forces calculated in steps 4 and 5 do not exceed the maximum allowable stem load:

585C (spring retracts actuator rod)

$$(P_s \times A_c) - \left(\text{Upward Spring Force at Given Travel}^{(1)}\right) \leq \text{Maximum Allowable Stem Load}$$

585C (spring extends actuator rod)

$$(P_s \times A_c) + \left(\text{Downward Spring Force at Given Travel}^{(2)}\right) \leq \text{Maximum Allowable Stem Load}$$

Refer to the stem load calculations procedure in this section for stem loads.

585C Actuator Sizing Guidelines

Following are simplified, word descriptions of the procedure used above. Use these guidelines if you understand the procedure above, but just need a reminder of the forces that must be considered. The guidelines apply only to push-down-to-close valves that do not have additional force requirements (force D from the Basic Valve Body Requirements procedure at the beginning of this section of the catalog). Use these guidelines only if the spring is required to provide the fail position. Also be sure to check the maximum allowable stem load.

585C Actuator (spring retracts actuator rod)—Pressure Tends to Open the Valve

- Spring force when the valve is on the seat must be equal to or greater than packing friction minus unbalance force. (Use spring force at valve travel (from fully open) in the spring force table.)
- Spring force when valve is open must be equal to or greater than packing friction. (Use spring force at 0 travel (from fully open) in the spring force table.)
- (Supply pressure times piston area) minus spring force when the valve is on the seat must be equal to or greater than seat load, packing friction, plus unbalance force. (Use spring force at valve travel (from fully open) in the spring force table.)

585C Actuator (spring retracts actuator rod)—Pressure Tends to Close the Valve

- Spring force when the valve is on the seat must be equal to or greater than packing friction plus unbalance force. (Use spring force at valve travel (from fully open) in the spring force table.)
- Spring force when valve is open must be equal to or greater than packing friction. (Use spring force at 0 travel (from fully open) in the spring force table.)
- (Supply pressure times piston area) minus spring force when the valve is on the seat must be equal to or greater than packing friction. (Use spring force at valve travel (from fully open) in the spring force table.)

585C Actuator (spring extends actuator rod)—Pressure Tends to Open the Valve

- Spring force when the valve is on the seat must be equal to or greater than the seat load plus packing friction plus unbalance force. (Use spring force at 0 travel (from fully closed) in the spring force table.)
- (Supply pressure times piston area) minus spring force when the valve is open must be greater than packing friction minus unbalance force. (Use spring force at valve travel (from fully closed) in the spring force table.)

585C Actuator (spring extends actuator rod)—Pressure Tends to Close the Valve

- Spring force when the valve is on the seat must be equal to or greater than seat load plus packing friction minus unbalance force. (Use spring force at 0 travel (from fully closed) in the spring force table.)
- Spring force when the valve is on the seat must be equal to or greater than packing friction. (Use spring force at 0 travel (from fully closed) in the spring force table.)
- (Supply pressure times piston area) minus spring force when the valve is open must be equal to or greater than seat load plus packing friction plus unbalance force. (Use spring force at valve travel (from fully closed) in the spring force table.)

Double-Acting Piston Actuators—Fisher 585C

Use the following procedure to select and size a 585C springless construction piston actuator. This procedure uses equations and forces designated by letters (A, B, C, and D). The equation and forces are described in the **Basic Valve Body Requirements** procedure at the beginning of this section (page B-1) of the catalog.

1. Knowing the valve stem connection size, select the proper yoke boss size from table 10.

2. Match the valve body yoke boss size to the smallest actuator with the same yoke boss size (see table 10).

3. On the graph in figure 5, find the force on the horizontal axis equal to the valve body force required. Any size actuator whose curve passes beyond the force required may be used. The necessary air supply pressure may be read on the vertical axis.

Note

Actuator force must not exceed the maximum allowable valve stem load. Refer to the Stem Load Calculation section for additional information and procedures.

4. If the actuator originally selected is too small, go to the next larger actuator with the same size yoke boss.

5. In step 3, figure 5 was used to find the approximate force available. To determine the exact force available for any size 585C piston actuator, multiply the appropriate force available shown in table 8 by the following factor:

$$\frac{\text{Actual Supply (or Operating) Pressure, Bar(Psig)}}{\text{6.9 bar(100 Psig)}}$$

6. When ordering, specify the desired actuator action and piston motion from table 9.

Table 8. Fisher 585C Piston Actuator Forces Available

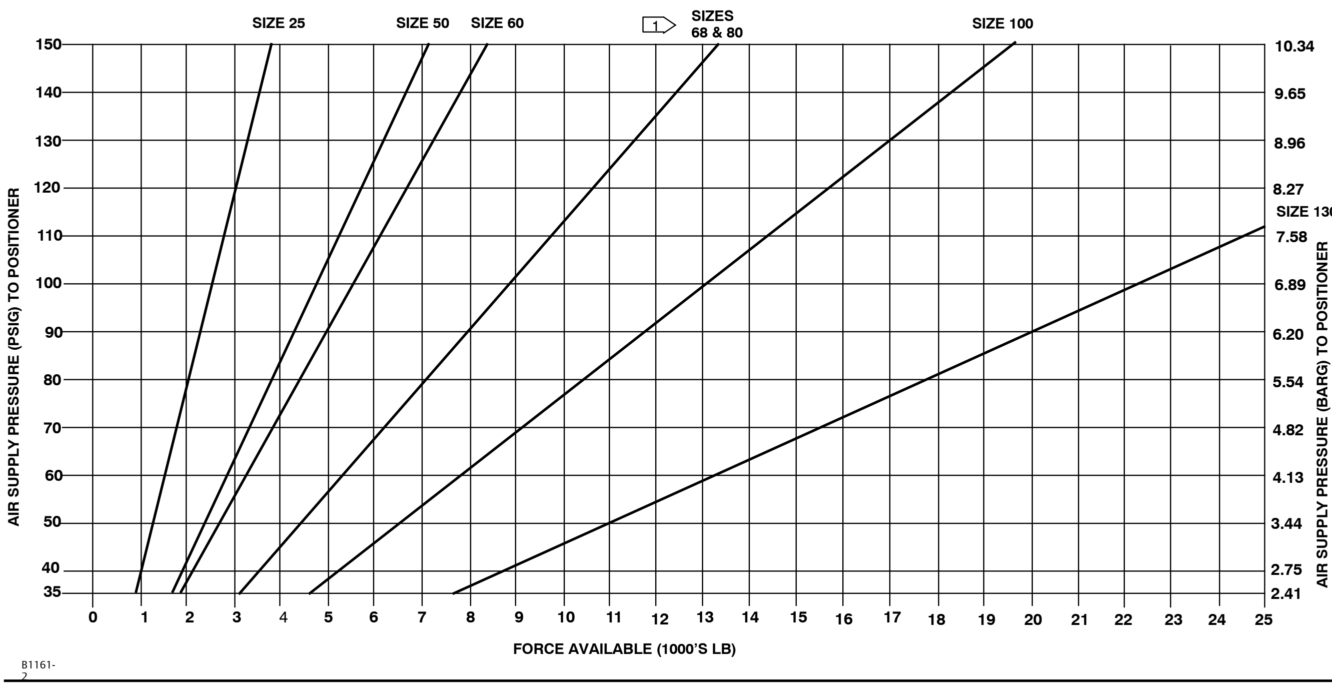
SIZE	FORCE AVAILABLE WITH 6.9 BAR (100 PSIG) AIR SUPPLY		MAXIMUM ALLOWABLE CYLINDER PRESSURES AND THRUSTS			
			Maximum Allowable Cylinder Pressure		Maximum Allowable Thrust Due To Actuator Construction — Ductile Iron Yoke	
	N	lb	bar	psig	N	lb
25	11600	2600	10.3	150	17300	3900
50	21000	4600	10.3	150	31400	6900
60	24700	5550	10.3	150	36900	8300
68	39400	8850	9.65	140	55600	12500(1)
80	39400	8850	10.3	150	58700	13200
100	58000	13050	10.3	150	86700	19500
130	98500	22150	7.72	112	111000	25000

1. The size 68 actuator with a handwheel is limited to 40000 Newtons (9000 lb) thrust.

Table 9. Fisher 585C Piston Actuator Actions Under Normal Operating Conditions

DESCRIPTION		PISTON MOTION: Down	PISTON MOTION: Up
With Positioner	Direct-Acting	Increasing input signal loads top of cylinder	Decreasing input signal exhausts top of cylinder
With Positioner	Reverse-Acting	Decreasing input signal exhausts bottom of cylinder	Increasing input signal loads bottom of cylinder
Without Positioner		Supply pressure loaded to top of cylinder, exhausted from bottom	Supply pressure loaded to bottom of cylinder, exhausted from top

Figure 5. Fisher 585C Piston Actuator Force when used with 3600 Series Positioner or DVC6000 Digital Valve Controller



NOTES:
1 MAXIMUM ALLOWABLE SUPPLY IS 140 PSIG FOR SIZE 68 ACTUATOR ONLY.

Table 10. Fisher 585C Piston Area, Actuator Travels, Yoke Boss Diameters, and Valve Stem Diameters

ACTUATOR SIZE	PISTON AREA		AVAILABLE ACTUATOR TRAVELS		YOKE BOSS DIAMETER		VALVE STEM DIAMETER	
	cm^2	$Inches^2$	cm	Inches	mm	Inches	mm	Inches
25	168	26	2.9	1-1/8	54 71	2-1/8 2-13/16	9.5 12.7	3/8 1/2
50	303	47	5.1	2	71 90	2-13/16 3-9/16	12.7 19.1	1/2 3/4
60	358	55.5	5.1	2	90	3-9/16	19.1	3/4
			10	4				
			20	8				
68	571	88.5	5.1	2	90	3-9/16	19.1	3/4
			10.2	4				
			20.3	8				
80	571	88.5	10.2	4	127	5	25.4 31.8	1 1-1/4
			20.3	8				
100	842	130.5	10.2	4	127	5	25.4 31.8	1 1-1/4
			20.3	8				
130	1430	221.5	10.2	4	127	5	31.8	1-1/4
			20.3	8				

Double-Acting Piston Actuators—Fisher 685

Use the following procedure to select and size a 685 piston actuator. This procedure uses equations and forces designated by letters (A, B, C, and D). The equation and forces are described in the Basic Valve Body Requirements procedure at the beginning of this section (page B-1) of the catalog.

1. Knowing the valve stem connection size, select the proper yoke boss size from table C.

2. Match the valve body yoke boss size to the smallest actuator with the same yoke boss size (see table C).

3. On the graph in figure A, find the force on the horizontal axis equal to the valve body force required. Any size actuator whose curve passes beyond the force required may be used. The necessary air supply pressure may be read on the vertical axis.

4. If the actuator originally selected is too small, go to the next larger actuator with the same size yoke boss.

5. In step 3, figure A was used to find the approximate force available. To determine the exact force available for any size 685 piston actuator, multiply the appropriate force available shown in table A by the following factor:

$$\frac{\textbf{Actual Supply (or Operating) Pressure, Bar(Psig)}}{\textbf{6.9 bar(100 Psig)}}$$

6. When ordering, specify the desired actuator action and piston motion from table B.

Table A. Fisher 685 Piston Actuator Forces Available

ACTUATOR SIZE	STROKE	FORCE AVAILABLE WITH 6.9 BARG (100 PSIG) AIR SUPPLY		MAXIMUM ALLOWABLE CYLINDER PRESSURE		MAXIMUM ALLOWABLE THRUST	
		N	lb	barg	psig	N	lb
12	Push	50306	11310	10.3	150	75460	16965
14		68472	15394	10.3	150	102709	23091
16		89432	20106	10.3	150	134147	30159
18		113188	25447	10.3	150	169780	38170
20		139738	31416	10.3	150	209608	47124
22		169083	38013	10.3	150	253625	57020
24		201223	45239	10.3	150	301832	67858
26		236157	53093	10.3	150	354234	79639
12	Pull	49234	11069	10.3	150	73851	16603
14		66288	14903	10.3	150	99432	22354
16		87248	19615	10.3	150	130873	29423
18		111004	24956	10.3	150	166506	37434
20		136593	30709	10.3	150	204890	46063
22		165938	37306	10.3	150	248907	55959
24		196944	44277	10.3	150	295416	66415
26		231878	52131	10.3	150	347817	78196

Table B. Fisher 685 Piston Actuator Actions Under Normal Operating Conditions

DESCRIPTION	DESIRED PISTON MOTION	
	Down	Up
Direct-Acting	Supply pressure loaded on top of piston, exhausted from bottom	Supply pressure loaded on bottom of piston, exhausted from top
Reverse-Acting	Supply pressure loaded on bottom of piston, exhausted from top	Supply pressure loaded on top of piston, exhausted from bottom

Figure A. Fisher 685 Piston Actuator Force when used with DVC6200 Digital Valve Controller

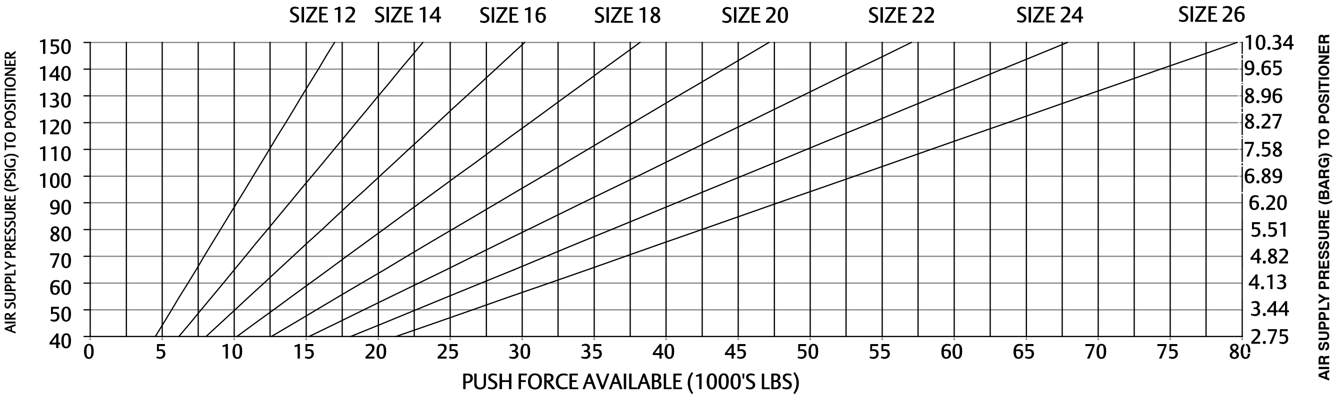


Table C. Fisher 685 Piston Area, Valve Travels, Yoke Boss Diameters, and Valve Stem Diameters

ACTUATOR SIZE	PISTON AREA		PISTON ROD AREA		YOKE BOSS DIAMETER		VALVE STEM DIAMETER		AVAILABLE VALVE TRAVELS	
	cm2	inches2	cm2	inches2	mm	inches	mm	Inches	mm	inches
12	730	113.10	16	2.41	127	5H	32	1-1/4	>203 to 606	>8 to 24
					178	7	51	2		
14	993	153.94	32	4.91	127	5H	32	1-1/4		
					178	7	51	2		
16	1297	201.06	32	4.91	127	5H	32	1-1/4		
					178	7	51	2		
18	1642	254.47	32	4.91	127	5H	32	1-1/4		
					178	7	51	2		
20	2027	314.16	46	7.07	127	5H	32	1-1/4	25 to 606	1 to 24
					178	7	51	2		
22	2452	380.13	46	7.07	127	5H	32	1-1/4		
					178	7	51	2		
24	2919	452.39	62	9.62	127	5H	32	1-1/4		
					178	7	51	2		
26	3425	530.93	62	9.62	127	5H	32	1-1/4		
					178	7	51	2		

Double-Acting Piston Actuators - Fisher 685SE (Spring Extend)

Use the following procedure to size and select a 685SE spring-biased piston actuator. This procedure uses equations and forces designated by letters (A, B, C, and D). The equations and forces are described in the Basic Valve Body Requirements procedure at the beginning of this section (page B-1) of the catalog. Note that all units are imperial (i.e. inch, pound, etc.).

1. Knowing the valve plug action and desired fail action, confirm that the 685SE is the correct type of actuator for your application.

2. Knowing the valve stem diameter and valve travel, select the smallest actuator size from table 2.

3. Calculate forces A, B, C, and D according to the beginning of this catalog.

4. Determine the Required Spring Thrust that the actuator spring must produce to move the valve plug to the desired fail position.

Pressure-Tend-To-Open (PTTO) Valve

Required Spring Thrust = A + Spring Shutoff Force + C + D + (Pf x Piston Area)
Spring Shutoff Force = Min [(40 lb/in) x (Valve Port Circumference), B]
Pf = 2 psi

Pressure-Tend-To-Close (PTTC) Valve

Required Spring Thrust = Max (A,0) + Spring Shutoff Force + C + D + (Pf x Piston Area)
Spring Shutoff Force = Min [(40 lb/in) x (Valve Port Circumference), B]
Pf = 2 psi

The Spring Shutoff Force is the amount of force that the actuator spring will provide for valve shutoff when zero supply pressure is available to the actuator cylinder. For most applications this amount of force will provide leakage consistent with ANSI/FCI 70-2 Class III shutoff. If tighter shutoff is required, this value can be replaced with force B. For some applications that do not need leakage consistent with Class III shutoff, even with full supply pressure to the actuator, this value can be replaced with force B (if lesser than 40 lb/in).

Pf represents the average amount of friction present in the actuator in terms of the supply pressure that must be delivered to the actuator to overcome the friction.

5. Using table 3, select an appropriate actuator spring Preload and Spring Rate (Ks) so that the preload is greater than or equal to the Required Spring Thrust. The spring will also need to result in a sufficient Bench Set.

Preload ≥ Required Spring Thrust

Bench Set = (Ks x Tac) / (Piston Area – Piston Rod Area)

Tac = (Valve Travel + 0.25 inches) rounded up to the nearest 0.50 inch

Bench Set ≥ 5 psi

If the Bench Set is <5 psi select a larger spring rate and repeat step 5.

Tac represents the maximum travel that the actuator cylinder is capable of. 685SE/SR actuators generally will allow for a greater travel than what is required by the valve.

6. Determine the amount of thrust the actuator size selected can produce both down and up with the customer available supply pressure (Pas).

Actuator Thrust Down = (Pas x Piston Area) + Preload – (Pf x Piston Area)

Actuator Thrust Up = [Pas x (Piston Area – Piston Rod Area)] – (Preload x 1.10) – (1.05 x Ks x Tac) – (Pf x Piston Area)

Note

All 685SE/SR actuator springs have a ±5% tolerance on the spring rate and a +10%/-0% tolerance on the preload. The equations listed in this document take into account these tolerances.

7. Determine the amount of thrust the valve requires both down and up.

Valve Thrust Down = A + B + C + D

Valve Thrust Up = C + D + W

W = Average plug weight per table 4

Note

It is important to take into account the weight of the valve plug as typically 685SE/SR actuators are used with medium to large valves of which have noticeable valve plug weights.

8. Check that the actuator can operate the valve.

Actuator Thrust Down > Valve Thrust Down

Actuator Thrust Up > Valve Thrust Up

If either of the above expressions is evaluated as False, the actuator size selected does not have enough piston area to produce the thrust required to operate the valve. If either is False select the next larger actuator size and repeat steps 4, 5, 6, 7, and 8. Otherwise, if the above expressions are evaluated as True proceed to step 9.

9. Determine the minimum required supply pressure (Ps) that must be delivered to the actuator to operate the valve.

Ps = Max(Pre, Prr, 40 psi) ≤ Pas

$$Pre = \frac{\text{Valve Thrust Down - Preload}}{\text{Piston Area}} + Pf + 3\text{ psi}$$

$$Prr = \frac{\text{Valve Thrust Up+(Preload x 1.10)+(Ks x Tac x 1.05)}}{\text{Piston Area - Piston Rod Area}} + Pf + 3\text{ psi}$$

Note

The 3 psi term in these above equations is a safety factor to ensure that the actuator will have sufficient thrust to overcome any unaccounted forces.

The following steps are operational checks

10. Check that the maximum allowable cylinder pressure of 150 psi is not exceeded by the customer supply pressure.

Pas ≤ 150 psi

11. Check that the actuator will not provide too much thrust onto the valve seat (i.e. excessive seat load). Too much seat load is defined as at or exceeding 1000 pounds per lineal inch of port circumference.

$$\frac{\text{Actuator Thrust Down}}{\text{Valve Port Circumference}} < 1000\text{ lb/in}$$

12. If the actuator is equipped with a manual override, a check will have to be made to verify that the manual override can produce sufficient thrust to position the valve. The required thrust that the actuator manual override must produce is as follows:

$$\text{Manual Override Thrust} = \text{Valve Thrust Up + (Preload x 1.10) + (Ks x Tac x 1.05)} + \frac{Pf}{\text{Piston Area}} + \frac{3\text{ psi}}{\text{Piston Area}}$$

$$\text{Manual Override Thrust} \le \text{MOTL}$$

Where MOTL represents the Manual Override Thrust Limit as indicated by actuator size in table 5.

13. Check that the actual stem load produced by the actuator will not overload the valve stem. Please refer to the Stem Load Calculation section of this document for more information. The valve stem load produced by the actuator can be calculated as follows:

Stem Load = (Pas x Piston Area) + (Preload x 1.10)

Double Acting Piston Actuators – Fisher 685SR (Spring Retract)

Use the following procedure to size and select a 685SR spring-biased piston actuator. This procedure uses equations and forces designated by letters (A, B, C, and D). The equations and forces are described in the Basic Valve Body Requirements procedure at the beginning of this section (page B-1) of the catalog. Note that all units are imperial (i.e. inch, pound, etc.).

1. Knowing the valve plug action and desired fail action, confirm that the 685SR is the correct type of actuator for your application.

2. Knowing the valve stem diameter and valve travel, select the smallest actuator size from table 2.

3. Calculate forces A, B, C, and D according to the beginning of this catalog.

4. Determine the Required Spring Thrust that the actuator spring must produce to move the valve plug to the desired fail position.

Pressure-Tends-To-Open (PTTO) Valve

Required Spring Thrust = C + D + (Pf x Piston Area) + W + SF

Pf = 2 psi

W = Average plug weight per table 4

SF = Piston Area x 3 psi

Pressure-Tends-To-Close (PTTC) Valve

Required Spring Thrust = -Min (A,0) + C + D + (Pf x Piston Area) + W + SF

Pf = 2 psi

W = Average plug weight per table 4

SF = Piston Area x 3 psi

Pf represents the average amount of friction present in the actuator in terms of the supply pressure that must be delivered to the actuator to overcome the friction.

Note

It is important to take into account the weight of the valve plug as typically 685SE/SR actuators are used with medium to large valves of which have noticeable valve plug weights.

The SF term is used to ensure the actuator spring has enough force to move the valve plug to the desired fail position within a reasonable amount of time.

5. Using table 3, select an appropriate actuator spring Preload and Spring Rate (Ks) so that the preload is greater than or equal to the Required Spring Thrust. The spring will also need to result in a sufficient Bench Set.

Preload ≥ Required Spring Thrust

Bench Set = (Ks x Tac) / (Piston Area – Piston Rod Area)

Bench Set ≥ 5 psi

If the Bench Set is <5 psi select a larger spring rate and repeat step 5.

Tac represents the maximum travel that the actuator cylinder is capable of. 685SE/SR actuators generally will allow for a greater travel than what is required by the valve.

6. Determine the amount of thrust the actuator size selected can produce both down and up with the customer available supply pressure (Pas).

Actuator Thrust Down = (Pas x Piston Area) – (Preload x 1.10) – (1.05 x Ks x Tac) – (Pf x Piston Area)

Actuator Thrust Up = (Pas x Piston Area) + Preload

Note

All 685SE/SR actuator springs have a ±5% tolerance on the spring rate and a +10%/-0% tolerance on the preload. The equations listed in this document take into account these tolerances.

---

7. Determine the amount of thrust the valve requires both down and up.

Valve Thrust Down = A + B + C + D

Valve Thrust Up = Required Spring Thrust – SF

8. Check that the actuator can operate the valve.

Actuator Thrust Down > Valve Thrust Down

Actuator Thrust Up > Valve Thrust Up

If either of the above expressions is evaluated as False, the actuator size selected does not have enough piston area to produce the thrust required to operate the valve. If either is False select the next larger actuator size and repeat steps 4, 5, 6, 7, and 8. Otherwise, if the above expressions are evaluated as True proceed to step 9.

9. Determine the minimum required supply pressure (Ps) that must be delivered to the actuator to operate the valve.

Ps = Max (Pre, Prr, 40 psi) ≤ Pas

$$Pre = \frac{\text{Valve Thrust Down}+(\text{Preload} \times 1.10)+(Ks \times Tac \times 1.05)}{\text{Piston Area}} + Pf + 3\text{ psi}$$

$$Prr = \frac{\text{Required Spring Thrust - Preload}}{\text{Piston Area - Piston Rod Area}} + Pf + 3\text{ psi}$$

Note

The 3 psi term in these above equations is a safety factor to ensure that the actuator will have sufficient thrust to overcome any unaccounted forces.

The following steps are operational checks

10. Check that the maximum allowable cylinder pressure of 150 psi is not exceeded by the customer supply pressure.

Pas ≤ 150 psi

11. Check that the actuator will not provide too much thrust onto the valve seat (i.e. excessive seat load). Too much seat load is defined as at or exceeding 1000 pounds per lineal inch of port circumference.

$$\frac{\text{Actuator Thrust Down}}{\text{Valve Port Circumference}} < 1000\text{ lb/in}$$

12. If the actuator is equipped with a manual override a check will have to be made to verify that the manual override can produce sufficient thrust to position the valve. The required thrust that the actuator manual override must produce is as follows:

$$\text{Manual Override Thrust} = \text{Valve Thrust Down} + (\text{Preload} \times 1.10) + (Ks \times Tac \times 1.05) + \frac{Pf}{\text{Piston Area}} + \frac{3\text{ psi}}{\text{Piston Area}} \leq MOTL$$

$$\text{Manual Override Thrust} \leq MOTL$$

Where MOTL represents the Manual Override Thrust Limit as indicated by actuator size in table 5.

13. Check that the actual stem load produced by the actuator will not overload the valve stem. Please refer to the Stem Load Calculation section of this document for more information. The valve stem load produced by the actuator can be calculated as follows:

Stem Load = (Pas x Piston Area) – Preload – (Ks x Tac x 1.05)

Table 2. Fisher 685SE and 685SR Piston Area, Valve Travels, Yoke Boss Diameters, and Valve Stem Diameters

Actuator Size	Piston Area		Piston Rod Area		Valve Stem Diameter		Yoke Boss Diameter		Available Valve Travels	
	cm2	in2	cm2	in2	mm	in	mm	in	mm	in
10	507	79	16	2.41	19	3/4	90	3-9/16	25 to 203	1 to 8
					25, 32	1, 1-1/4	127	5		
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
12	730	113	16	2.41	19	3/4	90	3-9/16	25 to 152	1 to 6
					25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
14	993	154	32	4.91	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
16	1297	201	32	4.91	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
18	1642	254	32	4.91	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
20	2027	314	46	7.07	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
22	2452	380	46	7.07	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
24	2919	452	62	9.62	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
26	3425	531	62	9.62	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		
28	3973	616	62	9.62	25, 32	1, 1-1/4	127	5	25 to 203	1 to 8
					32	1-1/4	127	5H	25 to 610	1 to 24
					51	2	178	7		

Table 3. Fisher 685SE and 685SR Spring Rates and Preloads

Actuator Size	Ks (lb/in)	Preload (lb)	Actuator Size	Ks (lb/in)	Preload (lb)
10 to 28	50	500	10 to 28	1050	10500
	100	1000		1100	11000
	150	1500		1150	11500
	200	2000		1200	12000
	250	2500		1250	12500
	300	3000		1300	13000
	350	3500		1350	13500
	400	4000		1400	14000
	450	4500		1450	14500
	500	5000		1500	15000
	550	5500		1550	15500
	600	6000		1600	16000
	650	6500		1650	16500
	700	7000		1700	17000
	750	7500		1750	17500
	800	8000		1800	18000
	850	8500		1850	18500
	900	9000		1900	19000
	950	9500		1950	19500
	1000	10000		2000	20000

Table 4. Average Valve Plug Weight (W)

Maximum Valve Port Diameter (in)	Maximum Valve Port Circumference (in)	W	
		All Globe Valves (lb)	FB Valves (lb)
≤5	15.71	0	0
6	18.85	30	30
7	21.99	70	70
8	25.13	90	140
9	28.27	100	207
10	31.42	150	273
11	34.56	180	339
12	37.70	234	406
13	40.84	280	472
14	43.98	327	539
15	47.12	373	605
16	50.27	419	671
17	53.41	466	738
18	56.55	512	804
19	59.69	558	871
20	62.83	605	937
22	69.12	697	1070
24	75.40	790	1203
26	81.68	883	1336
32	100.53	1161	1734

Table 5. 685SE and 685SR Actuator Manual Override Thrust Limit (MOTL)

Actuator Size	MOTL for 685SE (lb)	MOTL for 685SR (lb)
10	10,000(1)	10,000(1)
12	10,000(1)	10,000(1)
14	20,000(1)	20,000(1)
16	20,000(1)	20,000(1)
18	20,000(1)	20,000(1)
20	30,000(1)	30,000(1)
22	30,000(1)	30,000(1)
24	30,000(1)	30,000(1)
26	30,000(1)	30,000(1)
28	115,800(2)	143,200(2)

1. Values representative of a Side Mounted Handwheel
2. Values representative of a Side Mounted Hydraulic Hand-Pump

Spring-and Diaphragm Actuators

Use the following procedure to select a spring-and-diaphragm actuator.

1. Knowing the valve plug action and desired fail action, select an actuator type number from table 12.

2. Knowing the valve stem connection size, select the proper yoke boss diameter from table 13.

3. Match the valve body yoke boss diameter with the smallest actuator with the same yoke boss diameter (see table 13).

4. Now, knowing the actuator type number and the suggested actuator size, turn to the appropriate "available actuator force" page. These pages are listed in numerical order by type number and actuator size.

Note

In all of the following tables, the force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 psig signal and a 0 to 33 psig for a 6 to 30 psig signal. Any positioner or controller used with these actuators must be capable of delivering the appropriate slightly extended range.

Continue with step 5 for either Flow-Tends-to-Open or Flow-Tends-to-Close Applications.

Flow-Tends-To-Open Applications

5. Knowing the air signal to the actuator and the maximum valve travel, enter the "Available Actuator Force" table. Proceed down the column for the appropriate travel to find the available force that closely matches, but is not less than the force required for the valve body.

6. To be sure that the actuator will fully open the valve, be sure that the packing friction force divided by the effective diaphragm area is less than 3.5 psig:

$$\frac{\text{packing friction}}{\text{effective diaphragm area}}$$

Table 12. Spring-and-Diaphragm Actuator Recommendations for Desired Fail Action

VALVE PLUG ACTION	ACTUATOR TYPE NUMBER	
	Valve Plug to Fail Open	Valve Plug to Fail Closed
Push-down-to-close	657	667
Push-down-to-open	- - -	657R

Table 13. Spring-and-Diaphragm Actuator Valve Stem Connections, Yoke Boss Diameter, and Diaphragm Areas

Actuator Type	VSC,(1) Inches	Yoke Boss Dia., Inches	Actuator Size	Effective Diaphragm Area, Inches^2
657, 657R, & 667(2)	3/8	2-1/8	30, 30i	46
			34, 34i	69
	1/2	2-13/16	40, 40i	69
			45, 45i	105
			46, 46i	156
	3/4	3-9/16	50, 50i	105
			60, 60i	156
			70, 70i	220
	1, 1-1/4	5	87	220
			80	See table 14
			100	450
	2	7	100	450

1. Valve stem connection.
2. 667 size i actuators only available in sizes 30i - 46i.

Table 14. Fisher 657, 657R, and 667 Size 80 Diaphragm Area

Travel, Inches	Area, Inches^2
0	316
0.75	295
1.125	289
1.5	286
2	284
2.5	279
3	273

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If the answer is less than 3.5 psig, actuator selections from page B-31 through B-76 will be able to fully open valve (if actual supply to actuator is 0 to 18 psig or 0 to 33 psig).

If ≥ 3.5 psig, full valve travel will not be obtained. Use the Emerson Automation Solutions Sizing Program (available for use on a personal computer) to select the correct spring and bench set. The Emerson Automation Solutions Sizing Program can also be used when *actual* signal to actuator is 3 to 15 or 6 to 30 psig.

7. If the standard actuator size is too small, go to the next larger actuator size with the same size yoke diameters. Refer to table 13. Also try increasing supply pressure to actuator, if a greater supply is available from the control device and from your installation. Use the Emerson Automation Solutions Sizing Program to select spring and bench set.

8. To facilitate ordering, the “available actuator force” tables provide the spring part number and bench set.

Flow-Tends-To-Close Applications

Be sure to check for the effects of negative gradient. See the Sample Calculations in this section of the catalog.

Flow-tends-to-close, unbalanced valves not recommended for most throttling applications; see your Emerson Automation Solutions sales office if you have questions.

5. Knowing the air signal to the actuator and the maximum valve travel enter the “Available Actuator Force” table. Proceed down the column for the appropriate travel to find the available force that closely matches, but is not less than the force required for the valve body.

Continue with the appropriate step 6 for either 667 actuators or 657 actuators.

667 Actuators

6. For proper control, one-half the air span (either 1/2 X 12 = 6 psi or 1/2 X 24 =12 psi) multiplied by the diaphragm effective area (see table 13 or 14) must be greater than the closing force [ΔP X (unbalanced area—stem area)]. The unbalanced area is the port area with an unbalanced plug.

1/2 X (air span) X diaphragm effective area >
ΔP (shutoff) X (unbalance area—stem area)

If this condition is not satisfied, either increase the air to the diaphragm (and select a different spring) or select a larger actuator.

Next, continue with step 7.

657 Actuators

6. For a 657 actuator to open the valve plug, the spring force must overcome the closing force exerted by the following media.

Closing force = [ΔP (shutoff) X
(unbalanced area - stem area)]

The unbalance area is the port area with an unbalanced plug.

The total spring force consists of the initial force wound into the spring plus the travel compression.

(Spring compression rate X travel) +
(initial air to diaphragm X diaphragm effective area) >
ΔP (shutoff) X (unbalance area - stem area)

If this condition is not satisfied, increase the spring force by using higher compression rate spring and more air to diaphragm.

Next, continue with step 7.

657 and 667 Actuators

7. To be sure that the actuator will fully open the valve, be sure that the packing friction force divided by the effective diaphragm area is less than 3.5 psig:

$$\frac{\text{packing friction}}{\text{effective diaphragm area}}$$

If the answer is less than 3.5 psig, actuator selections from page B-31 through B-76 will be able to fully open valve (if actual supply to actuator is 0 to 18 psig or 0 to 33 psig).

If ≥ 3.5 psig, full valve travel will not be obtained. Use the Emerson Automation Solutions Program (available for use on a personal computer) to select the correct spring and bench set. The Emerson Automation Solutions Sizing Program can also be used when *actual* signal to actuator is 3 to 15 or 6 to 30 psig.

8. If the standard actuator size is too small, go to the next larger actuator size with the same size yoke diameters. Refer to table 13. Also try increasing supply pressure to actuator, if a greater supply is available from the control device and from your installation. Use the Emerson Automation Solutions Sizing Program to select spring and bench set.

9. To facilitate ordering, the “available actuator force” tables provide the spring part number and bench set.

Sensitivity Requirement

Note

The supply pressure rating in the following tables is for typical applications. If all requirements below are met, it may be possible to use a lower supply pressure than the rated supply.

1. For throttling applications, perform the following spring rate check to ensure that the valve/actuator system does not become overly sensitive to small changes in instrument signal.

Refer to table 13. Find the smallest actuator size with the appropriate yoke boss diameter. Then find the spring rate corresponding to the appropriate supply pressure. The change in spring force, K_ST (where K_S is spring rate and T is valve travel) must be greater than or equal to one half of the unbalance force (A) for pressure-tends-to-open valves and 1.5 times the unbalance force (A) for pressure-tends-to-close valves.

$$K_S \times T \geq A/2$$ *for pressure tends to open valves*

$$K_S \times T \geq 1.5\,A$$ *for pressure tends to close valves*

If this requirement is not met, try increasing the supply pressure to allow the use of a higher rate spring and repeat the above calculation. If it is not possible to increase supply pressure, select a larger actuator.

As shown in step 2, a larger actuator may require that the valve body have a larger yoke boss diameter. If the larger yoke boss can be selected, repeat the above calculation. If the larger yoke boss diameter cannot be selected, use another actuator type.

Available Actuator Force

Travel, Inch	0.25	0.375	0.4375	0.5	0.625	0.75	Spring Part Number (Spring Rate, Lb/In)
0-18 Psig to Diaphragm[1]							
Force, Lb (Bench Set, Psig)	184 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	1E793327082 (2100)
	230 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	1E795427082 (1770)
	322 (3-11)	138 (3-15)	--- ---	--- ---	--- ---	--- ---	1E792427082 (1470)
	368 (3-10)	230 (3-13)	138 (3-15)	--- ---	--- ---	--- ---	1E795327082 (1250)
	460 (3-8)	322 (3-11)	276 (3-12)	184 (3-14)	--- ---	--- ---	1J258127092 (1000)
	460 (3-8)	368 (3-10)	322 (3-11)	276 (3-12)	184 (3-14)	--- ---	1F714327092 (830)
	506 (3-7)	414 (3-9)	368 (3-10)	322 (3-11)	230 (3-13)	138 (3-15)	1E792327092 (735)
	--- ---	460 (3-8)	414 (3-9)	368 (3-10)	322 (3-11)	230 (3-13)	1F176927092 (612)
	--- ---	506 (3-7)	460 (3-8)	460 (3-8)	358 (3-10)	322 (3-11)	1F176827092 (490)
	--- ---	--- ---	--- ---	506 (3-7)	460 (3-8)	414 (3-9)	1F176727032 (368)
	--- ---	--- ---	--- ---	--- ---	--- ---	506 (3-7)	1J172227032 (250)
0-33 Psig to Diaphragm[1]							
Force, Lb (Bench Set, Psig)	598 (6-20)	276 (6-27)	138 (6-30)	--- ---	--- ---	--- ---	1E795627082 (2520)
	736 (6-17)	460 (6-23)	322 (6-26)	164 (6-29)	--- ---	--- ---	1E793327082 (2100)
	782 (6-16)	598 (6-20)	506 (6-22)	368 (6-25)	138 (6-30)	--- ---	1E795427082 (1770)
	874 (6-14)	690 (6-18)	598 (6-20)	506 (6-22)	322 (6-26)	138 (6-30)	1E792427082 (1470)
	--- ---	782 (6-16)	690 (6-18)	598 (6-20)	506 (6-22)	322 (6-26)	1E795327082 (1260)
	--- ---	874 (6-14)	782 (6-16)	7836 (6-17)	598 (6-20)	506 (6-22)	1J258127092 (1000)
	--- ---	--- ---	874 (6-14)	828 (6-15)	736 (6-17)	598 (6-20)	1F714327092 (830)
	--- ---	--- ---	--- ---	874 (6-14)	782 (6-16)	690 (6-18)	1F792327092 (735)
	--- ---	--- ---	--- ---	--- ---	874 (6-14)	782 (6-16)	1F176927092 (612)
	--- ---	--- ---	--- ---	--- ---	--- ---	874 (6-14)	1F176827092 (490)

1.The force values shown assume a diaphragm loading pressure to the actuator or 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

0-18 Psig to Diaphragm(1)							
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**1.125**	**Spring Part Number (Spring Rate, Lb/In)**
Force, Lb (Bench Set, Psig)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E805227082 (2210)
	345 (3-13)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	1E805127082 (1840)
	483 (3-11)	414 (3-12)	276 (3-14)	--- ---	--- ---	--- ---	1E805527082 (1470)
	552 (3-10)	483 (3-11)	345 (3-13)	207 (3-15)	--- ---	--- ---	1E804927082 (1327)
	552 (3-10)	483 (3-11)	414 (3-12)	276 (3-14)	--- ---	--- ---	1E805427082 (1230)
	621 (3-9)	552 (3-10)	483 (3-11)	345 (3-13)	207 (3-15)	--- ---	1E805827082 (1100)
	690 (3-8)	621 (3-9)	552 (3-10)	414 (3-12)	345 (3-13)	--- ---	1E805727092 (920)
	759 (3-7)	690 (3-8)	690 (3-8)	552 (3-10)	483 (3-11)	207 (3-15)	1E805327092 (736)
	--- ---	--- ---	759 (3-7)	690 (3-8)	621 (3-9)	414 (3-12)	1E805627092 (550)
	--- ---	--- ---	--- ---	759 (3-7)	690 (3-8)	552 (3-10)	1F177227092 (460)
	--- ---	--- ---	--- ---	--- ---	759 (3-7)	621 (3-9)	1F177127092 (370)
0-33 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	414 (6-27)	207 (6-30)	--- ---	--- ---	--- ---	--- ---	1E805027082 (3780)
	690 (6-23)	483 (6-26)	276 (6-29)	--- ---	--- ---	--- ---	1E804727082 (3160)
	897 (6-20)	759 (6-22)	552 (6-25)	207 (6-30)	--- ---	--- ---	1E804827082 (2650)
	1035 6-18)	897 (6-20)	759 (6-22)	483 (6-26)	207 (6-30)	--- ---	1E805227082 (2210)
	1173 (6-16)	1035 (6-18)	966 (6-19)	759 (6-22)	483 (6-26)	--- ---	1E805127082 (1840)
	1311 (6-14)	1242 (6-15)	1104 (6-17)	966 (6-19)	759 (6-22)	207 (6-30)	1E805527082 (1470)
	--- ---	1311 (6-14)	1173 (6-16)	1035 (6-18)	897 (6-20)	345 (6-28)	1E804927082 (1327)
	--- ---	1311 (6-14)	1242 (6-15)	1104 (6-17)	966 (6-190)	483 (6-26)	1E805427082 (1230)
	--- ---	--- ---	1311 (6-14)	1173 (6-16)	1035 (6-18)	621 (6-24)	1E805827082 (1100)
	--- ---	--- ---	--- ---	1311 (6-14)	1173 (6-16)	759 (6-22)	1E805727092 (924)
	--- ---	--- ---	--- ---	--- ---	1311 (6-14)	1035 (6-18)	1E805327092 (736)

1.The force values shown assume a diaphragm loading pressure to the actuator or 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

EMERSON.
Process Management

Available Actuator Force

0-18 Psig to Diaphragm(1)									
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**Spring Part Number (Spring Rate, Lb/in)**
Force, Lb (Bench Set, Psig)	207 (3-15	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E805227082 (2210)
	345 (3-13)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E805127082 (1840)
	483 (3-11)	414 (3-12)	276 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	1E805527082 (1470)
	552 (3-10)	483 (3-11)	345 (3-13)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	1E804927082 (1327)
	552 (3-10)	483 (3-11)	414 (3-12)	276 (3-14)	--- ---	--- ---	--- ---	--- ---	1E805427082 (1230)
	621 (3-9)	552 (3-10)	483 (3-11)	345 (3-13)	207 (3-15)	--- ---	--- ---	--- ---	1E805827082 (1100)
	690 (3-8)	621 (3-9)	552 (3-10)	414 (3-12)	345 (3-13)	207 (3-15)	--- ---	--- ---	1E805727092 (920)
	759 (3-7)	690 (3-8)	690 (3-8)	552 (3-10)	483 (3-11)	414 (3-12)	207 (3-15)	--- ---	1E805327092 (736)
	--- ---	--- ---	759 (3-7)	690 (3-8)	621 (3-9)	552 (3-10)	414 (3-12)	207 (3-15)	1E805627092 (550)
	--- ---	--- ---	--- ---	759 (3-7)	690 (3-8)	621 (3-9)	483 (3-11)	345 (3-13)	1F177227092 (460)
	--- ---	--- ---	--- ---	--- ---	759 (3-7)	690 (3-8)	621 (3-9)	483 (3-11)	1F177127092 (370)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	759 (3-7)	621 (3-9)	1F177027092 (275)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	759 (3-7)	1K509827032 (170)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

6-30 Psig to Diaphragm[1]									
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**Spring Part Number (Spring Rate, Lb)**
Force, Lb (Bench Set, Psig)	414 (6-27)	207 (6-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E805027082 (3780)
	690 (6-23)	483 (6-26)	276 (6-29)	--- ---	--- ---	--- ---	--- ---	--- ---	1E804727082 (3160)
	897 (6-20)	690 (6-23)	552 (6-25)	207 (6-30)	--- ---	--- ---	--- ---	--- ---	1E804827082 (2650)
	1035 (6-18)	897 (6-20)	759 (6-22)	483 (6-26)	207 (6-30)	--- ---	--- ---	--- ---	1E805227082 (2210)
	1173 (6-16)	1035 (6-18)	966 (6-19)	759 (6-22)	483 (6-26)	276 (6-29)	--- ---	--- ---	1E805127082 (1840)
	1311 (6-14)	1242 (6-15)	1104 (6-17)	966 (6-19)	759 (6-22)	552 (6-25)	207 (6-30)	--- ---	1E80552082 (1470)
	--- ---	1311 (6-14)	1173 (6-16)	1035 (6-18)	897 (6-20)	690 (6-23)	345 (6-28)	--- ---	1E804927082 (1327)
	--- ---	1311 (6-14)	1242 (6-15)	1104 (6-17)	966 (6-19)	759 (6-22)	483 (6-26)	--- ---	1E805427082 (1230)
	--- ---	--- ---	1311 (6-14)	1173 (6-16)	1035 (6-18)	897 (6-20)	621 (6-24)	207 (6-30)	1E805827082 (1100)
	--- ---	--- ---	--- ---	1311 (6-14)	1173 (6-16)	1035 (6-18)	759 (6-22)	483 (6-26)	1E805727092 (920)
	--- ---	--- ---	--- ---	--- ---	1311 (6-14)	1242 (6-15)	1035 (6-18)	--- ---	1E805327092 (736)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1242 (6-15)	--- ---	1E805627092 (550)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1173 (6-16)	1F177227092 (460)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1311 (6-14)	1F177127092 (370)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

EMERSON
Process Management

Available Actuator Force

0-18 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In)**
Force, Lb (Bench Set, Psig)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	630 (3-12)	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	735 (3-11)	630 (3-12)	420 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	840 (3-10)	735 (3-11)	525 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826727082 (2080)
	840 (3-10)	735 (3-11)	630 (3-12)	420 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	1E826327082 (1870)
	945 (3-9)	840 (3-10)	735 (3-11)	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	1E826227082 (1670)
	945 (3-9)	945 (3-8)	840 (3-10)	630 (3-12)	420 (3-14)	--- ---	--- ---	--- ---	--- ---	1E827127082 (1560)
	1050 (3-8)	945 (3-9)	840 (3-10)	735 (3-11)	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	1E826827082 (1400)
	1155 (3-7)	1050 (3-8)	945 (3-9)	840 (3-10)	630 (3-12)	525 (3-13)	--- ---	--- ---	--- ---	1E826527082 (1260)
	1155 (3-7)	1050 (3-8)	1050 (3-8)	840 (3-10)	735 (3-11)	630 (3-12)	315 (3-15)	--- ---	--- ---	1E826127082 (1120)
	1155 (3-7)	1155 (3-7)	1050 (3-8)	945 (3-9)	840 (3-10)	630 (3-12)	420 (3-14)	--- ---	--- ---	1E827227082 (1050)
	--- ---	1155 (3-7)	1155 (3-7)	945 (3-9)	840 (3-10)	735 (3-11)	525 (3-13)	--- ---	--- ---	1E827027082 (935)
	--- ---	--- ---	1155 (3-7)	1050 (3-8)	945 (3-9)	840 (3-10)	630 (3-12)	315 (3-15)	--- ---	1E826627082 (840)
	--- ---	--- ---	--- ---	1155 (3-7)	1155 (3-7)	1050 (3-8)	840 (3-10)	630 (3-12)	315 (3-15)	1E826927082 (630)
	--- ---	--- ---	--- ---	--- ---	--- ---	1155 (3-7)	1050 (3-8)	840 (3-10)	630 (3-12)	1F177327082 (472)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1155 (3-7)	945 (3-9)	1E921527092 (315)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1155 (3-7)	1F172827092 (225)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

6-30 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In)**
Force,Lb (Bench Set, Psig)	945 (6-24)	630 (6-27)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E826027082 (5000)
	1260 (6-21)	1050 (6-23)	735 (6-26)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E825627082 (4160)
	1575 (6-18)	1365 (6-20)	1155 (6-22)	735 (6-26)	315 (6-30)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E825527082 (3320)
	1785 (6-16)	1575 (6-18)	1470 (6-19)	1155 (6-22)	735 (6-26)	420 (6-29)	- - - - - -	- - - - - -	- - - - - -	1E825827082 (2770)
	1890 (6-15)	1785 (6-16)	1575 (6-18)	1260 (6-21)	945 (6-24)	630 (6-27)	- - - - - -	- - - - - -	- - - - - -	1E825727082 (2500)
	1995 (6-14)	1890 (6-15)	1680 (6-17)	1470 (6-19)	1155 (6-22)	840 (6-25)	315 (6-30)	- - - - - -	- - - - - -	1E826427082 (2240)
	- - - - - -	1995 (6-14)	1785 (6-16)	1575 (6-18)	1365 (6-20)	1050 (6-23)	525 (6-28)	- - - - - -	- - - - - -	1E826727082 (2080)
	- - - - - -	1995 (6-14)	1890 (6-15)	1680 (6-17)	1470 (6-19)	1155 (6-22)	735 (6-26)	- - - - - -	- - - - - -	1E826327082 (1870)
	- - - - - -	- - - - - -	1995 (6-14)	1785 (6-16)	1575 (6-18)	1365 (6-20)	945 (6-24)	315 (6-30)	- - - - - -	1E826227082 (1670)
	- - - - - -	- - - - - -	- - - - - -	1890 (6-15)	1680 (6-17)	1470 (6-19)	1155 (6-22)	525 (6-28)	- - - - - -	1E827127082 (1560)
	- - - - - -	- - - - - -	- - - - - -	1995 (6-14)	1785 (6-16)	1680 (6-17)	1260 (6-21)	735 (6-26)	- - - - - -	1E826827082 (1400)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1890 (6-15)	1785 (6-16)	1470 (6-19)	945 (6-24)	315 (6-30)	1E826527082 (1260)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1995 (6-14)	1890 (6-15)	1575 (6-18)	1155 (6-22)	630 (6-27)	1E826127082 (1120)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1890 (6-15)	1680 (6-17)	1260 (6-21)	735 (6-26)	1E827227082 (1050)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1995 (6-14)	1785 (6-16)	1470 (6-19)	945 (6-24)	1E827027082 (935)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1890 (6-15)	1575 (6-18)	1155 (6-22)	1E826627082 (840)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1890 (6-15)	1575 (6-18)	1E826927082 (630)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1890 (6-15)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

0-18 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In)**
Force, Lb (Bench Set, Psig)	468 (3-15)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E826027082 (5000)
	780 (3-13)	468 (3-15)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E825627082 (4160)
	1092 (3-11)	936 (3-12)	624 (3-14)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E825527082 (3320)
	1248 (3-10)	1092 (3-11)	936 (3-12)	624 (3-14)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E825827082 (2770)
	1404 (3-9)	1248 (3-10)	1092 (3-11)	780 (3-13)	468 (3-15)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E825727082 (2500)
	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	624 (3-14)	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1E826427082 (2240)
	1560 (3-8)	1404 (3-9)	1248 (3-10)	1092 (3-11)	780 (3-13)	468 (3-15)	- - - - - -	- - - - - -	- - - - - -	1E826727082 (2080)
	1716 (3-7)	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	780 (3-13)	- - - - - -	- - - - - -	- - - - - -	1E826327082 (1870)
	1716 (3-7)	1560 (3-8)	1560 (3-8)	1248 (3-10)	1092 (3-11)	936 (3-12)	468 (3-15)	- - - - - -	- - - - - -	1E826227082 (1670)
	1716 (3-7)	1716 (3-7)	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	624 (3-14)	- - - - - -	- - - - - -	1E827127082 (1560)
	- - - - - -	1716 (3-7)	1716 (3-7)	1404 (3-9)	1248 (3-10)	1092 (3-11)	780 (3-13)	- - - - - -	- - - - - -	1E826827082 (1400)
	- - - - - -	1716 (3-7)	1716 (3-7)	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	468 (3-15)	- - - - - -	1E826527082 (1260)
	- - - - - -	- - - - - -	- - - - - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	624 (3-14)	- - - - - -	1E826127082 (1120)
	- - - - - -	- - - - - -	- - - - - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	780 (3-13)	- - - - - -	1E827227082 (1050)
	- - - - - -	- - - - - -	- - - - - -	1716 (3-7)	1716 (3-7)	1560 (3-8)	1248 (3-10)	936 (3-12)	468 (3-15)	1E827027082 (935)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	624 (3-14)	1E826627082 (840)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	1E826927082 (630)
	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	- - - - - -	1560 (3-8)	1404 (3-9)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

0-33 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In)**
Force, Lb (Bench Set, Psig)	2340 (6-18)	2028 (6-20)	1716 (6-22)	1092 (6-26)	468 (6-30)	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	2652 (6-16)	2340 (6-18)	2184 (6-19)	1560 (6-23)	1092 (6-26)	624 (6-29)	--- ---	--- ---	--- ---	1E825627082 (4160)
	2964 (6-14)	2808 (6-15)	2496 (6-17)	2184 (6-19)	1716 (6-22)	1248 (6-25)	468 (6-30)	--- ---	--- ---	1E825527082 (3320)
	--- ---	2964 (6-14)	2808 (6-15)	2496 (6-17)	2184 (6-19)	1716 (6-22)	1092 (6-26)	--- ---	--- ---	1E825827082 (2770)
	--- ---	--- ---	2964 (6-14)	2652 (6-16)	2340 (6-18)	2028 (6-20)	1404 (6-24)	468 (6-30)	--- ---	1E825727082 (2500)
	--- ---	--- ---	--- ---	2808 (6-15)	2496 (6-17)	2184 (6-19)	1716 (6-22)	--- ---	--- ---	1E826427082 (2240)
	--- ---	--- ---	--- ---	2964 (6-14)	2652 (6-16)	2340 (6-18)	1872 (6-21)	1092 (6-26)	--- ---	1E826727082 (2080)
	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2652 (6-16)	2184 (6-19)	1404 (6-24)	468 (6-30)	1E826327082 (1870)
	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2808 (6-15)	2340 (6-18)	1716 (6-22)	--- ---	1E826227082 (1670)
	--- ---	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2496 (6-17)	1872 (6-21)	1092 (6-26)	1E827127082 (1560)
	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2652 (6-16)	2184 (6-19)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2340 (6-18)	1716 (6-22)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2496 (6-17)	2028 (6-20)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2652 (6-16)	2184 (6-19)	1E827227082 (1050)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2340 (6-18)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2496 (6-17)	1E826627082 (840)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

0-18 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In)**
Force, Lb (Bench Set, Psig)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	630 (3-12)	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	735 (3-11)	630 (3-12)	420 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	840 (3-10)	735 (3-11)	525 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826727082 (2080)
	840 (3-10)	735 (3-11)	630 (3-12)	420 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	1E826327082 (1870)
	945 (3-9)	840 (3-10)	735 (3-11)	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	1E826227082 (1670)
	945 (3-9)	945 (3-9)	840 (3-10)	630 (3-12)	420 (3-14)	--- ---	--- ---	--- ---	--- ---	1E827127082 (1560)
	1050 (3-8)	945 (3-9)	840 (3-10)	735 (3-11)	525 (3-13)	315 (3-15)	--- ---	--- ---	--- ---	1E826827082 (1400)
	1155 (3-7)	1050 (3-8)	945 (3-9)	840 (3-10)	630 (3-12)	525 (3-13)	--- ---	--- ---	--- ---	1E826527082 (1260)
	1155 (3-7)	1050 (3-8)	1050 (3-8)	840 (3-10)	735 (3-11)	630 (3-12)	315 (3-15)	--- ---	--- ---	1E826127082 (1120)
	1155 (3-7)	1155 (3-7)	1050 (3-8)	945 (3-9)	840 (3-10)	630 (3-12)	420 (3-14)	--- ---	--- ---	1E827227082 (1050)
	--- ---	1155 (3-7)	1155 (3-7)	945 (3-9)	840 (3-10)	735 (3-11)	525 (3-13)	--- ---	--- ---	1E827027082 (935)
	--- ---	--- ---	1155 (3-7)	1050 (3-8)	945 (3-9)	840 (3-10)	630 (3-12)	315 (3-15)	--- ---	1E826627082 (840)
	--- ---	--- ---	--- ---	1155 (3-7)	1155 (3-7)	1050 (3-8)	840 (3-10)	630 (3-12)	315 (3-15)	1E826927082 (630)
	--- ---	--- ---	--- ---	--- ---	--- ---	1155 (3-7)	1050 (3-8)	840 (3-10)	630 (3-12)	1F177327082 (472)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1155 (3-7)	945 (3-9)	1E921527092 (315)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1155 (3-7)	1F172827092 (225)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

6-30 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In)**
Force, Lb (Bench Set, Psig)	945 (6-24)	630 (6-27)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	1260 (6-21)	1050 (6-23)	735 (6-26)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1575 (6-18)	1365 (6-20)	1155 (6-22)	735 (6-26)	315 (6-30)	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	1785 (6-16)	1575 (6-18)	1470 (6-19)	1155 (6-22)	735 (6-26)	420 (6-29)	--- ---	--- ---	--- ---	1E825827082 (2770)
	1890 (6-15)	1785 (6-16)	1575 (6-18)	1260 (6-21)	945 (6-24)	630 (6-27)	--- ---	--- ---	--- ---	1E825727082 (2500)
	1995 (6-14)	1890 (6-15)	1680 (6-17)	1470 (6-19)	1155 (6-22)	840 (6-25)	315 (6-30)	--- ---	--- ---	1E826427082 (2240)
	--- ---	1995 (6-14)	1785 (6-16)	1575 (6-18)	1365 (6-20)	1050 (6-23)	525 (6-28)	--- ---	--- ---	1E826727082 (2080)
	--- ---	1995 (6-14)	1890 (6-15)	1680 (6-17)	1470 (6-19)	1155 (6-22)	735 (6-26)	--- ---	--- ---	1E826327082 (1870)
	--- ---	--- ---	1995 (6-14)	1785 (6-16)	1575 (6-18)	1365 (6-20)	945 (6-24)	315 (6-30)	--- ---	1E826227082 (1670)
	--- ---	--- ---	--- ---	1890 (6-15)	1680 (6-17)	1470 (6-19)	1050 (6-23)	420 (6-29)	--- ---	1E827127082 (1560)
	--- ---	--- ---	--- ---	1995 (6-14)	1785 (6-16)	1680 (6-17)	1260 (6-21)	735 (6-26)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	1890 (6-15)	1785 (6-16)	1470 (6-19)	945 (6-24)	315 (6-30)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	1995 (6-14)	1890 (6-15)	1575 (6-18)	1155 (6-22)	630 (6-27)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	1890 (6-15)	1680 (6-17)	1260 (6-21)	735 (6-26)	1E827227082 (1050)
	--- ---	--- ---	--- ---	--- ---	--- ---	1995 (6-14)	1785 (6-16)	1470 (6-19)	945 (6-24)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1890 (6-15)	1575 (6-18)	1155 (6-22)	1E826627082 (840)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1890 (6-15)	1575 (6-18)	1E826927082 (630)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1890 (6-15)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

0-18 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/in.)**
Force, Lb (Bench Set, Psig)	468 (3-15)	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1E826027082 (5000)
	780 (3-13)	468 (3-15)	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1E825627082 (4160)
	1092 (3-11)	936 (3-12)	624 (3-14)	- - -	- - -	- - -	- - -	- - -	- - -	1E825527082 (3320)
	1248 (3-10)	1092 (3-11)	936 (3-12)	624 (3-14)	- - -	- - -	- - -	- - -	- - -	1E825827082 (2770)
	1404 (3-9)	1248 (3-10)	1092 (3-11)	780 (3-13)	468 (3-15)	- - -	- - -	- - -	- - -	1E825727082 (2500)
	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	624 (3-14)	- - -	- - -	- - -	- - -	1E826427082 (2240)
	1560 (3-8)	1404 (3-9)	1248 (3-10)	1092 (3-11)	780 (3-13)	468 (3-15)	- - -	- - -	- - -	1E826727082 (2080)
	1716 (3-7)	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	780 (3-13)	- - -	- - -	- - -	1E826327082 (1870)
	1716 (3-7)	1560 (3-8)	1560 (3-8)	1248 (3-10)	1092 (3-11)	936 (3-12)	468 (3-15)	- - -	- - -	1E826227082 (1670)
	1716 (3-7)	1716 (3-7)	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	624 (3-14)	- - -	- - -	1E827127082 (1560)
	- - -	1716 (3-7)	1716 (3-7)	1404 (3-9)	1248 (3-10)	1092 (3-11)	780 (3-13)	- - -	- - -	1E826827082 (1400)
	- - -	1716 (3-7)	1716 (3-7)	1560 (3-8)	1404 (3-9)	1248 (3-10)	936 (3-12)	468 (3-15)	- - -	1E826527082 (1260)
	- - -	- - -	1716 (3-7)	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	624 (3-14)	- - -	1E826127082 (1120)
	- - -	- - -	- - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	780 (3-13)	- - -	1E827227082 (1050)
	- - -	- - -	- - -	1716 (3-7)	1716 (3-7)	1560 (3-8)	1248 (3-10)	936 (3-12)	468 (3-15)	1E827027082 (935)
	- - -	- - -	- - -	- - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	624 (3-14)	1E826627082 (840)
	- - -	- - -	- - -	- - -	- - -	1716 (3-7)	1560 (3-8)	1404 (3-9)	1092 (3-11)	1E826927082 (630)
	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1560 (3-8)	1404 (3-9)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

6-30 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/in.)**
Force, Lb (Bench Set, Psig)	2340 (6-18	2028 (6-20)	1716 (6-22)	1092 (6-26)	468 (6-30)	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	2652 (6-16)	2340 (6-18)	2184 (6-19)	1560 (6-23)	1092 (6-26)	624 (6-29)	--- ---	--- ---	--- ---	1E825627082 (4160)
	2964 (6-14)	2808 (6-15)	2496 (6-17)	2184 (6-19)	1716 (6-22)	1248 (6-25)	468 (6-30)	--- ---	--- ---	1E825527082 (3320)
	--- ---	2964 (6-14)	2808 (6-15)	2496 (6-17)	2184 (6-19)	1716 (6-22)	1092 (6-26)	--- ---	--- ---	1E825827082 (2770)
	--- ---	--- ---	2964 (6-14)	2652 (6-16)	2340 (6-18)	2028 (6-20)	1404 (6-24)	468 (6-30)	--- ---	1E825727082 (2500)
	--- ---	--- ---	--- ---	2808 (6-15)	2496 (6-17)	2184 (6-19)	1716 (6-22)	--- ---	--- ---	1E826427082 (2240)
	--- ---	--- ---	--- ---	2964 (6-14)	2652 (6-16)	2340 (6-18)	1872 (6-21)	1092 (6-26)	--- ---	1E826727082 (2080)
	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2652 (6-16)	2184 (6-19)	1404 (6-24)	468 (6-30)	1E826327082 (1870)
	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2808 (6-15)	2340 (6-18)	1716 (6-22)	--- ---	1E826227082 (1670)
	--- ---	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2496 (6-17)	1872 (6-21)	1092 (6-26)	1E827127082 (1560)
	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2652 (6-16)	3184 (6-19)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2340 (6-18	1716 (6-22)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2496 (6-17)	2028 (6-20)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	1652 (6-16)	2184 (6-19)	1E827227082 (1050)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2808 (6-15)	2340 (6-18)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2964 (6-14)	2496 (6-17)	1E826627082 (840)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

EMERSON.
Process Management

Available Actuator Force

0-18 Psig to Diaphragm[1]													
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**2.5**	**3**	**4**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1540 (3-11)	1320 (3-12)	1100 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	1980 (3-9)	1760 (3-10)	1540 (3-11)	1100 (3-13)	880 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	2420 (3-7)	2200 (3-8)	1980 (3-9)	1760 (3-10)	1320 (3-12)	1100 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128527082 (2520)
	2420 (3-7)	2420 (3-7)	2200 (3-8)	1980 (3-9)	1540 (3-11)	1320 (3-12)	880 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	2420 (3-7)	2200 (3-8)	1980 (3-9)	1760 (3-10)	1320 (3-12)	660 (3-15)	--- ---	--- ---	--- ---	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	2420 (3-7)	2420 (3-7)	2200 (3-8)	1980 (3-9)	1320 (3-12)	660 (3-15)	--- ---	--- ---	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2420 (3-7)	1980 (3-9)	1540 (3-11)	1100 (3-13)	660 (3-15)	660[2] (3-18)	1N128627082 (840)
0-33 Psig to Diaphragm[1]													
Force, Lb (Bench Set, Psig)	4180 (6-14)	3960 (6-15)	3740 (6-16)	3080 (6-19)	2640 (6-21)	1980 (6-24)	880 (6-29)	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	--- ---	--- ---	4180 (6-14)	3740 (6-16)	3520 (6-17)	3080 (6-19)	2200 (6-23)	880 (6-29)	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	--- ---	--- ---	--- ---	--- ---	3960 (6-15)	3740 (6-16)	3080 (6-19)	2200 (6-23)	880 (6-29)	--- ---	--- ---	--- ---	1N128527082 (2520)
	--- ---	--- ---	--- ---	--- ---	4180 (6-14)	3960 (6-15)	3520 (6-17)	2640 (6-21)	1540 (6-26)	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	3960 (6-15)	3520 (6-17)	2640 (6-21)	1760 (6-25)	880 (6-29)	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	3960 (6-15)	3520 (6-17)	2860 (6-20)	2200 (6-23)	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	4180 (6-14)	3740 (6-16)	3520 (6-17)	3300 (3-18)	1N128627082 (840)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 0 to 21 psig supply pressure assumed.

Available Actuator Force

0-18 Psig to Diaphragm[1]						
Travel, Inch	**0.75**	**1.125**	**1.5**	**2**	**3**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	2065 (3-11)	--- ---	--- ---	--- ---	--- ---	1H747027082 (3100)
	2360 (3-10)	1445 (3-13)	--- ---	--- ---	--- ---	1H747627082 (2600)
	2655 (3-9)	2023 (3-11)	1144 (3-14)	--- ---	--- ---	1H747327082 (2100)
	3245 (3-7)	2312 (3-10)	1716 (3-12)	852 (3-15)	--- ---	1H747527082 (1650)
	--- ---	3179 (3-7)	2860 (3-8)	2272 (3-10)	819 (3-15)	1H747727082 (1000)
0-33 Psig to Diaphragm[1]						
Force, Lb (Bench Set, Psig)	5605 (6-14)	4335 (6-18)	3146 (6-22)	852 (6-30)	--- ---	1H747027082 (3100)
	--- ---	4913 (6-16)	3718 (6-20)	2556 (6-24)	--- ---	1H747627082 (2600)
	--- ---	5491 (6-14)	4576 (6-17)	3124 (6-22)	819 (6-30)	1H747327082 (2100)
	--- ---	--- ---	5148 (6-15)	4260 (6-18)	1911 (6-26)	1H747527082 (1650)
	--- ---	--- ---	--- ---	--- ---	4368 (6-17)	1H747727082 (1000)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

Travel, Inch	0.375	0.4375	0.5	0.625	0.75	0.875	1.125	1.5	2	2.5	3	4	Spring Part Number (Spring Rate, Lb/In.)
0-18 Psig to Diaphragm[1]													
Force, Lb (Bench Set, Psig)	1540 (3-11)	1320 (3-12)	1100 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	1980 (3-9)	1760 (3-10)	1540 (3-11)	1100 (3-13)	880 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	2420 (3-7)	2200 (3-8)	1980 (3-9)	1760 (3-10)	1320 (3-12)	1100 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128527082 (2520)
	2420 (3-7)	2420 (3-7)	2200 (3-8)	1980 (3-9)	1540 (3-11)	1320 (3-12)	880 (3-14)	--- ---	--- ---	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	2420 (3-7)	2200 (3-8)	1980 (3-9)	1760 (3-10)	1320 (3-12)	660 (3-15)	--- ---	--- ---	--- ---	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	2420 (3-7)	2420 (3-7)	2200 (3-8)	1980 (3-9)	1320 (3-12)	660 (3-15)	--- ---	--- ---	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2420 (3-7)	1980 (3-9)	1540 (3-11)	1100 (3-13)	660 (3-15)	660[2] (3-18)	1N128627082 (840)
0-33 Psig to Diaphragm[1]													
Force, Lb (Bench Set, Psig)	4180 (6-14)	3960 (6-15)	3740 (6-16)	3080 (6-19)	2640 (6-21)	1980 (6-24)	880 (6-29)	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	--- ---	--- ---	4180 (6-14)	3740 (6-16)	3520 (6-17)	3080 (6-19)	2200 (6-23)	880 (6-29)	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	--- ---	--- ---	--- ---	--- ---	3960 (6-15)	3740 (6-16)	3080 (6-19)	2200 (6-23)	880 (6-29)	--- ---	--- ---	--- ---	1N128527082 (2520)
	--- ---	--- ---	--- ---	--- ---	4180 (6-14)	3960 (6-15)	3520 (6-17)	2640 (6-21)	1540 (6-26)	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	3960 (6-15)	3520 (6-17)	2640 (6-21)	1760 (6-25)	880 (6-29)	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	3960 (6-15)	3520 (6-17)	2860 (6-20)	2200 (6-23)	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	4180 (6-14)	3740 (6-16)	3520 (6-17)	--- ---	1N128627082 (840)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. 0 to 21 psig supply pressure assumed.

Available Actuator Force

0-18 Psig to Diaphragm[1]							
Travel, Inch	**0.75**	**1.125**	**1.5**	**2**	3	4	Spring Part Number (Spring Rate, Lb/In.)
Force, Lb (Bench Set, Psig)	2250 (3-13)	--- ---	--- ---	--- ---	--- ---	--- ---	10A2564X012 (6000)
	3600 (3-10)	1800 (3-14)	--- ---	--- ---	--- ---	--- ---	10A2563X012 (4500)
	4500 (3-8)	3150 (3-11)	2250 (3-13)	--- ---	--- ---	--- ---	1H747027082 (3100)
	4500 (3-8)	3600 (3-10)	2250 (3-13)	--- ---	--- ---	--- ---	10A2562X012 (2950)
	4950 (3-7)	4050 (3-9)	2700 (3-12)	1350 (3-15)	--- ---	--- ---	1H747627082 (2600)
	--- ---	4500 (3-8)	3600 (3-10)	2700 (3-12)	--- ---	--- ---	1H747327082 (2100)
	--- ---	4950 (3-7)	4050 (3-9)	3150 (3-11)	1350 (3-15)	--- ---	10A2561X012 (1775)
	--- ---	4950 (3-7)	4500 (3-8)	3600 (3-10)	1800 (3-14)	--- ---	1H747527082 (1650)
	--- ---	--- ---	--- ---	4950 (3-7)	3600 (3-10)	2700 (3-12)	1H747727082 (1000)
0-33 Psig to Diaphragm[1]							
Force, Lb (Bench Set, Psig)	7650 (6-16)	5400 (6-21)	3150 (6-26)	--- ---	--- ---	--- ---	10A2564X012 (6000)
	--- ---	7200 (6-17)	5400 (6-21)	3150 (6-26)	--- ---	--- ---	10A2563X012 (4500)
	--- ---	8550 (6-14)	7650 (6-16)	5400 (6-20)	2700 (6-27)	--- ---	1H747027082 (3100)
	--- ---	--- ---	7650 (6-16)	6300 (6-19)	3150 (6-26)	--- ---	10A2562X012 (2950)
	--- ---	--- ---	8100 (6-15)	6750 (6-18)	4500 (6-23)	--- ---	1H747627082 (2600)
	--- ---	--- ---	--- ---	8100 (6-15)	5400 (6-20)	--- ---	1H747327082 (2100)
	--- ---	--- ---	--- ---	8550 (6-14)	6750 (6-18)	4950 (6-22)	10A2561X012 (1775)
	--- ---	--- ---	--- ---	--- ---	7200 (6-17)	--- ---	1H747527082 (1650)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

Travel, Inch	0.25	0.375	0.4375	0.5	0.625	0.75	Spring Part Number (Spring Rate, Lb/In.)
0-18 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	184 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E793327082 (2100)
	230 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E795427082 (1770)
	322 (7-15)	138 (3-15)	--- ---	--- ---	--- ---	--- ---	1E792427082 (1470)
	368 (8-15)	230 (5-15)	138 (3-15)	--- ---	--- ---	--- ---	1E795327082 (1260)
	460 (10-15)	322 (7-15)	276 (6-15)	184 (4-15)	--- ---	--- ---	1J258127092 (1000)
	460 (10-15)	368 (8-15)	322 (7-15)	276 (6-15)	184 (4-15)	--- ---	1F714327092 (830)
	506 (11-15)	414 (9-15)	368 (8-15)	322 (7-15)	230 (5-15)	138 (3-15)	1E792327092 (735)
	--- ---	460 (10-15)	414 (9-15)	368 (8-15)	322 (7-15)	230 (5-15)	1F176927092 (612)
	--- ---	506 (11-15)	460 (10-15)	460 (10-15)	368 (8-15)	322 (7-15)	1F176827092 (490)
	--- ---	--- ---	--- ---	506(2) (11-15)	460 (10-15)	414 (9-15)	1F176727032 (368)
0-33 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	736 (16-30)	414 (9-30)	276 (6-30)	--- ---	--- ---	--- ---	1E795627082 (2520)
	874 (19-30)	598 (13-30)	460 (10-30)	322 (7-30)	--- ---	--- ---	1E793327082 (2100)
	920 (20-30)	736 (16-30)	644 (14-30)	506 (11-30)	276 (6-30)	--- ---	1E795427082 (1770)
	1012 (22-30)	828 (18-30)	736 (16-30)	644 (14-30)	460 (10-30)	276 (6-30)	1E792427082 (1470)
	--- ---	920 (20-30)	828 (18-30)	736 (16-30)	644 (14-30)	460 (10-30)	1E795327082 (1260)
	--- ---	1012 (22-30)	920 (20-30)	874 (19-30)	736 (16-30)	644 (14-30)	1J258127092 (1000)
	--- ---	--- ---	1012 (22-30)	966 (21-30)	874 (19-30)	736 (16-30)	1F174327092 (830)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1R9209X00A2.

Available Actuator Force

0-18 Psig to Diaphragm(1)						
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	345 (5-15)	207 (3-15)	--- ---	--- ---	--- ---	1E805127082 (1840)
	483 (7-15)	414 (6-15)	276 (4-15)	--- ---	--- ---	1E805527082 (1470)
	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	--- ---	1E804927082 (1327)
	552 (8-15)	483 (7-15)	414 (6-15)	276 (4-15)	--- ---	1E805427082 (1230)
	621 (9-15)	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	1E805827082 (1100)
	690 (10-15)	621 (9-15)	552 (8-15)	414 (6-15)	345 (5-15)	1E805727092 (920)
	759 (11-15)	690 (10-15)	690 (10-15)	552 (8-15)	483 (7-15)	1E805327092 (736)
	--- ---	--- ---	759 (11-15)	690 (10-15)	552 (9-15)	1E805627092 (550)
	--- ---	--- ---	--- ---	759(2) (11-15)	690 (10-15)	1F177227092 (460)
	--- ---	--- ---	--- ---	--- ---	759(2) (11-15)	1F177127092 (370)
0-33 Psig to Diaphragm(1)						
Force, Lb (Bench Set, Psig)	621 (9-30)	414 (6-30)	--- ---	--- ---	--- ---	1E805027082 (3780)
	897 (13-30)	690 (10-30)	483 (7-30)	--- ---	--- ---	1E804727082 (3160)
	1104 (16-30)	966 (14-30)	759 (11-30)	414 (6-30)	--- ---	1E804827082 (2650)
	1242 (18-30)	1104 (16-30)	966 (14-30)	690 (10-30)	414 (6-30)	1E805227082 (2210)
	1380 (20-30)	1242 (18-30)	1173 (17-30)	966 (14-30)	690 (10-30)	1E805127082 (1840)
	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	966 (14-30)	1E805527082 (1470)
	--- ---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1104 (16-30)	1E804927082 (1327)
	--- ---	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	1E805427082 (1230)
	--- ---	--- ---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1E805827082 (1100)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1H153924102.

EMERSON
Process Management

Available Actuator Force

0-18 Psig to Diaphragm(1)									
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig) *FS Number*	345 (5-15)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E805127082 (1840)
	483 (7-15)	414 (6-15)	276 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E805527082 (1470)
	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	1E804927082 (1327)
	552 (8-15)	483 (7-15)	414 (6-15)	276 (4-15)	--- ---	--- ---	--- ---	--- ---	1E805427082 (1230)
	621 (9-15)	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	--- ---	--- ---	--- ---	1E805827082 (1110)
	690 (10-15)	621 (9-15)	552 (8-15)	414 (6-15)	345 (5-15)	207 (3-15)	--- ---	--- ---	1E805727092 (920)
	759 (11-15)	690 (10-15)	690 (10-15)	552 (8-15)	483 (7-15)	414 (6-15)	207 (3-15)	--- ---	1E805327092 (736)
	--- ---	--- ---	759 (11-15)	690 (10-15)	621 (9-15)	552 (8-15)	414 (6-15)	207 (3-15)	1E805627092 (550)
	--- ---	--- ---	--- ---	759(2) (11-15)	690 (10-15)	621 (9-15)	552 (8-15)	345 (5-15)	1F177227092 (460)
	--- ---	--- ---	--- ---	--- ---	759(2) (11-15)	690(2) (10-15)	621(2) (9-15)	483 (7-15)	1F177127092 (370)
0-33 Psig to Diaphragm(1)									
Force, Lb (Bench Set, Psig) *FS Number*	621 (9-30)	414 (6-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E805027082 (3780)
	897 (13-30)	690 (10-30)	483 (7-30)	--- ---	--- ---	--- ---	--- ---	--- ---	1E804727082 (3160)
	1104 (16-30)	897 (13-30)	759 (11-30)	414 (6-30)	--- ---	--- ---	--- ---	--- ---	1E804827082 (2650)
	1242 (18-30)	1104 (16-30)	966 (14-30)	690 (10-30)	414 (6-30)	--- ---	--- ---	--- ---	1E805227082 (2210)
	1380 (20-30)	1242 (18-30)	1173 (17-30)	966 (14-30)	690 (10-30)	483 (7-30)	--- ---	--- ---	1E805127082 (1840)
	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	966 (14-30)	759 (11-30)	414 (6-30)	--- ---	1E805527082 (1470)
	--- ---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1104 (16-30)	897 (13-30)	552 (8-30)	--- ---	1E804927082 (1327)
	--- ---	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	966 (14-30)	690 (10-30)	--- ---	1E805427082 (1230)
	--- ---	--- ---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1104 (16-30)	828 (12-30)	414 (6-30)	1E805827082 (1100)

1. The force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1H153924102.

Available Actuator Force

0-18 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	630 (6-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	735 (7-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	840 (8-15)	735 (7-15)	525 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826727082 (2080)
	840 (8-15)	735 (7-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E826327082 (1870)
	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	1E826227082 (1670)
	945 (9-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	1E827127082 (1560)
	1050 (10-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	1E826827082 (1400)
	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	525 (5-15)	--- ---	--- ---	--- ---	1E826527082 (1260)
	1155 (11-15)	1050 (10-15)	1050 (10-15)	840 (8-15)	735 (7-15)	630 (6-15)	315 (3-15)	--- ---	--- ---	1E826127082 (1120)
	1155 (11-15)	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	1E827227082 (1050)
	--- ---	1155 (11-15)	1155 (11-55)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	--- ---	--- ---	1E827027082 (935)
	--- ---	--- ---	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	315 (3-15)	--- ---	1E826627082 (840)
	--- ---	--- ---	--- ---	1155 (11-15)	1155 (11-15)	1050 (10-15)	840 (8-15)	630 (6-15)	315 (3-15)	1E826927082 (630)
	--- ---	--- ---	--- ---	--- ---	--- ---	1155[2] (11-15)	1050[3] (10-15)	840 (8-15)	630 (6-15)	1F177327082 (472)

1. The force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1K331724102.

Available Actuator Force

0-33 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	1575 (15-30)	1365 (13-30)	1050 (10-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1890 (18-30)	1680 (16-30)	1470 (14-30)	1050 (10-30)	630 (6-30)	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	2100 (20-30)	1890 (18-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	735 (7-30)	--- ---	--- ---	--- ---	1E825827082 (2770)
	2205 (21-30)	2100 (20-30)	1890 (18-30)	1575 (15-30)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	1E825727082 (2500)
	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1155 (11-30)	630 (6-30)	--- ---	--- ---	1E826427082 (2240)
	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1365 (13-30)	840 (8-30)	--- ---	--- ---	1E826727082 (2080)
	--- ---	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	--- ---	--- ---	1E826327082 (1870)
	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1260 (12-30)	630 (6-30)	--- ---	1E286227082 (1670)
	--- ---	--- ---	--- ---	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	840 (8-30)	--- ---	1E827127082 (1560)
	--- ---	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1995 (19-30)	1575 (15-30)	1050 (10-30)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	2205 (21-30)	2100 (20-30)	1785 (17-30)	1260 (12-30)	630 (6-30)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	2310(2) (22-30)	2205(2) (21-30)	1890 (18-30)	1470 (14-30)	945 (9-30)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	2205(2) (21-30)	1995(2) (19-30)	1575 (15-30)	1050 (10-30)	1E827227082 (1050)

1. The force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1K677324102.

Available Actuator Force

0-18 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	1248 (8-15)	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	1E826727082 (2080)
	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	780 (5-15)	--- ---	--- ---	--- ---	1E826327082 (1870)
	1716 (11-15)	1560 (10-15)	1560 (10-15)	1248 (8-15)	1092 (7-15)	936 (6-15)	468 (3-15)	--- ---	--- ---	1E826227082 (1670)
	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	1E827127082 (1560)
	--- ---	1716 (11-15)	1716 (11-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	--- ---	--- ---	1E826827082 (1400)
	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	468 (3-15)	--- ---	1E826527082 (1260)
	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	--- ---	1E826127082 (1120)
	--- ---	--- ---	--- ---	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	780 (5-15)	--- ---	1E827227082 (1050)
	--- ---	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1248 (8-15)	936 (6-15)	468 (3-15)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	1716[2] (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	1E826627082 (840)
0-33 Psig to Diaphragm[1]										
Force, Lb (Bench Set, Psig)	2808 (18-30)	2496 (16-30)	2184 (14-30)	1560 (10-30)	936 (6-30)	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	3120 (20-30)	2808 (18-30)	2652 (17-30)	2028 (13-30)	1560 (10-30)	1092 (7-30)	--- ---	--- ---	--- ---	1E825627082 (4160)
	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1716 (11-30)	936 (6-30)	--- ---	--- ---	1E825527082 (3320)
	--- ---	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1560 (10-30)	--- ---	--- ---	1E825827082 (2770)
	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2496 (16-30)	1872 (12-30)	936 (6-30)	--- ---	1E825727082 (2500)
	--- ---	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2340 (15-30)	1560 (10-30)	--- ---	1E826727082 (2080)
	--- ---	--- ---	--- ---	--- ---	3276 (21-30)	3120 (20-30)	2652 (17-30)	1872 (12-30)	936 (6-30)	1E826327082 (1870)

1. The force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1K331724102.

EMERSON.
Process Management

Available Actuator Force

0-18 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	630 (6-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	735 (7-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	840 (8-15)	735 (7-15)	525 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826727082 (2080)
	840 (8-15)	735 (7-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E826327082 (1870)
	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	1E826227082 (1670)
	945 (9-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	1E827127082 (1560)
	1050 (10-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	1E826827082 (1400)
	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	525 (5-15)	--- ---	--- ---	--- ---	1E826527082 (1260)
	1155 (11-15)	1050 (10-15)	1050 (10-15)	840 (8-15)	735 (7-15)	630 (6-15)	315 (3-15)	--- ---	--- ---	1E826127082 (1120)
	1155 (11-15)	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	1E827227082 (1050)
	--- ---	1155 (11-15)	1155 (11-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	--- ---	--- ---	1E827027082 (935)
	--- ---	--- ---	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	315 (3-15)	--- ---	1E826627082 (840)
	--- ---	--- ---	--- ---	1155 (11-15)	1155 (11-15)	1050 (10-15)	840 (8-15)	630 (6-15)	315 (3-15)	1E826927082 (630)
	--- ---	--- ---	--- ---	--- ---	--- ---	1155(2) (11-15)	1050(3) (10-15)	840 (8-15)	630 (6-15)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1K677324102.
3. Specify spring adjustor 1K331724102.

Available Actuator Force

6-30 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	1575 (15-30)	1365 (13-30)	1050 (10-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1890 (18-30)	1680 (16-30)	1470 (14-30)	1050 (10-30)	630 (6-30)	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	2100 (20-30)	1890 (18-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	735 (7-30)	--- ---	--- ---	--- ---	1E825827082 (2770)
	2205 (21-30)	2100 (20-30)	1890 (18-30)	1575 (15-30)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	1E825727082 (2500)
	2300 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1555 (11-30)	630 (6-30)	--- ---	--- ---	1E826427082 (2240)
	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1365 (13-30)	840 (8-30)	--- ---	--- ---	1E826727082 (2020)
	--- ---	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	--- ---	--- ---	1E826327082 (1870)
	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1260 (12-30)	630 (6-30)	--- ---	1E826227082 (1670)
	--- ---	--- ---	--- ---	2205 (21-30)	1995 (19-30)	1785 (17-30)	1365 (13-30)	840 (8-30)	--- ---	1E827127082 (1560)
	--- ---	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1995 (19-30)	1575 (15-30)	1050 (10-30)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	2205 (21-30)	2100 (20-30)	1785 (17-30)	1260 (12-30)	630 (6-30)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	2310[2] (22-30)	2205[2] (21-30)	1890 (18-30)	1470 (14-30)	945 (9-30)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	2205[2] (21-30)	1995[2] (19-30)	1575 (15-30)	1050 (10-30)	1E827227082 (1050)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1K331724102.

Available Actuator Force

0-18 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	1248 (8-15)	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	1E826727082 (2080)
	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	780 (5-15)	--- ---	--- ---	--- ---	1E826327082 (1870)
	1716 (11-15)	1560 (10-15)	1560 (10-15)	1248 (8-15)	1092 (7-15)	936 (6-15)	468 (3-15)	--- ---	--- ---	1E826227082 (1670)
	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	1E827127082 (1560)
	--- ---	1716 (11-15)	1716 (11-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	--- ---	--- ---	1E826827082 (1400)
	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	468 (3-15)	--- ---	1E826527082 (1260)
	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	--- ---	1E826127082 (1120)
	--- ---	--- ---	--- ---	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	780 (5-15)	--- ---	1E827227082 (1050)
	--- ---	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1248 (8-15)	936 (6-15)	468 (3-15)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	1716[2] (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	1E826627082 (840)
0-33 Psig to Diaphragm[1]										
Force, Lb (Bench Set, Psig)	2808 (18-30)	2496 (16-30)	2184 (14-30)	1560 (10-30)	936 (6-30)	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	3120 (20-30)	2808 (18-30)	2652 (17-30)	2028 (13-30)	1560 (10-30)	1092 (7-30)	--- ---	--- ---	--- ---	1E825627082 (4160)
	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1716 (11-30)	936 (6-30)	--- ---	--- ---	1E825527082 (3320)
	--- ---	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1560 (10-30)	--- ---	--- ---	1E825827082 (2770)
	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2496 (16-30)	1872 (12-30)	936 (6-30)	--- ---	1E825727082 (2500)
	--- ---	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2340 (15-30)	1560 (10-30)	--- ---	1E826727082 (2080)
	--- ---	--- ---	--- ---	--- ---	3276 (21-30)	3120 (20-30)	2652 (17-30)	1872 (12-30)	936 (6-30)	1E826327082 (1870)

1. The force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1K331724102.

Available Actuator Force

0-18 Psig to Diaphragm(1)											
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**3**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1540 (7-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	1980 (9-15)	1760 (8-15)	1540 (7-15)	1100 (5-15)	880 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	1N128527082 (2520)
	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1540 (7-15)	1320 (6-15)	880 (4-15)	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	660 (3-15)	--- ---	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1320 (6-15)	660 (3-15)	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1980(2) (9-15)	1760 (8-15)	660 (3-15)	1N128627082 (840)
0-33 Psig to Diaphragm(1)											
Force, Lb (Bench Set, Psig)	4840 (22-30)	4620 (21-30)	4400 (20-30)	3740 (17-30)	3300 (15-30)	2640 (12-30)	1540 (7-30)	--- ---	--- ---	--- ---	1N128127082 (4475)
	--- ---	--- ---	4840 (22-30)	4400 (20-30)	4180 (19-30)	3740 (17-30)	2860 (13-30)	1320 (6-30)	--- ---	--- ---	1N127927082 (3360)
	--- ---	--- ---	--- ---	--- ---	4620 (21-30)	4400 (20-30)	3740 (17-30)	2860 (13-30)	1320 (6-30)	--- ---	1N128527082 (2520)
	--- ---	--- ---	--- ---	--- ---	4840(2) (22-30)	4620(2) (21-30)	4180 (19-30)	3080 (14-30)	2200 (10-30)	--- ---	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	4620(3) (21-30)	4180(2) (19-30)	3080 (14-30)	1320 (6-30)	1N128727082 (1680)

1. The force values shown assume a supply pressure to the actuator of 0 to 18 psig for a 3 to 15 nominal psig signal and a 0 to 33 psig supply for a 6 to 30 nominal psig signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1N827035132.
3. Specify spring adjustor 1P994435132.

Available Actuator Force

0-18 Psig to Diaphragm(1)						
Travel, Inch	**0.75**	**1.125**	**1.5**	**2**	3	Spring Part Number (Spring Rate, Lb/In.)
Force, Lb (Bench Set, Psig)	2212 (7-15)	--- ---	--- ---	--- ---	--- ---	1H747027082 (3100)
	2528 (8-15)	1580 (5-15)	--- ---	--- ---	--- ---	1H747627082 (2600)
	2844 (9-15)	2212 (7-15)	1264 (4-15)	--- ---	--- ---	1H747327082 (2100)
	3476 (11-15)	2528 (8-15)	1896 (6-15)	948 (3-15)	--- ---	1H747527082 (1650)
	--- ---	--- ---	--- ---	2528 (8-15)	948 (3-15)	1H747727082 (1000)
0-33 Psig to Diaphragm(1)						
Force, Lb (Bench Set, Psig)	6952 (22-30)	5688 (18-30)	4424 (14-30)	1896 (6-30)	--- ---	1H747027082 (3100)
	--- ---	6320(2) (20-30)	5056 (16-30)	3792 (12-30)	--- ---	1H747627082 (2600)
	--- ---	--- ---	--- ---	4424 (14-30)	1896 (6-30)	1H747327082 (2100)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1P161724492.

Available Actuator Force

3-15 Psig to Diaphragm[1]											
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**3**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig) *FS Number*	1540 (7-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	1980 (9-15)	1760 (8-15)	1540 (7-15)	1100 (5-15)	880 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	1N128527082 (2520)
	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1540 (7-15)	1320 (6-15)	880 (4-15)	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	880 (4-15)	--- ---	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1320 (6-15)	660 (3-15)	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1980[2] (9-15)	1760 (8-15)	660 (3-15)	1N128627082 (840)
6-30 Psig to Diaphragm[1]											
Force, Lb (Bench Set, Psig) *FS Number*	4840 (22-30)	4620 (21-30)	4400 (20-30)	3740 (17-30)	3300 (15-30)	2640 (12-30)	1540 (7-30)	--- ---	--- ---	--- ---	1N128127082 (4475)
	--- ---	--- ---	4840 (22-30)	440 (20-30)	4180 (19-30)	3740 (17-30)	2860 (13-30)	1540 (7-30)	--- ---	--- ---	1N127927082 (3360)
	--- ---	--- ---	--- ---	--- ---	4620 (21-30)	4400 (20-30)	3740 (17-30)	2860 (13-30)	1320 (6-30)	--- ---	1N128527082 (2520)
	--- ---	--- ---	--- ---	--- ---	4840[2] (22-30)	4620[2] (21-30)	4180 (19-30)	3300 (15-30)	2200 (10-30)	--- ---	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	4620[3] (21-30)	4180[2] (19-30)	3080 (14-30)	1320 (6-30)	1N128727082 (1680)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1N872035132.
3. Specify spring adjustor 1P994435132.

Available Actuator Force

Travel, Inch	**0.75**	**1.125**	**1.5**	**2**	3	4	Spring Part Number (Spring Rate, Lb/In.)
0-18 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	2250 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	10A2564X012 (6000)
	3600 (8-15)	1800 (4-15)	--- ---	--- ---	--- ---	--- ---	10A2563X012 (4500)
	4500 (10-15)	3150 (7-15)	2250 (5-15)	--- ---	--- ---	--- ---	1H747027082 (3100)
	4500 (10-15)	3600 (8-15)	2250 (5-15)	--- ---	--- ---	--- ---	10A2562X012 (2950)
	4950 (11-15)	4050 (9-15)	2700 (6-15)	1350 (3-15)	--- ---	--- ---	1H747627082 (2600)
	--- ---	4500 (10-15)	3600 (8-15)	2700 (6-15)	--- ---	--- ---	1H747327082 (2100)
	--- ---	4950 (11-15)	4050 (9-15)	3150 (7-15)	1350 (3-15)	--- ---	10A2561X012 (1775)
	--- ---	4950 (11-15)	4500 (10-15)	3600 (8-15)	1800 (4-15)	--- ---	1H747527082 (1650)
	--- ---	--- ---	--- ---	--- ---	--- ---	2700 (6-15)	1H747727082 (1000)
0-33 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	9000 (20-30)	6750 (15-30)	4500 (10-30)	--- ---	--- ---	--- ---	10A2564X012 (6000)
	--- ---	8550 (19-30)	6750 (15-30)	4500 (10-30)	--- ---	--- ---	10A2563X012 (4500)
	--- ---	9900 (22-30)	9000 (20-30)	7200 (16-30)	4050 (9-30)	--- ---	1H747027082 (3100)
	--- ---	--- ---	9000 (20-30)	7650 (17-30)	4500 (10-30)	--- ---	10A2562X012 (2950)
	--- ---	--- ---	--- ---	9900 (22-30)	8100 (18-30)	6300 (14-30)	10A2561X012 (1775)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

0-18 Psig to Diaphragm(1)							
Travel, Inch	**0.25**	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	184 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E793327082 (2100)
	230 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E795427082 (1770)
	322 (7-15)	138 (3-15)	--- ---	--- ---	--- ---	--- ---	1E792427082 (1470)
	368 (8-15)	230 (5-15)	138 (3-15)	--- ---	--- ---	--- ---	1E795327082 (1260)
	460 (10-15)	322 (7-15)	276 (6-15)	184 (4-15)	--- ---	--- ---	1J258127092 (1000)
	460 (10-15)	368 (8-15)	322 (7-15)	276 (6-15)	184 (4-15)	--- ---	1F714327092 (830)
	506 (11-15)	414 (9-15)	368 (8-15)	322 (7-15)	230 (5-15)	138 (3-15)	1E792327092 (735)
	--- ---	460 (10-15)	414 (9-15)	368 (8-15)	322 (7-15)	230 (5-15)	1F176927092 (612)
	--- ---	506 (11-15)	460 (10-15)	460 (10-15)	368 (8-15)	322 (7-15)	1F176827092 (490)
	--- ---	--- ---	--- ---	506(2) (11-15)	460 (10-15)	414 (9-15)	1F176727032 (368)
0-33 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	736 (16-30)	414 (9-30)	276 (6-30)	--- ---	--- ---	--- ---	1E795627082 (2520)
	874 (19-30)	598 (13-30)	460 (10-30)	322 (7-30)	--- ---	--- ---	1E793327082 (2100)
	920 (20-30)	736 (16-30)	644 (14-30)	506 (11-30)	276 (6-30)	--- ---	1E795427082 (1770)
	1012 (22-30)	828 (18-30)	736 (16-30)	644 (14-30)	460 (10-30)	276 (6-30)	1E792427082 (1470)
	--- ---	920 (20-30)	828 (18-30)	736 (16-30)	644 (14-30)	460 (10-30)	1E795327082 (1260)
	--- ---	1012 (22-30)	920 (20-30)	874 (19-30)	736 (16-30)	644 (14-30)	1J258127092 (1000)
	--- ---	--- ---	1012 (22-30)	966 (21-30)	874 (19-30)	736 (16-30)	1F174327092 (830)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J711524102.

Available Actuator Force

0-18 Psig to Diaphragm(1)							
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	0.75	1.125	Spring Part Number (Spring Rate, Lb/In.)
Force, Lb (Bench Set, Psig)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E805227082 (2210)
	345 (5-15)	207 (3-15)	--- ---	--- ---	--- ---	--- ---	1E805127082 (1840)
	483 (7-15)	414 (6-15)	276 (4-15)	--- ---	--- ---	--- ---	1E805527082 (1470)
	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	--- ---	--- ---	1E804927082 (1327)
	552 (8-15)	483 (7-15)	414 (6-15)	276 (4-15)	--- ---	--- ---	1E805427082 (1230)
	621 (9-15)	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	--- ---	1E805827082 (1100)
	690 (10-15)	621 (9-15)	552 (8-15)	414 (6-15)	345 (5-15)	--- ---	1E805727092 (920)
	759 (11-15)	690 (10-15)	690 (10-15)	552 (8-15)	483 (7-15)	207 (3-15)	1E805327092 (736)
	--- ---	--- ---	759 (11-15)	690 (10-15)	621 (9-15)	414 (6-15)	1E805627092 (550)
	--- ---	--- ---	--- ---	759(2) (11-15)	690 (10-15)	552 (8-15)	1F177227092 (460)
	--- ---	--- ---	--- ---	--- ---	759(3) (11-15)	621(2) (9-15)	1F177127092 (370)
0-33 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	621 (9-30)	414 (6-30)	--- ---	--- ---	--- ---	--- ---	1E805027082 (3780)
	897 (13-30)	690 (10-30)	483 (7-30)	--- ---	--- ---	--- ---	1E804727082 (3160)
	1104 (16-30)	966 (14-30)	759 (11-30)	414 (6-30)	--- ---	--- ---	1E804827082 (2650)
	1242 (18-30)	1104 (16-30)	966 (14-30)	690 (10-30)	414 (6-30)	--- ---	1E805227082 (2210)
	1380 (20-30)	1242 (18-30)	1173 (17-30)	966 (14-30)	690 (10-30)	--- ---	1E805127082 (1840)
	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	966 (14-30)	414 (6-30)	1E805527082 (1470)
	--- ---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1104 (16-30)	55 (8-30)	1E804927082 (1327)
	--- ---	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	690 (10-30)	1E805427082 (1230)
	--- ---	--- ---	1518 (22-30)	1380 (20-30)	1242 (18-30)	828 (12-30)	1E805827082 (1100)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J717724102.
3. Specify spring adjustor 1J711924102.

Available Actuator Force

Travel, Inch	0.375	0.4375	0.5	0.625	0.75	0.875	1.125	1.5	Spring Part Number (Spring Rate, Lb/In.)
0-18 Psig to Diaphragm(1)									
Force, Lb (Bench Set, Psig)	207 (3-15)	---	---	---	---	---	---	---	1E805227082 (2210)
	345 (5-15)	207 (3-15)	---	---	---	---	---	---	1E805127082 (1840)
	483 (7-15)	414 (6-15)	276 (4-15)	---	---	---	---	---	1E805527082 (1470)
	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	---	---	---	---	1E804927082 (1327)
	552 (8-15)	483 (7-15)	414 (6-15)	276 (4-15)	---	---	---	---	1E805427082 (1230)
	621 (9-15)	552 (8-15)	483 (7-15)	345 (5-15)	207 (3-15)	---	---	---	1E805827082 (1100)
	690 (10-15)	621 (9-15)	552 (8-15)	414 (6-15)	345 (5-15)	207 (3-15)	---	---	1E805727092 (920)
	759 (11-15)	690 (10-15)	690 (10-15)	552 (8-15)	483 (7-15)	414 (6-15)	207 (3-15)	---	1E805327092 (736)
	---	---	759 (11-15)	690 (10-15)	621 (9-15)	552 (8-15)	414 (6-15)	207 (3-15)	1E805627092 (550)
	---	---	---	759(2) (11-15)	690 (10-15)	721 (9-15)	552 (8-15)	345 (5-15)	1F177227092 (460)
	---	---	---	---	759(3) (11-15)	690 (10-15)	621(2) (9-15)	483 (7-15)	1F177127092 (370)
0-33 Psig to Diaphragm(1)									
Force, Lb (Bench Set, Psig)	621 (9-30)	414 (6-30)	---	---	---	---	---	---	1E805027082 (3780)
	897 (13-30)	690 (10-30)	483 (7-30)	---	---	---	---	---	1E804727082 (3160)
	1104 (16-30)	897 (13-30)	759 (11-30)	414 (6-30)	---	---	---	---	1E804827082 (2650)
	1242 (18-30)	1104 (16-30)	966 (14-30)	690 (10-30)	414 (6-30)	---	---	---	1E805227082 (2210)
	1380 (20-30)	1242 (18-30)	1173 (17-30)	966 (14-30)	690 (10-30)	483 (7-30)	---	---	1E805127082 (1840)
	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	966 (14-30)	759 (11-30)	414 (6-30)	---	1E805527082 (1470)
	---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1104 (16-30)	897 (13-30)	552 (8-30)	---	1E804927082 (1327)
	---	1518 (22-30)	1449 (21-30)	1311 (19-30)	1173 (17-30)	966 (14-30)	690 (10-30)	---	1E805427082 (1230)
	---	---	1518 (22-30)	1380 (20-30)	1242 (18-30)	1104 (16-30)	828 (12-30)	414 (6-30)	1E805827082 (1100)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J717724102.
3. Specify spring adjustor 1J711924102.

Available Actuator Force

0-18 Psig to Diaphragm(1)										
Travel, Inch	0.375	0.4375	0.5	0.625	0.75	0.875	1.125	1.5	2	Spring Part Number (Spring Rate, Lb/In.)
Force, Lb (Bench Set, Psig)	315 (3-15)	---	---	---	---	---	---	---	---	1E825527082 (3320)
	525 (5-15)	315 (3-15)	---	---	---	---	---	---	---	1E825827082 (2770)
	630 (6-15)	525 (5-15)	315 (3-15)	---	---	---	---	---	---	1E825727082 (2500)
	735 (7-15)	630 (6-15)	420 (4-15)	---	---	---	---	---	---	1E826427082 (2240)
	840 (8-15)	735 (7-15)	525 (5-15)	---	---	---	---	---	---	1E826727082 (2080)
	840 (8-15)	735 (7-15)	630 (6-15)	420 (4-15)	---	---	---	---	---	1E826327082 (1870)
	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	---	---	---	---	1E826227082 (1670)
	945 (9-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	---	---	---	---	1E827127082 (1560)
	1050 (10-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	---	---	---	1E826827082 (1400)
	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	525 (5-15)	---	---	---	1E826527082 (1260)
	1155 (11-15)	1050 (10-15)	1050 (10-15)	840 (8-15)	735 (7-15)	630 (6-15)	315 (3-15)	---	---	1E826127082 (1120)
	1155 (11-15)	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	---	---	1E827227082 (1050)
	---	1155 (11-15)	1155 (11-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	---	---	1E827027082 (935)
	---	---	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	315 (3-15)	---	1E826627082 (840)
	---	---	---	1155 (11-15)	1155 (11-15)	1050 (10-15)	840 (8-15)	630 (6-15)	315 (3-15)	1E826927082 (630)
	---	---	---	---	---	1155(2) (11-15)	1050(2) (10-15)	840 (8-15)	630 (6-15)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J712224102.

Available Actuator Force

0-33 Psig to Diaphragm[1]										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1260 (12-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	1575 (15-30)	1365 (13-30)	1050 (10-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1890 (18-30)	1680 (16-30)	1470 (14-30)	1050 (10-30)	630 (6-30)	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	2100 (20-30)	1890 (18-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	735 (7-30)	--- ---	--- ---	--- ---	1E825827082 (2770)
	2205 (21-30)	2100 (20-30)	1890 (18-30)	1575 (15-30)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	1E825727082 (2500)
	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1155 (11-30)	630 (6-30)	--- ---	--- ---	1E826427082 (2240)
	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1365 (13-30)	840 (8-30)	--- ---	--- ---	1E826727082 (2080)
	--- ---	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	--- ---	--- ---	1E826327082 (1870)
	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1260 (12-30)	630 (6-30)	--- ---	1E826227082 (1670)
	--- ---	--- ---	--- ---	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	840 (8-30)	--- ---	1E827127082 (1560)
	--- ---	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1995 (19-30)	1575 (15-30)	1050 (10-30)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	2205 (21-30)	2100 (20-30)	1785 (17-30)	1260 (12-30)	630 (6-30)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	2310[2] (22-30)	2205[2] (21-30)	1890 (18-30)	1470 (14-30)	945 (9-30)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	2205[2] (21-30)	1995[2] (19-30)	1575 (15-30)	1050 (10-30)	1E827227082 (1050)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig diaphragm loading for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J712224102.

EMERSON
Process Management

Available Actuator Force

Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
0-18 Psig to Diaphragm(1)										
Force, Lb (Bench Set, Psig)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	1248 (8-15)	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	1E826727082 (2080)
	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	780 (5-15)	--- ---	--- ---	--- ---	1E826327082 (1870)
	1716 (11-15)	1560 (10-15)	1560 (10-15)	1248 (8-15)	1092 (7-15)	936 (6-15)	468 (3-15)	--- ---	--- ---	1E826227082 (1670)
	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	1E827127082 (1560)
	--- ---	1716 (11-15)	1716 (11-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	--- ---	--- ---	1E826827082 (1400)
	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	468 (3-15)	--- ---	1E826527082 (1260)
	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	--- ---	1E826127082 (1120)
	--- ---	--- ---	--- ---	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	780 (5-15)	--- ---	1E827227082 (1050)
	--- ---	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1248 (8-15)	936 (6-15)	468 (3-15)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	1716(2) (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	1E826627082 (840)
0-33 Psig to Diaphragm(1)										
Force, Lb (Bench Set, Psig)	2808 (18-30)	2496 (16-30)	2184 (14-30)	1560 (10-30)	936 (6-30)	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	3120 (20-30)	2808 (18-30)	2652 (17-30)	2028 (13-30)	1560 (10-30)	1092 (7-30)	--- ---	--- ---	--- ---	1E825627082 (4160)
	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1716 (11-30)	936 (6-30)	--- ---	--- ---	1E825527082 (3320)
	--- ---	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1560 (10-30)	--- ---	--- ---	1E825827082 (2770)
	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2496 (16-30)	1872 (12-30)	936 (6-30)	--- ---	1E825727082 (2500)
	--- ---	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2340 (15-30)	1560 (10-30)	--- ---	1E826727082 (2080)
	--- ---	--- ---	--- ---	--- ---	3276 (21-30)	3120 (20-30)	2652 (17-30)	1872 (12-30)	936 (6-30)	1E826327082 (1870)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J712224102.

Available Actuator Force

0-18 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	630 (6-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	735 (7-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	840 (8-15)	735 (7-15)	525 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826727082 (2080)
	840 (8-15)	735 (7-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E826327082 (1870)
	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	--- ---	1E826227082 (1670)
	945 (9-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	--- ---	--- ---	1E827127082 (1560)
	1050 (10-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	315 (3-15)	--- ---	--- ---	--- ---	1E826827082 (1400)
	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	525 (5-15)	--- ---	--- ---	--- ---	1E826527082 (1260)
	1155 (11-15)	1050 (10-15)	1050 (10-15)	840 (8-15)	735 (7-15)	630 (6-15)	315 (3-15)	--- ---	--- ---	1E826127082 (1120)
	1155 (11-15)	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	420 (4-15)	--- ---	--- ---	1E827227082 (1050)
	--- ---	1155 (11-15)	1155 (11-15)	945 (9-15)	840 (8-15)	735 (7-15)	525 (5-15)	--- ---	--- ---	1E827027082 (935)
	--- ---	--- ---	1155 (11-15)	1050 (10-15)	945 (9-15)	840 (8-15)	630 (6-15)	315 (3-15)	--- ---	1E826627082 (840)
	--- ---	--- ---	--- ---	1155 (11-15)	1155 (11-15)	1050 (10-15)	840 (8-15)	630 (6-15)	315 (3-15)	1E826927082 (630)
	--- ---	--- ---	--- ---	--- ---	--- ---	1155(2) (11-15)	1050(2) (10-15)	840 (8-15)	630 (6-15)	1F177327082 (472)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J712224102.

Available Actuator Force

0-33 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	1575 (15-30)	1365 (13-30)	1050 (10-30)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1890 (18-30)	1680 (16-30)	1470 (14-30)	1050 (10-30)	630 (6-30)	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	2100 (20-30)	1890 (18-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	735 (7-30)	--- ---	--- ---	--- ---	1E825827082 (2770)
	2205 (21-30)	2100 (20-30)	1890 (18-30)	1575 (15-30)	1260 (12-30)	945 (9-30)	--- ---	--- ---	--- ---	1E825727082 (2500)
	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1555 (11-30)	630 (6-30)	--- ---	--- ---	1E826427082 (2240)
	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1365 (13-30)	840 (8-30)	--- ---	--- ---	1E826727082 (2020)
	--- ---	2310 (22-30)	2205 (21-30)	1995 (19-30)	1785 (17-30)	1470 (14-30)	1050 (10-30)	--- ---	--- ---	1E826327082 (1870)
	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1890 (18-30)	1680 (16-30)	1260 (12-30)	630 (6-30)	--- ---	1E826227082 (1670)
	--- ---	--- ---	--- ---	2205 (21-30)	1995 (19-30)	1785 (17-30)	1365 (13-30)	840 (8-30)	--- ---	1E827127082 (1560)
	--- ---	--- ---	--- ---	2310 (22-30)	2100 (20-30)	1995 (19-30)	1575 (15-30)	1050 (10-30)	--- ---	1E826827082 (1400)
	--- ---	--- ---	--- ---	--- ---	2205 (21-30)	2100 (20-30)	1785 (17-30)	1260 (12-30)	630 (6-30)	1E826527082 (1260)
	--- ---	--- ---	--- ---	--- ---	2310(2) (22-30)	2205(2) (21-30)	1890 (18-30)	1470 (14-30)	945 (9-30)	1E826127082 (1120)
	--- ---	--- ---	--- ---	--- ---	--- ---	2205(2) (21-30)	1995(2) (19-30)	1575 (15-30)	1050 (10-30)	1E827227082 (1050)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J712224102.

Available Actuator Force

3-15 Psig to Diaphragm(1)										
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825627082 (4160)
	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1E825527082 (3320)
	1248 (8-15)	1092 (7-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1E825827082 (2770)
	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	--- ---	1E825727082 (2500)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	--- ---	--- ---	1E826427082 (2240)
	1560 (10-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	468 (3-15)	--- ---	--- ---	--- ---	1E826727082 (2080)
	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	780 (5-15)	--- ---	--- ---	--- ---	1E826327082 (1870)
	1716 (11-15)	1560 (10-15)	1506 (10-15)	1248 (8-15)	1092 (7-15)	936 (6-15)	468 (3-15)	--- ---	--- ---	1E826227082 (1670)
	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	624 (4-15)	--- ---	--- ---	1E827127082 (1560)
	--- ---	1716 (11-15)	1716 (11-15)	1404 (9-15)	1248 (8-15)	1092 (7-15)	780 (5-15)	--- ---	--- ---	1E826827082 (1400)
	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1248 (8-15)	936 (6-15)	468 (3-15)	--- ---	1E826527082 (1260)
	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	--- ---	1E826127082 (1120)
	--- ---	--- ---	--- ---	1716 (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	780 (5-15)	--- ---	1E827227082 (1050)
	--- ---	--- ---	--- ---	1716 (11-15)	1716 (11-15)	1560 (10-15)	1248 (8-15)	936 (6-15)	468 (3-15)	1E827027082 (935)
	--- ---	--- ---	--- ---	--- ---	1716(2) (11-15)	1560 (10-15)	1404 (9-15)	1092 (7-15)	624 (4-15)	1E826627082 (840)
6-30 Psig to Diaphragm(1)										
Force, Lb (Bench Set, Psig)	2808 (18-30)	2496 (16-30)	2184 (14-30)	1560 (10-30)	936 (6-30)	--- ---	--- ---	--- ---	--- ---	1E826027082 (5000)
	3120 (20-30)	2808 (18-30)	2652 (17-30)	2028 (13-30)	1560 (10-30)	1092 (7-30)	--- ---	--- ---	--- ---	1E825627082 (4160)
	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1716 (11-30)	936 (6-30)	--- ---	--- ---	1E825527082 (3320)
	--- ---	3432 (22-30)	3276 (21-30)	2964 (19-30)	2652 (17-30)	2184 (14-30)	1560 (10-30)	--- ---	--- ---	1E825827082 (2770)
	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2496 (16-30)	1872 (12-30)	936 (6-30)	--- ---	1E825727082 (2500)
	--- ---	--- ---	--- ---	3432 (22-30)	3120 (20-30)	2808 (18-30)	2340 (15-30)	1560 (10-30)	--- ---	1E826727082 (2080)
	--- ---	--- ---	--- ---	--- ---	3276 (21-30)	3120 (20-30)	2652 (17-30)	1872 (12-30)	936 (6-30)	1E826327082 (1870)

1. The force values shown assume a diaphragm loading pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1J712224102.

Available Actuator Force

667 0-18 Psig to Diaphragm[1]													
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**2.5**	**3**	**4**	**Spring Part Number (Spring Rate, Lb/Inch)**
Force, Lb (Bench Set, Psig)	1540 (7-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	1980 (9-15)	1760 (8-15)	1540 (7-15)	1100 (5-15)	880 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128527082 (2520)
	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1540 (7-15)	1320 (6-15)	880 (3-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	660 (3-15)	--- ---	--- ---	--- ---	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (8-15)	1320 (6-15)	660 (3-15)	--- ---	--- ---	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2420[2] (11-15)	1980[3] (9-15)	1540 (7-15)	1100 (5-15)	660 (3-15)	660 (3-18)	1N128627082 (840)
667 0-33 Psig to Diaphragm[1]													
Force, Lb (Bench Set, Psig)	4840 (22-30)	4620 (21-30)	4400 (20-30)	3740 (17-30)	3300 (15-30)	2640 (12-30)	1540 (6-30)	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	--- ---	--- ---	4840 (22-30)	4400 (20-30)	4180 (19-30)	3740 (17-30)	2860 (13-30)	1320 (6-30)	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	--- ---	--- ---	--- ---	--- ---	4620 (21-30)	4400 (20-30)	3740 (17-30)	2860 (13-30)	1320 (6-30)	--- ---	--- ---	--- ---	1N128527082 (2520)
	--- ---	--- ---	--- ---	--- ---	4840[2] (22-30)	4620[3] (21-30)	4180 (19-30)	3080 (14-30)	2200 (10-30)	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	4620[2] (21-30)	4180[3] (19-30)	3080 (14-30)	2420 (11-30)	1320 (6-30)	--- ---	1N128727082 (1680)

667-4 0-33 Psig to Diaphragm[1]			
Travel, Inch	**3**	**4**	**Spring Part Number (Spring Rate, Lb/Inch)**
Force, Lb (Bench Set, Psig)	3080[5] (14-26)	2420[6] (11-26)	1R676027082 (860)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1U1079X00A2.
3. Specify spring adjustor 1N909524502.
4. 3 to 18 psig to diaphragm (0 to 21 psig supply).
5. 1980 lb force, 9 to 21 psig bench set with side-mounted handwheel.
6. 1980 lb force, 9 to 25 psig bench set with side-mounted handwheel.

Available Actuator Force

Travel, Inch	0.75	0.875	1	1.125	1.5	2	Spring Part Number (Spring Rate, Lb/Inch)
Size 76—0-33 Psig to Diaphragm[1]							
Force, Lb (Bench Set, Psig)	--- ---	--- ---	--- ---	2808 (18-30)	2184 (14-30)	1404 (9-30)	1N128727082 (1680)
	--- ---	--- ---	--- ---	3276 (21-30)	2808 (18-30)	2184 (14-30)	1N128427082 (1260)
Size 76—0-48 Psig to Diaphragm[1]							
Force, Lb (Bench Set, Psig)	3588 (23-45)	3120 (20-45)	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	4524 (29-45)	--- ---	3588 (23-45)	3276 (21-45)	--- ---	--- ---	1N127927082 (3360)
	--- ---	4836 (31-45)	4524 (29-45)	--- ---	3276 (21-45)	2028 (13-45)	1N128527082 (2520)
	--- ---	--- ---	4836 (31-45)	4524 (29-45)	3744 (24-45)	2496 (16-45)	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	4212 (27-43)	3276 (21-43)	1N128727082 (1680)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 33 psig for a 6-30 psig nominal signal, and 0-48 psig for a 3-45 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the slightly extended range.

Available Actuator Force

Travel, Inch	0.75	1.125	1.5	2	3	Spring Part Number (Spring Rate, Lb/Inch)
Size 80—0-18 Psig to Diaphragm[1]						
Force, Lb (Bench Set, Psig)	2212 (7-15)	--- ---	--- ---	--- ---	--- ---	1H747027082 (3100)
	2528 (8-15)	1580 (5-15)	--- ---	--- ---	--- ---	1H747627082 (2600)
	2844 (9-15)	2212 (7-15)	1264 (4-15)	--- ---	--- ---	1H747327082 (2100)
	3476 (11-15)	2528 (8-15)	1896 (6-15)	948 (3-15)	--- ---	1H747527082 (1650)
	--- ---	--- ---	--- ---	2528 (8-15)	948 (3-15)	1H747727082 (1000)
Size 80—0-33 Psig to Diaphragm[1]						
Force, Lb (Bench Set, Psig)	6952 (22-30)	5688 (18-30)	4424 (14-30)	1896 (6-30)	--- ---	1H747027082 (3100)
	--- ---	6320[2] (20-30)	5056 (16-30)	3160 (10-30)	--- ---	1H747627082 (2600)
	--- ---	--- ---	--- ---	4424 (14-30)	1896 (6-30)	1H747327082 (2100)
	--- ---	--- ---	--- ---	--- ---	2844 (9-29)	1H747527082 (1650)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1N329219042.

Available Actuator Force

667 0-18 Psig to Diaphragm[1]													
Travel, Inch	**0.375**	**0.4375**	**0.5**	**0.625**	**0.75**	**0.875**	**1.125**	**1.5**	**2**	**2.5**	**3**	**4**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	1540 (7-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	1980 (9-15)	1760 (8-15)	1540 (7-15)	1100 (5-15)	880 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	1100 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	1N128527082 (2520)
	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1540 (7-15)	1320 (6-15)	880 (4-15)	--- ---	--- ---	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	2420 (11-15)	2200 (10-15)	1980 (9-15)	1760 (8-15)	1320 (6-15)	880 (4-15)	--- ---	--- ---	--- ---	--- ---	1N128727082 (1680)
	--- ---	--- ---	--- ---	2420 (11-15)	2420 (11-15)	2200 (10-15)	1980 (9-15)	1320 (6-15)	660 (3-15)	--- ---	--- ---	--- ---	1N128427082 (1260)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	2420[2] (11-15)	1980[3] (9-15)	1760 (8-15)	1100 (5-15)	660 (3-15)	660 (3-18)	1N128627082 (840)
667 0-33 Psig to Diaphragm[1]													
Force, Lb (Bench Set, Psig)	4840 (22-30)	4620 (21-30)	4400 (20-30)	3740 (17-30)	3300 (15-30)	2640 (12-30)	1540 (7-30)	--- ---	--- ---	--- ---	--- ---	--- ---	1N128127082 (4475)
	--- ---	--- ---	4840 (22-30)	4400 (20-30)	4180 (19-30)	3740 (17-30)	2860 (13-30)	1540 (7-30)	--- ---	--- ---	--- ---	--- ---	1N127927082 (3360)
	--- ---	--- ---	--- ---	--- ---	4620 (21-30)	4400 (20-30)	3740 (17-30)	2860 (13-30)	1320 (6-30)	--- ---	--- ---	--- ---	1N128527082 (2520)
	--- ---	--- ---	--- ---	--- ---	4840 (22-30)	4620 (21-30)	4180 (19-30)	3300 (15-30)	2200 (10-30)	--- ---	--- ---	--- ---	1N719327082 (2240)
	--- ---	--- ---	--- ---	--- ---	--- ---	--- ---	4620 (21-30)	4180 (19-30)	3080 (14-30)	2420 (11-30)	1320 (6-30)	--- ---	1N128727082 (1680)

667-4 0-33 Psig to Diaphragm[1]			
Travel, Inch	**3**	**4**	**Spring Part Number (Spring Rate, Lb/In.)**
Force, Lb (Bench Set, Psig)	3080[5] (14-26)	2420[6] (11-26)	1R676027082 (860)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.
2. Specify spring adjustor 1U1079X00A2.
3. Specify spring adjustor 1N909524502.
4. 3 to 18 psig to diaphragm (0 to 21 psig supply).
5. 1980 lb force, 9 to 21 psig bench set with side-mounted handwheel.
6. 1980 lb force, 9 to 25 psig bench set with side-mounted handwheel.

Available Actuator Force

Travel, Inch	0.75	1.125	1.5	2	3	4	Spring Part Number (Spring Rate, Lb/Inch)
0-18 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	2250 (5-15)	--- ---	--- ---	--- ---	--- ---	--- ---	10A2564X012 (6000)
	3600 (8-15)	1800 (4-15)	--- ---	--- ---	--- ---	--- ---	10A2563X012 (4500)
	4500 (10-15)	3600 (8-15)	2250 (5-15)	--- ---	--- ---	--- ---	10A2562X012 (2950)
	--- ---	4950 (11-15)	4050 (9-15)	3150 (7-15)	1350 (3-15)	--- ---	10A2561X012 (1775)
0-33 Psig to Diaphragm(1)							
Force, Lb (Bench Set, Psig)	9000 (20-30)	6750 (15-30)	4500 (10-30)	--- ---	--- ---	--- ---	10A2564X012 (6000)
	--- ---	8550 (19-30)	6750 (15-30)	4500 (10-30)	--- ---	--- ---	10A2563X012 (4500)
	--- ---	--- ---	9000 (20-30)	7650 (17-30)	4500 (10-30)	--- ---	10A2562X012 (2950)
	--- ---	--- ---	--- ---	9900 (22-30)	8100 (18-30)	6300 (14-30)	10A2561X012 (1775)

1. The force values shown assume a diaphragm pressure to the actuator of 0 to 18 psig for a 3 to 15 psig nominal signal and a 0 to 33 psig supply for a 6 to 30 psig nominal signal. Any positioner, controller, or transducer used with these actuators must be capable of delivering the appropriate slightly extended range.

Available Actuator Force

Air-To-Open (Spring Closes)			
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**THRUST**
Inch	**Bar**	**lb/in**	**lbs**
5	0.6 - 1.2	400	2350
	0.8 - 1.9	611	3595
	1.5 - 2.8	730	6085
6	0.6 - 1.3	400	2350
	0.8 - 2.1	611	3595
	1.5 - 3	730	6085
6.5	0.6 - 1.4	400	2350
	0.8 - 2.2	611	3595
	1.5 - 3.1	730	6085
7	0.6 - 1.5	400	2350
	0.8 - 2.3	611	3595
	1.5 - 3.3	730	6085
8	0.6 - 1.6	400	2350
	0.8 - 2.5	611	3595
	1.5 - 3.5	730	6085

Air-To-Close (Spring Opens)					
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**SUPPLY BAR**		
			2.0	**3.0**	**4.0**
Inch	**Bar**	**lb/in**	**Thrust, lbs**		
5	0.6 - 1.2	400	2855	6460	10065
6	0.6 - 1.3	400	2280	5795	9315
6.5	0.6 - 1.4	400	2190	5660	9135
7	0.6 - 1.5	400	1700	5125	8555
8	0.6 - 1.6	400	1125	4465	7805

Available Actuator Force

Air-To-Open (Spring Closes)			
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**THRUST**
Inch	**Bar**	**lb/in**	**lbs**
5	0.6 - 1.2	400	2350
	0.8 - 1.9	611	3595
	1.5 - 2.8	730	6085
6	0.6 - 1.3	400	2350
	0.8 - 2.1	611	3595
	1.5 - 3	730	6085
6.5	0.6 - 1.4	400	2350
	0.8 - 2.2	611	3595
	1.5 - 3.1	730	6085
7	0.6 - 1.5	400	2350
	0.8 - 2.3	611	3595
	1.5 - 3.3	730	6085
8	0.6 - 1.6	400	2350
	0.8 - 2.5	611	3595
	1.5 - 3.5	730	6085

1. These FS numbers are for the 5-inch yoke boss only. An option is required for 5H yoke boss.

Air-To-Close (Spring Opens)					
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**SUPPLY BAR**		
			2.0	**3.0**	**4.0**
Inch	**Bar**	**lb/in**	**Thrust, lbs**		
5	0.6 - 1.2	400	2855	6460	10065
6	0.6 - 1.3	400	2280	5795	9315
6.5	0.6 - 1.4	400	2190	5660	9135
7	0.6 - 1.5	400	1700	5125	8555
8	0.6 - 1.6	400	1125	4465	7805

1. These FS numbers are for the 5-inch yoke boss only. An option is required for 5H yoke boss.

EMERSON.
Process Management

Available Actuator Force

Air-To-Open (Spring Closes) (3-9/16 Inch Yoke Boss)			
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**THRUST**
Inch	**Bar**	**lb/in**	**lbs**
2	0.5 - 0.8	531	1830
	1.1 - 1.8	1285	4325
	1.6 - 2.5	1599	6010
3	0.5 - 0.9	531	1830
	1.1 - 2.2	1285	4325
	1.5 - 2.4	970	5885
4	0.5 - 1.1	531	1830
	1.3 - 2.5	970	5120
120 mm	0.5 - 1.2	531	1830
	1.2 - 2.6	970	4550

Air-To-Close (Spring Opens) (3-9/16 Inch Yoke Boss)					
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**SUPPLY BAR**		
			2.0	**3.0**	**4.0**
Inch	**Bar**	**lb/in**	**Thrust, lbs**		
2	0.5 - 0.8	531	4860	8730	12610
3	0.5 - 0.9	531	4160	7950	11740
4	0.5 - 1.1	531	3455	7160	10865
120 mm	0.5 - 1.2	531	2945	6585	10230

Air-To-Open (Spring Closes) (5-Inch and 5H Yoke Boss)			
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**THRUST**
Inch	Bar	lb/in	lbs
2	0.5 - 0.8	531	1830
	1.1 - 1.8	1285	4325
	1.6 - 2.5	1599	6010
3	0.5 - 0.9	531	1830
	1.1 - 2.2	1285	4325
	1.5 - 2.4	970	5885
4	0.5 - 1.1	531	1830
	1.3 - 2.5	970	5120
120 mm	0.5 - 1.2	531	1830
	1.2 - 2.6	970	4550

Air-To-Close (Spring Opens) (5-Inch and 5H Yoke Boss)					
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**SUPPLY BAR**		
			2.0	**3.0**	**4.0**
Inch	**Bar**	**lb/in**	**Thrust, lbs**		
2	0.5 - 0.8	531	4860	8730	12610
3	0.5 - 0.9	531	4160	7950	11740
4	0.5 - 1.1	531	3455	7160	10865
120 mm	0.5 - 1.2	531	2945	6585	10230

Available Actuator Force

Air-To-Open (Spring Closes)			
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**THRUST**
Inch	Bar	lb/in	lbs
2	1.1 - 1.9	2713	7795
3	1.1 - 2.3	2713	7795
	1.7 - 2.8	2312	13750
4	1.2 - 2.4	1810	8625
	1.7 - 3.1	1816	12580
120 mm	1.2 - 2.6	1810	8625
	1.7 - 3.3	1816	12580

Air-To-Close (Spring Opens)				
VALVE TRAVEL	**SPRING RANGE**	**SPRING RATE**	**SUPPLY BAR**	
			3.0	**4.0**
Inch	**Bar**	**lb/in**	**Thrust, lbs**	
2	1.1 - 1.9	2713	9560	17155
3	1.1 - 2.3	2713	5595	12770
4	1.2 - 2.4	1810	5100	12085
120 mm	1.2 - 2.6	1810	3630	10565

Sample Calculations

The sizing procedures which follow enable the user to select the appropriate piston actuator or to select the appropriate spring and to determine the bench set for a spring-opposed diaphragm actuator under given service conditions.

Note

The numbers used in this calculation are for example only and may not reflect actual availability of product. Contact your Emerson Process Management sales office for your specific application.

585C Piston Actuator (Springless Construction)

Pressure-Tends-To-Open

Sizing Calculation

Problem: Determine the appropriate size, 585C piston actuator (springless construction), for the valve and service conditions described below:

- NPS 4 ES
- Push-Down-To-Close
- Flow Up
- Metal Seat
- PTFE Packing
- Travel--2 inches
- Port Area--15.03 square inches
- Port Circumference--13.74 inches
- Valve Stem Connection--1/2 inch
- $\Delta P_{shutoff}$--100 psi
- Customer Required Seat Load--50 pounds per lineal inch of port circumference
- Customer Air Supply--80 psig
- Valve Stem Material--316 strain-hardened stainless steel
- Process Temperature--80°F

Initially, select the smallest size actuator that matches the 1/2 inch valve stem connection and the 2-13/16 inch yoke boss of an NPS 4 ES valve body. The smallest actuator size meeting this criterion is a 585C size 25.

The force required to overcome static unbalance will be determined by multiplying the pressure drop at shutoff by the port area against which this pressure is applied. (Assuming no downstream restrictions; i.e., downstream pressure is zero.)

100 psi x 15.03 in.^{2} = 1503 lb

Assuming a seat load requirement of 50 pounds per lineal inch of port circumference, the seat load can be determined as follows:

50 lb/in. x 13.74 in. = 687 lb

The force required to overcome packing friction with a 1/2 inch stem is 50 pounds.

The total force required of the actuator will be the sum of the forces required to overcome static unbalance, to overcome packing friction, and to provide seat load.

Force required = 1503 lb + 687 lb + 50 lb = 2240 lb. The force generated by a 585C Springless actuator can be found by using the following equation with the force available to the actuator at 100 psig (table 8).

$$\text{Actual Available Force} = \frac{\text{Actual Supply (or Operating) Pressure, psig}}{\text{100 psig}} \times \text{Force Available at 100 psig}$$

The force available for the 585C Springless actuator in this example at 100 psig is 2600 pounds. The available force is then:

$$\frac{\text{80 psig}}{\text{100 psig}} \times 2600\text{ lb} = 2080\text{ lb}$$

Since the force available is less than the force required, proceed to the next larger actuator (585C size 50) with an available force of 4710 pounds at 100 psig (table 8). The actual available force at 80 psig is:

$$\frac{\text{80 psig}}{\text{100 psig}} \times 4710\text{ lb} = 3768\text{ lb}$$

Since this force available is greater than the force required (2240 pounds), the 585C size 50 actuator will operate the NPS 4 ES under the given conditions.

Note

Additional breakout force will be required in the initial cycles of a 585C actuator which has not been operated for a period of time.

Operational Checks

Using table 8, make certain that the maximum allowable cylinder pressure and maximum allowable thrust are not exceeded. Also, check that the actual available force at 80 psig does not exceed the maximum allowable valve stem load for the 1/2 inch 316 strain-hardened stainless steel stem.

1. The 80 psig supply pressure does not exceed the 150 psig maximum allowable cylinder pressure. In cases in which the maximum allowable cylinder pressure is exceeded, a different actuator must be selected.

2. The actual available force at 80 psig, 3768 pounds, does not exceed the maximum allowable stem load of 4970 pounds for the 1/2 inch 316 strain-hardened valve stem. For cases in which the stem is overloaded, either (1) reduce the air supply if possible to do so and still provide adequate available force, (2) select a different stem material using the procedures in the Stem Load Calculation section, or (3) select an actuator with a larger yoke boss and larger valve stem.

3. The thrust produced, 3768 pounds, does not exceed the 7050 pounds maximum allowable thrust (table 8). In cases in which the maximum allowable thrust is exceeded, a larger actuator must be selected.

Fisher 685 Piston Actuator

Pressure-Tends-To –Open

Sizing Calculation

Problem: Determine the appropriate size, 685 piston actuator, for the valve and service conditions described below:

- NPS 20 x 16 EWT
- Push-Down-To-Close
- Flow Up
- Metal Seat
- PTFE Packing
- Travel: 14.88 inches
- Unbalance Area: 0.72 square inches
- Port Circumference: 51.05 inches
- Valve Stem Connection: 1-1/4 inches
- $\Delta P_{shutoff}$: 300 psi
- Class IV Shutoff
- Customer Air Supply: 85 psig
- Valve Stem Material: S20910
- Process Temperature: 200°F

Initially select the smallest size actuator that matches the 1-1/4 inch valve stem connection, 5H inch yoke boss, and travel of the NPS 20 x 16 EWT valve body. The smallest actuator size meeting this criterion is a 685 size 12.

The force required to overcome static unbalance will be determined by multiplying the pressure drop at shutoff by the unbalanced area as indicated in table 2. (Assuming no downstream restriction; i.e., downstream pressure is zero.)

$$300 \text{ psi} \times 0.72 \text{ in.}^2 = 216 \text{ lb}$$

As indicated in table 4 the seat load requirement consistent with metal seating and Class IV shutoff is 80 pounds per lineal inch of port circumference, the seat load can be determined as follows:

$$80 \text{ lb/in.} \times 51.05 \text{ in.} = 4084 \text{ lb}$$

The force required to overcome packing friction with a 1-1/4 inch stem is 120 pounds.

The total force required of the actuator will be the sum of the forces required to overcome static unbalance, to overcome packing friction, and to provide seat load.

Force required = 216 + 4084 + 120 = 4420 lb. The force generated by a 685 actuator can be found by using the following equation with the force available to the actuator at 100 psig (table A).

$$\text{Actual Available Force} = \frac{\text{Actual Supply (or Operating) Pressure, psig}}{\text{100 psig}} \times \text{Force Available at 100 psig}$$

The force available for the 685 actuator in this example at 100 psig is 11310 pounds. The available force is then:

$$\frac{\text{85 psig}}{\text{100 psig}} \times \text{11310 lb} = \text{9614 lb}$$

Since the force available is greater than the force required (4420 pounds), the 685 size 12 actuator will operate the NPS 20 x 16 EWT-2 under the given conditions.

Operational Checks

Using table A, make certain that the maximum allowable cylinder pressure and maximum allowable thrust are not exceeded.

1. The 85 psig supply pressure does not exceed the 150 psig maximum allowable cylinder pressure. In cases in which the maximum allowable cylinder pressure is exceeded, a different actuator must be selected.

2. The thrust produced, 9614 pounds, does not exceed the 16965 pounds maximum allowable thrust (table A). In cases in which the maximum allowable thrust is exceeded, a larger actuator must be selected.

Fisher 685SE (Spring Extend) Piston Actuator

Pressure-Tends-To - Open

Sizing Calculation

Problem: Determine the appropriate size, 685SE piston actuator, for the valve and service conditions described below:

- NPS 6 HPT
- Push-Down-To-Close
- Fail Mode: Valve Plug to Fail Close
- Manual Override Required
- Flow Down
- Metal Seat
- PTFE Packing
- Travel: 3 inches
- Unbalance Area: 0.206 square inches
- Port Circumference: 16.89 inches
- Valve Stem Connection: 1 inches
- $\Delta P_{shutoff}$: 750 psi
- Class V Shutoff
- Customer Available Supply Pressure: 85 psig
- Valve Stem Material: S20910
- Process Temperature: 400°F

Initially select the smallest size actuator that matches the 1 inch valve stem connection, 5 inch yoke boss, and travel of the NPS 6 HPT. The smallest size actuator meeting this criterion is a 685SE size 10.

The force required to overcome static unbalance will be determined by multiplying the pressure drop at shutoff by the unbalanced area as indicated in table 2. (Assuming no downstream restriction; i.e. downstream pressure is zero.)

750 psi x 0.206 in. = 155 lb

As indicated in table 4, the seat load requirement consistent with metal seating and Class V shutoff at the 450 psi shutoff pressure drop is 192 pounds per lineal inch of port circumference, the seat load can be determined as follows:

192 lb/in. x 16.89 in. = 3243 lb

The force required to overcome packing friction with a 1 inch stem is 100 pounds.

The actuator spring will need to provide enough force to overcome the unbalance and packing friction forces in addition to providing 40 lb/in of seat load and overcoming the actuator friction. The required spring thrust is as follows:

155 lb + (40 lb/in. x 16.89 in.) + 100 + (79 in^2 x 2 psi) = 1089 lb

As indicated in table 3, the spring that will provide a preload equal to or greater than the required 1089 lb of force is a 150 lb/in spring rate with a maximum preload of 1500 lb. However this spring must also be checked to ensure that it provides a bench set span of greater than or equal to 5 psi:

(150 lb/in. x 3.5 in.) / 79 in^2 = 6.65 psi   PASS

Now that the actuator spring is selected we must now determine if the size 10 actuator will provide enough thrust at the 85 psig customer available supply pressure to operate the valve. First we will calculate the available actuator thrusts in both the down and up directions:

Actuator Thrust Down = (85 psig x 79 in^2) + 1500 lb – (79 in^2 x 2 psig) = 8057 lb

Actuator Thrust Up = [85 psig x (79 in^2 – 2.41 in^2)] – (1500 lb x 1.10) – (1.05 x 150 lb/in x 3.5 in) – (79 in^2 x 2 psig) = 4151 lb

Next we should determine the amount of thrust the valve would require the actuator to produce in both the down and up directions:

Valve Thrust Down = 155 lb + 3243 lb + 100 lb = 3498 lb

Valve Thrust Up = 100 lbs + 30 lb = 130 lb

Since both the Valve Thrust Down and Up are less than the Actuator Thrust Down and Up the actuator has enough thrust to operate the valve.

Operational Checks

1. Check that the maximum allowable cylinder pressure of 150 psi is not exceeded by the customer available supply pressure.

85 psi ≤ 150 psi PASS

2. Check that the actuator will not provide too much thrust onto the valve seat (i.e. excessive seat load). Too much seat load is defined as at or exceeding 1000 lb/in.

3498 lb / 16.89 in = 207.10 lb/in

207.10 lb/in < 1000 lb/in PASS

3. Check that the actuator manual override can produce sufficient thrust to position the valve. The required thrust that the actuator manual override must produce is as follows:

130 lb + (1500 x 1.10) + (150 lb/in x 3.5 in x 1.05) + (2 psi / 79 in^2) + (3 psi / 79 in^2) = 2331 lb

As indicated in table 5, the manual override with the 685SE size 10 can produce 10000 lb of thrust, which is more than enough to position the valve.

4. Check that the actual stem load produced by the actuator is less than the maximum allowable stem load.

Actual Stem Load = (85 psi x 79 in2) + (1500 x 1.10) = 8365 lb

Per table 1 of the Stem Load Calculation section of this document, for a NPS 6 HPT valve with a S20910 valve stem table 4 is used to determine the maximum allowable stem load.

Allowable Stem Load = 8990 lb x 1.878 = 16883 lb

8365 lb < 16883 lb PASS

Fisher 685SR (Spring Retract) Piston Actuator

Pressure-Tends-To - Open

Sizing Calculation

Problem: Determine the appropriate size, 685SR piston actuator, for the valve and service conditions described below:

- NPS 16 Large ET
- Push-Down-To-Close
- Fail Mode: Valve Plug to Fail Open
- Manual Override Required
- Flow Up
- Metal Seat
- PTFE Packing
- Travel: 8 inches
- Unbalance Area: 0.49 square inches
- Valve Stem Area: 1.23 square inches
- Port Circumference: 34.56 inches
- Valve Stem Connection: 1.25 inches
- $\Delta P_{shutoff}$: 200 psi
- Class V Shutoff
- Customer Available Supply Pressure: 85 psig
- Valve Stem Material: S20910
- Process Temperature: 300°F

Initially select the smallest size actuator that matches the 1.25 inch valve stem connection, 5H inch yoke boss, and travel of the NPS 16 Large ET. The smallest size actuator meeting this criterion is a 685SR size 10.

The force required to overcome static unbalance will be determined according to the section at the beginning of this document, taking into account the unbalanced area and the stem area. (Assuming no downstream restriction; i.e., downstream pressure is zero.)

-[(200 psi x 0.49 in^2) – (200 psi x 1.23 in^2)] = 148 lb

As indicated in table 4, the seat load requirement consistent with metal seating and Class V shutoff at the 200 psi shutoff pressure drop 124 pounds per lineal inch of port circumference, the seat load can be determined as follows:

124 lb/in. x 34.56 in. = 4299 lb

The force required to overcome packing friction with a 1.25 inch stem is 120 pounds.

Referring to figure 2 at the beginning of this document it can be determined that the Large ET in this example is a pressure-tends-to-close valve. Therefore the actuator spring will need to provide enough force to overcome the unbalance force, packing friction force, actuator friction force, and the valve plug weight (per table 4). Note that since the force to overcome static unbalance is positive, it is replaced by zero when calculating the required spring force:

120 lb + (79 in^2 x 2 psi) + 180 lb + (79 in^2 x 3 psi) = 695 lb

As indicated in table 3, the spring that will provide a preload equal to or greater than the required 695 lb of force is a 100 lb/in spring rate with a maximum preload of 1000 lb. However this spring must also be checked to ensure that it provides a bench set span of greater than or equal to 5 psi:

(100 lb/in. x 8.5 in.) / 79 in^2 = 10.76 psi   PASS

Now that the actuator spring is selected we must now determine if the size 10 actuator will provide enough thrust at the 85 psig customer available supply pressure to operate the valve. First we will calculate the available actuator thrusts in both the down and up directions:

Actuator Thrust Down = (85 psig x 79 in^2) – (1000 lb x 1.10) – (1.05 x 100 lb/in x 8.5 in) – (79 in^2 x 2 psig) = 4565 lb

Actuator Thrust Up = (85 psig x 79 in^2) + 1000 lb = 7715 lb

Next we should determine the amount of thrust the valve would require the actuator to produce in both the down and up directions:

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Valve Thrust Down = 148 lb + 4299 lb + 120 lb = 4567 lb

Valve Thrust Up = 695 lbs – (79 in^2 x 3 psi) = 458 lb

Since the Valve Thrust Down is greater than the Actuator Thrust Down, the actuator does not have enough force to close the valve and provide seat load. The next larger actuator size should be selected and calculations be repeated. The next larger actuator size that meets the yoke boss, valve stem connection, and travel of the NPS 16 Large ET is a size 12. Repeating the calculations:

Required Spring Force:

120 lb + (113 in^2 x 2 psi) + 180 lb + (113 in^2 x 3 psi) = 865 lb

Per table 3, the preload remains at 1000 lb along with the spring rate at 100 lb/in.

Bench Set Check:

(100 lb/in. x 8.5 in.) / 113 in^2 = 7.52 psi   PASS

Actuator Thrust Down = (85 psig x 113 in^2) – (1000 lb x 1.10) – (1.05 x 100 lb/in x 8.5 in) – (113 in^2 x 2 psig) = 7387 lb

Actuator Thrust Up = (85 psig x 113 in^2) + 1000 lb = 10605 lb

Valve Thrust Down = 4567 lb (No change from prior)

Valve Thrust Up = 865 lbs – (113 in^2 x 3 psi) = 526 lb

Since both the Valve Thrust Down and Up are now greater than the Actuator Thrust Down and Up the size 12 actuator has enough thrust to operate the valve.

Operational Checks

1. Check that the maximum allowable cylinder pressure of 150 psi is not exceeded by the customer available supply pressure.

85 psi ≤ 150 psi   PASS

2. Check that the actuator will not provide too much thrust onto the valve seat (i.e. excessive seat load). Too much seat load is defined as at or exceeding 1000 lb/in.

7.387 lb / 34.56 in = 213.74 lb/in

213.74 lb/in < 1000 lb/in   PASS

3. Check that the actuator manual override can produce sufficient thrust to position the valve. The required thrust that the actuator manual override must produce is as follows:

4567 lb + (1000 x 1.10) + (100 lb/in x 8.5 in x 1.05) + (2 psi / 113 in^2) + (3 psi / 113 in^2) = 7125 lb

As indicated in table 5, the manual override with the 685SE size 12 can produce 10000 lb of thrust, which is more than enough to position the valve.

4. Check that the actual stem load produced by the actuator is less than the maximum allowable stem load.

Actual Stem Load = (85 psi x 113 in2) – (1000) – (100 lb/in x 8.5 in x 1.05) = 7713 lb

Per table 1 of the Stem Load Calculation section of this document, for a NPS 16 Large ET valve with a S20910 valve stem, table 4 is used to determine the maximum allowable stem load.

Allowable Stem Load = 14050 lb x 1.977 = 27777 lb

7713 lb < 27777 lb   PASS

657 Actuator (except size 80)

Pressure-Tends-To-Open

Sizing Calculation

Problem: Determine the size of the 657 actuator for the valve and service conditions described below.

- NPS 2 ES
- Push-Down-To-Close
- Flow Up
- Metal Seat
- PTFE Packing
- Travel--1.125 inches
- Port Circumference--7.26 inches
- Port Area--4.2 square inches
- Valve Stem Connection--1/2 inch
- The 657 will fail open
- $\Delta P_{(shutoff)}$--15 psi
- Valve Stem Material--316 strain-hardened stainless steel
- Process Temperature--100°F

Service Conditions: 3 to 15 psig air to the diaphragm. (The following sample problem illustrates actuator sizing using a positioner with a 3 to 15 psig output signal and assumes the positioner is not capable of producing a 0 to 18 psig output.)

Note

Customer specifications require a seat load of 50 pounds per lineal inch of port circumference for this application.

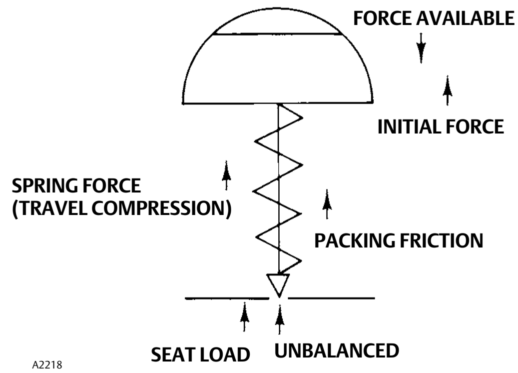
Initially, select a size 40 or 40i actuator, the smallest size actuator which matches the 1/2 inch valve stem connection and the 2-13/16 inch yoke boss of an NPS 2 ES valve body (see table 13). Add to the given data the size 40 or 40i diaphragm effective area of 69 square inches.

Choosing the appropriate spring is the purpose of the sizing calculations (see figure 6).

The force available results from applying air pressure to the actuator diaphragm. Calculate the force available using the following equations:

Maximum air pressure to diaphragm times diaphragm effective area equals force available.

Figure 6. 657 Actuator Free Body Diagram



Supply numbers from the given service conditions:

15 Psig x 69 Sq In. = 1035 Lb

To ensure quick response when we apply air to the diaphragm, some initial compression will be applied to the spring. Using the adjusting screw, a force equal to that force obtained by applying 3 psig of air to the diaphragm will be wound in. The initial force will be:

3 Psig x 69 Sq In. = 207 Lb

This initial force acts upward, and therefore must be subtracted from the maximum actuator force.

1035 - 207 = 828 Lb

The resultant force (828 lb) is the force available to stroke the actuator.

The actuator must provide force to overcome unbalance, to provide a seat load, and to overcome packing friction. In this example, the valve is required to shut off against a force of 15 psig acting against that portion of the plug which closes the port. The port area of an NPS 2 ES valve body is 4.2 square inches. the unbalance force will be:

15 Psig x 4.2 Sq In. = 63 Lb

Assuming a seat load requirement of 50 lb/lineal inch of port circumference, the seat load can be determined as follows:

Seat Load = 50 Lb/In. x 7.26 In. = 363 Lb

The force required to overcome packing friction with a 1/2 inch stem is 50 lb (see table 6).

The actuator must provide force to overcome the unbalance force, to provide seat load, and to overcome packing friction. The total of these forces is:

63 Lb + 363 Lb + 50 Lb = 476 Lb

The resultant force which must be opposed by the actuator spring is:

828 Lb - 476 Lb = 352 Lb

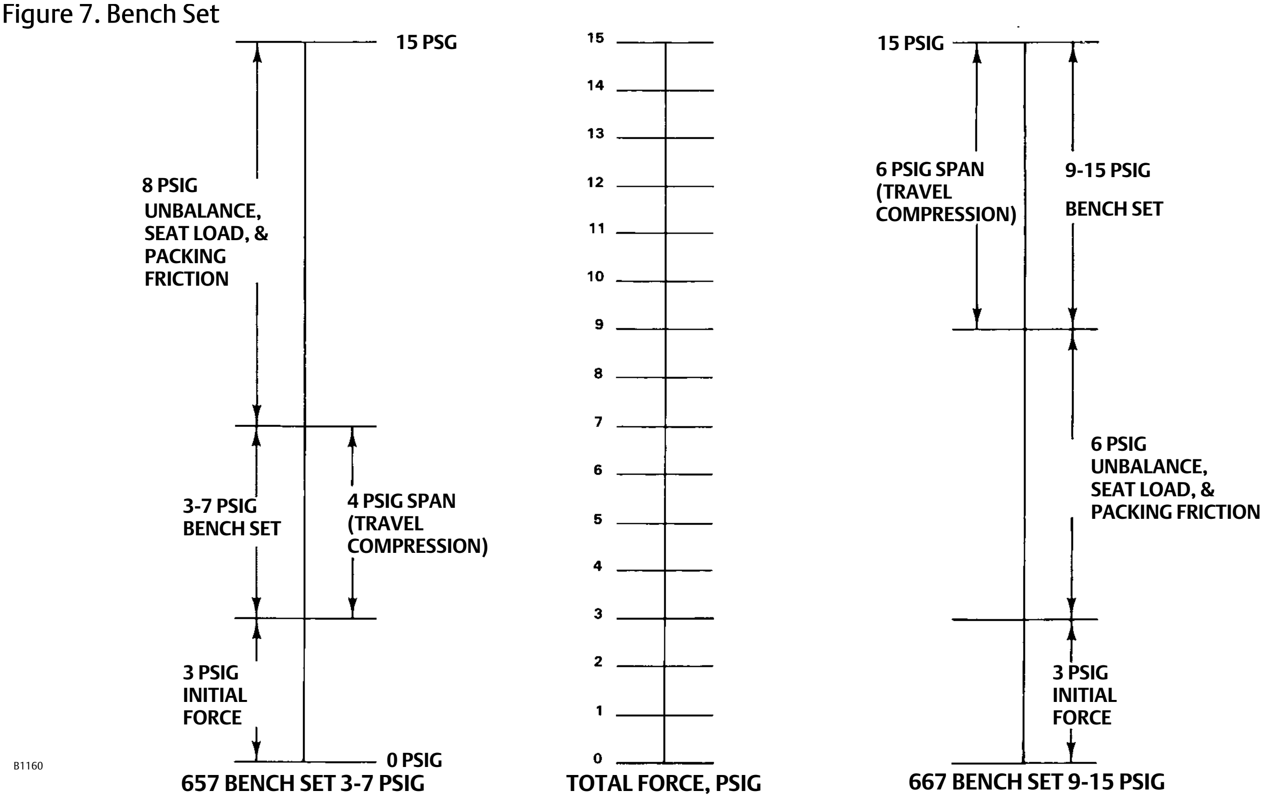
This net force must be opposed by the actuator spring. The required spring compression rate will be found by dividing the resultant force by the valve plug travel. Since the plug on an NPS 2 ES valve body travels 1.125 inches, the ideal spring compression rate will be determined by the following equation:

Net Force ÷ Travel = Spring Compression Rate

352 Lb ÷ 1.125 = 313 Lb/In.

The spring whose compression rate most closely matches, but is not greater than, the ideal spring compression rate should be selected from the table for the size 40 or 40i 657 actuator. (If the ideal spring compression rate is not among the compression rates listed in the table, either (1) select a larger size actuator or (2) provide greater available force by supplying more air pressure to the diaphragm and recalculating the ideal spring compression rate.)

Figure 7. Bench Set



The ideal spring rate falls between available spring compression rates of 275 lb/in. and 370 lb/in. The spring with the lesser compression rate must be chosen, since the greater spring force cannot be completely overcome by the total force available. When the available spring rate does not match exactly the ideal spring rate, the static force can be easily balanced by using the adjusting screw to wind in a greater initial force. This simple adjustment facilitates limiting the number of spring choices available.

The spring with a compression rate closest to, and less than, the ideal spring rate is spring 1F1770 27092, which has a compression rate of 275 lb/in. This spring should be chosen for the given service conditions. This same method of calculating the spring rate applies to any non-standard travel and to any air supply pressure.

Bench Set

The bench set is the spring setting required to ensure that the actuator matches the given service conditions. The actuator tables indicate the appropriate bench set under each of the various travels. Spring 1F1770 27092, with a travel of 1-1/8 inches, has a bench set of 3-7 psi. This means that, in addition to the initial 3 psig, another force produced by 8 psig (15 minus 7) must be included in the system to achieve static balance (see figure 7).

A disproportionately small air change is usually unacceptable. When service conditions dictate, for example, a 3-6 psi bench set, select a larger actuator or provide a greater air supply pressure. The following general guideline serves for throttling applications:

For cage-guided or post-guided plugs, not more than two-thirds of the operating span [e.g., 2/3 x (15 - 3) = 8 psig] should be used to achieve static balance.

The following calculations verify the 3-7 psi bench set.

With a spring compression rate of 275 lb/in. and 1.125 inches of travel, the total spring force is 309 lb.

275 Lb/In. X 1.125 In. = 309 Lb (rounded)

This spring force opposes the maximum actuator force, 1035 lb., less the initial force of 207 lb, less the unbalance force of 63 lb, less the seat load force of 363 lb, less the force to overcome packing friction of 50 lb.

The bench set of 3-7 psi includes both 3 psig to produce an initial force and 8 psig (15 -7 = 8) to oppose the unbalance force, to provide seat load, and to overcome packing friction. The force obtained by the total 11 psig of air to the diaphragm can be determined by using the following equation:

11 Psig X 69 Sq In. = 759 Lb

Table 16. Spring Adjustors for 657, 657-4, 657R, 667 and 667-4 Diaphragm Actuators

Actuator Size	657 and 657R		667(5)		657-4		667-4	
	Adjustment Length, Inches	Part Number	Adjustment Length, Inches	Part Number	Adjustment Length, Inches	Part Number	Adjustment Length, Inches	Part Number
30/30i	1.250(1) 1.625	1E7929 24102 1R9209X00A2	1.250(1) 1.375 1.563 1.875	1E801724102 1J711524102 1J711624102 16A8186X012	--- --- --- ---	--- --- --- ---	--- --- --- ---	--- --- --- ---
34/34i & 40/40i	1.500(1) 2.000	1E807324102 1H153924102	1.500(1) 1.688 1.938 2.063 2.188 2.375 2.750	1E821024102 1J717724102 1J711824102 1J711924102 1J712024102 1J712124102 1U415024102	--- --- --- --- --- --- ---	--- --- --- --- --- --- ---	--- --- --- --- --- --- ---	--- --- --- --- --- --- ---
45/45i, 46/46i, 50/50i, & 60/60i	1.875(1) 2.375 3.938	1E832624102 1K331724102 1K677324102	1.875(1) 2.500 2.875 3.125 3.250	1E846224102 1J712224102 1J712324102 1J712424012 1J712524102	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---	--- --- --- --- ---
70/70i(2), 76(3), & 87(2)	2.000(1) 2.500 2.750	1N129724102 1N872035132 1P994424092	2.000(1) 2.500 3.500	1N131824102 1N909524502 1U1079X00A2	2.000 3.625	1N129724102 1V9655X00A2	3.750	11A3811X012
70/70i, 76(3), & 87MO(4)	2.250 2.750	1N886924392 1V176624092	2.250 2.750	1N886924392 1V176624092	3.000	1V176624092	2.500 2.750 3.125	1N886924392 1V176624092 22B9229X012
80	2.250(1) 2.625	1H733324392 1P161724492	2.250(1) 2.750	1H733219042 1N329219042	--- ---	--- ---	--- ---	--- ---

1. Standard.
2. Without side-mounted handwheel.
3. Size 76 is 667 only.
4. MO—side mounted handwheel.
5. 667 size i is limited to 30i through 46i.

To achieve static balance, the spring force plus the force produced by the bench set must equal the total force available to the system.

309 Lb + 759 Lb = 1068 Lb

The available force is 1035 lb; thus the bench set is correct. (The deviation between 1035 lb and 1068 lb can be attributed to rounding air supply pressure to the nearest whole number; that is, the bench set would be 3-7.48 psi).

Operational Checks

To ensure proper actuator operation, check (1) spring adjustor length, (2) safe spring load, (3) safe stem load, (4) casing pressure limitations according to the procedure below.

1. Spring Adjustor

Winding in sufficient initial force requires a spring adjustor long enough to provide the required spring compression. In this example, the service conditions dictate a 3 psig initial wind-in requirement. The initial force can be determined by multiplying the 3 psig by the diaphragm effective area.

3 Psig X 69 Sq In. = 207 Lb Initial Force

Spring 1F177027092, already selected, has a compression rate of 275 lb/in. To find the distance which the spring must be compressed, divide the required initial force by the spring compression rate.

207 Lb ÷ 275 Lb/In. = .75 In.

Thus, spring 1F177027092 must be compressed .75 in. to provide a 207 Lb force. The spring adjustor, therefore, must be long enough to provide this compression. Table 16 shows the available spring adjustors for each actuator and designates the standard spring adjustor provided with each actuator. The table indicates the distance which each spring adjustor can compress a spring.

Since the standard spring adjustor for a size 40 Type 657 can compress the actuator spring up to 1.5 inches, this adjustor will be adequate for the required .75 in. of compression. When initial compression requirements necessitate choosing a longer spring adjustor, the appropriate spring adjustor can be selected from table 16.

2. Safe spring load

Before placing a spring in an actuator, the actual load to be placed on the spring must be compared to the maximum safe load for that particular spring. The actual load on the spring consists of two forces, (1) the initial compression force, and (2) the spring compression force.

The initial force is the product of the initial air pressure supplied to the diaphragm multiplied by the diaphragm effective area.

3 Psig X 69 Sq In. = 207 Lb

The spring compression force is found by multiplying the spring rate by the travel.

275 lb/in. x 1.125 in. = 309 lb

The actual load on the spring is the sum of these two forces.

207 lb + 309 lb = 516 lb

Since this force (516 pounds) is less than the maximum safe load of 843 pounds for spring 1F177027092 found in table 17, this spring can safely be used in the actuator selected above.

If the safe spring load will be exceeded, either(1) select a larger actuator or (2) supply more air pressure to the diaphragm to increase the force available, making possible the selection of a spring with a greater compression rate.

1. Safe stem load

The safe stem load will be determined by multiplying the force to counteract the unbalance (15 psig - 7 psig = 8 psig) by the diaphragm effective area.

8 psi x 69 in.^{2} = 552 lb

Since this 552 pound force is less than the allowable stem load of 4970 pounds from the Stem Load Calculation section for a 1/2-inch 316 strain-hardened stainless steel stem, this actuator can be used to meet the given conditions. When the stem load is exceeded, either (1) select a larger actuator/stem combination or (2) select a different stem material using the procedure in the Stem Load Calculation section.

2. Maximum Casing Pressure Limitations

The casing and diaphragm of spring and diaphragm actuators are pressure operated. The air pressure supplied to the actuator cannot exceed the actuator's maximum pressure limitations. Refer to the instruction manual of the type and size of actuator being checked for definitions and values of its maximum pressure limitations.

Table 17. Safe Spring Loads for Diaphragm Actuator Springs

Spring Part Number	Maximum Allowable Spring Load, Lb	Spring Part Number	Maximum Allowable Spring Load, Lb
657, 657R, and 667			
1E792327082	1160	1E827227082	3300
1E792427082	2200	1E921527082	1290
1E793327082	3045	1F172827082	1060
1E795327082	1840	1F177027092	843
1E795427082	2600	1F177127092	1060
1E795627082	3150	1F177227092	1190
1E804727082	3560	1F177327082	1835
1E804827082	2980	1F713027112	290
1E804927082	2610	1F714327082	1630
1E805027082	4250	1F714427122	545
1E805127082	2900	1F716727032	843
1E805227082	2980	1F716827092	1060
1E805327092	1472	1F716927092	1170
1E805427082	2215	1H747027082	13,800
1E805527082	2400	1H747327082	10,600
1E805627092	1170	1H747527082	7900
1E805727092	1875	1H747627082	10,600
1E805827082	2220	1H747727082	5630
1E825527082	7250	1J172227032	710
1E825627082	7500	1J258127092	1575
1E825727082	5930	1K509827032	570
1E825827082	5930	1N127927082	11,000
1E826027082	6750	1N128127082	12,000
1E826127082	3290	1N128427082	5500
1E826227082	3940	1N128527082	9000
1E826327082	4750	1N128627082	4100
1E826427082	4290	1N128727082	6800
1E826527082	3680	1N719327082	8000
1E826627082	2645	1R676027082	6375
1E826727082	5350	10A2561X012	17,500
1E826827082	3620	10A2562X012	25,000
1E826927082	2150	10A2563X012	36,000
1E827027082	2880	10A2564X012	45,000
1E827127082	4220		

3. Dynamic stability (negative gradient)

Negative gradient is the rate at which the fluid reaction force on the valve plug increases in the direction tending to open the valve (or decreases in the direction tending to close the valve) with increasing valve plug travel. This problem is most critical in designs utilizing balanced valve plugs.

As the valve plug travels, the fluid force curve may have a negative gradient at some point. If this negative gradient creates a force equal to, or greater than, the spring force of the actuator spring, the actuator will be unable to control the position of the valve plug, making the system unstable in that portion of the travel range where the negative gradient occurs.

Table 18. Negative Gradients for Fisher™ Double-Port A Throttle Plug Valve Body

Body Size, NPS	Negative Gradient (K_n) (Pounds/Inch)/Psid
2	3.5
3	3.5
4	3.8
6	8.5
8	11.0

Table 19. Negative Gradients for Fisher CL125 Through CL600 ED, EAD, ET, and EAT

PORT DIAMETER, INCHES	NEGATIVE GRADIENT (K_n) (Pounds/Inch)/Psid				
	Flow Down Cages				Flow Up Cage
	Quick Opening	Linear	Equal Percentage	Cavitrol™ III 1 Stage	Whisper Trim™
1.3125	0.6	0.3	0.5	0.5	0.7
1.875	0.4	0.9	0.7	0.8	0.9
2.3125	0.5	0.4	0.5	0.6	0.9
2.875	0.3	0.4	0.5	0.6	1.3
3.4375	0.2	0.8	0.4	0.8	0.7
4.375	0.8	1.3	0.3	2.2	0.3
7	4.0	4.2	1.0	2.4	1.4
8	3.9	2.1(1)	1.6	4.4	- - -

1. For 2-inch travel optional Linear, use K_n = 3.9.

When no positioner is used, and when the system is not subject to rapid change, the actuator spring rate (K_s) must be greater than or equal to the product of the negative gradient (K_n) and the maximum flowing pressure drop (not the pressure drop at shutoff). $K_s \geq K_n \Delta P_{(\text{maximum flowing})}$

Table 20. Negative Gradient for Fisher ED-J and ET-J

PORT DIAMETER, INCHES	NEGATIVE GRADIENT (K_n) (Pounds/Inch)/Psid		
	Linear	Equal Percentage	Whisper III Cavitrol III
	CL300	CL300	CL300
9.5	6.34	6.00	4.00
11	4.38	6.84	4.00
14.75	5.71	6.00	4.00

Table 21. Negative Gradients for Fisher CHPD / CHPT

PORT DIAMETER, INCHES	NEGATIVE GRADIENT (K_n) (Pounds/Inch)/Psid				
	Flow Down Cages			Flow Up Cages	
	Linear	Equal or Modified Equal Percentage	Cavitrol III 2 Stage	Linear	Equal or Modified Equal Percentage
5.375	CL2500	CL2500	CL2500	CL2500	CL2500
	1.5	3.4	1.3	1.2	0.9

Table 22. Negative Gradient for Fisher EHD, EHT, and EHS Flow Down (Except Where Noted)

PORT DIAMETER, INCHES	NEGATIVE GRADIENT (K_n) (Pounds/Inch)/Psid			
	Linear		Equal Percentage	
	CL1500	CL2500	CL1500	CL2500
0.25 to 0.75	- - -	- - -	0	0
1	- - -	- - -	0.1	0.2
1.5	- - -	1.5	1.6	1.1
1.875	2.0	- - -	1.4	- - -
2.875	4.0	2.3	3.1	1.9
2.3125	- - -	4.0	- - -	0.9
3.625	4.0	- - -	2.5	- - -
5.375	5.4	3.1	3.6	6.4(4)
4.375	- - -	3.2	- - -	1.2
7	5.6(1)	6.4(3)	4.0	8.0(5)
10	5.2(2)	- - -	2.0	- - -

PORT DIAMETER, INCHES	CAVITROL III				WHISPER III (Flow Up)	
	CL1500		CL2500		CL1500	CL2500
	2 Stg	3 Stg	2-Stg	3-Stg		
0.625	- - -	- - -	1.3	0.6	- - -	- - -
0.875	3.5	- - -	- - -	- - -	- - -	- - -
1	- - -	1.1	- - -	- - -	- - -	- - -
1.25	- - -	- - -	0.28	- - -	- - -	- - -
1.3125	- - -	- - -	- - -	1.25	- - -	- - -
1.5	- - -	- - -	- - -	- - -	- - -	1.5
1.75	- - -	- - -	- - -	- - -	- - -	- - -
1.875	- - -	- - -	0.4	- - -	1.5	- - -
2.3125	- - -	- - -	- - -	0.72	- - -	1.2
2.5	- - -	- - -	- - -	- - -	- - -	- - -
2.875	- - -	- - -	1.6	- - -	0.8	0.9
3.4375	- - -	- - -	- - -	- - -	- - -	- - -
4.375	- - -	- - -	3.07	1.0	- - -	- - -
4.5625	- - -	0.68	- - -	- - -	- - -	- - -
5.25	2.0	- - -	- - -	- - -	- - -	- - -

1. 4.8 for maximum travel ≤ 2-inches.
2. 2.8 for maximum travel ≤ 2-inches.
3. 5.6 for maximum travel ≤ 2-inches.
4. 4.0 for maximum travel ≤ 2.5-inches.
5. 2.0 for maximum travel ≤ 2.5-inches.

Table 23. Negative Gradient for Fisher HPD and HPT Flow Down (Except Where Noted)

PORT DIAMETER, INCHES	NEGATIVE GRADIENT (K_n) (Pounds/Inch)/Psid	
	Linear	Equal Percentage
	CL1500	CL1500
0.25 thru 0.75	- - -	0
1	- - -	0.1
1.5	- - -	1.6
1.875	2.0	1.4
2.875	4.0	3.1
3.625	4.0	2.5
5.375	5.4	3.6

PORT DIAMETER, INCHES	CAVITROL III		WHISPER III (Flow Up
	CL1500		CL1500
	2-Stage	3-Stage	
0.875	3.5	- - -	- - -
1	- - -	1.1	- - -
1.75	0.4	- - -	- - -
1.875	- - -	- - -	1.5
2.875	- - -	- - -	0.8
3.4375	- - -	- - -	- - -

To determine negative gradient (K_n) values:

- For balanced valve designs, refer to tables 19, 20, 21, and 21A. For NPS 12 and larger ED/ET/ET-C valves and NPS 16 and larger EWD/EWT/EWT-C valves, use 4.0 (pounds/inch)/psid. For other valves not in the tables, contact your Emerson Process Management sales office.
- For unbalanced valves with pressure tending to open the valve, use $K_n = 0$.
- For unbalanced valves with pressure tending to close the valve, use the equation:

$$K_n = \frac{2 \times \text{Unbalance Area}}{\text{Travel}}$$

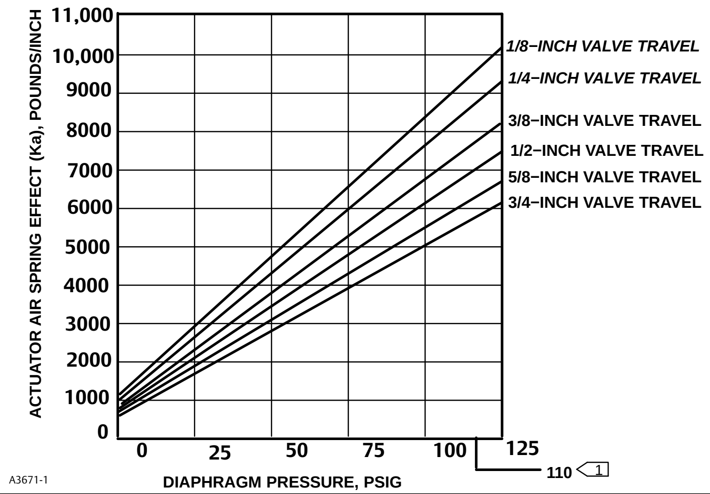
If the system is dynamically unstable, an actuator spring with a greater spring rate will create a more stable system.

An alternate method of checking dynamic stability (negative gradient) which may produce more accurate actuator sizing introduces the beneficial effect that the air spring has on actuator sizing. The actuator spring rate (K_s) plus the actuator air spring (K_a) must be greater than the product of the negative gradient (K_n) and the maximum pressure drop when the fluid is flowing through the valve body (not the pressure drop at shutoff).

$$K_s + K_a \geq K_n \Delta P_{(\text{maximum flowing})}$$

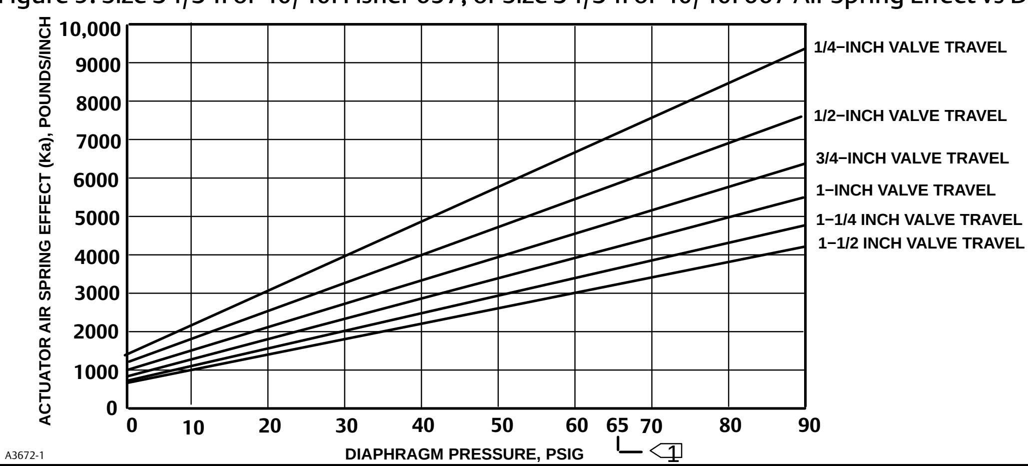
657 or 667 actuator air spring rate (K_a) can be determined from figures 8 through 14. For 480 Series and 585C actuators, see figures 15 and 16.

Figure 8. Size 30/30i Fisher 657 or Size 30/30i 667 Actuator Air Spring Effect vs Diaphragm Pressure



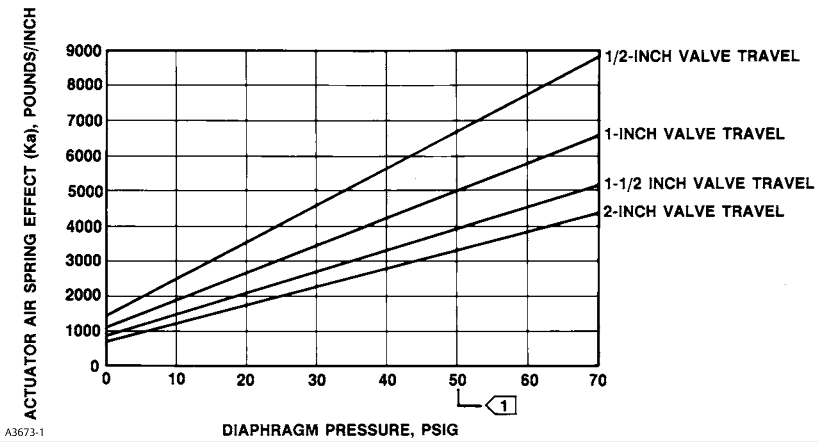
Note:
1 Limit 657 actuators to this value.

Figure 9. Size 34/34i or 40/40i Fisher 657, or Size 34/34i or 40/40i 667 Air Spring Effect vs Diaphragm Pressure



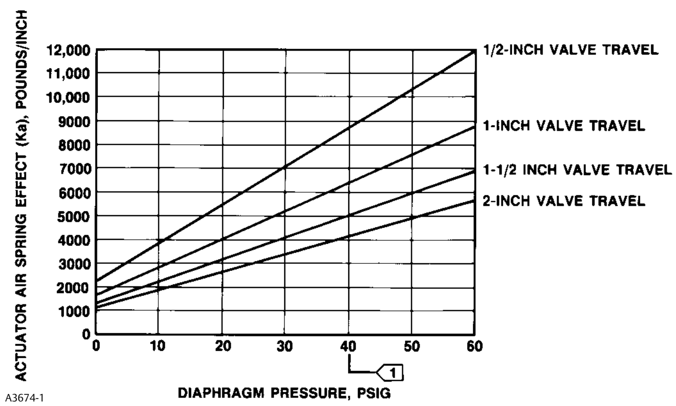
Note:
1 Limit 657 actuators to this value.

Figure 10. Size 45/45i or 50/50i Fisher 657, or Size 45/45i or 50 667 Actuator Air Spring Effect vs Diaphragm Pressure



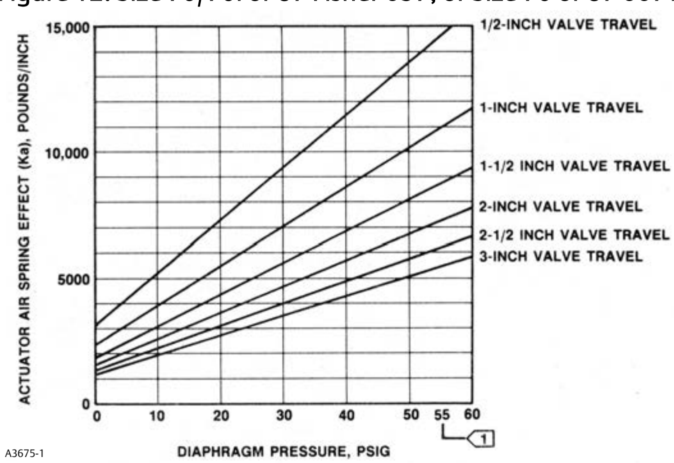
Note:
1 Limit 657 actuators to this value.

Figure 11. Size 46/46i or 60/60i Fisher 657, or Size 46/46i or 60 667 Actuator Air Spring Effect vs Diaphragm Pressure



Note:
1 Limit 657 actuators to this value.

Figure 12. Size 70/70i or 87 Fisher 657, or Size 70 or 87 667 Actuator Air Spring Effect vs Diaphragm Pressure



Note:
1 Limit 657 actuators to this value.

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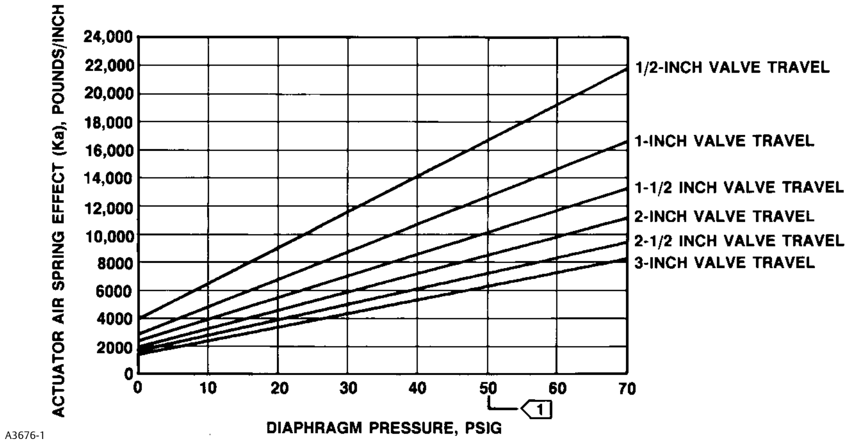
Figure 13. Size 80 Fisher 657 or 667 Actuator Air Spring Effect versus Diaphragm Pressure



Note:
1 Limit cast iron yoke construction to 50 psig.

Figure 14. Size 100 Fisher 657 or 667 Actuator Air Spring Effect versus Diaphragm Pressure

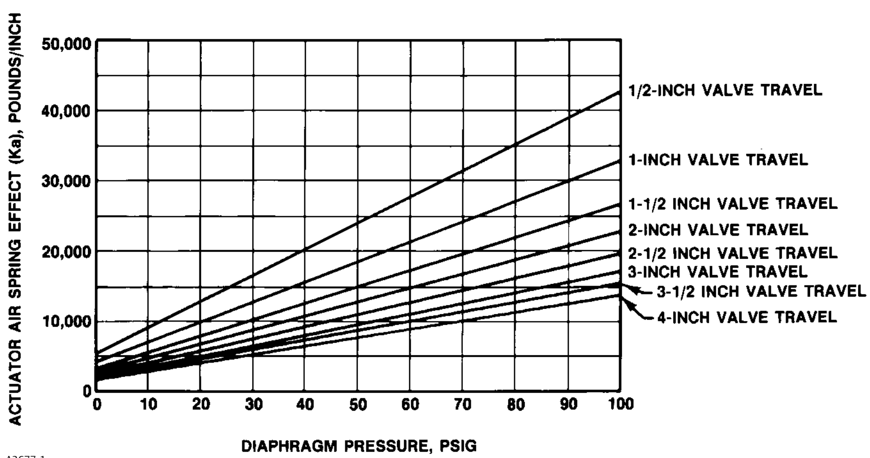


Figure 15. Size 20, 30, or 40 Fisher 480 Actuator Air Spring Effect versus Supply Pressure

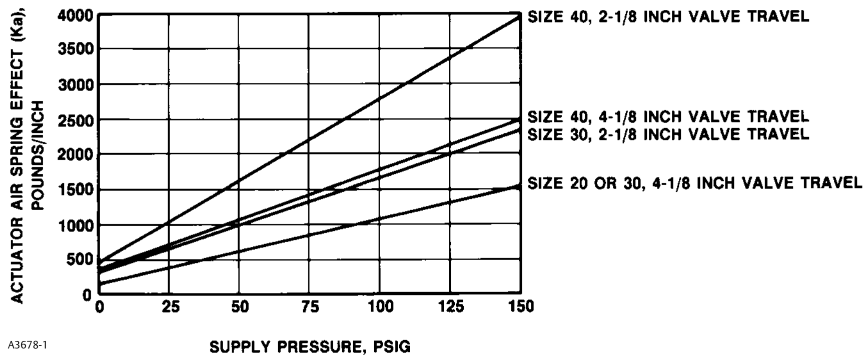
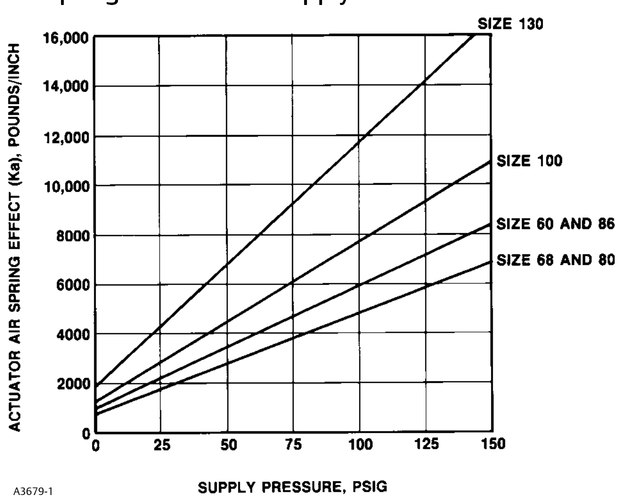


Figure 16. Size 60 through 130 Fisher 585C Actuator Air Spring Effect versus Supply Pressure

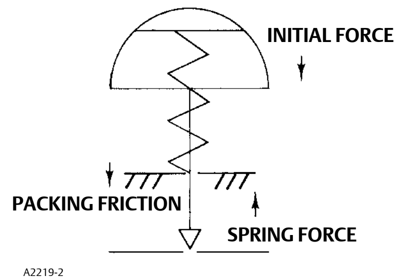


1. Actual travel

The sizing procedure ensures that the actuator will properly close the valve. Due to packing friction, the valve may not, in some cases, travel fully open unless the initial air supply is reduced below the nominal 3 psig minimum pressure. The force diagram in Figure 17 illustrates the forces involved in opening a valve with a 657 actuator. (Assume no downstream pressure.)

The spring force is determined by multiplying the spring compression rate by the initial wind-in—the distance the spring is compressed. Checking the length of the spring adjustor in operational check (1) indicated an initial wind-in of 0.75 inches. The spring selected has a compression rate of 275 pounds per inch.

Figure 17. Fisher 657 Actuator Free Body Diagram



Spring force = 275 (.75) = 206.25 lb

The spring force must overcome the packing friction (50 pounds) and the initial force determined by multiplying the diaphragm effective area by the initial air supply pressure (P_A).

$206.25 = 50 + P_A(69)$

$2.3 \quad = P_A$

This means the initial air supply pressure must be reduced to 2.3 psig to permit full travel upward, or to stroke the valve fully open. The actuator will properly seat the valve, and the system can be operated with a 3 psig initial air supply pressure, but the valve will not stroke fully open unless the initial supply pressure is reduced to 2.3 psig.

In this example, an initial air supply pressure of 3 psig will allow the valve plug to travel 0.94 inches from the fully closed position to the maximum open position.

Pressure-Tends-To-Close

Sizing Calculation

If the flow direction is reversed through the ES valve body, so that pressure tends to close the valve, the pressure will assist the actuator in closing the valve. Determining the appropriate actuator and spring combination will involve the same problem in static equilibrium involved in the pressure-tends-to-open application above. When the pressure tends to close the valve, assign a negative value to the unbalance force, and proceed as for pressure-tends-to-open application. The unbalance area is the port area minus the cross-sectional area of the valve stem.

Operational Checks

In addition to the operational checks performed for the pressure-tends-to-open application, make certain that the actuator spring can overcome the closing force. For the 657 actuator to open the valve, the total spring force must overcome the closing force exerted by the flowing medium. The closing force results from the ΔP working against the top of the plug. The unbalance area is the port area minus the cross-sectional area of the valve stem.

Closing Force = 15 psig x (4.2 in.^{2} - 0.2 in.^{2}) = 60 lb

The total spring force will be the initial force plus the travel compression.

Initial Force = 3 psig x 69 in.^{2} = 207 lb

The spring compression force (spring compression rate x travel) is:

275 lb/in. x 1-1/8 in. = 309 lb

The total spring force is:

207 lb + 309 lb = 516 lb

Since 516 pounds is greater than the 60-pound closing force, the 657 actuator with spring 1F177027092 will control the system under the given conditions.

667 Actuator

Pressure-Tends-To-Open

Sizing Calculation

Problem: Determine the best possible 667 actuator for the valve and service conditions described below.

- NPS 2 ED
- Push-Down-To-Close
- Flow Down
- Metal Seat, Standard ANSI Class II Leakage
- Single PTFE Packing
- Travel--1.125 inches
- Unbalance Area--0.27 square inches
- Port Circumference--7.26 inches
- Valve Stem Connection--1/2 inch
- Inlet Pressure--200 psig
- $\Delta P_{(shutoff)}$--200 psi
- Outlet Pressure--0 psig
- Valve Stem Material--316 strain-hardened stainless steel
- Process Temperature--100°F

Service Conditions: 3-15 psig air to the diaphragm. (The following sample problem illustrates actuator sizing using a positioner with a 3-15 psig output signal and assumes the positioner is not capable of producing a 0-18 psig output.)

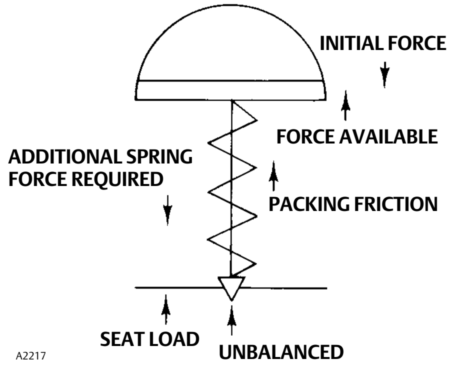
Initially, select a size 40/40i actuator, the smallest size actuator that matches the 1/2-inch valve stem connection and the 2-13/16 inch yoke boss of an NPS 2 ED valve body (see table 13). Add to the given data the size 40/40i diaphragm effective area of 69 square inches.

Choosing the appropriate spring is the purpose of the sizing calculations (see figure 18).

The force available results from applying air pressure to the actuator diaphragm. Calculate the force available using the following equation:

Maximum Air Pressure to Diaphragm times Diaphragm Effective Area equals Force Available

Figure 18. Fisher 667 Actuator Free Body Diagram



Supply numbers from the given service conditions:

15 Psig x 69 Sq In. = 1035 Lb

The minimum supply pressure given in the service conditions is 3 psig. Using the spring adjusting screw, wind in a force equal to the force obtained by applying 3 psig of air to the diaphragm:

3 Psig x 69 Sq In. = 207 Lb

This initial force acts down, and therefore must be subtracted from the maximum actuator force.

1035 - 207 = 828 Lb

The resultant force (828 lb) is the force available to stroke the actuator.

The actuator must provide force to overcome unbalance, to provide a seat load, and to overcome packing friction. In this example, the valve is required to shut off against a force of 200 psig acting against the unbalance area of the plug The unbalance area of an NPS 2 ED valve body is 0.27 square inches.

The unbalance force will be:

200 Psi x 0.27 Sq. In. = 54 Lb

This unbalance force pushes the plug upward. A part of the total spring force available, therefore, must be utilized to overcome this unbalance force. The force required to overcome static unbalance must be subtracted from the force available to the system.

Standard ANSI Class II leakage has a seat load requirement of 20 lb/lineal inch (from table 6) of port circumference, the seat load can be determined as follows:

Seat Load = 20 Lb/In. x 7.26 In. - 145 Lb

In the case of a reverse-acting actuator on a push-down-to-close valve, the initial force wound into the spring can be used for seat load if the positioner can deliver a 0 psig output. The positioner in our sample problem has a minimum supply of 3 psig that matches the initial wind-in, therefore we must size our actuator for the full 145 lb of seating force required.

The force required to overcome packing friction with a 1/2 inch stem is 50 lb (see table 6). The total of the unbalance force, seat load force, and packing friction force is:

54 Lb + 145 Lb + 50 Lb = 249 Lb

The force available, less the initial force, was 828 lb. To find the net force which must be opposed by the actuator spring, subtract the total of the forces required to overcome unbalance, to provide seat load, and to overcome packing friction from the 828 lb resultant force.

828 Lb - 249 Lb = 579 Lb

The ideal spring compression rate will be found by dividing the 579 lb force by the valve plug travel. Since the valve plug travel for an NPS 2 ED valve body is 1.125 inches, the ideal spring compression rate will be:

579 Lb ÷ 1.125 inches = 515 Lb/In.

The spring whose compression rate most closely matches, but is not greater than, the ideal compression rate should be selected from the table for the size 40 or 40i 667 actuator. (If the ideal spring compression rate is not among the compression rates listed in the table, either (a) select a larger size actuator or (b) provide greater actuator force by supplying more air pressure to the diaphragm and recalculating the ideal spring rate.)

The ideal spring rate falls between available spring compression rates of 460 lb/in. and 550 lb/in. The spring with the lesser compression rate must be chosen, since the greater spring force cannot be completely overcome by the total force available. When the available spring rate does not match exactly the ideal spring rate, the static forces can be easily balanced by using the adjusting screw to wind in a greater initial force. This simple adjustment facilitates limiting the number of spring choices available.

The spring with a compression rate closest to, and less than, the ideal spring rate is spring 1F177227092, which has a compression rate of 460 lb/in. This spring should be chosen for the given service conditions. This same method of calculating the spring rate applies to any non-standard travel and to any air supply pressure.

Bench Set

The bench set is the spring setting required to ensure that the actuator matches the given service conditions. Divide the total required force (initial + unbalance + seat load + packing friction) by the diaphragm area to determine the lower bench set.

$$\frac{207 + 54 + 145 + 50}{69 \text{ Sq In.}} = 7 \text{ psig (rounded)}$$

A force must be wound into the spring to balance this 7 psig air supplied to the diaphragm. This total initial compression force is equal to the air supplied to the diaphragm multiplied by the diaphragm area.

7 Psig x 69 Sq In. = 483 Lb

Adequate spring adjustor length must be checked in “Operational Check (1)" below.

Add the total initial compression force and the spring travel compression force to get the maximum force requirement (spring 1F177227092).

483 Lb + (1.125 In. x 460 Lb/In.) = 1001 Lb

Divide the maximum actuator force requirement by the diaphragm area to get the maximum air requirement (upper bench set).

$$\frac{1001 \text{ Lb}}{69 \text{ Sq In.}} = 14.5 \text{ psig}$$

The actual bench set for this application is 7-15 psig.

A disproportionately small air change is usually unacceptable. When service conditions dictate, for example, a 12-15 psi bench set, select a larger actuator or provide a greater air supply pressure. The following general guideline serves for throttling applications:

- For cage-guided or post-guided plugs, not more than two-thirds of the operating span [e.g., 2/3 x (15 - 3) = 8 psig] should be used to achieve static balance.

Operational Checks

To ensure proper actuator operation, check (1) spring adjustor length, (2) safe spring load, (3) safe stem load, and (4) casing pressure limitations according to the procedures below.

Note

Overloaded springs and overloaded stems are indicated in the tables.

1. Spring adjustor

Winding in sufficient total initial compression force requires a spring adjustor long enough to provide the required spring compression. In this example, the total initial compression force is 483 lb.

Spring 1F177227092, already selected, has a compression rate of 460 lb/in. To find the distance which the spring must be compressed, divide the required initial force by the spring compression rate.

483 ÷ 460 = 1.05 In.

Thus, spring 1F177227092 must be compressed 1.05 in. to provide a 483 lb force. The spring adjustor, therefore, must be long enough to provide this compression.

Table 16 shows the available spring adjustors for each actuator and designates the standard spring adjustor for each actuator. The table indicates the distance which each adjustor can compress a spring.

The standard spring adjustor for a size 40 667 can compress the actuator spring up to 1-1/2 inches. In this case, the standard spring adjustor 1E821024102 can be used.

2. Safe spring load

Before placing a spring in an actuator, the actual load to be placed on the spring must be compared to the maximum safe load for that particular spring.

The actual load on the spring consists of two forces, (1) the initial force, and (2) the spring compression force.

The total initial compression force is the product of the initial air pressure supplied to the diaphragm multiplied by the diaphragm effective area.

7 psig x 69 in.^{2} = 483 lb

The spring travel compression force is found by multiplying the spring rate by the travel.

460 lb/in. x 1.125 in. = 518 lb

The actual load on the spring is the sum of these two forces.

483 lb + 518 lb = 1001 lb

Since this force (1001 pounds) is less than the maximum safe load for spring 1F177227092 found in table 17 (1190 pounds), this spring can safely be used in the actuator selected above. If the safe spring load will be exceeded, either (1) select a larger actuator or (2) supply more air pressure to the diaphragm to increase the force available, making possible the selection of a heavier spring.

3. Safe stem load

The load applied to the actuator stem must be less than the safe stem load found in the Stem Load Calculation section.

The actual load on the stem is the initial spring compression, found by multiplying the spring compression rate by the distance which the spring is initially compressed.

460 lb/in. x 1.05 in. = 483 lb

This force can also be determined by multiplying the initial air to the diaphragm (7 psi bench set) by the diaphragm effective area (69 square inches).

7 psi x 69 in.^{2} = 483 lb

Since this stem load (483 pounds) is less than the safe stem load of 4970 pounds for a 1/2-inch 316 strain-hardened stainless steel stem, the actuator selected above can safely be used to meet the given service conditions.

When the safe stem load is exceeded, either (1) select a larger actuator/stem combination or (2) select a nonstandard stem material.

4. Casing pressure

When the air pressure supplied to the diaphragm exceeds 40 psi, the total force available should be compared to the maximum allowable casing pressure for the actuator. Actuator casing pressure limitations can be found in table 20 or in the individual actuator bulletins.

5. Dynamic stability (negative gradient)

Negative gradient is the rate at which the fluid reaction force on the valve plug increases in the direction tending to open the valve (or decreases in the direction tending to close the valve) with increasing valve plug travel. This problem is most critical in designs utilizing balanced valve plugs.

As the valve plug travels, the fluid force curve may have a negative gradient at some point. If this negative gradient creates a force equal to or greater than the spring rate of the actuator spring, the actuator will be unable to control the position of the valve plug, making the system unstable in that portion of the travel range where the negative gradient occurs.

When no positioner is used, and when the system is not subject to rapid change, the actuator spring rate (K_s) must be greater than or equal to the product of the negative gradient (K_n) and the pressure drop when the fluid is flowing through the valve (not the pressure drop at shutoff).

$$K_s \geq K_n \Delta P_{(\text{maximum flowing})}$$

To determine negative gradient (K_n) values:

- For balanced valve designs, refer to tables 19, 20, 21, and 21A. For NPS 12 and larger ED/ET/ET-C valves and NPS 16 and larger EWD/EWT/EWT-C valves, use 4.0 (pounds/inch)/psid. For other valves not in the tables, contact your Emerson Process Management sales office.
- For unbalanced valves with pressure tending to open the valve, use $K_n = 0$.
- For unbalanced valves with pressure tending to close the valve, use the equation:

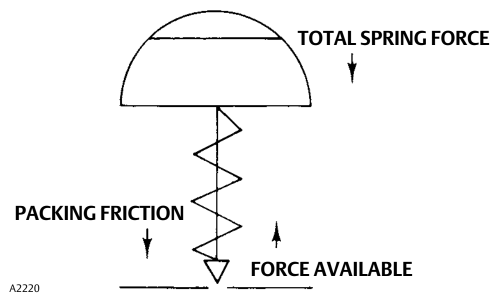
$$K_n = \frac{2 \times \text{Unbalance Area}}{\text{Travel}}$$

If the system is dynamically unstable, an actuator spring with a greater spring rate will create a more stable system.

An alternate method of checking dynamic stability (negative gradient) which may produce more accurate actuator sizing introduces the beneficial effect that the air spring has on actuator sizing. The actuator spring rate (K_s) plus the actuator air spring (K_a) must be greater than the product of the negative gradient (K_n) and the maximum pressure drop when the fluid is flowing through the valve body (not the pressure drop at shutoff).

$$K_s + K_a \geq K_n \Delta P_{(\text{maximum flowing})}$$

657 or 667 actuator air spring rate (K_a) can be determined from figures 8 through 14. For 480 Series and 585C actuators, see figures 15 and 16.



6. Actual travel

The sizing procedure described above ensures that the actuator will properly close the valve. Due to packing friction, the valve may not, in some cases, travel fully open unless a larger than nominal air pressure is supplied to open the valve. The force diagram below illustrates forces involved in opening a valve with a 667 actuator. (Assume no downstream pressure.)

The total spring force and the packing friction force must be overcome by the force available. The total spring force is found by multiplying the spring compression rate by the total spring compression (initial wind-in plus travel).

Checking the length of the spring adjustor in operational check (1) indicated an initial wind-in of 1.05 inches. The travel is 1.125 inches. The spring compression rate of the spring selected above is 460 pounds per inch.

The total spring force = 460 (1.05 + 1.125) = 1001 lb

The total packing friction force is 50 pounds.

The maximum air supply pressure (P_B) acting on the diaphragm area must overcome the sum of the spring force and the packing friction force.

P_B (69) = 1001 + 50
P_B = 15.2 psig

This means that a pressure of 15.2 psig will be required to ensure full travel, or to stroke the valve fully open. The actuator will properly seat the valve, and the system can be operated with only 15 psig air supply, but the valve will not stroke fully open unless an additional 0.2 psig supply pressure is available.

Assuming a maximum air supply of 15 psig, the valve plug will travel 1.1 inch from the fully closed position to the maximum open position.

Pressure-Tends-To-Close

Sizing Calculation

If the flow direction is reversed through the ED valve body, so that pressure tends to close the valve, the pressure will assist the 667 actuator spring in closing the valve. Determining the appropriate actuator and spring combination will involve the same problem in static equilibrium involved in the pressure-tends-to-open application above.

When the pressure-tends-to-close the valve, assign a negative value to the unbalance force and proceed as for a pressure-tends-to-open application. The unbalance area is given in table 2.

Operational Checks

In addition to the operational checks performed for the pressure-tends-to-close application, check the relationship between the actuator force and the closing force as indicated below.

For the 667 actuator to control properly, a force equal to the diaphragm area times one-half of the available air span (either 1/2 x 12 = 6 or 1/2 x 24 = 12) must be greater than the closing force exerted by the flowing media. The closing force will be the $\Delta P_{(shutoff)}$ multiplied by the unbalance area found in table 2, since the media will exert a force down in a flow up situation.

Using the service conditions from the example above:

- ΔP = 200 psi
- Unbalanced area = 0.27 square inches
- stem (1/2-inch) area = 0.2 square inch

Closing force = ΔP (unbalance area — stem area)

= 200 (0.27 - 0.2)

= 14 lb

When given 3 to 15 psig air supply to a size 40 or 40i actuator, a force of 6 psig x 69 square inches = 414 pounds must be greater than the closing force.

Since 414 pounds is greater than the 14-pound closing force, the actuator will control the system under the given conditions.

657 and 667 Actuators (Size 80)

657

Sizing Calculation

Problem: Determine the correct spring for a size 80 657 actuator for the valve and service conditions described below:

- NPS 4 CL1500 ES
- Push-Down-To-Close
- Flow Up
- Metal Seat
- PTFE Packing
- Travel—1.5 inches

- Port Circumference--10.8 inches
- Port Area--9.28 square inches
- Valve Stem Connection--1 inch
- Inlet Pressure--200 psig
- $\Delta P_{(shutoff)}$--200 psi
- Outlet Pressure--0 psig
- Valve Stem Material--316 strain-hardened stainless steel
- Process Temperature--100°F

Service Conditions: 6-30 psig air to the diaphragm. (The following sample problem illustrates actuator sizing using a positioner with a 6-30 psig signal and assumes the positioner is not capable of producing a 0-33 psig output.)

Note

Customer specifications require a seat load of 50 pounds per lineal inch of port circumference for this application.

Proper sizing of a size 80 actuator requires considering the varying diaphragm effective area. The diaphragm effective area at various travels is shown in table 14. At 1.5 inches of travel, the diaphragm effective area is 286 square inches. At zero travel, the diaphragm effective area is 316 square inches. With a 657 actuator, the initial air pressure, applied when the valve is open, is exerted against the maximum diaphragm effective area. At full travel, air pressure is exerted against the lesser diaphragm area.

The total force available is the product of the diaphragm effective area at 1.5 inches of travel (286 square inches) and the maximum air supply pressure (30 psig).

286 Sq In. x 30 psig = 8580 Lbs

The initial force is the product of the diaphragm effective area at zero travel (316 square inches) and the initial air pressure supplied to the diaphragm (6 psig).

316 Sq In. x 6 psig = 1896 Lb

The force required to overcome static unbalance is the product of the port area (9.28 square inches) and the force against which the valve plug must shut off (200 psig).

9.28 Sq In. x 200 psig = 1856 Lb

Assuming a seat load requirement of 50 lb/lineal inch of port circumference, the seat load can be determined as follows:

50 Lb/In. x 10.8 In. = 540 Lb

The force required to overcome packing friction with a 1 inch stem is 100 lb (see table 6).

The actuator must provide force to overcome the unbalance force, to provide a seat load, and to overcome packing friction. The total of these forces is:

1856 Lb + 540 Lb + 100 Lb = 2496 Lb

The actuator spring must oppose the resultant force determined by subtracting the initial force and the force required to achieve static balance from the total force available. This resultant force is:

8580 lb - 1896 Lb - 2496 Lb = 4188 Lb

To find the ideal spring compression rate, divide the resultant force by the travel.

4188 Lb ÷ 1.5 In. = 2792 Lb/In.

The spring whose compression rate most closely matches, but is not greater than, the ideal spring compression rate should be selected from the table for the size 80 657 actuator. (If the ideal spring compression rate is not among the compression rates listed in the table, either (1) select a larger size actuator or (2) provide greater available force by supplying more air pressure to the diaphragm and recalculating the ideal spring compression rate.)

The ideal spring compression rate falls between available spring compression rates of 2600 lb/in. and 3100 lb/in. The spring with the lesser compression rate must be chosen, since the greater spring force cannot be completely overcome by the total force available. When the available spring compression rate does not match exactly the ideal spring rate, the static forces can be balanced by using the adjusting screw to compress the spring.

The spring with a compression rate closest to, and less than, the ideal spring rate is spring 1H747627082, which has a compression rate of 2600 lb/in. This spring should be chosen for the given service conditions.

Note

This same method of calculating the spring rate applies to any non-standard travel and to any air supply pressure.

Bench Set

The table for the size 80 657 actuator indicates a bench set of 6-20 psig at 1.5 inches of travel for the spring selected. The force required for full actuator travel is the sum of the spring force (spring compression rate x travel) and the initial force divided by the minimum diaphragm effective area (286 square inches).

$$\frac{(2600\text{Lb/In. x } 1.5 \text{ In}) + 1896}{286} = \frac{20 \text{ Psig}}{\text{(rounded)}}$$

The 20 psig will position the plug at the full travel position. The bench set, therefore, will be 6-20 psig.

657 Operational Checks

Operational checks may be performed using the same methods demonstrated for any other size 657 actuator.

667

Sizing Calculation

Problem: Determine the correct spring for a size 80 667 actuator for the valve and service conditions described below:

- NPS 4 CL1500 ES
- Push-Down-To-Close
- Flow Up
- Metal Seat
- PTFE Packing
- Travel--1.5 inches
- Port Circumference--10.8 inches
- Port Area--9.28 square inches
- Valve Stem Connection--1 inch
- Inlet Pressure--200 psig
- $\Delta P_{(shutoff)}$--200 psi
- Outlet Pressure--0 psig
- Valve Stem Material--316 strain-hardened stainless steel
- Process Temperature--90°F

Service Conditions: 6-30 psig air to the diaphragm. (The following sample problem illustrates actuator sizing using a positioner with a 6-30 psig output signal and assumes the positioner is not capable of producing a 0-33 psig output.)

Note

Customer specifications require a seat load of 50 pounds per lineal inch of port circumference for this application.

Proper sizing of a size 80 actuator requires considering the varying diaphragm effective area. The diaphragm effective area at various travels is shown in table 14. At 1.5 inches of travel, the diaphragm effective area is 286 square inches. At zero travel, the diaphragm effective area is 316 square inches. The force available is the product of the diaphragm area at full travel (286 square inches) and the maximum air supply pressure (30 psig).

286 in.^{2} x 30 psig = 8580 lb

The initial force is the product of the diaphragm effective area at zero travel (316 square inches) and the initial air supply pressure (6 psig).

316 in.^{2} x 6 psig = 1896 lb

The force required to overcome static unbalance is the product of the port area (9.28 square inches) and the force against which the plug must shut off (200 psig).

9.28 in.^{2} x 200 psig = 1856 lb

Assuming a seat load requirement of 50 pounds per lineal inch of port circumference, the required seat load force will be:

50 lb/in. x 10.8 in. = 540 lb

In the case of a reverse-acting actuator on a push-down-to-close valve, the initial force wound into the spring can be used for seat load if the positioner can deliver a 0 psig output. The positioner in our sample problem has a minimum supply of 6 psig that matches the initial wind-in, therefore we must size our actuator for the full 540 pounds of seating force required.

The force required to overcome packing friction, with a 1-inch stem is 100 pounds (see table 6). The total unbalance force, seat load force, and packing friction force is:

1856 lb + 540 lb + 100 lb = 2496 lb

The force available, less the initial force and the total of the unbalance force, seat load force, and packing friction force is:

8580 lb - 1896 lb - 2496 lb = 4388 lb

To find the ideal spring rate, divide this resultant force by the travel.

4388 lb ÷ 1.5 in. = 2925 lb/in. (rounded)

The spring table for the size 80 667 indicates spring 1H747627082, with the compression rate of 2600 pounds per inch, as the spring whose compression rate most closely matches, without exceeding, the ideal spring compression rate. If the ideal spring compression rate is not among the compression rates listed in the table, either (1) select a larger size actuator or (2) provide greater available force by supplying more air pressure to the diaphragm and recalculating the ideal spring compression rate.

Bench Set

The table for the size 80 667 actuator indicates a bench set of 14 to 30 psig at 1.5 inches of travel for the spring selected. The force wound in to achieve static balance and the required seat load can be determined by dividing the forces which must be overcome (in this case, the unbalance force of 2496 pounds) by the diaphragm effective area at zero travel (316 square inches).

2496 lb ÷ 316 in.^{2} = 8 psig (rounded)

The 14 psig bench set is determined by adding the initial air supply pressure (6 psig) to the air pressure required to provide the force to achieve static balance and seat load (8 psig).

6 psig + 8 psig = 14 psig

Thus, the bench set will be 14 to 30 psig air to the diaphragm.

Operational Checks

Operational checks may be performed using the same methods demonstrated for any other size 667 actuator.

Stem Load Calculation

After selecting an actuator with enough force to overcome the valve body force requirements, the available actuator force must be compared to the maximum allowable valve stem load. If the former is greater than the latter, the actuator may damage the valve stem. Calculate the maximum allowable valve stem load using the tables in this section.

First, refer to table 1 to determine the appropriate tables to use for a specific valve design. For all valves listed in table 1, read the strain-hardened 316 stainless steel stem loads for all temperatures from tables 3, 5, or 7; read the material factors for other materials for all temperatures from tables 4, 6, or 8.

For example, find the maximum allowable valve stem load of a CL300 NPS 6 Fisher® ED valve with a standard bonnet and 3/4-inch diameter 316 stainless steel strain-hardened stem, at a process temperature of 204°C (400°F). Table 1 refers to tables 3 and 4. Table 3, for strain-hardened 316 stainless steel stems, lists a maximum allowable valve stem load of 7980 pounds for a 3/4-inch diameter stem at 204°C (400°F).

For the same valve at 399°C (750°F), interpolate to find that the maximum allowable valve stem load is 30.292 kN (6810 pounds).

For the same valve with a 17-4PH H1150 stainless steel stem at 204°C (400°F) process temperature, refer to table 4. Find the 3/4-inch stem reference load of 22.508 kN (5060 pounds), the 204°C (400°F) material factor of 1.997, and multiply to find the stem load of 44.927 kN (10100 pounds).

When the actuator force is greater than the stem load of the standard material, a larger valve stem or a nonstandard stem material may be required. If an electric actuator is being used, the maximum thrust limit must be set to no greater than the maximum stem load. Selecting a larger valve stem usually requires the selection of a larger yoke boss and actuator. The selection of a nonstandard valve stem requires picking a material compatible with the process and strong enough for the available actuator force. If a nonstandard stem material is required, use the following formula to determine the minimum material factor required at the given process temperature:

$$\frac{\text{available actuator force}}{\text{reference load of given stem diameter}} < \text{minimum required material factor}$$

Any material with a material factor equal to or greater than the minimum required will withstand the available actuator force.

One of the factors that determines maximum allowable stem load is the L/D ratio (the ratio of unsupported stem length to stem diameter). Tables 3 and 4 are for valves having an L/D ratio up to 12.5 to 1; Tables 5 and 6 are for valves having an L/D ratio up to 15 to 1; Tables 7 and 8 are for valves having an L/D ratio up to 20 to 1. All of these tables deal with the length of unsupported stem between the bottom of the packing and the top of the plug when the plug is in the closed position.

When calculating the required stem force at the closed position, packing friction is excluded. The upward force component of packing friction expected when the valve is seated may under service conditions be virtually lost. However, packing friction must be considered when calculating the available actuator force to compare with the maximum allowable stem load.

Use this information only for the valve designs, sizes, ratings, and bonnet styles listed in table 1. The stem load information is valid for standard travels only; special long travel construction using bonnet spacers or extension bonnets not listed are not covered. For constructions not specifically listed, contact your Emerson Process Management sales office.

The allowable stem loads are for use with published standard and optional bonnet boss sizes. For special boss sizes and increased pressure and temperature ratings, consult your Emerson Process Management sales office for possible bonnet joint limitations.

Table 1. Usage Guide

VALVE BODY DESIGN	SIZE, NPS	PRESSURE RATING	BONNET STYLE	STEM DIAMETER, INCHES	TABLE REFERENCES
D & DA	- - -	- - -	Plain	- - -	3 & 4
ED, ES, ET, EZ, EAD, EAS, & EAT	- - -	Through CL600	Plain	- - -	3 & 4
ED, ES, ET, & EZ	- - -	Through CL600	Style 1 extension	0.375 & 0.5 0.75 1 & 1.25	7 & 8 5 & 6 3 & 4
ET-C, EWT-C, & EZ-C	- - -	- - -	Style 3 extension	- - -	2
EDR & ETR	- - -	- - -	Plain	- - -	5 & 6
EHD(9), EHS, & EHT	1(1,2)	CL2500	Plain	0.5 0.75	7 & 8 3 & 4
	2(1)	CL2500(3)	Plain	0.5 0.75 1	7 & 8 5 & 6 3 & 4
	3(1,4)	CL2500	Plain	0.5 0.75 1	5 & 6 7 & 8 3 & 4
	4(1,4)	CL2500	Plain	0.75 1	5 & 6 3 & 4
	6(1,5)	CL2500	Plain	0.75 1 & 1.25	5 & 6 3 & 4
EHD, EHP, & EHT	8 Through 14	- - -	Plain	1.25 2	7 & 8 3 & 4
EWD & EWS	Through 12 x 6	Through CL900	Plain	- - -	3 & 4
EWT, EWD-1, & EWT-1	12 x 8(5)	- - -	Plain	- - -	7 & 8
	12 x 8(5)	- - -	Plain	0.75	7 & 8
	12 x 8(6)	- - -	Plain	1.25	5 & 6
EWND-1 & EWND-2	8 x 6(7)	- - -	Plain	0.75	7 & 8
EWND-1 & EWNT-1	12 x 8(8)	- - -	Plain	1.25	7 & 8
HPD, HPS, & HPT	1	CL1500	Plain	0.5 & 0.75	3 & 4
	2	CL1500	Plain	0.5, 0.75, & 1	3 & 4
	3	CL900 & 1500	Plain	0.5	5 & 6
				0.75 & 1	3 & 4
	4	CL900 & 1500	Plain	0.75 & 1	3 & 4
	6	CL900 & 1500	Plain	0.75, 1, & 1.25	3 & 4
HPS-C, & HPT-C	- - -	- - -	Style 3 Extension	- - -	9
YD & YS(10)	- - -	- - -	Plain	- - -	7 & 8

1. Refers to trim size.
2. Through 1 in. maximum travel only.
3. Through 1.5 in. maximum travel only.
4. Through 2 in. maximum travel only.
5. Through 3 in. maximum travel only.
6. 6 in. maximum travel.
7. 5 in. maximum travel.
8. 8 in. maximum travel.
9. Includes Cavitrol™ III and Whisper Trim™ III constructions.
10. Electric actuators mountedc on YD and YS valves must be capable of thrust limits in both the up and down positions.

Table 2. Maximum Allowable Stem Loads for Fisher ET-C, EWT-C, and EZ-C with Standard Extension Bonnet Length and S20910(XM-19) Stem Material, 38°C (100°F) or Lower Service Temperature

VALVE SIZE	"A" DIMENSION(1)	STEM DIAMETER "D"	UNSUPPORTED STEM LENGTH "L"	L/D RATIO	MAXIMUM ALLOWABLE STEM LOAD	
NPS	Inches	Inches	Inches		kN	Lb
1	21	3/8 1/2	17.1 18.0	45.6 36.0	5.382 13.166	1210 2960
1-1/2	21	3/8 1/2	17.2 18.0	45.9 36.0	5.337 13.166	1200 2960
2	21	1/2 3/4	16.7 16.8	33.4 22.4	14.367 44.170	3230 9930
3	21	1/2 3/4	15.7 15.8	31.4 21.0	15.301 45.460	3440 10220
4 6 x 4 8 x 4	21 22.38 22.44	1/2 3/4	14.5 14.6	29.0 19.5	16.458 46.973	3700 10560
6 8 x 6 12 x 6	30 31.38 34.06	3/4 1	22.2 20.7	29.6 20.7	36.386 81.491	8180 18320
8 10 x 8	30	3/4 1	18.8 17.2	25.1 17.2	41.368 87.007	9300 19560

1. The "A" dimension for a style 3 extension bonnet refers to the distance from the match line for the actuator to the center line of the valve body. This is commonly specified as dimension D in product bulletins.

Table 3. Stem Loads for Strain-Hardened 316 Stainless Steel (SA-276-B) Stems (Only for the Appropriate Valves Listed in Table 1 Having L/D Ratios of up to 12.5 to 1)

STEM DIAMETER, mm	TEMPERATURE, °C							
	to 38(1)	93	149	204	260	316	371	427(2)
	Maximum Allowable Stem Load, kN							
8	8.629	7.517	6.850	6.183	5.827	5.560	5.293	5.204
9.5	12.455	10.809	9.830	8.851	8.362	8.006	7.650	7.517
12.7	22.107	19.216	17.481	15.791	14.901	14.234	13.567	13.344
19.1	49.775	43.236	39.366	35.496	33.539	32.027	30.514	30.025
25.4	71.749	62.186	56.581	50.976	48.219	45.905	43.814	43.058
31.8	92.033	79.623	72.417	66.322	61.518	58.761	55.958	55.113
50.8	111.205	95.903	86.695	79.712	74.552	70.459	67.524	65.655
STEM DIAMETER, INCH	TEMPERATURE, °F							
	to 100(1)	200	300	400	500	600	700	800(2)
	Maximum Allowable Stem Load, Lb							
5/16	1940	1690	1540	1390	1310	1250	1190	1170
3/8	2800	2430	2210	1990	1880	1800	1720	1690
1/2	4970	4320	3930	3550	3350	3200	3050	3000
3/4	11190	9720	8850	7980	7540	7200	6860	6750
1	16130	13980	12720	11460	10820	10320	9850	9680
1-1/4	20690	17900	16280	14910	13830	13210	12580	12390
2	25000	21560	19490	17920	16760	15840	15180	14760

1. Stem loads shown for temperatures to 38°C (100°F) are valid for temperatures to -253.8°C (-425°F). Do not use below the lower temperature limit of the bonnet, packing, or valve construction materials being used.
2. For temperatures above 427°C (800°F), calculate stem load using the reference loads and stem material factors given in table 4 for 316 stainless steel annealed (SA-479-316) stems.

Table 4. Stem Material Factors (Only for the Appropriate Valves Listed in Table 1 Having L/D Ratios of Up to 12.5 to 1 and with Reference Loads Listed in this Table)

REFERENCE LOADS

TO OBTAIN STEM LOAD, MULTIPLY REFERENCE LOAD AT RIGHT BY MATERIAL FACTOR BELOW	5/16 Inch Stem: 3.914 kN (880 Lb) 3/8 Inch Stem: 5.604 kN (1260 Lb) 1/2 Inch Stem: 10.008 kN (2250 Lb)	3/4 Inch Stem: 22.508 kN (5060 Lb) 1 Inch Stem: 39.989 kN (8990 Lb) 1-1/4 Inch Stem: 62.497 kN (14050 Lb) 2 Inch Stem: 159.958 kN (35960 Lb)

Stem Material Factors

Stem Material	Temperature,										
	to 38°C(1)	93°C	149°C	204°C	260°C	316°C	371°C	427°C	482°C	537°C	593°C
	to 100°F(1)	200°F	300°F	400°F	500°F	600°F	700°F	800°F	900°F	1000°F	1100°F
316 stainless steel annealed (SA-479-316)	0.833	0.705	0.638	0.576	0.548	0.518	0.497	0.483	0.475	0.466	---
316L stainless steel (SA-479-316L)	0.684	0.579	0.519	0.473	0.437	0.413	0.393	0.377	0.361	0.341	---
17-4PH stainless steel H1150 (SA-564 630)(2)	2.319	2.153	2.065	1.997	1.936	1.883	1.860(3)	---	---	---	---
S66286 stainless steel (SA 638-660 Type B)	1.903	1.847	1.814	1.812	1.810	1.808	1.806	1.803	1.800	1.777	---
N05500 Alloy (N05500 HT 27-35 RC)	2.303	2.220	2.159	2.117	2.115	2.113	2.090	2.081	---	---	---
S20910 (SA-479 Grade XM-19)	2.322	2.076	1.977	1.878	1.806	1.734	1.668	1.605	1.549	1.494	1.435
N04400	0.683	0.603	0.562	0.543	0.543	0.543	0.543	0.521	---	---	---
N10665 (ASME SB335)	1.245	1.157	1.096	1.046	1.000	0.968	0.944	0.919	---	---	---
N10276 (ASME SB574)	1.242	1.166	1.102	1.046	1.003	0.957	0.943	0.943	---	---	---
N06600 (ASME SB166)	0.923	0.900	0.877	0.855	0.809	0.804	0.786	0.786	0.785	0.740	---
R05200 (ASTM B-365)(4)	2.022	1.895	1.747	1.683	1.639	1.616	1.605	1.594	---	---	---

1. Except where indicated, stem loads calculated using the factors shown for temperatures to 38°C (100°F) are valid for temperatures to -253°C (-425°F). Do not use below the lower temperature limit of the bonnet, packing, or valve construction materials being used.
2. Do not use below -78.8°C (-110°F).
3. At 343°C (650°F).
4. Do not use below -17.7°C (0°F).

Table 5. Stem Loads for Strain-Hardened 316 and 316L Stainless Steel (ASTM-276-B) Stems (Only for the Appropriate Valves Listed in Table 1 Having L/D Ratios of Up to 15 to 1)

STEM DIAMETER, mm	TEMPERATURE, °C							
	To 38(1)	93	149	204	260	316	371	427(2)
	Maximum Allowable Stem Load, kN							
8	8.362	7.295	6.672	6.049	5.693	5.426	5.204	5.115
9.5	12.054	10.542	9.608	8.674	8.229	7.828	7.473	7.339
12.7	21.707	18.727	17.081	15.435	14.590	13.967	13.300	13.077
19.1	48.263	42.080	38.432	34.740	32.827	31.359	29.936	29.402
25.4	70.059	60.896	55.513	50.086	47.329	45.238	43.103	42.391
31.8	90.254	78.333	71.304	64.276	60.718	58.049	55.291	54.401
STEM DIAMETER, INCH	TEMPERATURE, °F							
	To 100(1)	200	300	400	500	600	700	800(2)
	Maximum Allowable Stem Load, Lb							
5/16	1880	1640	1500	1360	1280	1220	1170	1150
3/8	2710	2370	2160	1950	1850	1760	1680	1650
1/2	4880	4210	3840	3470	3280	3140	2990	2940
3/4	10850	9460	8640	7810	7380	7050	6730	6610
1	15750	13690	12480	11260	10640	10170	9690	9530
1-1/4	20290	17610	16030	14450	13650	13050	12430	12230

1. Stem loads shown for temperatures to 38°C (100°F) are valid for temperatures to -253.58°C (-425°F). Do not use below the lower temperature limit of the bonnet, packing, or valve construction materials being used.
2.For temperatures above 427°C (800°F), calculate stem load using the reference loads and stem material factors given in table 6 for 316 stainless steel annealed (ASME-SA479-316) stems.

Table 6. Stem Material Factors (Only for the Appropriate Valves Listed in Table 1 Having L/D Ratios of Up to 15 to 1 and with Reference Loads Listed in this Table)

REFERENCE LOADS		
TO OBTAIN STEM LOAD, MULTIPLY REFERENCE LOAD AT RIGHT BY MATERIAL FACTOR BELOW	5/16 Inch Stem: 3.914 kN (880 Lb) 3/8 Inch Stem: 5.604 kN (1260 Lb) 1/2 Inch Stem: 10.008 kN (2250 Lb)	3/4 Inch Stem: 22.508 kN (5060 Lb) 1 Inch Stem: 39.989 kN (8990 Lb) 1-1/4 Inch Stem: 62.497 kN (14050 Lb)

Stem Material Factors Based on Annealed 316 L/D Ratio of 10 to 1

Stem Material	Temperature										
	to 38°C(1)	93°C	149°C	204°C	260°C	316°C	371°C	427°C	482°C	537°C	593°C
	to 100°F(1)	200°F	300°F	400°F	500°F	600°F	700°F	800°F	900°F	1000°F	1100°F
316 stainless steel annealed (ASME SA479-316)	0.811	0.700	0.634	0.583	0.545	0.515	0.494	0.480	0.472	0.463	- - -
316L stainless steel annealed (ASME SA479-316L)	0.679	0.575	0.516	0.470	0.435	0.411	0.391	0.375	0.359	0.340	- - -
17-4PH stainless steel H1150 (ASME SA564 630)(2)	2.245	2.089	2.005	1.925	1.882	1.834	1.808(3)	- - -	- - -	- - -	- - -
S66286 stainless steel (ASTM SA638-660 Type B)	1.856	1.801	1.769	1.766	1.764	1.761	1.757	1.753	1.749	1.726	- - -
N05500 (N05500 HT 27-35 RC)	2.222	2.145	2.088	2.048	2.046	2.043	2.020	2.010	- - -	- - -	- - -
S20910 (ASME SA479 Grade XM-19)	2.257	2.024	1.929	1.833	1.763	1.694	1.630	1.568	1.515	1.461	1.401
N10665 (ASME SB335)	1.230	1.144	1.084	1.034	0.990	0.958	0.934	0.910	- - -	- - -	- - -
N10276 (ASME SB574)	1.226	1.151	1.150	1.034	0.992	0.947	0.933	0.932	- - -	- - -	- - -
N06625 (ASME SB446)	0.913	0.891	0.868	0.846	0.801	0.796	0.778	0.778	0.777	0.732	- - -
Titanium Grade 5 R56400 (ASTM B348)	1.964	1.845	1.705	1.643	1.600	1.578	1.567	1.557	- - -	- - -	- - -

1. Except where indicated, stem loads calculated using the factors shown for temperatures to 38°C (100°F) are valid for temperatures to -253°C (-425°F). Do not use below the lower temperature limit of the bonnet, packing, or valve construction materials being used.
2. Do not use below -78.8°C (-110°F).
3. At 343°C (650°F).

Table 7. Stem Loads for Strain-Hardened 316 and 316L Stainless Steel (ASTM-276-B) Stems (Only for the Appropriate Valves Listed in Table 1 Having L/D Ratiosof Up to 20 to 1)

STEM DIAMETER, mm	TEMPERATURE, °C							
	To 38(1)	93	149	204	260	316	371	427(2)
	Maximum Allowable Stem Load, kN							
9.5	11.076	9.786	8.985	8.140	7.739	7.384	7.072	6.939
12.7	19.750	17.437	16.013	14.545	13.789	13.255	12.588	12.366
19.1	44.393	39.233	36.030	32.738	31.048	29.669	28.379	27.845
25.4	65.655	57.648	52.800	47.862	45.282	43.325	41.368	40.612
31.8	85.717	74.997	68.547	61.963	58.627	56.092	53.467	52.622
STEM DIAMETER, INCH	**TEMPERATURE, °F**							
	To 100(1)	200	300	400	500	600	700	800(2)
	Maximum Allowable Stem Load, Lb							
3/8	2490	2200	2020	1830	1740	1660	1590	1560
1/2	4440	3920	3600	3270	3100	2980	2830	2780
3/4	9980	8820	8100	7360	6980	6670	6380	6260
1	14760	12960	11870	10760	10180	9740	9300	9130
1-1/4	19270	16860	15410	13930	13180	12610	12020	11830

1. Stem loads shown for temperatures to 38°C (100°F) are valid for temperatures to -253.8°C (-425°F). Do not use below the lower temperature limit of the bonnet, packing, or valve construction materials being used.
2.For temperatures above 427°C (800°F), calculate stem load using the reference loads and stem material factors given in table 6 for 316 stainless steel annealed (ASME SA479-316) stems.

Table 8. Stem Material Factors (Only for the Appropriate Valves Listed in Table 1 Having L/D Ratios of Up to 20 to 1 and with Reference Loads Listed in this Table)

REFERENCE LOADS

TO OBTAIN STEM LOAD, MULTIPLY REFERENCE LOAD AT RIGHT BY MATERIAL FACTOR BELOW	3/8 Inch Stem: 5.604 kN (1260 Lb) 1/2 Inch Stem: 10.008 kN (2250 Lb)	3/4 Inch Stem: 22.508 kN (5060 Lb) 1 Inch Stem: 39.989 kN (8990 Lb) 1-1/4 Inch Stem: 62.497 kN (14050 Lb)

Stem Material Factors Based on Annealed 316 L/D Ratio of 10 to 1

Stem Material	Temperature										
	to 38°C(1)	93°C	149°C	204°C	260°C	316°C	371°C	427°C	482°C	537°C	593°C
	to 100°F(1)	200°F	300°F	400°F	500°F	600°F	700°F	800°F	900°F	1000°F	1100°F
316 stainless steel annealed (ASME SA479-316)	0.674	0.584	0.529	0.487	0.456	0.432	0.414	0.402	0.395	0.388	- - -
316L stainless steel annealed (ASME SA479-316L)	0.567	0.482	0.433	0.395	0.365	0.345	0.329	0.315	0.302	0.286	- - -
17-4PH stainless steel H1150 (ASME SA564 630)(2)	2.060	1.926	1.854	1.783	1.745	1.701	1.676(3)	- - -	- - -	- - -	- - -
S66286 stainless steel (ASTM SA638-660 Type B)	1.735	1.684	1.653	1.649	1.644	1.639	1.633	1.626	1.619	1.596	- - -
N05500 (N05500 HT 27-35 RC)	2.019	1.956	1.909	1.875	1.872	1.865	1.844	1.832	- - -	- - -	- - -
S20910 (ASME SA479 Grade XM-19)	2.074	1.875	1.790	1.706	1.644	1.580	1.523	1.466	1.417	1.368	1.313
N10665 (ASME SB335)	1.013	0.944	0.896	0.855	0.820	0.794	0.774	0.754	- - -	- - -	- - -
N10276 (ASMW SB574)	1.185	1.115	1.055	1.033	0.963	0.920	0.906	0.905	- - -	- - -	- - -
N06625 Grade 1 (ASME SB446)	0.888	0.866	0.845	0.823	0.780	0.776	0.758	0.757	0.756	0.714	- - -
Titanium Grade 5 R56400 (ASTM B348)	1.816	1.715	1.594	1.541	1.501	1.480	1.470	1.460	- - -	- - -	- - -

1. Except where indicated, stem loads calculated using the factors shown for temperatures to 38°C (100°F) are valid for temperatures to -253.8°C (-425°F). Do not use below the lower temperature limit of the bonnet, packing, or valve construction materials being used.
2. Do not use below -78.8°C (-110°F).
3. At 343°C (650°F).

Table 9. Max Allowable Loads for Fisher HPT-C and HPS-C with Std Bonnet Extension Length and S20910 Stem Mat'l

VALVE	VALVE SIZE, NPS	STEM DIA (D)	UNSUPPORTED STEM LENGTH (L)	L/D RATIO	MAX ALLOWABLE STEM LOAD FOR S20910 STEM MAT'L	
		Inches	Inches		N	lb
HPT-C	4	3/4	13.6	18.1	48055	10803
		1	12.5	12.5	89956	20223
	6	1	19.5	19.5	83382	18745
		1-1/4	19.5	15.6	139185	31290
HPS-C	1	1/2	15.6	31.2	15413	3465
		3/4	16.0	21.3	45176	10156
	2	1/2	14.5	29.0	16458	3700
		3/4	14.8	19.7	46738	10507
		1	9.7	9.7	95130	21386
	3	3/4	12.8	17.1	48873	10987
		1	12.5	12.5	89956	20223

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Introduction

This actuator sizing method is based on the pressure drop in the valve. Actual torque calculations are not required. The maximum allowable pressure drop tables in this section are for standard valve and actuator combinations.

Using the following procedure, you can quickly size 1052 spring-and-diaphragm actuators and 1061 piston actuators for Fisher 9500 butterfly valves, 8500 series eccentric disk valves, Vee-Ball™ valves, and V500 valves.

The specific valve constructions included in this section are shown in table 1. Actuators for other constructions can be sized using section D of this catalog.

Additional rotary actuator sizing information using the valve torque requirements as a base can be found in section D of this catalog.

The following information must be known to use the pressure drop sizing method:

- Valve type number, design, size and construction
- Actuator type number
- Valve action and fail position
- Shutoff and flowing service conditions
- Supply pressure available to the actuator

Table 1. Constructions Covered for Each Valve Type

Valve Body	Constructions Covered
8532	S17400 (H1025 SST) shaft Metal or PEEK bearings Graphite or PTFE V-ring packing PTFE (CL300 only), Phoenix III, Novex, or S31600 high temperature seal
9500	S17400 shaft PTFE-lined bearings S31600 stainless steel FISHTAIL™ disk or aluminum/bronze conventional disk Nitrile or PTFE liner
CV500	440C or PTFE/composition lined bearings
V150, V200, V300	S20910 shaft PTFE/S31600 bearings TCM or metal ball seal Flow ring construction
V500	S17400 or S20910 shaft Trim levels 1, 2, and 3 Reverse flow Full and reduced ports

Maximum Rotation: Definition and Use

The term maximum rotation, as used in the tables and text of this section, is defined as the angle of valve disk or ball in the fully open position.

Normally, maximum rotation is 90 degrees; that is, the ball or disk rotates 90 degrees from the closed position to the wide open position.

Some of the actuator tables in this section indicate maximum allowable pressure drops at a maximum rotation of 60 degrees or 75 degrees. In these cases, valve rotation has been limited by travel stops in the actuator.

How to Use the Pressure Drop Method

Calculate the maximum effective pressure drops and choose an actuator by using the following procedure.

CAUTION

Use the valve bulletin first to determine pressure and temperature limitations for a specific valve construction. Then use the pressure drops in this section only for actuators selection. Do not exceed any pressure or temperature limitation given in the valve bulletin.

1. Calculate ΔP_{eff} for the valve, fluid, and angles of opening shown in table 2. The ΔP_{eff} equation for each valve type is shown in table 3 for gas or liquid service. K values are in table 4 or 5. Calculate ΔP_{eff}.

2. Compare ΔP_{eff} to ΔP_{actual} (if ΔP_{actual} is known) at each angle of rotation. Use the smaller of the two values (ΔP_{eff} or ΔP_{actual}) as the effective pressure drop at open angles of rotation.

3. Turn to the appropriate Section C table. Make sure the valve and actuator descriptions listed on the table match the valve and actuator constructions in question.

4. Use the actual maximum shutoff pressure drop, $\Delta P_{shutoff}$, as the pressure drop in the closed position, 0 degrees angle of opening.

5. Find an actuator selection that has a pressure drop at 0 degrees angle of opening equal to or greater than $\Delta P_{shutoff}$. The pressure drop in the table at each open angle of rotation must also be equal to or greater than either ΔP_{eff} or ΔP_{actual}, whichever is less.

Table 2. Angles of Rotation for Required ΔP_{eff} Calculation

Valve	Actuator	Maximum Disk Rotation	Angles of Rotation at Which Calculations are Required
9500	All	60°	60° for all valve sizes
		90°	90° for all valve sizes
V150	All	60°	60° for all valve sizes
		90°	70° for all valve sizes
V500	All	60°	60°
		90°	60° and 90°

1. For 1052 and 1066 actuators. If 75° maximum rotation is needed for a 1051 or 1066SR actuator, consult your Emerson Process Management sales office.

Table 3. ΔP_{eff} Equations for Various Valves

VALVE	DEGREES MAXIMUM ROTATION	DISK STYLE	ΔP_{eff} EQUATIONS	
			Gas Service	Liquid Service
9500	60	FISHTAIL™ Disk	$\Delta P_{eff} = 0.18\ P_{1abs}$	$\Delta P_{eff} = 0.60\ P_{1abs}$
		Conventional Disk	$\Delta P_{eff} = 0.20\ P_{1abs}$	$\Delta P_{eff} = 0.45\ P_{1abs}$
	90	FISHTAIL Disk	$\Delta P_{eff} = 0.09\ P_{1abs}$	$\Delta P_{eff} = 0.45\ P_{1abs}$
		Conventional Disk	$\Delta P_{eff} = 0.14\ P_{1abs}$	$\Delta P_{eff} = 0.35\ P_{1abs}$
8532 (CL150)	90	---	$\Delta P_{eff} = K\ P_{1abs}$ See table 4 for K values	$\Delta P_{eff} = K_m\ (P_{1abs} - r_c P_v)$ See Valve Sizing for Flashing and Cavitating Liquids procedure in Catalog 12 for definition of variables.
8532 (CL300)	90	---		
V150	60 or 90	---		
V500	60 90	---	$\Delta P_{eff} = K\ P_{1abs}$ See table 5 for K values	

Table 4. 8532 and V150 K Values for Effective Pressure Drop, ΔP_{eff}

VALVE BODY SIZE, NPS	ANGLE OF OPENING, DEGREES									
	10	**20**	**30**	**40**	**50**	**60**	**70**	**75**	**80**	**90**
8532 Valves										
All Sizes	---	0.246	0.249	0.238	0.212	0.181	0.147	---	0.117	0.102
V150 Valves										
2	---	---	---	---	---	0.238	0.222	---	---	---
3	---	---	---	---	---	0.225	0.200	---	---	---
4	---	---	---	---	---	0.233	0.194	---	---	---
6	---	---	---	---	---	0.233	0.216	---	---	---
8	---	---	---	---	---	0.241	0.219	---	---	---
10	---	---	---	---	---	0.213	0.177	---	---	---
12	---	---	---	---	---	0.220	0.189	---	---	---

Actuator Sizing for Rotary Valves

Pressure Drop Method

Table 5. Fisher V500 K Values for Effective Pressure Drop, ΔP_{eff}

VALVE BODY SIZE, NPS	REVERSE FLOW			
	Full Port		Reduced Port	
	Rotation	Rotation	Rotation	
	60 Degree	90 Degree	60 Degree	90 Degree
1	0.145	0.128	0.157	0.154
1-1/2	0.162	0.161	0.187	0.187
2	0.119	0.119	0.162	0.159
3	0.170	0.161	0.129	0.126
4	0.183	0.187	0.145	0.144
6	0.174	0.098	0.179	0.116
8	0.154	0.163	0.174	0.140

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Body Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, and Spring Part Number	
		Size 70	
		40 Psig	55 Psig
		3.3 Psig	10.1 Psig
		1R676027082	1R676027082
14	0°	285	285
	60°	6	12
	90°	1	3
16	0°	---	285
	60°	---	7
	90°	---	2
18	0°	---	213
	60°	---	4
	90°	---	1
20	0°	---	126
	60°	---	3
	90°	---	1

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Body Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, and Spring Part Number		
		Size 70		
		33 Psig	40 Psig	55 Psig
		10.1 Psig	10.1 Psig	10.1 Psig
		1R676027082	1R676027082	1R676027082
14	0°	94	94	94
	60°	9	15	18
	90°	1	3	8
16	0°	25	25	25
	60°	5	8	12
	90°	1	2	4

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Body Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, and Spring Part Number	
		Size 70	
		40 Psig	55 Psig
		3.3 Psig	10.1 Psig
		1R676027082	1R676017082
14	0° 60° 90°	177 6 1	285 12 5
16	0° 60° 90°	- - - - - - - - -	200 7 2
18	0° 60° 90°	- - - - - - - - -	74 4 1

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Body Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, and Spring Part Number	
		Size 70	
		40 Psig	55 Psig
		3.3 Psig	10.1 Psig
		1R676027082	1R676027082
14	0°	285	285
	60°	7	8
	90°	1	2
16	0°	285	285
	60°	4	8
	90°	1	2
18	0°	---	285
	60°	---	5
	90°	---	1
20	0°	---	218
	60°	---	3
	90°	---	1

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Body Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, and Spring Part Number		
		Size 70		
		33 Psig	40 Psig	55 Psig
		10.1 Psig	10.1 Psig	10.1 Psig
		1R676027082	1R676027082	1R676027082
14	0°	201	201	201
	60°	10	16	19
	90°	1	4	8
16	0°	83	83	83
	60°	6	9	12
	90°	1	2	5
18	0°	12	12	12
	60°	3	6	10
	90°	1	1	3

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Body Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure[3]											
		Size 30			Size 40				Size 60			Size 68	
		60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
14	0°	---	---	---	---	40	106	172	172	285	285	285	285
	60°	---	---	---	---	6	8	10	10	14	17	17	18
	90°	---	---	---	---	2	3	3	3	5	6	6	8
16	0°	---	---	---	---	---	34	80	80	173	265	247	285
	60°	---	---	---	---	---	5	6	6	7	10	10	12
	90°	---	---	---	---	---	2	2	2	3	4	3	5
18	0°	---	---	---	---	---	---	21	21	84	147	134	235
	60°	---	---	---	---	---	---	4	4	5	6	6	8
	90°	---	---	---	---	---	---	1	1	2	2	2	3
20	0°	---	---	---	---	---	---	---	---	34	79	70	141
	60°	---	---	---	---	---	---	---	---	3	4	4	5
	90°	---	---	---	---	---	---	---	---	1	1	1	2

Valve Body Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure[2]							
		Size 80				Size 100			
		60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	120 Psig
18	0°	285	285	285	285	285	285	285	285
	60°	11	11	11	11	11	11	11	11
	90°	4	6	6	6	6	6	6	6
20	0°	258	285	285	285	285	285	285	285
	60°	8	10	11	11	11	11	11	11
	90°	3	4	5	5	4	5	5	5
24	0°	97	167	236	285	201	285	285	285
	60°	3	5	6	7	5	7	9	11
	90°	1	2	2	3	2	3	3	4

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)

Valve Body Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)											
		Size 30			Size 40				Size 60			Size 68	
		60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
14	0°	---	---	---	---	---	---	---	---	127	258	232	285
	60°	---	---	---	---	---	---	---	---	14	17	17	18
	90°	---	---	---	---	---	---	---	---	5	6	6	8
16	0°	---	---	---	---	---	---	---	---	10	102	84	232
	60°	---	---	---	---	---	---	---	---	8	10	10	12
	90°	---	---	---	---	---	---	---	---	3	4	3	5
18	0°	---	---	---	---	---	---	---	---	---	8	---	96
	60°	---	---	---	---	---	---	---	---	---	6	---	8
	90°	---	---	---	---	---	---	---	---	---	2	---	3
20	0°	---	---	---	---	---	---	---	---	---	---	---	19
	60°	---	---	---	---	---	---	---	---	---	---	---	5
	90°	---	---	---	---	---	---	---	---	---	---	---	2

Valve Body Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)							
		Size 80				Size 100			
		60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	120 Psig
18	0°	259	285	285	285	285	285	285	285
	60°	11	11	11	11	11	11	11	11
	90°	4	6	6	6	6	6	6	6
20	0°	136	270	285	285	285	285	285	285
	60°	8	10	11	11	11	11	11	11
	90°	3	4	5	5	4	5	5	5
24	0°	---	69	139	208	104	208	285	285
	60°	---	5	6	7	5	7	9	11
	90°	---	2	2	3	2	3	3	4

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a Type 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10 percent greater than the cylinder pressure shown above.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)

Valve Body Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure[2]											
		Size 30			Size 40				Size 60			Size 68	
		60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
14	0	- - -	- - -	- - -	22	121	219	285	285	285	285	285	285
	60	- - -	- - -	- - -	5	7	9	11	11	15	19	18	19
	90	- - -	- - -	- - -	2	3	3	4	4	5	7	6	9
16	0	- - -	- - -	- - -	- - -	27	97	166	166	285	285	285	285
	60	- - -	- - -	- - -	- - -	4	5	6	6	9	11	10	12
	90	- - -	- - -	- - -	- - -	2	2	2	2	3	4	4	5
18	0	- - -	- - -	- - -	- - -	- - -	21	69	69	163	257	238	285
	60	- - -	- - -	- - -	- - -	- - -	3	4	4	5	7	6	9
	90	- - -	- - -	- - -	- - -	- - -	1	1	1	2	2	2	3
20	0	- - -	- - -	- - -	- - -	- - -	- - -	14	14	81	148	135	242
	60	- - -	- - -	- - -	- - -	- - -	- - -	3	3	4	4	4	6
	90	- - -	- - -	- - -	- - -	- - -	- - -	1	1	1	2	2	2

Valve Body Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure[2]							
		Size 80				Size 100			
		60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	120 Psig
18	0	285	285	285	285	285	285	285	285
	60	11	11	11	11	11	11	11	11
	90	4	6	6	6	6	6	6	6
20	0	285	285	285	285	285	285	285	285
	60	8	11	11	11	11	11	11	11
	90	3	4	5	5	4	5	5	5
24	0	164	269	285	285	285	285	285	285
	60	4	5	6	7	6	6	9	11
	90	1	2	2	3	2	2	3	4

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10 percent greater than the cylinder pressure shown above.

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Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, psig/barg															
		Size 70															
		0-33 psig		0-33 psig		0-33 psig		0-40 psig		0-55 psig							
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig							
		90°		75°		60°		90°		90°							
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082							
		psi	bar	psi	bar	psi	bar	psi	bar	psi	bar						
8	0°	702	48	750	52	750	52	702	48	702	48						
	90°	44	3.0	- - -	- - -	- - -	- - -	44	3.0	44	3.0						
10	0°	333	23	441	30	524	36	333	23	333	23						
	90°	27	1.9	- - -	- - -	- - -	- - -	27	1.9	27	1.9						
12	0°	184	13	270	19	368	25	184	13	184	13						
	90°	19	1.3	- - -	- - -	- - -	- - -	19	1.3	19	1.3						

1. At 0 degrees, use maximum actual shutoff pressure drop.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, psig/barg															
		Size 70															
		0-33 psig		0-40 psig		0-55 psig											
		3.0 psig		3.3 psig		10.1 psig											
		90°		90°		90°											
		1R676027082		1R676027082		1R676027082											
		psi	bar	psi	bar	psi	bar										
8	0°	750	52	750	52	750	52										
	90°	44	3.0	44	3.0	44	3.0										
10	0°	428	30	524	36	524	36										
	90°	27	1.9	27	1.9	27	1.9										
12	0°	260	18	514	35	600	41										
	90°	19	1.3	19	1.3	19	1.3										

1. At 0 degrees, use maximum actual shutoff pressure drop.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Size 30, 40, 60, 68															
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure													
		Size 30						Size 40							
		60 psig		80 psig		100 psig		60 psig		80 psig		100 psig		120 psig	
		psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar
2	0°	750	52	750	52	750	52	750	52	---	---	---	---	---	---
	90°	210	14	210	14	210	14	210	14	---	---	---	---	---	---
3	0°	750	52	750	52	750	52	750	52	---	---	---	---	---	---
	90°	113	7.8	113	7.8	113	7.8	113	7.8	---	---	---	---	---	---
4	0°	750	52	750	52	750	52	750	52	750	52	750	52	750	52
	90°	71	4.9	94	6.5	100	6.9	100	6.9	100	6.9	100	6.9	100	6.9
6	0°	353	24.4	526	36.3	698	48	750	52	750	52	750	52	750	52
	90°	32	2.2	43	3.0	54	3.7	64	4.4	86	5.9	89	6.1	89	6.1
8	0°	131	9.0	217	15.0	303	21	390	27	562	39	734	51	750	52
	90°	6.7	0.5	9.0	0.6	11	0.8	13	0.9	18	1.2	22	1.5	27	1.9
10	0°	---	---	37	2.5	89	6.2	142	9.8	247	17	353	24	458	32
	90°	---	---	5.6	0.4	7.0	0.5	8.4	0.6	11	0.8	14	1.0	17	1.2
12	0°	---	---	---	---	---	---	33	2.3	117	8.0	200	14	283	20
	90°	---	---	---	---	---	---	4.8	0.3	6.4	0.4	8.0	0.6	10	0.7
Valve Size, NPS	Angle of Opening	Size 60						Size 68							
		60 psig		80 psig		100 psig		60 psig		80 psig					
		psi	bar	psi	bar	psi	bar	psi	bar	psi	bar				
4	0°	750	52	750	52	750	52	750	52	750	52				
	90°	100	6.9	100	6.9	100	6.9	100	6.9	100	6.9				
6	0°	750	52	750	52	750	52	750	52	750	52				
	90°	89	6.1	89	6.1	89	6.1	89	6.1	89	6.1				
8	0°	750	52	750	52	750	52	750	52	750	52				
	90°	27	1.9	36	2.5	44	3.0	43	3.0	44	3.0				
10	0°	458	32	524	36	524	36	524	36	524	36				
	90°	17	1.2	22	1.5	27	1.9	27	1.8	27	1.9				
12	0°	283	20	450	31	600	41	583	40	600	41				
	90°	10	0.7	13	0.9	16	1.1	15	1.1	19	1.3				

1. At 0 degrees, use maximum actual shutoff pressure drop.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	29	421	52	750	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	9.0	131	14	210	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0°	9.4	136	37	541	52	750	52	750	- - -	- - -	- - -	- - -
	90°	2.0	30	4.1	59	7.8	113	7.8	113	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	15	223	49	705	52	750	52	750	52	750
	90°	- - -	- - -	2.1	30	5.0	73	6.9	100	6.9	100	6.9	100
6	0°	- - -	- - -	- - -	- - -	15	214	43	618	52	750	52	750
	90°	- - -	- - -	- - -	- - -	2.3	33	4.6	66	6.1	89	6.1	89
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	17	241	31	455	52	750
	90°	- - -	- - -	- - -	- - -	- - -	- - -	1.0	14	1.5	22	3.0	44
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	16	226	38	547
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.0	14	1.9	27
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	7.8	114	23	329
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.5	7.9	1.1	16

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	29	421	52	750	---	---	---	---	---	---	---	---
	90°	14	210	14	210	---	---	---	---	---	---	---	---
3	0°	9.4	136	37	541	52	750	52	750	---	---	---	---
	90°	4.9	71	7.8	113	7.8	113	7.8	113	---	---	---	---
4	0°	---	---	15	223	49	705	49	750	52	750	52	750
	90°	---	---	5.0	72	6.9	100	6.9	100	6.9	100	6.9	100
6	0°	---	---	---	---	15	214	43	618	52	750	52	750
	90°	---	---	---	---	4.9	72	6.1	89	6.1	89	6.1	89
8	0°	---	---	---	---	---	---	17	241	25	370	52	750
	90°	---	---	---	---	---	---	2.1	30	2.5	37	3.0	44
10	0°	---	---	---	---	---	---	---	---	12	176	35	508
	90°	---	---	---	---	---	---	---	---	1.6	23	1.9	27
12	0°	---	---	---	---	---	---	---	---	5.6	81	20	296
	90°	---	---	---	---	---	---	---	---	0.9	13	1.3	19

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	47	678	---	---	---	---	---	---	---	---
	90°	---	---	14	210	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	52	750	52	750	---	---	---	---
	90°	---	---	---	---	7.8	113	7.8	113	---	---	---	---
4	0°	---	---	---	---	7.2	105	44	645	52	750	52	750
	90°	---	---	---	---	5.0	73	6.9	100	6.9	100	6.9	100
6	0°	---	---	---	---	---	---	6.5	94	42	612	52	750
	90°	---	---	---	---	---	---	4.6	66	6.1	89	6.1	89
8	0°	---	---	---	---	---	---	---	---	13	186	31	450
	90°	---	---	---	---	---	---	---	---	1.5	22	3.0	44
10	0°	---	---	---	---	---	---	---	---	---	---	14	201
	90°	---	---	---	---	---	---	---	---	---	---	1.9	27
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	47	678	---	---	---	---	---	---	---	---
	90°	---	---	14	210	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	52	750	52	750	---	---	---	---
	90°	---	---	---	---	7.8	113	7.8	113	---	---	---	---
4	0°	---	---	---	---	7.2	105	44	645	52	750	52	750
	90°	---	---	---	---	5.0	73	6.9	100	6.9	100	6.9	100
6	0°	---	---	---	---	---	---	6.5	94	42	612	52	750
	90°	---	---	---	---	---	---	4.6	66	6.1	89	6.1	89
8	0°	---	---	---	---	---	---	---	---	13	186	31	450
	90°	---	---	---	---	---	---	---	---	1.5	22	3.0	44
10	0°	---	---	---	---	---	---	---	---	---	---	14	201
	90°	---	---	---	---	---	---	---	---	---	---	1.9	27
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	14	202	---	---	---	---	---	---	---	---
	90°	---	---	14	202	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	16	237	16	239	---	---	---	---
	90°	---	---	---	---	7.8	113	7.8	113	---	---	---	---
4	0°	---	---	---	---	1.7	24	14	202	14	202	14	202
	90°	---	---	---	---	1.7	24	6.9	100	6.9	100	6.9	100
6	0°	---	---	---	---	---	---	0.6	8.3	10	140	13	185
	90°	---	---	---	---	---	---	0.6	8.3	6.1	89	6.1	89
8	0°	---	---	---	---	---	---	---	---	3.6	52	11	159
	90°	---	---	---	---	---	---	---	---	1.5	22	3.0	44
10	0°	---	---	---	---	---	---	---	---	---	---	3.8	55
	90°	---	---	---	---	---	---	---	---	---	---	1.9	27
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	14.0	202	---	---	---	---	---	---	---	---
	90°	---	---	14.0	202	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	16	237	16	239	---	---	---	---
	90°	---	---	---	---	7.8	113	7.8	113	---	---	---	---
4	0°	---	---	---	---	1.7	24	14	202	14	202	14	202
	90°	---	---	---	---	1.7	24	6.9	100	6.9	100	6.9	100
6	0°	---	---	---	---	---	---	0.6	8.3	6.0	88	13	185
	90°	---	---	---	---	---	---	0.6	8.3	6.0	88	6.1	89
8	0°	---	---	---	---	---	---	---	---	1.9	28	11	159
	90°	---	---	---	---	---	---	---	---	1.9	28	3.0	44
10	0°	---	---	---	---	---	---	---	---	---	---	2.7	39
	90°	---	---	---	---	---	---	---	---	---	---	1.9	27
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close															
Valve Body Size, NPS	Liner Material	Disk Style(3)	Angle of Opening	Actuator Size and Cylinder Pressure(2)											
				Size 30			Size 40				Size 60			Size 68	
				60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
2	Nitrile or PTFE	C	0°	220	220	220	---	---	---	---	---	---	---	---	---
			60°	220	220	220	---	---	---	---	---	---	---	---	---
			90°	126	126	126	---	---	---	---	---	---	---	---	---
		F	0°	220	220	220	---	---	---	---	---	---	---	---	---
			90°	220	220	220	---	---	---	---	---	---	---	---	---
3	Nitrile or PTFE	C	0°	220	220	220	---	---	---	---	---	---	---	---	---
			60°	220	220	220	---	---	---	---	---	---	---	---	---
			90°	73	73	73	---	---	---	---	---	---	---	---	---
		F	0°	220	220	220	---	---	---	---	---	---	---	---	---
			90°	220	220	220	---	---	---	---	---	---	---	---	---
4	Nitrile or PTFE	C	0°	220	220	220	---	---	---	---	---	---	---	---	---
			60°	98	98	98	---	---	---	---	---	---	---	---	---
			90°	31	31	31	---	---	---	---	---	---	---	---	---
		F	0°	220	220	220	---	---	---	---	---	---	---	---	---
			90°	101	101	101	---	---	---	---	---	---	---	---	---
6	Nitrile	C	0°	150	150	150	150	150	150	150	150	150	150	150	150
			60°	50	50	50	50	50	50	50	50	50	50	50	50
			90°	14	16	16	16	16	16	16	16	16	16	16	16
		F	0°	150	150	150	150	150	150	150	150	150	150	150	150
			90°	39	43	43	43	43	43	43	43	43	43	43	43
	PTFE	C	0°	220	220	220	220	220	220	220	220	220	220	220	220
			60°	50	50	50	50	50	50	50	50	50	50	50	50
			90°	14	16	16	16	16	16	16	16	16	16	16	16
		F	0°	220	220	220	220	220	220	220	220	220	220	220	220
			90°	39	43	43	43	43	43	43	43	43	43	43	43
8	Nitrile	C	0°	---	150	150	150	150	150	150	150	150	150	150	150
			60°	---	36	44	51	51	51	51	51	51	51	51	51
			90°	---	8.2	10	12	16	16	16	16	16	16	16	16
		F	0°	---	150	150	150	150	150	150	150	150	150	150	150
			90°	---	22	28	33	43	43	43	43	43	43	43	43
	PTFE	C	0°	---	220	220	220	220	220	220	220	220	220	220	220
			60°	---	36	44	51	51	51	51	51	51	51	51	51
			90°	---	8.2	10	12	16	16	16	16	16	16	16	16
		F	0°	---	220	220	220	220	220	220	220	220	220	220	220
			90°	---	22	28	33	43	43	43	43	43	43	43	43

-continued-

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close															
Valve Body Size, NPS	Liner Material	Disk Style(3)	Angle of Opening	Actuator Size and Cylinder Pressure(2)											
				Size 30			Size 40				Size 60			Size 68	
				60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Pig	60 Psig	80 Psig
10	Nitrile	C	0°	- - -	- - -	- - -	150	150	150	150	150	150	150	150	150
			60°	- - -	- - -	- - -	26	26	26	26	26	26	26	26	26
			90°	- - -	- - -	- - -	6.3	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
		F	0°	- - -	- - -	- - -	150	150	150	150	150	150	150	150	150
			90°	- - -	- - -	- - -	13	17	17	17	17	17	17	17	17
	PTFE	C	0°	- - -	- - -	182	220	220	220	220	220	220	220	220	220
			60°	- - -	- - -	23	26	26	26	26	26	26	26	26	26
			90°	- - -	- - -	5.2	6.3	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
		F	0°	- - -	- - -	182	220	220	220	220	220	220	220	220	220
			90°	- - -	- - -	11	13	17	17	17	17	17	17	17	17
12	Nitrile	C	0°	- - -	- - -	- - -	- - -	- - -	150	150	150	150	150	150	150
			60°	- - -	- - -	- - -	- - -	- - -	26	29	29	29	29	29	29
			90°	- - -	- - -	- - -	- - -	- - -	6.1	7.3	7.3	9.2	9.2	9.2	9.2
		F	0°	- - -	- - -	- - -	- - -	- - -	150	150	150	150	150	150	150
			90°	- - -	- - -	- - -	- - -	- - -	13	15	15	19	19	19	19
	PTFE	C	0°	- - -	- - -	- - -	- - -	218	220	220	220	220	220	220	220
			60°	- - -	- - -	- - -	- - -	21	26	29	29	29	29	29	29
			90°	- - -	- - -	- - -	- - -	4.9	6.1	7.3	7.3	9.2	9.2	9.2	9.2
		F	0°	- - -	- - -	- - -	- - -	218	220	220	220	220	220	220	220
			90°	- - -	- - -	- - -	- - -	10	13	15	15	19	19	19	19

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10 percent greater than the cylinder pressure shown above.
3. Symbols for disk styles are as follows: C-conventional style; F-FISHTAIL™ style.

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Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	49.0	710	63.0	913	79.2	1148	49.0	710	49.0	710	79.2	1148								
	80°	2.6	38	---	---	---	---	5.1	74	10.5	152	---	---								
10	0°	21.9	318	29.6	430	38.5	558	21.9	318	21.9	318	38.5	558								
	80°	1.1	16	---	---	---	---	2.2	32	4.6	67	---	---								
12	0°	8.3	120	12.7	184	17.8	258	8.3	120	8.3	120	17.8	258								
	80°	0.8	11	---	---	---	---	1.5	22	3.1	45	---	---								
14	0°	4.1	59	7.4	107	11.3	163	4.1	59	4.1	59	11.3	163								
	80°	0.6	9	---	---	---	---	1.2	18	2.6	37	---	---								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)																	
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig															
		Size 70															
		0-40 Psig		0-55 Psig													
		3.3 psig		10.1 psig													
		90°		90°													
		1R676027082		1R676027082													
		bar	psi	bar	psi												
4	0°	---	---	---	---												
	80°	---	---	---	---												
6	0°	---	---	---	---												
	80°	---	---	---	---												
8	0°	103.2	1497	103.4	1500												
	80°	1.7	25	4.3	62												
10	0°	51.7	749	78.2	1134												
	80°	0.8	11	1.9	27												
12	0°	25.4	368	40.6	589												
	80°	0.5	8	1.3	18												
14	0°	17.0	246	28.5	413												
	80°	0.4	6	1.0	15												

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	25.5	369	38.1	553	52.7	765	25.5	369	25.5	369	52.7	765								
	80°	2.6	38	---	---	---	---	5.1	74	10.5	152	---	---								
10	0°	8.4	122	15.3	222	23.3	338	8.4	122	8.4	122	23.3	338								
	80°	1.1	16	---	---	---	---	2.2	32	4.6	67	---	---								
12	0°	0.8	11	4.8	69	9.4	136	0.8	11	0.8	11	9.4	136								
	80°	0.8	11	---	---	---	---	0.8	11	0.8	11	---	---								
14	0°	---	---	1.6	24	5.1	75	---	---	---	---	5.1	75								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)																			
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																	
		Size 70																	
		0-33 Psig		0-40 Psig		0-55 Psig													
		3.0 psig		3.3 psig		10.1 psig													
		90°		90°		90°													
		1R676027082		1R676027082		1R676027082													
		bar	psi	bar	psi	bar	psi												
4	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
6	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
8	0°	36.7	532	74.5	1080	103.4	1500												
	80°	1.6	24	1.7	25	4.3	62												
10	0°	14.5	211	35.1	509	58.9	854												
	80°	0.7	10	0.8	11	1.9	27												
12	0°	4.3	62	16.2	236	30.1	436												
	80°	0.5	7	0.5	8	1.3	18												
14	0°	---	---	10.3	150	20.8	301												
	80°	---	---	0.4	6	1.0	15												

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	16.9	245	26.7	388	38.1	552	16.9	245	16.9	245	38.1	552								
	80°	2.6	38	---	---	---	---	5.1	74	10.5	152	---	---								
10	0°	4.3	62	9.6	140	15.8	229	4.3	62	4.3	62	15.8	229								
	80°	1.1	16	---	---	---	---	2.2	32	4.3	62	---	---								
12	0°	---	---	1.4	21	5.0	72	---	---	---	---	5.0	72								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								
14	0°	---	---	---	---	1.8	26	---	---	---	---	1.8	26								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)																			
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																	
		Size 70																	
		0-33 Psig		0-40 Psig		0-55 Psig													
		3.0 psig		3.3 psig		10.1 psig													
		90°		90°		90°													
		1R676027082		1R676027082		1R676027082													
		bar	psi	bar	psi	bar	psi												
4	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
6	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
8	0°	25.6	371	55.0	797	88.9	1290												
	80°	1.6	24	1.7	25	4.3	62												
10	0°	9.0	131	25.0	362	43.4	629												
	80°	0.7	10	0.8	11	1.9	27												
12	0°	1.1	16	10.2	148	20.8	302												
	80°	0.5	7	0.5	8	1.3	18												
14	0°	---	---	5.8	84	13.8	200												
	80°	---	---	0.4	6	1.0	15												

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	32.1	465	45.0	652	59.9	868	32.1	465	32.1	465	59.9	868								
	80°	2.6	38	- - -	- - -	- - -	- - -	5.1	74	10.5	152	- - -	- - -								
10	0°	8.5	123	15.2	221	23.1	335	8.5	123	8.5	123	23.1	335								
	80°	1.1	16	- - -	- - -	- - -	- - -	2.2	32	4.6	67	- - -	- - -								
12	0°	- - -	- - -	2.4	35	6.9	100	- - -	- - -	- - -	- - -	6.9	100								
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -								
14	0°	- - -	- - -	- - -	- - -	1.9	28	- - -	- - -	- - -	- - -	1.9	28								
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)																			
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig**																	
		Size 70																	
		0-33 Psig		**0-40 Psig**		**0-55 Psig**													
		3.0 psig		**3.3 psig**		**10.1 psig**													
		90°		**90°**		**90°**													
		1R676027082		**1R676027082**		**1R676027082**													
		bar	**psi**	**bar**	**psi**	**bar**	**psi**												
4	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
6	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
8	0°	43.5	631	82.0	1189	103.4	1500												
	80°	1.6	24	1.7	25	4.3	62												
10	0°	14.5	210	34.7	503	58.1	843												
	80°	0.7	10	0.8	11	1.9	27												
12	0°	2.0	29	13.6	197	26.9	391												
	80°	0.5	7	0.5	8	1.3	18												
14	0°	---	---	6.9	100	16.9	246												
	80°	---	---	0.4	6	1.0	15												

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	21.9	318	31.9	462	43.4	629	21.9	318	21.9	318	43.4	629								
	80°	2.6	38	---	---	---	---	5.1	74	10.5	152	---	---								
10	0°	4.4	64	9.6	140	15.7	228	4.4	64	4.4	64	15.7	228								
	80°	1.1	16	---	---	---	---	2.2	32	4.4	64	---	---								
12	0°	---	---	---	---	3.2	46	---	---	---	---	3.2	46								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								
14	0°	---	---	---	---	---	---	---	---	---	---	---	---								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)																			
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig**																	
Valve Size, NPS	**Angle of Opening**	**Size 70**																	
		0-33 Psig		**0-40 Psig**		**0-55 Psig**													
		3.0 psig		**3.3 psig**		**10.1 psig**													
		90°		**90°**		**90°**													
		1R676027082		**1R676027082**		**1R676027082**													
		bar	**psi**	**bar**	**psi**	**bar**	**psi**												
4	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
6	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
8	0°	30.7	446	60.5	878	95.0	1377												
	80°	1.6	24	1.7	25	4.3	62												
10	0°	9.0	131	24.8	359	42.9	623												
	80°	0.7	10	0.8	11	1.9	27												
12	0°	---	---	8.3	120	18.6	270												
	80°	---	---	0.5	8	1.3	18												
14	0°	---	---	3.3	48	11.0	160												
	80°	---	---	0.4	6	1.0	15												

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	19.7	286	28.4	412	38.5	559	19.7	286	19.7	286	38.5	559								
	80°	2.6	38	---	---	---	---	5.1	74	10.5	152	---	---								
10	0°	7.6	110	12.8	186	18.9	274	7.6	110	7.6	110	18.9	274								
	80°	1.1	16	---	---	---	---	2.2	32	4.6	67	---	---								
12	0°	1.2	17	4.5	65	8.3	121	1.2	17	1.2	17	8.3	121								
	80°	0.8	11	---	---	---	---	1.2	17	1.2	17	---	---								
14	0°	---	---	1.8	25	4.8	69	---	---	---	---	4.8	69								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. When ordering a 1052 actuator, the FS number shown must be preceded by 1052- for size 20 and 33, or 1052K- for all other sizes. Right-hand actuator mounting FS numbers are shown.

FISHER

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Process Management

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)																			
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																	
Valve Size, NPS	Angle of Opening	Size 70																	
		0-33 Psig		0-40 Psig		0-55 Psig													
		3.0 psig		3.3 psig		10.1 psig													
		90°		90°		90°													
		1R676027082		1R676027082		1R676027082													
		bar	psi	bar	psi	bar	psi												
4	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
6	0°	---	---	---	---	---	---												
	80°	---	---	---	---	---	---												
8	0°	27.4	398	53.5	776	83.7	1214												
	80°	1.6	24	1.7	25	4.3	62												
10	0°	12.2	177	28.0	406	46.2	670												
	80°	0.7	10	0.8	11	1.9	27												
12	0°	4.1	60	14.0	204	25.5	370												
	80°	0.5	7	0.5	8	1.3	18												
14	0°	---	---	9.2	134	18.2	264												
	80°	---	---	0.4	6	1.0	15												

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Push-Down-To-Open (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig																			
		Size 70																			
		0-33 Psig		0-33 Psig		0-33 Psig		0-40 Psig		0-55 Psig		0-40 Psig									
		10.1 psig		12.2 psig		14.7 psig		10.1 psig		10.1 psig		14.7 psig									
		90°		75°		60°		90°		90°		60°									
		1R676027082		1R676027082		1R676027082		1R676027082		1R676027082		1R6760									
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi								
8	0°	14.3	207	21.6	313	30.0	435	14.3	207	14.3	207	30.3	435								
	80°	2.6	38	---	---	---	---	5.1	74	10.5	152	---	---								
10	0°	4.4	64	8.7	126	13.7	198	4.4	64	4.4	64	13.7	198								
	80°	1.1	16	---	---	---	---	2.2	32	4.4	64	---	---								
12	0°	---	---	1.7	24	4.7	69	---	---	---	---	4.7	69								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								
14	0°	---	---			1.9	27	---	---	---	---	1.9	27								
	80°	---	---	---	---	---	---	---	---	---	---	---	---								

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close (90° Maximum Rotation)							
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number, bar/psig**					
Valve Size, NPS	**Angle of Opening**	**Size 70**					
		0-33 Psig		**0-40 Psig**		**0-55 Psig**	
		3.0 psig		**3.3 psig**		**10.1 psig**	
		90°		**90°**		**90°**	
		1R676027082		**1R676027082**		**1R676027082**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**
6	0°	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -
8	0°	20.7	301	42.5	617	67.7	982
	80°	1.6	24	1.7	25	4.3	62
10	0°	8.2	119	21.1	306	35.9	521
	80°	0.7	10	0.8	11	1.9	27
12	0°	1.4	20	9.3	135	18.4	267
	80°	0.5	7	0.5	8	1.3	18
14	0°	- - -	- - -	5.4	78	12.5	181
	80°	- - -	- - -	0.4	6	1.0	15

1. At 0 degrees, use maximum actual shutoff pressure. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 30						Size 40								Size 60					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	98.9	1435	98.9	1435	98.9	1435	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	20.0	290	26.7	387	33.3	483	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	103.1	1495	103.1	1495	103.1	1495	103.1	1495	103.1	1495	103.1	1495	103.1	1495	---	---	---	---	---	---
	80°	15.0	218	20.0	290	25.0	363	30.3	435	40.0	580	50.0	725	60.0	870	---	---	---	---	---	---
6	0°	28.0	406	44.5	645	61.0	884	77.5	1123	103.4	1500	103.4	1500	103.4	1500	103.4	1500	103.4	1500	103.4	1500
	80°	2.5	36	3.3	48	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	---	---	---	---	---	---	24.1	350	37.8	549	51.5	747	65.2	946	65.2	946	92.6	1344	103.4	1500
	80°	---	---	---	---	---	---	2.3	34	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	---	---	---	---	---	---	8.3	121	15.8	230	23.3	339	30.9	447	30.9	447	45.9	665	60.9	883
	80°	---	---	---	---	---	---	1.0	15	1.4	20	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	---	---	---	---	---	---	0.5	7	4.8	69	9.1	132	13.4	194	13.4	194	22.0	320	30.7	445
	80°	---	---	---	---	---	---	0.5	7	0.9	13	1.2	17	1.4	20	1.4	20	1.8	27	2.3	33
14	0°	---	---	---	---	---	---	---	---	1.4	21	4.7	68	7.9	115	7.9	115	14.5	210	21.0	304
	80°	---	---	---	---	---	---	---	---	0.8	11	0.9	14	1.1	17	1.1	17	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 68				Size 80								Size 100							
		60 Psig		80 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig		120 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
8	0°	103.4	1500	103.4	1500	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	7.4	108	9.9	144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	57.9	840	81.9	1188	99.1	1437	99.1	1437	99.1	1437	99.1	1437	99.1	1437	99.1	1437	99.1	1437	99.1	1437
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	29.0	420	42.8	620	65.2	946	91.1	1322	103.4	1500	103.4	1500	103.4	1500	103.4	1500	103.4	1500	88.5	1285
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	19.7	285	30.1	437	47.0	682	66.6	966	86.1	1249	103.4	1500	76.4	1108	103.4	1500	103.4	1500	103.4	1500
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	---	---	---	---	28.0	406	40.8	592	53.7	778	66.5	965	47.2	685	66.5	965	85.8	1244	103.4	1500
	80°	---	---	---	---	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 30						Size 40								Size 60					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	94.9	1376	94.9	1376	94.9	1376	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	20.0	290	26.7	387	33.3	483	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	67.2	975	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456	---	---	---	---	---	---
	80°	15.0	218	20.0	290	25.0	363	30.0	435	40.0	580	50.0	725	60.0	870	---	---	---	---	---	---
6	0°	1.6	24	16.6	241	31.6	459	46.6	676	76.6	1111	100.7	1460	100.7	1460	100.7	1460	100.7	1460	100.7	1460
	80°	1.6	24	3.3	48	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	---	---	---	---	---	---	3.0	44	15.4	223	27.8	403	40.2	582	40.2	582	64.9	941	89.7	1301
	80°	---	---	---	---	---	---	2.3	34	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	---	---	---	---	---	---	---	---	2.9	43	9.7	140	16.4	238	16.4	238	29.9	434	43.4	629
	80°	---	---	---	---	---	---	---	---	1.4	20	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	---	---	---	---	---	---	---	---	---	---	1.5	22	5.4	78	5.4	78	13.2	192	21.0	305
	80°	---	---	---	---	---	---	---	---	---	---	1.2	17	1.4	20	1.4	20	1.8	27	2.3	33
14	0°	---	---	---	---	---	---	---	---	---	---	---	---	2.1	31	2.1	31	8.0	117	14.0	203
	80°	---	---	---	---	---	---	---	---	---	---	---	---	1.1	17	1.1	17	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 68				Size 80								Size 100							
		60 Psig		80 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig		120 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
8	0°	84.7	1229	103.4	1500	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	7.4	108	9.9	144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	40.7	590	62.2	903	97.3	1411	98.1	1423	98.1	1423	98.1	1423	98.1	1423	98.1	1423	98.1	1423	98.1	1423
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	19.5	283	32.0	464	52.3	759	75.8	1099	88.6	1285	88.6	1285	87.5	1269	88.6	1285	88.6	1285	88.6	1285
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	12.8	185	22.2	323	37.6	546	55.4	803	73.1	1061	90.9	1318	64.3	932	90.9	1318	103.4	1500	103.4	1500
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	---	---	---	---	22.4	324	34.1	495	45.9	665	57.6	835	40.0	580	57.6	835	75.2	1091	92.8	1347
	80°	---	---	---	---	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 30						Size 40								Size 60					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	91.8	1331	91.8	1331	91.8	1331	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	20.0	290	26.7	387	33.3	483	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	49.4	716	82.5	1197	98.4	1427	98.4	1427	98.4	1427	98.4	1427	98.4	1427	---	---	---	---	---	---
	80°	15.0	218	20.0	290	25.0	363	30.0	435	40.0	580	50.0	725	60.0	870	---	---	---	---	---	---
6	0°	---	---	9.3	135	21.1	306	32.9	477	56.4	818	75.3	1092	75.3	1092	75.3	1092	75.3	1092	75.3	1092
	80°	---	---	3.3	48	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	---	---	---	---	---	---	---	---	9.1	132	18.7	271	28.3	411	28.3	411	47.5	690	66.8	968
	80°	---	---	---	---	---	---	---	---	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	---	---	---	---	---	---	---	---	0.1	1	5.3	77	10.5	152	10.5	152	20.9	304	31.4	455
	80°	---	---	---	---	---	---	---	---	0.1	1	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	1.9	28	1.9	28	7.9	115	13.9	202
	80°	---	---	---	---	---	---	---	---	---	---	---	---	1.4	20	1.4	20	1.8	27	2.3	33
14	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4.0	58	8.5	124
	80°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 68				Size 80								Size 100							
		60 Psig		80 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig		120 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
8	0°	62.9	913	93.7	1359	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	7.4	108	9.9	144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	29.3	425	46.0	667	73.1	1060	96.6	1401	96.6	1401	96.6	1401	96.6	1401	96.6	1401	96.6	1401	96.6	1401
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	12.7	184	22.3	323	37.9	549	55.9	810	65.7	953	65.7	953	64.8	940	65.7	953	65.7	953	65.7	953
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	7.6	111	14.9	216	26.6	386	40.2	583	53.8	780	67.3	976	47.0	681	67.3	976	87.8	1271	103.4	1500
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	---	---	---	---	14.9	216	23.8	345	32.7	475	41.7	604	28.3	410	41.7	604	55.0	798	68.4	992
	80°	---	---	---	---	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	**Angle of Opening**	**Actuator Size and Cylinder Pressure(2)**																			
		Size 30						**Size 40**								**Size 60**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**120 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	93.1	1350	93.1	1350	93.1	1350	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	20.0	290	26.7	387	33.3	483	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	58.3	845	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.0	1453	100.1	1453	- - -	- - -	- - -	- - -	- - -	- - -
	80°	15.0	218	20.0	290	25.0	363	30.0	435	40.0	580	50.0	725	60.0	870	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	0.3	4	16.3	237	32.4	469	48.4	702	80.5	1167	103.4	1500	103.4	1500	103.4	1500	103.4	1500	103.4	1500
	80°	0.3	4	3.3	48	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	9.2	134	21.8	317	34.4	499	47.0	682	47.0	682	72.3	1048	94.5	1414
	80°	- - -	- - -	- - -	- - -	- - -	- - -	2.3	34	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.1	45	9.7	141	16.3	237	16.3	237	29.6	429	42.9	622
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.4	20	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.1	44	3.1	44	10.6	154	18.2	264
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.4	20	1.4	20	1.8	27	2.3	33
14	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	4.7	69	10.4	151
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	**Angle of Opening**	**Actuator Size and Cylinder Pressure(2)**																			
		Size 68				**Size 80**								**Size 100**							
		60 Psig		**80 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**120 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**120 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
8	0°	92.4	1340	103.4	1500	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	7.4	108	9.9	144	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	40.2	583	61.4	891	95.9	1391	98.1	1422	98.1	1422	98.1	1422	98.1	1422	98.1	1422	98.1	1422	98.1	1422
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	16.7	242	28.8	418	48.5	704	71.3	1033	94.0	1363	98.4	1427	82.6	1198	83.7	1214	83.7	1214	65.7	953
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	9.3	134	18.3	266	33.1	480	50.1	727	67.1	974	84.2	1221	58.6	850	84.2	1221	103.4	1500	103.4	1500
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	- - -	- - -	- - -	- - -	17.6	256	28.8	418	39.9	579	51.1	741	34.4	498	51.1	741	67.8	984	84.5	1226
	80°	- - -	- - -	- - -	- - -	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)

Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 30						Size 40								Size 60					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	74.7	1084	74.7	1084	74.7	1084	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	20.0	290	26.7	387	33.3	483	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	41.0	595	78.1	1132	98.1	1423	98.1	1423	98.1	1423	98.1	1423	98.1	1423	---	---	---	---	---	---
	80°	15.0	218	20.0	290	25.0	363	30.0	435	40.0	580	50.0	725	60.0	870	---	---	---	---	---	---
6	0°	---	---	8.7	126	21.1	306	33.5	486	58.3	846	78.1	1133	78.1	1133	78.1	1133	78.1	1133	78.1	1133
	80°	---	---	3.3	48	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	---	---	---	---	---	---	4.2	61	14.0	203	23.7	344	33.5	485	33.5	485	53.0	768	72.5	1051
	80°	---	---	---	---	---	---	2.3	34	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	---	---	---	---	---	---	---	---	0.2	3	5.4	78	10.5	152	10.5	152	20.8	301	31.1	451
	80°	---	---	---	---	---	---	---	---	0.2	3	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	0.2	3	0.2	3	6.0	88	11.9	172
	80°	---	---	---	---	---	---	---	---	---	---	---	---	0.2	3	0.2	3	1.8	27	2.3	33
14	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.6	23	6.0	87
	80°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)

Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 68				Size 80								Size 100							
		60 Psig		80 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig		120 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
8	0°	68.6	995	99.8	1447	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	7.4	108	9.9	144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	29.0	421	45.5	660	72.2	1048	96.5	1400	96.5	1400	96.5	1400	96.5	1400	96.5	1400	96.5	1400	96.5	1400
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	10.7	155	20.1	291	35.3	511	52.8	766	62.4	905	62.4	905	61.5	893	62.4	905	62.4	905	65.7	953
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	5.1	74	12.1	175	23.5	341	36.6	531	49.7	721	62.9	912	43.2	626	62.9	912	82.6	1198	102.3	1483
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	---	---	---	---	11.6	168	20.1	292	28.7	417	37.3	541	24.4	354	37.3	541	50.2	728	63.1	915
	80°	---	---	---	---	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 30						Size 40								Size 60					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	18.9	274	18.9	274	18.9	274	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	18.9	274	18.9	274	18.9	274	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	17.1	248	34.9	507	49.0	710	49.0	710	49.0	710	49.0	710	49.0	710	---	---	---	---	---	---
	80°	15.0	218	20.0	290	25.0	363	30.0	435	40.0	580	49.0	710	49.0	710	---	---	---	---	---	---
6	0°	---	---	6.1	89	14.7	213	23.3	338	40.4	586	51.4	746	51.4	746	51.4	746	51.4	746	51.4	746
	80°	---	---	3.3	48	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	---	---	---	---	---	---	4.2	61	12.7	185	21.3	309	29.8	433	29.8	433	46.9	681	64.0	928
	80°	---	---	---	---	---	---	2.3	34	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	---	---	---	---	---	---	---	---	3.4	49	8.5	124	13.7	198	13.7	198	24.0	348	34.3	497
	80°	---	---	---	---	---	---	---	---	1.4	20	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	---	---	---	---	---	---	---	---	---	---	1.8	26	5.0	73	5.0	73	11.5	167	18.0	261
	80°	---	---	---	---	---	---	---	---	---	---	1.2	17	1.4	20	1.4	20	1.8	27	2.3	33
14	0°	---	---	---	---	---	---	---	---	---	---	---	---	2.2	32	2.2	32	7.3	105	12.3	179
	80°	---	---	---	---	---	---	---	---	---	---	---	---	1.1	17	1.1	17	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 68				Size 80								Size 100							
		60 Psig		80 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig		120 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
8	0°	60.6	879	87.9	1275	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	7.4	108	9.9	144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	32.2	467	48.7	707	75.5	1095	96.6	1401	96.6	1401	96.6	1401	96.6	1401	96.6	1401	96.6	1401	96.6	1401
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	16.7	243	27.1	393	44.0	638	63.5	921	71.7	1040	71.7	1040	71.7	1040	71.7	1040	71.7	1040	65.7	953
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	11.3	164	19.5	282	32.7	474	47.9	695	63.2	916	78.4	1137	55.5	806	78.4	1137	101.3	1469	103.4	1500
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	---	---	---	---	20.2	293	30.7	445	41.2	598	51.8	751	36.0	522	51.8	751	67.6	980	83.4	1209
	80°	---	---	---	---	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 30						Size 40								Size 60					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	17.5	254	17.5	254	17.5	254	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	17.5	254	17.5	254	17.5	254	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	13.3	193	29.4	427	44.2	641	44.2	641	44.2	641	44.2	641	44.2	641	---	---	---	---	---	---
	80°	13.3	193	20.0	290	25.0	363	30.0	435	40.0	580	44.2	641	44.2	641	---	---	---	---	---	---
6	0°	---	---	3.0	43	10.4	150	17.8	258	32.6	473	44.5	645	44.5	645	44.5	645	44.5	645	44.5	645
	80°	---	---	3.0	43	4.2	60	5.0	73	6.7	97	8.3	121	10.0	145	10.0	145	13.3	193	16.7	242
8	0°	---	---	---	---	---	---	1.4	20	8.5	123	15.6	227	22.8	330	22.8	330	37.0	537	51.3	744
	80°	---	---	---	---	---	---	1.4	20	3.1	45	3.9	56	4.7	68	4.7	68	6.2	90	7.8	113
10	0°	---	---	---	---	---	---	---	---	1.0	14	5.2	75	9.4	136	9.4	136	17.8	258	26.2	381
	80°	---	---	---	---	---	---	---	---	1.0	14	1.7	25	2.0	30	2.0	30	2.7	39	3.4	49
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	2.1	31	2.1	31	7.3	106	12.5	181
	80°	---	---	---	---	---	---	---	---	---	---	---	---	1.4	20	1.4	20	1.8	27	2.3	33
14	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3.9	56	7.9	114
	80°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.5	22	1.9	28

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)																					
Valve Size, NPS	Angle of Opening	Actuator Size and Cylinder Pressure(2)																			
		Size 68				Size 80								Size 100							
		60 Psig		80 Psig		60 Psig		80 Psig		100 Psig		120 Psig		60 Psig		80 Psig		100 Psig		120 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
8	0°	48.4	702	71.2	1033	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	80°	7.4	108	9.9	144	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	24.6	356	38.0	552	59.9	869	85.2	1236	94.7	1374	94.7	1374	94.7	1374	94.7	1374	94.7	1374	94.7	1374
	80°	3.3	47	4.3	63	6.1	89	8.1	118	10.2	148	12.2	177	20.9	303	27.9	405	34.9	506	41.9	607
12	0°	11.4	166	19.7	286	33.2	481	48.7	707	57.2	830	57.2	830	57.2	830	57.2	830	57.2	830	65.7	953
	80°	2.2	32	2.9	43	4.1	60	5.5	80	6.9	100	8.3	120	6.2	90	8.3	120	10.4	150	12.4	180
14	0°	7.1	102	13.5	196	23.9	347	36.0	522	48.0	697	60.1	871	42.0	609	60.1	871	78.1	1133	96.2	1395
	80°	1.8	26	2.4	35	3.4	49	4.5	66	5.7	82	6.8	99	5.1	74	6.8	99	8.5	124	10.2	149
16	0°	---	---	---	---	13.8	200	22.0	319	30.2	438	38.4	557	26.1	378	38.4	557	50.7	735	63.0	914
	80°	---	---	---	---	2.3	34	3.1	45	3.9	57	4.7	68	3.5	51	4.7	68	5.9	85	7.0	102

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure at the positioner should be 10 percent greater than the cylinder pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	10	150	53	762	99	1435	99	1435	- - -	- - -	- - -	- - -
	80°	3.4	49	6.8	98	9.1	132	9.1	132	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	14	202	57	830	103	1495	103	1495	103	1495
	80°	- - -	- - -	5.1	74	10	152	21	304	24	349	24	349
6	0°	- - -	- - -	- - -	- - -	9.2	133	40	578	74	1071	103	1500
	80°	- - -	- - -	- - -	- - -	1.7	25	3.5	51	4.7	68	9.8	142
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	8.5	123	23	328	60	863
	80°	- - -	- - -	- - -	- - -	- - -	- - -	1.6	24	2.2	32	4.6	66
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	7.5	109	28	402
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.0	14	2.0	29
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	12	168
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.4	20
14	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	6.6	95
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.1	16

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	10	150	53	762	99	1435	99	1435	---	---	---	---
	80°	3.2	47	6.5	94	9.1	132	9.1	132	---	---	---	---
4	0°	---	---	14	202	57	830	103	1495	103	1495	103	1495
	80°	---	---	4.9	70	10	148	20	297	24	349	24	349
6	0°	---	---	---	---	9.2	133	40	578	60	874	103	1500
	80°	---	---	---	---	1.7	25	3.4	49	5.3	77	10	147
8	0°	---	---	---	---	---	---	8.5	123	17	246	54	782
	80°	---	---	---	---	---	---	1.6	23	2.5	36	4.8	69
10	0°	---	---	---	---	---	---	---	---	4.4	64	25	357
	80°	---	---	---	---	---	---	---	---	1.1	16	2.1	30
12	0°	---	---	---	---	---	---	---	---	---	---	10	142
	80°	---	---	---	---	---	---	---	---	---	---	1.4	21
14	0°	---	---	---	---	---	---	---	---	---	---	5.2	76
	80°	---	---	---	---	---	---	---	---	---	---	1.2	17

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	8.4	122	74	1071	74	1071	- - -	- - -	- - -	- - -
	80°	- - -	- - -	6.8	98	9.1	132	9.1	132	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	20	288	97	1408	100	1456	100	1456
	80°	- - -	- - -	- - -	- - -	10	152	21	304	24	349	24	349
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	12	180	43	628	103	1500
	80°	- - -	- - -	- - -	- - -	- - -	- - -	3.5	51	4.7	68	9.8	142
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.7	24	35	508
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.7	24	4.6	66
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	14	198
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.0	29
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.8	55
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.4	20
14	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.9	13
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.9	13

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	8.4	122	74	1071	74	1071	---	---	---	---
	80°	---	---	6.5	94	9.1	132	9.1	132	---	---	---	---
4	0°	---	---	---	---	20	288	97	1408	100	1456	100	1456
	80°	---	---	---	---	10	148	20	297	24	349	24	349
6	0°	---	---	---	---	---	---	12	180	31	450	103	1500
	80°	---	---	---	---	---	---	3.4	49	5.3	77	10	147
8	0°	---	---	---	---	---	---	---	---	---	---	30	434
	80°	---	---	---	---	---	---	---	---	---	---	4.8	69
10	0°	---	---	---	---	---	---	---	---	---	---	11	158
	80°	---	---	---	---	---	---	---	---	---	---	2.1	30
12	0°	---	---	---	---	---	---	---	---	---	---	2.2	31
	80°	---	---	---	---	---	---	---	---	---	---	1.4	21
14	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg/ 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	2.1	30	49	716	49	716	---	---	---	---
	80°	---	---	2.1	30	9.1	132	9.1	132	---	---	---	---
4	0°	---	---	---	---	12	168	73	1062	98	1427	98	1427
	80°	---	---	---	---	10	152	21	304	24	349	24	349
6	0°	---	---	---	---	---	---	6.0	88	30	439	94	1359
	80°	---	---	---	---	---	---	3.5	51	4.7	68	9.8	142
8	0°	---	---	---	---	---	---	---	---	---	---	24	353
	80°	---	---	---	---	---	---	---	---	---	---	4.6	66
10	0°	---	---	---	---	---	---	---	---	---	---	8.3	121
	80°	---	---	---	---	---	---	---	---	---	---	2.0	29
12	0°	---	---	---	---	---	---	---	---	---	---	0.7	10
	80°	---	---	---	---	---	---	---	---	---	---	0.7	10
14	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	2.1	30	49	716	49	716	---	---	---	---
	80°	---	---	2.1	30	9.1	132	9.1	132	---	---	---	---
4	0°	---	---	---	---	12	168	73	1062	98	1427	98	1427
	80°	---	---	---	---	10	148	20	297	24	349	24	349
6	0°	---	---	---	---	---	---	6.0	88	21	299	84	1218
	80°	---	---	---	---	---	---	3.4	49	5.3	77	10	147
8	0°	---	---	---	---	---	---	---	---	---	---	20	295
	80°	---	---	---	---	---	---	---	---	---	---	4.8	69
10	0°	---	---	---	---	---	---	---	---	---	---	6.2	90
	80°	---	---	---	---	---	---	---	---	---	---	2.1	30
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---
14	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	39	573	39	573	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	9.1	132	9.1	132	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	4.4	64	92	1338	103	1500	103	1500
	80°	- - -	- - -	- - -	- - -	4.4	64	21	304	24	349	24	349
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	12	172	45	651	103	1500
	80°	- - -	- - -	- - -	- - -	- - -	- - -	3.5	51	4.7	68	9.8	142
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	7.8	114	42	606
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.2	32	4.6	66
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	14	197
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.0	29
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.5	22
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.4	20
14	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	39	573	39	573	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	9.1	132	9.1	132	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	4.4	64	92	1338	103	1500	103	1500
	80°	- - -	- - -	- - -	- - -	4.4	64	20	297	24	349	24	349
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	12	172	32	460	103	1500
	80°	- - -	- - -	- - -	- - -	- - -	- - -	3.4	49	5.3	77	10	147
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.7	39	37	531
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.5	36	4.8	69
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	11	157
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.1	30
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
14	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	25	369	25	369	---	---	---	---
	80°	---	---	---	---	9.1	132	9.1	132	---	---	---	---
4	0°	---	---	---	---	---	---	68	982	103	1500	103	1500
	80°	---	---	---	---	---	---	21	304	24	349	24	349
6	0°	---	---	---	---	---	---	5.2	76	31	446	98	1415
	80°	---	---	---	---	---	---	3.5	51	4.7	68	9.8	142
8	0°	---	---	---	---	---	---	---	---	3.1	46	29	427
	80°	---	---	---	---	---	---	---	---	2.2	32	4.6	66
10	0°	---	---	---	---	---	---	---	---	---	---	8.4	121
	80°	---	---	---	---	---	---	---	---	---	---	2.0	29
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---
14	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	25	369	25	369	---	---	---	---
	80°	---	---	---	---	9.1	132	9.1	132	---	---	---	---
4	0°	---	---	---	---	---	---	68	982	103	1500	103	1500
	80°	---	---	---	---	---	---	20	297	24	349	24	349
6	0°	---	---	---	---	---	---	5.2	76	21	299	87	1267
	80°	---	---	---	---	---	---	3.4	49	5.3	77	10	147
8	0°	---	---	---	---	---	---	---	---	---	---	25	368
	80°	---	---	---	---	---	---	---	---	---	---	4.8	69
10	0°	---	---	---	---	---	---	---	---	---	---	6.2	90
	80°	---	---	---	---	---	---	---	---	---	---	2.1	30
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---
14	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	3.3	47	3.3	47	---	---	---	---
	80°	---	---	---	---	3.3	47	3.3	47	---	---	---	---
4	0°	---	---	---	---	---	---	30	434	63	918	63	918
	80°	---	---	---	---	---	---	21	304	24	349	24	349
6	0°	---	---	---	---	---	---	3.7	54	21	310	68	980
	80°	---	---	---	---	---	---	3.5	51	4.7	68	9.8	142
8	0°	---	---	---	---	---	---	---	---	3.3	47	26	381
	80°	---	---	---	---	---	---	---	---	2.2	32	4.6	66
10	0°	---	---	---	---	---	---	---	---	---	---	12	167
	80°	---	---	---	---	---	---	---	---	---	---	2.0	29
12	0°	---	---	---	---	---	---	---	---	---	---	3.7	54
	80°	---	---	---	---	---	---	---	---	---	---	1.4	20
14	0°	---	---	---	---	---	---	---	---	---	---	1.1	16
	80°	---	---	---	---	---	---	---	---	---	---	1.1	16

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	3.3	47	3.3	47	---	---	---	---
	80°	---	---	---	---	3.3	47	3.3	47	---	---	---	---
4	0°	---	---	---	---	---	---	30	434	52	755	63	918
	80°	---	---	---	---	---	---	20	297	24	349	24	349
6	0°	---	---	---	---	---	---	3.7	54	14	208	61	878
	80°	---	---	---	---	---	---	3.4	49	5.3	77	10	147
8	0°	---	---	---	---	---	---	---	---	---	---	23	330
	80°	---	---	---	---	---	---	---	---	---	---	4.8	69
10	0°	---	---	---	---	---	---	---	---	---	---	9.4	137
	80°	---	---	---	---	---	---	---	---	---	---	2.1	30
12	0°	---	---	---	---	---	---	---	---	---	---	2.4	34
	80°	---	---	---	---	---	---	---	---	---	---	1.4	21
14	0°	---	---	---	---	---	---	---	---	---	---	0.1	1.1
	80°	---	---	---	---	---	---	---	---	---	---	0.1	1.1

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	1.2	18	1.2	18	---	---	---	---
	80°	---	---	---	---	1.2	18	1.2	18	---	---	---	---
4	0°	---	---	---	---	---	---	25	362	55	798	55	798
	80°	---	---	---	---	---	---	21	304	24	349	24	349
6	0°	---	---	---	---	---	---	0.9	13	16	234	56	813
	80°	---	---	---	---	---	---	0.9	13	4.7	68	9.8	142
8	0°	---	---	---	---	---	---	---	---	0.6	8.5	20	287
	80°	---	---	---	---	---	---	---	---	0.6	8.5	4.6	66
10	0°	---	---	---	---	---	---	---	---	---	---	7.6	111
	80°	---	---	---	---	---	---	---	---	---	---	2.0	29
12	0°	---	---	---	---	---	---	---	---	---	---	1.0	15
	80°	---	---	---	---	---	---	---	---	---	---	1.0	15
14	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	1.2	18	1.2	18	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	1.2	18	1.2	18	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	25	362	45	651	55	798
	80°	- - -	- - -	- - -	- - -	- - -	- - -	20	297	24	349	24	349
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	0.9	13	10	146	50	725
	80°	- - -	- - -	- - -	- - -	- - -	- - -	0.9	13	5.3	77	10	147
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	17	245
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	4.8	69
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	5.9	86
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.1	30
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
14	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	**Angle of Opening**	**Q 40**						**Q 65**						**Q 100**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	---	---	---	---	---	---	11.0	159	11.7	170	11.7	170	28.3	411	28.3	411	28.3	411
	90°	---	---	---	---	---	---	0.8	12	2.8	40	4.3	62	1.7	24	4.5	66	5.9	86
4	0°	---	---	---	---	---	---	---	---	---	---	---	---	2.2	32	2.2	32	2.2	32
	90°	---	---	---	---	---	---	---	---	---	---	---	---	1.2	18	2.2	32	2.2	32
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Valve Size, NPS	**Angle of Opening**	**Q 150**						**Q 200**						**Q 350**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	68.2	989	68.2	989	68.2	989	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435
	90°	2.0	29	6.6	95	10.1	146	3.3	48	9.6	139	13.3	193	5.2	76	16.1	234	23.5	342
4	0°	21.6	313	21.6	313	21.6	313	38.5	558	38.5	558	38.5	558	90.5	1313	92.4	1339	92.4	1339
	90°	1.5	22	4.9	71	7.6	110	2.5	36	7.2	104	10.0	145	3.9	57	12.1	175	17.7	256
6	0°	---	---	---	---	---	---	2.3	34	2.3	34	2.3	34	21.3	309	21.9	318	21.9	318
	90°	---	---	---	---	---	---	0.4	6	1.2	17	1.7	24	0.7	9	2.0	29	2.9	43
8	0°	---	---	---	---	---	---	---	---	---	---	---	---	0.8	11	1.0	15	1.0	15
	90°	---	---	---	---	---	---	---	---	---	---	---	---	0.3	4	0.9	14	1.0	15
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Valve Size, NPS	**Angle of Opening**	**Q 600**						**Q 950**						**Q 1600**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435
	90°	9.4	136	27.9	404	39.6	574	14.2	206	41.8	607	58.9	854	24.6	357	70.3	1020	96.4	1398
4	0°	68.2	989	68.2	989	68.2	989	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435
	90°	2.0	29	6.6	95	10.1	146	3.3	48	9.6	139	13.3	193	5.2	76	16.1	234	23.5	342
6	0°	49.9	724	49.9	724	49.9	724	83.2	1207	83.2	1207	83.2	1207	103.4	1500	103.4	1500	103.4	1500
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	12.7	184	12.7	184	12.7	184	26.5	384	26.5	384	26.5	384	55.5	806	55.5	806	55.5	806
	90°	0.5	8	1.6	24	2.3	33	0.8	12	2.4	35	3.4	50	1.4	21	4.1	59	5.6	81
10	0°	2.1	30	2.1	30	2.1	30	9.6	140	9.6	140	9.6	140	25.5	370	25.5	370	25.5	370
	90°	0.2	3	0.7	10	1.0	15	0.4	5	1.1	15	1.5	22	0.6	9	1.8	26	2.5	36
12	0°	---	---	---	---	---	---	1.2	18	1.2	18	1.2	18	10.4	150	10.4	150	10.4	150
	90°	---	---	---	---	---	---	0.2	4	0.7	10	1.0	15	0.4	6	1.2	18	1.7	24

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	11.7	170	---	---	12.9	186	37.5	543	---	---	41.4	600	64.3	932
	90°	---	---	---	---	1.7	24	---	---	2.7	39	2.7	39	---	---	3.7	54	3.7	54
4	0°	---	---	---	---	---	---	---	---	---	---	6.6	96	---	---	8.5	124	19.7	286
	90°	---	---	---	---	---	---	---	---	---	---	2.0	29	---	---	2.8	40	2.8	40
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	0.2	3	24.5	1081	98.9	1435	21.6	314	98.9	1435	98.9	1435	52.7	765	98.9	1435	98.9	1435
	90°	0.2	3	6.2	90	6.2	90	8.3	121	8.3	121	8.3	121	14.9	216	15.1	220	15.1	220
4	0°	---	---	24.7	358	52.5	762	---	---	48.4	701	77.9	1130	14.1	204	100.1	1451	103.1	1495
	90°	---	---	4.6	67	4.6	67	---	---	6.2	90	6.2	90	11.2	162	11.4	165	11.4	165
6	0°	---	---	---	---	7.5	108	---	---	5.9	86	16.7	242	---	---	24.7	359	46.1	668
	90°	---	---	---	---	0.8	11	---	---	1.0	15	1.0	15	---	---	1.9	27	1.9	27
8	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	2.2	32	11.1	161
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.9	13	0.9	13
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.2	17
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.4	6
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435	98.9	1435
	90°	24.9	361	24.9	361	24.9	361	36.5	529	36.5	529	36.5	529	60.8	882	60.8	882	60.8	882
4	0°	46.7	678	103.1	1495	103.1	1495	85.0	1233	103.1	1495	103.1	1495	103.1	1495	103.1	1495	103.1	1495
	90°	18.7	271	18.7	271	18.7	271	27.4	397	27.4	397	27.4	397	45.6	662	45.6	662	45.6	662
6	0°	5.3	78	58.5	848	92.2	1337	19.3	279	98.6	1430	103.4	1500	49.2	714	103.4	1500	103.4	1500
	90°	3.1	45	3.1	45	3.1	45	4.6	66	4.6	66	4.6	66	7.6	110	7.6	110	7.6	110
8	0°	---	---	16.2	235	30.2	438	---	---	32.9	477	53.2	772	12.4	180	66.9	970	97.9	1420
	90°	---	---	1.4	21	1.4	21	---	---	2.1	31	2.1	31	3.5	51	3.5	51	3.5	51
10	0°	---	---	4.0	58	11.7	169	---	---	13.1	191	24.3	352	1.9	27	31.8	461	48.8	707
	90°	---	---	0.6	9	0.6	9	---	---	0.9	14	0.9	14	1.6	23	1.6	23	1.6	23
12	0°	---	---	---	---	2.4	35	---	---	3.2	47	9.6	140	---	---	13.9	202	23.7	344
	90°	---	---	---	---	0.4	6	---	---	0.6	9	0.6	9	---	---	1.1	15	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	22.9	333	22.9	333	22.9	333	55.0	798	55.0	798	55.0	798	66.7	968	66.7	968	66.7	968
	90°	2.0	29	6.6	95	10.1	146	3.3	48	9.6	139	13.3	193	5.2	76	16.1	234	23.5	342
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	2.7	39	2.7	39	2.7	39	50.3	730	52.0	754	52.0	754
	90°	- - -	- - -	- - -	- - -	- - -	- - -	2.5	36	2.7	39	2.7	39	3.9	57	12.1	175	17.7	256
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968
	90°	9.4	136	27.9	404	39.6	574	14.2	206	41.8	607	58.9	854	24.6	357	66.7	968	66.7	968
4	0°	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456
	90°	7.0	102	20.9	303	29.7	431	10.7	155	31.4	455	44.2	641	18.5	268	52.7	765	72.3	1048
6	0°	21.6	313	21.6	313	21.6	313	51.9	752	51.9	752	51.9	752	103.4	1500	103.4	1500	103.4	1500
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	5.2	75	5.2	75	5.2	75	31.4	455	31.4	455	31.4	455
	90°	- - -	- - -	- - -	- - -	- - -	- - -	0.8	12	2.4	35	3.4	50	1.4	21	4.1	59	5.6	81
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	11.7	169	11.7	169	11.7	169
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.6	9	1.8	26	2.5	36
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.6	38	2.6	38	2.6	38
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.4	6	1.2	18	1.7	24

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	**Angle of Opening**	**Q 40**						**Q 65**						**Q 100**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	19.3	280
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.7	54
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	**Angle of Opening**	**Q 150**						**Q 200**						**Q 350**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	- - -	- - -	28.8	418	66.7	968	- - -	- - -	66.7	968	66.7	968	8.6	125	66.7	968	66.7	968
	90°	- - -	- - -	6.2	90	6.2	90	- - -	- - -	8.3	121	8.3	121	8.6	125	15.1	220	15.1	220
4	0°	- - -	- - -	- - -	- - -	15.5	225	- - -	- - -	11.7	170	38.8	563	- - -	- - -	59.1	857	100.4	1456
	90°	- - -	- - -	- - -	- - -	4.6	67	- - -	- - -	6.2	90	6.2	90	- - -	- - -	11.4	165	11.4	165
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	18.1	263
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.9	27
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	**Angle of Opening**	**Q 600**						**Q 950**						**Q 1600**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968	66.7	968
	90°	24.9	361	24.9	361	24.9	361	36.5	529	36.5	529	36.5	529	60.8	882	60.8	882	60.8	882
4	0°	10.2	148	100.4	1456	100.4	1456	45.3	657	100.4	1456	100.4	1456	100.4	1456	100.4	1456	100.4	1456
	90°	10.2	148	18.7	271	18.7	271	27.4	397	27.4	397	27.4	397	45.6	662	45.6	662	45.6	662
6	0°	- - -	- - -	29.4	426	60.0	870	- - -	- - -	65.8	955	103.4	1500	21.0	304	103.4	1500	103.4	1500
	90°	- - -	- - -	3.1	45	3.1	45	- - -	- - -	4.6	66	4.6	66	7.6	110	7.6	110	7.6	110
8	0°	- - -	- - -	- - -	- - -	8.5	124	- - -	- - -	11.0	159	29.3	425	- - -	- - -	41.6	604	69.7	1011
	90°	- - -	- - -	- - -	- - -	1.4	21	- - -	- - -	2.1	31	2.1	31	- - -	- - -	3.5	51	3.5	51
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.5	8	10.5	153	- - -	- - -	17.2	250	32.5	471
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.5	8	0.9	14	- - -	- - -	1.6	23	1.6	23
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.0	29	- - -	- - -	5.9	85	14.7	214
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.6	9	- - -	- - -	1.1	15	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	13.9	202	13.9	202	13.9	202	40.1	582	40.1	582	40.1	582	49.4	717	49.4	717	49.4	717
	90°	2.0	29	6.6	95	10.1	146	3.3	48	9.6	139	13.3	193	5.2	76	16.1	234	23.5	342
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	35.9	521	37.3	540	37.3	540
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.9	52	12.1	175	17.7	256
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717
	90°	9.4	136	27.9	404	39.6	574	14.2	206	41.8	607	49.4	717	24.6	357	49.4	717	49.4	717
4	0°	93.5	1356	93.5	1356	93.5	1356	98.4	1427	98.4	1427	98.4	1427	98.4	1427	98.4	1427	98.4	1427
	90°	7.0	102	20.9	303	29.7	431	10.7	155	31.4	455	44.2	641	18.5	268	52.7	765	72.3	1048
6	0°	13.2	192	13.2	192	13.2	192	37.0	537	37.0	537	37.0	537	86.8	1259	86.8	1259	86.8	1259
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	1.1	17	1.1	17	1.1	17	21.5	312	21.5	312	21.5	312
	90°	- - -	- - -	- - -	- - -	- - -	- - -	0.8	12	1.1	17	1.1	17	1.4	21	4.1	59	5.6	81
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	6.8	99	6.8	99	6.8	99
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.6	9	1.8	26	2.5	36
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	11.0	159
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.7	54
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	18.7	271	49.4	717	- - -	- - -	49.4	717	49.4	717	2.3	33	49.4	717	49.4	717
	90°	- - -	- - -	6.2	90	6.2	90	- - -	- - -	8.3	121	8.3	121	2.3	33	15.1	220	15.1	220
4	0°	- - -	- - -	- - -	- - -	8.2	118	- - -	- - -	5.1	74	26.7	388	- - -	- - -	42.9	622	85.8	1244
	90°	- - -	- - -	- - -	- - -	4.6	67	- - -	- - -	5.1	74	6.2	90	- - -	- - -	11.4	165	11.4	165
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	10.5	152
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.9	27
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717	49.4	717
	90°	24.9	361	24.9	361	24.9	361	36.5	529	36.5	529	36.5	529	49.4	717	49.4	717	49.4	717
4	0°	3.9	57	98.4	1427	98.4	1427	31.9	463	98.4	1427	98.4	1427	92.1	1336	98.4	1427	98.4	1427
	90°	3.9	57	18.7	271	18.7	271	27.4	397	27.4	397	27.4	397	45.6	662	45.6	662	45.6	662
6	0°	- - -	- - -	19.3	281	43.4	629	- - -	- - -	48.0	696	82.9	1202	12.7	185	103.4	1500	103.4	1500
	90°	- - -	- - -	3.1	45	3.1	45	- - -	- - -	4.6	66	4.6	66	7.6	110	7.6	110	7.6	110
8	0°	- - -	- - -	- - -	- - -	3.8	54	- - -	- - -	5.6	82	19.9	289	- - -	- - -	29.5	427	51.2	743
	90°	- - -	- - -	- - -	- - -	1.4	21	- - -	- - -	2.1	31	2.1	31	- - -	- - -	3.5	51	3.5	51
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	5.9	86	- - -	- - -	11.1	161	22.9	333
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.9	14	- - -	- - -	1.6	23	1.6	23
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.3	33	9.1	131
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.1	15	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	**Angle of Opening**	**Q 40**						**Q 65**						**Q 100**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Valve Size, NPS	**Angle of Opening**	**Q 150**						**Q 200**						**Q 350**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	---	---	---	---	---	---	25.5	370	25.5	370	25.5	370	39.6	574	39.6	574	39.6	574
	90°	---	---	---	---	---	---	3.3	48	9.6	139	13.3	193	5.2	76	16.1	234	23.5	342
4	0°	---	---	---	---	---	---	---	---	---	---	---	---	39.1	567	41.0	595	41.0	595
	90°	---	---	---	---	---	---	---	---	---	---	---	---	3.9	57	12.1	175	17.7	256
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Valve Size, NPS	**Angle of Opening**	**Q 600**						**Q 950**						**Q 1600**					
		60 Psig		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**		**60 Psig**		**80 Psig**		**100 Psig**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
3	0°	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574
	90°	9.4	136	27.9	404	39.6	574	14.2	206	39.6	574	39.6	574	24.6	357	39.6	574	39.6	574
4	0°	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.1	1453
	90°	7.0	102	20.9	303	29.7	431	10.7	155	31.4	455	44.2	641	18.5	268	52.7	765	72.3	1048
6	0°	21.6	313	21.6	313	21.6	313	54.0	783	54.0	783	54.0	783	103.4	1500	103.4	1500	103.4	1500
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	---	---	---	---	---	---	11.4	166	11.4	166	11.4	166	38.1	553	38.1	553	38.1	553
	90°	---	---	---	---	---	---	0.8	12	2.4	35	3.4	50	1.4	21	4.1	59	5.6	81
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	11.6	169	11.6	169	11.6	169
	90°	---	---	---	---	---	---	---	---	---	---	---	---	0.6	9	1.8	26	2.5	36
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	0.4	6	0.4	6	0.4	6
	90°	---	---	---	---	---	---	---	---	---	---	---	---	0.4	6	0.4	6	0.4	6

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	39.6	574	- - -	- - -	39.6	574	39.6	574	- - -	- - -	39.6	574	39.6	574
	90°	- - -	- - -	- - -	- - -	6.2	90	- - -	- - -	8.3	121	8.3	121	- - -	- - -	15.1	220	15.1	220
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	26.0	377	- - -	- - -	49.0	711	100.1	1453
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	6.2	90	- - -	- - -	11.4	165	11.4	165
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	17.9	260
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.9	27
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574	39.6	574
	90°	24.9	361	24.9	361	24.9	361	36.5	529	36.5	529	36.5	529	39.6	574	39.6	574	39.6	574
4	0°	- - -	- - -	100.1	1453	100.1	1453	33.3	484	100.1	1453	100.1	1453	100.1	1453	100.1	1453	100.1	1453
	90°	- - -	- - -	18.7	271	18.7	271	27.4	397	27.4	397	27.4	397	45.6	662	45.6	662	45.6	662
6	0°	- - -	- - -	30.0	434	62.7	909	- - -	- - -	68.9	1000	103.4	1500	20.9	304	103.4	1500	103.4	1500
	90°	- - -	- - -	3.1	45	3.1	45	- - -	- - -	4.6	66	4.6	66	7.6	110	7.6	110	7.6	110
8	0°	- - -	- - -	2.0	29	14.8	215	- - -	- - -	17.3	251	36.0	522	- - -	- - -	48.6	704	77.1	1118
	90°	- - -	- - -	1.4	21	1.4	21	- - -	- - -	2.1	31	2.1	31	- - -	- - -	3.5	51	3.5	51
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.7	10	10.5	153	- - -	- - -	17.1	248	32.1	466
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.7	10	0.9	14	- - -	- - -	1.6	23	1.6	23
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.5	51	12.1	175
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.1	15	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	14.4	210	14.4	210	14.4	210	25.4	368	25.4	368	25.4	368
	90°	- - -	- - -	- - -	- - -	- - -	- - -	3.3	48	9.6	139	13.3	193	5.2	76	16.1	234	23.5	342
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	25.9	376	27.4	398	27.4	398
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.9	57	12.1	175	17.7	256
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368
	90°	9.4	136	25.4	368	25.4	368	14.2	206	25.4	368	25.4	368	24.6	357	25.4	368	25.4	368
4	0°	90.3	1310	90.3	1310	90.3	1310	98.1	1423	98.1	1423	98.1	1423	98.1	1423	98.1	1423	98.1	1423
	90°	7.0	102	20.9	303	29.7	431	10.7	155	31.4	455	44.2	641	18.5	268	52.7	765	72.3	1048
6	0°	12.8	186	12.8	186	12.8	186	37.8	549	37.8	549	37.8	549	90.4	1311	90.4	1311	90.4	1311
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	5.9	86	5.9	86	5.9	86	26.6	385	26.6	385	26.6	385
	90°	- - -	- - -	- - -	- - -	- - -	- - -	0.8	12	2.4	35	3.4	50	1.4	21	4.1	59	5.6	81
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	6.9	99	6.9	99	6.9	99
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.6	9	1.8	26	2.5	36
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	25.4	368	---	---	25.4	368	25.4	368	---	---	25.4	368	25.4	368
	90°	---	---	---	---	6.2	90	---	---	8.3	121	8.3	121	---	---	15.1	220	15.1	220
4	0°	---	---	---	---	---	---	---	---	---	---	15.6	227	---	---	33.7	489	81.7	1185
	90°	---	---	---	---	---	---	---	---	---	---	6.2	90	---	---	11.4	165	11.4	165
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	9.9	144
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.9	27
8	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368
	90°	24.9	361	24.9	361	24.9	361	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368	25.4	368
4	0°	---	---	98.1	1423	98.1	1423	21.4	311	98.1	1423	98.1	1423	88.7	1287	98.1	1423	98.1	1423
	90°	---	---	18.7	271	18.7	271	21.4	311	27.4	397	27.4	397	45.6	662	45.6	662	45.6	662
6	0°	---	---	19.2	279	44.6	646	---	---	49.4	717	86.2	1250	12.3	178	103.4	1500	103.4	1500
	90°	---	---	3.1	45	3.1	45	---	---	4.6	66	4.6	66	7.6	110	7.6	110	7.6	110
8	0°	---	---	---	---	8.6	124	---	---	10.5	152	24.9	262	---	---	34.6	502	56.7	823
	90°	---	---	---	---	1.4	21	---	---	2.1	31	2.1	31	---	---	3.5	51	3.5	51
10	0°	---	---	---	---	---	---	---	---	---	---	6.0	87	---	---	11.1	161	22.8	330
	90°	---	---	---	---	---	---	---	---	---	---	0.9	14	---	---	1.6	23	1.6	23
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.5	8	7.2	104
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.5	8	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.3	47	3.3	47	3.3	47
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.3	47	3.3	47	3.3	47
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	9.8	142	10.5	153	10.5	153
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.9	57	10.5	153	10.5	153
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47
	90°	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47
4	0°	40.8	592	40.8	592	40.8	592	63.1	916	63.1	916	63.1	916	63.1	916	63.1	916	63.1	916
	90°	7.0	102	20.9	303	29.7	431	10.7	155	31.4	455	44.2	641	18.5	268	52.7	765	63.1	916
6	0°	9.0	130	9.0	130	9.0	130	26.3	381	26.3	381	26.3	381	62.6	908	62.6	908	62.6	908
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	5.7	83	5.7	83	5.7	83	23.8	345	23.8	345	23.8	345
	90°	- - -	- - -	- - -	- - -	- - -	- - -	0.8	12	2.4	35	3.4	50	1.4	21	4.1	59	5.6	81
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	10.0	146	10.0	146	10.0	146
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.6	9	1.8	26	2.5	36
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.7	40	2.7	40	2.7	40
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.4	6	1.2	18	1.7	24

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	3.3	47	- - -	- - -	3.3	47	3.3	47	- - -	- - -	3.3	47	3.3	47
	90°	- - -	- - -	- - -	- - -	3.3	47	- - -	- - -	3.3	47	3.3	47	- - -	- - -	3.3	47	3.3	47
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	4.9	70	- - -	- - -	13.6	197	36.7	532
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	4.9	70	- - -	- - -	11.4	165	11.4	165
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	7.0	101
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.9	27
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47
	90°	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47	3.3	47
4	0°	- - -	- - -	50.1	727	63.1	916	7.6	111	63.1	916	63.1	916	40.1	581	63.1	916	63.1	916
	90°	- - -	- - -	18.7	271	18.7	271	7.6	111	27.4	397	27.4	397	40.1	581	45.6	662	45.6	662
6	0°	- - -	- - -	13.4	195	30.9	449	- - -	- - -	34.3	497	59.7	866	8.6	125	76.8	1114	92.5	1341
	90°	- - -	- - -	3.1	45	3.1	45	- - -	- - -	4.6	66	4.6	66	7.6	110	7.6	110	7.6	110
8	0°	- - -	- - -	- - -	- - -	8.0	116	- - -	- - -	9.7	140	22.4	324	- - -	- - -	30.9	448	50.2	728
	90°	- - -	- - -	- - -	- - -	1.4	21	- - -	- - -	2.1	31	2.1	31	- - -	- - -	3.5	51	3.5	51
10	0°	- - -	- - -	- - -	- - -	0.5	7	- - -	- - -	1.5	22	9.2	133	- - -	- - -	14.3	207	26.0	377
	90°	- - -	- - -	- - -	- - -	0.5	7	- - -	- - -	0.9	14	0.9	14	- - -	- - -	1.6	23	1.6	23
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.2	32	- - -	- - -	5.4	79	12.8	185
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.6	9	- - -	- - -	1.1	15	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Spring-To-Close (90° Maximum Rotation), Actuator Size, Supply Pressure																			
Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
4	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	---	---	---	---	---	---	---	---	---	---	---	---	1.2	18	1.2	18	1.2	18
	90°	---	---	---	---	---	---	---	---	---	---	---	---	1.2	18	1.2	18	1.2	18
4	0°	---	---	---	---	---	---	---	---	---	---	---	---	6.8	99	7.4	108	7.4	108
	90°	---	---	---	---	---	---	---	---	---	---	---	---	3.9	57	7.4	108	7.4	108
6	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	90°	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18
	90°	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18
4	0°	34.8	504	34.8	504	34.8	504	57.0	827	57.0	827	57.0	827	57.0	827	57.0	827	57.0	827
	90°	7.0	102	20.9	303	29.7	431	10.7	155	31.4	455	44.2	641	18.5	268	52.7	765	57.0	827
6	0°	5.4	78	5.4	78	5.4	78	20.4	295	20.4	295	20.4	295	51.8	751	51.8	751	51.8	751
	90°	1.2	17	3.5	51	4.9	72	1.8	26	5.2	76	7.4	107	3.1	45	8.8	128	12.0	175
8	0°	---	---	---	---	---	---	2.6	38	2.6	38	2.6	38	17.7	257	17.7	257	17.7	257
	90°	---	---	---	---	---	---	0.8	12	2.4	35	2.6	38	1.4	21	4.1	59	5.6	81
10	0°	---	---	---	---	---	---	---	---	---	---	---	---	6.4	93	6.4	93	6.4	93
	90°	---	---	---	---	---	---	---	---	---	---	---	---	0.6	9	1.8	26	2.5	36
12	0°	---	---	---	---	---	---	---	---	---	---	---	---	0.3	4	0.3	4	0.3	4
	90°	---	---	---	---	---	---	---	---	---	---	---	---	0.3	4	0.3	4	0.3	4

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)[1] for Reverse Flow

Spring-To-Open (90° Maximum Rotation), Actuator Size, Supply Pressure

Valve Size, NPS	Angle of Opening	Q 40						Q 65						Q 100					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 150						Q 200						Q 350					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	- - -	- - -	- - -	- - -	1.2	18	- - -	- - -	1.2	18	1.2	18	- - -	- - -	1.2	18	1.2	18
	90°	- - -	- - -	- - -	- - -	1.2	18	- - -	- - -	1.2	18	1.2	18	- - -	- - -	1.2	18	1.2	18
4	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.3	34	- - -	- - -	10.2	148	31.0	450
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.3	34	- - -	- - -	10.2	148	11.4	165
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.7	53
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.9	27
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

Valve Size, NPS	Angle of Opening	Q 600						Q 950						Q 1600					
		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig		60 Psig		80 Psig		100 Psig	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	0°	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18
	90°	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18	1.2	18
4	0°	- - -	- - -	43.1	626	57.0	827	4.8	70	57.0	827	57.0	827	34.1	494	57.0	827	57.0	827
	90°	- - -	- - -	18.7	271	18.7	271	4.8	70	27.4	397	27.4	397	34.1	494	45.6	662	45.6	662
6	0°	- - -	- - -	9.3	134	24.4	354	- - -	- - -	27.3	396	49.3	715	5.1	74	64.0	929	79.9	1160
	90°	- - -	- - -	3.1	45	3.1	45	- - -	- - -	4.6	66	4.6	66	5.1	74	7.6	110	7.6	110
8	0°	- - -	- - -	- - -	- - -	4.5	66	- - -	- - -	5.9	86	16.5	240	- - -	- - -	23.6	343	39.8	577
	90°	- - -	- - -	- - -	- - -	1.4	21	- - -	- - -	2.1	31	2.1	31	- - -	- - -	3.5	51	3.5	51
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	5.7	83	- - -	- - -	9.9	144	19.4	282
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	0.9	14	- - -	- - -	1.6	23	1.6	23
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	2.4	35	8.3	120
	90°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.1	15	1.1	15

1. At 0 degrees, use maximum actual shutoff pressure drop.
2. Optional minimum supply pressure, select appropriate option (S60 or S100)

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Size 70 Push-Down-To-Open											
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air to Diaphragm, Maximum Rotation, Spring Part Number, psig/barg**									
		Size 70									
		0-33 psig		**0-33 psig**		**0-33 psig**		**0-40 psig**		**0-55 psig**	
		1R676027082		**1R676027082**		**1R676027082**		**1R676027082**		**1R676027082**	
		psi	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**
8	0°	702	48	750	52	750	52	702	48	702	48
	80°	54	3.7	- - -	- - -	- - -	- - -	54	3.7	54	3.7
10	0°	333	23	441	30	524	36	333	23	333	23
	80°	69	4.7	- - -	- - -	- - -	- - -	53	3.7	69	4.7
12	0°	184	13	270	19	368	25	184	13	184	13
	80°	75	5.2	- - -	- - -	- - -	- - -	75	5.2	75	5.2

1. At 0 degrees, use maximum actual shutoff pressure drop.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Size 70 Push-Down-To-Close							
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air to Diaphragm, Maximum Rotation, Spring Part Number, psig/barg**					
		Size 70					
		0-33 psig		**0-40 psig**		**0-55 psig**	
		1R676027082		**1R676027082**		**1R676027082**	
		psi	**bar**	**psi**	**bar**	**psi**	**bar**
8	0°	750	52	750	52	750	52
	80°	64	4.4	79	5.4	96	6.6
10	0°	428	30	524	36	524	36
	80°	40	2.8	49	3.4	60	4.1
12	0°	260	18	514	35	600	41
	80°	23	1.6	23	1.6	23	1.6

1. At 0 degrees, use maximum actual shutoff pressure drop.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Size 30, 40, 60, 68															
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation, psig/barg													
		Size 30						Size 40							
		60 psig		80 psig		100 psig		60 psig		80 psig		100 psig		120 psig	
		psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar
2	0°	750	52	750	52	750	52	750	52	- - -	- - -	- - -	- - -	- - -	- - -
	80°	393	27	393	27	393	27	393	27	- - -	- - -	- - -	- - -	- - -	- - -
3	0°	750	52	750	52	750	52	750	52	- - -	- - -	- - -	- - -	- - -	- - -
	80°	578	40	578	40	578	40	578	40	- - -	- - -	- - -	- - -	- - -	- - -
4	0°	750	52	750	52	750	52	750	52	750	52	750	52	750	52
	80°	250	17	305	21	305	21	305	21	305	21	305	21	305	21
6	0°	353	24	526	36	698	48	750	52	750	52	750	52	750	52
	80°	95	6.5	126	8.7	158	11	189	13	225	16	225	16	225	16
8	0°	131	9.0	217	15	303	21	390	27	562	39	734	51	750	52
	80°	38	2.6	51	3.5	63	4.4	76	5.2	101	7.0	127	8.7	152	10
10	0°	- - -	- - -	37	2.5	89	6.2	142	9.8	247	17	353	24	458	32
	80°	- - -	- - -	16	1.1	20	1.4	24	1.7	32	2.2	41	2.8	49	3.4
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	33	2.3	117	8.0	200	14	283	20
	80°	- - -	- - -	- - -	- - -	- - -	- - -	22	1.5	29	2.0	36	2.5	44	3.0

Valve Size, NPS	Angle of Opening	Size 60						Size 68			
		60 psig		80 psig		100 psig		60 psig		80 psig	
		psi	bar	psi	bar	psi	bar	psi	bar	psi	bar
4	0°	750	52	750	52	750	52	750	52	750	52
	80°	305	21	305	21	305	21	305	21	305	21
6	0°	750	52	750	52	750	52	750	52	750	52
	80°	225	16	225	16	225	16	225	16	225	16
8	0°	750	52	750	52	750	52	750	52	750	52
	80°	152	10	203	14	214	15	214	15	214	15
10	0°	458	32	524	36	524	36	524	36	524	36
	80°	49	3.4	65	4.5	69	4.7	69	4.7	69	4.7
12	0°	283	20	450	31	600	41	583	40	600	41
	80°	44	3.0	58	4.0	73	5.0	70	4.8	75	5.2

1. At 0 degrees, use maximum actual shutoff pressure drop.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	29	421	52	750	---	---	---	---	---	---	---	---
	80°	15	224	27	393	---	---	---	---	---	---	---	---
3	0°	9.4	136	37.3	541	52	750	52	750	---	---	---	---
	80°	9.4	136	19.1	277	40	573	40	578	---	---	---	---
4	0°	---	---	15	223	49	705	52	750	52	750	52	750
	80°	---	---	5.8	85	12	175	21	305	21	305	21	305
6	0°	---	---	---	---	15	214	43	618	52	750	52	750
	80°	---	---	---	---	4.6	66	9.1	132	12	178	16	225
8	0°	---	---	---	---	---	---	17	241	31	455	52	750
	80°	---	---	---	---	---	---	3.7	53	4.9	72	10	149
10	0°	---	---	---	---	---	---	---	---	16	226	38	547
	80°	---	---	---	---	---	---	---	---	1.6	23	3.3	48
12	0°	---	---	---	---	---	---	---	---	7.8	114	23	329
	80°	---	---	---	---	---	---	---	---	1.4	21	3.0	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	29	421	52	750	---	---	---	---	---	---	---	---
	80°	15	215	27	393	---	---	---	---	---	---	---	---
3	0°	9.4	136	37	541	52	750	52	750	---	---	---	---
	80°	9.2	133	18	265	39	560	40	578	---	---	---	---
4	0°	---	---	15	223	49	705	52	750	52	750	52	750
	80°	---	---	5.6	81	12	171	21	305	21	305	21	305
6	0°	---	---	---	---	15	214	43	618	52	750	52	750
	80°	---	---	---	---	4.5	65	8.9	129	14	200	16	225
8	0°	---	---	---	---	---	---	17	241	25	370	52	750
	80°	---	---	---	---	---	---	3.6	52	5.5	80	11	156
10	0°	---	---	---	---	---	---	---	---	12	176	35	508
	80°	---	---	---	---	---	---	---	---	1.8	26	3.4	50
12	0°	---	---	---	---	---	---	---	---	5.6	81	20	296
	80°	---	---	---	---	---	---	---	---	1.6	23	3.1	45

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	47	678	---	---	---	---	---	---	---	---
	80°	---	---	27	393	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	52	750	52	750	---	---	---	---
	80°	---	---	---	---	40	573	40	578	---	---	---	---
4	0°	---	---	---	---	7.2	105	44	645	52	750	52	750
	80°	---	---	---	---	7.2	105	21	305	21	305	21	305
6	0°	---	---	---	---	---	---	6.5	94	42	612	52	750
	80°	---	---	---	---	---	---	6.5	94	12	178	16	225
8	0°	---	---	---	---	---	---	---	---	13	186	31	450
	80°	---	---	---	---	---	---	---	---	4.9	72	10	149
10	0°	---	---	---	---	---	---	---	---	---	---	14	201
	80°	---	---	---	---	---	---	---	---	---	---	3.3	48
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close													
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air to Diaphragm, Maximum Rotation**											
		Size 1				**Size 2**				**Size 3**			
		2 barg / 29 psig		**4 barg / 58 psig**		**2 barg / 29 psig**		**4 barg / 58 psig**		**2 barg / 29 psig**		**4 barg / 58 psig**	
		90°		**90°**		**90°**		**90°**		**90°**		**90°**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
2	0°	- - -	- - -	47	678	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	27	393	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0°	- - -	- - -	- - -	- - -	52	750	52	750	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	39	560	40	578	- - -	- - -	- - -	- - -
4	0°	- - -	- - -	- - -	- - -	7.2	105	44	645	52	750	52	750
	80°	- - -	- - -	- - -	- - -	7.2	105	21	305	21	305	21	305
6	0°	- - -	- - -	- - -	- - -	- - -	- - -	6.5	94	28	406	52	750
	80°	- - -	- - -	- - -	- - -	- - -	- - -	6.5	94	14	200	16	225
8	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	7.5	109	31	450
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	5.5	80	11	156
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	10	146
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3.4	50
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	80°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

FISHER

EMERSON. Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	14	202	---	---	---	---	---	---	---	---
	80°	---	---	14	202	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	16	237	16	239	---	---	---	---
	80°	---	---	---	---	16	237	16	239	---	---	---	---
4	0°	---	---	---	---	1.7	24	14	202	14	202	14	202
	80°	---	---	---	---	1.7	24	14	202	14	202	14	202
6	0°	---	---	---	---	---	---	0.6	8.3	10	140	13	185
	80°	---	---	---	---	---	---	0.6	8.3	10	140	13	185
8	0°	---	---	---	---	---	---	---	---	3.6	52	11	159
	80°	---	---	---	---	---	---	---	---	3.6	52	10	149
10	0°	---	---	---	---	---	---	---	---	---	---	3.8	55
	80°	---	---	---	---	---	---	---	---	---	---	3.3	48
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close													
Valve Size, NPS	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
2	0°	---	---	14	202	---	---	---	---	---	---	---	---
	80°	---	---	14	202	---	---	---	---	---	---	---	---
3	0°	---	---	---	---	16	237	16	239	---	---	---	---
	80°	---	---	---	---	16	237	16	239	---	---	---	---
4	0°	---	---	---	---	1.7	24	14	202	14	202	14	202
	80°	---	---	---	---	1.7	24	14	202	14	202	14	202
6	0°	---	---	---	---	---	---	0.6	8.3	6.0	88	13	185
	80°	---	---	---	---	---	---	0.6	8.3	6.0	88	13	185
8	0°	---	---	---	---	---	---	---	---	1.9	28	11	159
	80°	---	---	---	---	---	---	---	---	1.9	28	11	156
10	0°	---	---	---	---	---	---	---	---	---	---	2.7	39
	80°	---	---	---	---	---	---	---	---	---	---	2.7	39
12	0°	---	---	---	---	---	---	---	---	---	---	---	---
	80°	---	---	---	---	---	---	---	---	---	---	---	---

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Shaft Size, Inches	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, and Spring Part Number			
			SIZE 70	SIZE 70	SIZE 70	SIZE 70
			0-33	0-40	0-55	3-30
			3	3.3	10.1	3
			1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	1 X 3/4(2)	0 10 80	600 600 366	600 600 366	600 600 366	600 600 140
3	1	0 10 80	600 600 422	600 600 451	600 600 600	600 600 140
4	1-1/4	0 10 80	600 600 165	600 600 165	600 600 165	600 600 165
6	1-1/2 X 1-1/4(2)	0 10 80	318 318 93	535 535 93	600 600 93	220 220 93
6	1-1/2	0 10 80	318 318 119	535 535 127	600 600 311	220 220 39
8	1-1/2	0 10 80	148 148 47	250 250 50	350 350 122	103 103 15
10	1-3/4	0 10 80	66 66 21	122 122 23	186 186 56	42 42 7
12	2-1/8 X 2(2)	0 10 80	35 35 12	69 69 13	110 110 32	19 19 4

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

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Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Shaft Size, Inches	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, and Spring Part Number			
			SIZE 70	SIZE 70	SIZE 70	SIZE 70
			0-33	0-40	0-55	3-30
			10.1	10.1	10.1	10.1
			1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	1 X 3/4[2]	0 10 80	600 600 366	600 600 366	600 600 366	600 600 366
3	1	0 10 80	600 600 600	600 600 600	600 600 600	600 600 390
4	1-1/4	0 10 80	600 600 127	600 600 127	600 600 127	600 600 127
6	1-1/2 X 1-1/4[2]	0 10 80	253 253 71	253 253 71	253 253 71	150 150 71
6	1-1/2	0 10 80	253 253 188	253 253 253	253 253 253	150 150 110
8	1-1/2	0 10 80	118 118 74	118 118 118	118 118 118	70 70 43
10	1-3/4	0 10 80	50 50 34	50 50 50	50 50 50	24 24 20
12	2-1/8 X 2[2]	0 10 80	24 24 19	24 24 24	24 24 24	--- --- ---

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Shaft Size, Inches	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, and Spring Part Number			
			SIZE 70	SIZE 70	SIZE 70	SIZE 70
			0-33	0-40	0-55	3-30
			3	3.3	10.1	3
			1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	1 X 3/4(2)	0 10 80	600 600 366	600 600 366	600 600 366	600 600 140
3	1	0 10 80	600 600 422	600 600 451	600 600 600	600 600 140
4	1-1/4	0 10 80	600 600 165	600 600 165	600 600 165	600 600 165
6	1-1/2 X 1-1/4(2)	0 10 80	318 318 93	535 535 93	600 600 93	220 220 93
6	1-1/2	0 10 80	318 318 119	535 535 127	600 600 311	220 220 39
8	1-1/2	0 10 80	148 148 47	220 220 50	220 220 122	103 103 15
10	1-3/4	0 10 80	66 66 21	122 122 23	186 186 56	42 42 7
12	2-1/8 X 2(2)	0 10 80	35 35 12	69 69 13	110 110 32	19 19 4

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

EMERSON. Process Management

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Shaft Size, Inch	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, and Spring Part Number			
			Size 70			
			0-33	0-40	0-55	3-30
			10.1	10.1	10.1	10.1
			1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	1 x 3/4[2]	0 10 80	600 600 366	600 600 366	600 600 366	600 600 366
3	1	0 10 80	600 600 600	600 600 600	600 600 600	600 600 390
4	1-1/4	0 10 80	600 600 127	600 600 127	600 600 127	600 600 127
6	1-1/2 x 1-1/4[2]	0 10 80	253 253 71	253 253 71	253 253 71	150 150 71
6	1-1/2	0 10 80	253 253 188	253 253 253	253 253 253	150 150 110
8	1-1/2	0 10 80	118 118 74	118 118 118	118 118 118	70 70 43
10	1-3/4	0 10 80	50 50 34	50 50 50	50 50 50	24 24 20
12	2-1/8 x 2[2]	0 10 80	24 24 19	24 24 24	24 24 24	--- --- ---

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Shaft Size, Inch	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, and Spring Part Number			
			Size 70			
			0-33	0-40	0-55	3-30
			3	3.3	10.1	3
			1R676027082	1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0 10 80	600 600 366	600 600 366	600 600 366	600 600 140
3	1	0 10 80	600 600 422	600 600 451	600 600 600	600 600 140
4	1-1/4	0 10 80	600 600 165	600 600 165	600 600 165	600 600 165
6	1-1/2 x 1-1/4(2)	0 10 80	345 345 93	578 578 93	600 600 93	240 240 93
6	1-1/2	0 10 80	345 345 119	578 578 127	600 600 311	240 240 39
8	1-1/2	0 10 80	151 151 47	252 252 50	360 360 122	105 105 15
10	1-3/4	0 10 80	72 72 21	130 130 23	196 196 56	46 46 7
12	2-1/2 x 2(2)	0 10 80	43 43 12	79 79 13	120 120 32	28 28 4

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree rotation. Peak dynamic torque occurs at 80 degrees.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Shaft Size, Inch	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, and Spring Part Number			
			Size 70			
			0-33	0-44	0-55	3-30
			10.1	10.1	10.1	10.1
			1R676027082	1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0	600	600	600	600
		10	600	600	600	600
		80	366	366	366	366
3	1	0	600	600	600	600
		10	600	600	600	600
		80	600	600	600	390
4	1-1/4	0	600	600	600	600
		10	600	600	600	600
		80	127	127	127	127
6	1-1/2 x 1-1/4(2)	0	276	276	276	166
		10	276	276	276	166
		80	71	71	71	71
6	1-1/2	0	276	276	276	166
		10	276	276	276	166
		80	188	276	276	110
8	1-1/2	0	120	120	120	73
		10	120	120	120	73
		80	74	120	120	43
10	1-3/4	0	55	55	55	28
		10	55	55	55	28
		80	34	55	55	20
12	2-1/8 x 2(2)	0	33	33	33	16
		10	33	33	33	16
		80	19	33	33	11

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Shaft Size, Inch	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure(2)							
			Size 80				Size 100			
			60	80	100	120	60	80	100	120
10	1-3/4	0	290	390	390	390	390	390	390	390
		10	290	390	390	390	390	390	390	390
		80	181	205	205	205	205	205	205	205
12	2-1/8 x 2(3)	0	174	237	237	237	237	237	237	237
		10	174	237	237	237	237	237	237	237
		80	104	117	117	117	117	117	117	117
12	2-1/8	0	174	243	311	379	277	379	400	400
		10	174	243	311	379	277	379	400	400
		80	104	138	173	207	156	207	259	277

1.At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610P positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree rotation. Peak dynamic torque occurs at 80 degrees.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Shaft Size, Inches	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure(2)											
		SIZE 30	SIZE 30	SIZE 30	SIZE 40	SIZE 40	SIZE 40	SIZE 40	SIZE 60	SIZE 60	SIZE 60	SIZE 68	SIZE 68
		60	80	100	60	80	100	120	60	80	100	60	80
1 X 3/4(3)	0	571	600	600	600	600	600	600	600	600	600	600	600
	10	571	600	600	600	600	600	600	600	600	600	600	600
	80	300	366	366	366	366	366	366	366	366	366	366	366
1	0	571	600	600	600	600	600	600	600	600	600	600	600
	10	571	600	600	600	600	600	600	600	600	600	600	600
	80	300	400	500	600	600	600	600	600	600	600	600	600
1-1/4	0	225	327	429	532	600	600	600	600	600	600	600	600
	10	225	327	429	532	600	600	600	600	600	600	600	600
	80	150	200	250	300	400	500	600	600	600	600	600	600
1-1/2 X 1-1/4(3)	0	16	52	88	123	195	266	338	338	480	600	595	600
	10	16	52	88	123	195	266	338	338	480	600	595	600
	80	16	52	88	123	195	266	338	338	450	476	476	476
1-1/2	0	16	52	88	123	195	266	338	338	480	600	595	600
	10	16	52	88	123	195	266	338	338	480	600	595	600
	80	16	52	88	123	195	266	338	338	450	563	539	583
1-1/2	0	---	24	41	58	91	124	158	158	220	220	220	220
	10	---	24	41	58	91	124	158	158	220	220	220	220
	80	---	24	41	58	88	110	133	133	177	220	211	220
1-3/4	0	---	---	---	17	35	53	72	72	108	144	137	195
	10	---	---	---	17	35	53	72	72	108	144	137	195
	80	---	---	---	17	35	51	61	61	81	101	97	129
2-1/8 X 2(3)	0	---	---	---	---	15	27	38	38	61	83	79	115
	10	---	---	---	---	15	27	38	38	61	83	79	115
	80	---	---	---	---	15	27	35	35	46	58	55	74

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Shaft Size, Inches	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure(2)							
			SIZE 80	SIZE 80	SIZE 80	SIZE 80	SIZE 100	SIZE 100	SIZE 100	SIZE 100
			60	80	100	120	60	80	100	120
10	1-3/4	0	290	390	390	390	390	390	390	390
		10	290	390	390	390	390	390	390	390
		80	181	205	205	205	205	205	205	205
12	2-1/8 X 2(3)	0	174	237	237	237	237	237	237	237
		10	174	237	237	237	237	237	237	237
		80	104	117	117	117	117	117	117	117
12	2-1/8	0	174	243	311	379	277	379	400	400
		10	174	243	311	379	277	379	400	400
		80	104	138	173	207	156	207	259	277

1. At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree maximum rotation. Peak dynamic torque occurs at 80 degrees.

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Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Shaft Size, Inch	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure[2]											
			Size 40			Size 40				Size 60			Size 68	
			60	80	100	60	80	100	120	60	80	100	60	80
3	1 x 3/4[3]	0	600	600	600	600	600	600	600	600	600	600	600	600
		10	600	600	600	600	600	600	600	600	600	600	600	600
		80	300	366	366	366	366	366	366	366	366	366	366	366
3	1	0	600	600	600	600	600	600	600	600	600	600	600	600
		10	600	600	600	600	600	600	600	600	600	600	600	600
		80	300	400	500	600	600	600	600	600	600	600	600	600
4	1-1/4	0	265	376	487	597	600	600	600	600	600	600	600	600
		10	265	376	487	597	600	600	600	600	600	600	600	600
		80	150	200	250	300	400	500	600	600	600	600	600	600
6	1-1/2 x 1-1/4[3]	0	23	61	99	137	214	290	366	366	519	600	600	600
		10	23	61	99	137	214	290	366	366	519	600	600	600
		80	23	61	99	137	214	282	338	338	450	476	475	476
6	1-1/2	0	23	61	99	137	214	290	366	366	519	600	600	600
		10	23	61	99	137	214	290	366	366	519	600	600	600
		80	23	61	99	137	214	282	338	338	450	563	539	583
8	1-1/2	0	10	27	43	60	93	127	160	160	227	293	280	350
		10	10	27	43	60	93	127	160	160	227	293	280	350
		80	10	27	43	60	88	110	133	133	177	221	211	229
10	1-3/4	0	---	---	11	21	40	58	77	77	115	153	145	206
		10	---	---	11	21	40	58	77	77	115	153	145	206
		80	---	---	11	21	40	51	61	61	81	101	97	129
12	2-1/8 x 2[3]	0	---	---	---	12	23	35	47	47	70	93	89	126
		10	---	---	---	12	23	35	47	47	70	93	89	126
		80	---	---	---	12	23	29	35	35	46	58	55	74

1.At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610P positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degrees rotation. Peak dynamic torque occurs at 80 degrees.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Shaft Size, Inch	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure[2]							
			Size 80				Size 100			
			60	80	100	120	60	80	100	120
10	1-3/4	0	304	400	400	400	400	400	400	400
		10	304	400	400	400	400	400	400	400
		80	181	205	205	205	205	205	205	205
12	2-1/8 x 2[3]	0	186	251	251	251	251	251	251	251
		10	186	251	251	251	251	251	251	251
		80	104	117	117	117	117	117	117	117
12	2-1/8	0	186	256	326	396	291	396	400	400
		10	186	256	326	396	291	396	400	400
		80	104	138	173	207	156	207	259	277

1.At 0 degrees, use actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610P positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Note: The CV500 valve can be used for 90 degree rotation. Peak dynamic torque occurs at 80 degrees.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	1x3/4	0°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	6.39	93	14.5	210	25.2	366	25.2	366	25.2	366
	1	0°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	---	---	14.5	210	28.9	419	39.0	565	41.4	600
4	1-1/4	0°	---	---	---	---	7.47	108	20.6	299	35.1	509	41.4	600
		10°	---	---	---	---	7.47	108	20.6	299	35.1	509	41.4	600
		80°	---	---	---	---	7.23	105	14.5	210	19.5	283	40.5	587
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	2.88	42	7.95	115	21.2	308
		10°	---	---	---	---	---	---	2.88	42	7.95	115	21.2	308
		80°	---	---	---	---	---	---	2.88	42	7.95	115	21.2	308
	1-1/2	0°	---	---	---	---	---	---	---	---	7.95	115	21.2	308
		10°	---	---	---	---	---	---	---	---	7.95	115	21.2	308
		80°	---	---	---	---	---	---	---	---	7.95	115	21.2	308
8	1-1/2	0°	---	---	---	---	---	---	---	---	3.71	54	9.90	144
		10°	---	---	---	---	---	---	---	---	3.71	54	9.90	144
		80°	---	---	---	---	---	---	---	---	3.71	54	8.94	130
10	1-3/4	0°	---	---	---	---	---	---	---	---	1.04	15	4.41	64
		10°	---	---	---	---	---	---	---	---	1.04	15	4.41	64
		80°	---	---	---	---	---	---	---	---	1.04	15	4.09	59
12	2-1/4x 2	0°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		10°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		80°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
	2-1/8	0°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		10°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		80°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33

1. At 0 degrees, use maximum actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	1x3/4	0°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	6.39	93	14.1	205	25.2	366	25.2	366	25.2	366
	1	0°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	---	---	14.1	205	28.2	410	41.4	600	41.4	600
4	1-1/4	0°	---	---	---	---	7.47	108	20.6	299	29.3	425	41.4	600
		10°	---	---	---	---	7.47	108	20.6	299	29.3	425	40.5	587
		80°	---	---	---	---	7.06	102	14.1	205	21.9	317	40.5	587
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	2.88	42	5.93	86	19.2	278
		10°	---	---	---	---	---	---	2.88	42	5.93	86	19.2	278
		80°	---	---	---	---	---	---	2.88	42	5.93	86	19.2	278
	1-1/2	0°	---	---	---	---	---	---	---	---	5.93	86	19.2	278
		10°	---	---	---	---	---	---	---	---	5.93	86	19.2	278
		80°	---	---	---	---	---	---	---	---	5.93	86	19.2	278
8	1-1/2	0°	---	---	---	---	---	---	---	---	2.77	40	8.96	130
		10°	---	---	---	---	---	---	---	---	2.77	40	8.96	130
		80°	---	---	---	---	---	---	---	---	2.77	40	8.96	130
10	1-3/4	0°	---	---	---	---	---	---	---	---	0.52	7.6	3.90	57
		10°	---	---	---	---	---	---	---	---	0.52	7.6	3.90	57
		80°	---	---	---	---	---	---	---	---	0.52	7.6	3.90	57
12	2-1/4x 2	0°	---	---	---	---	---	---	---	---	---	---	1.97	29
		10°	---	---	---	---	---	---	---	---	---	---	1.97	29
		80°	---	---	---	---	---	---	---	---	---	---	1.97	29
	2-1/8	0°	---	---	---	---	---	---	---	---	---	---	1.97	29
		10°	---	---	---	---	---	---	---	---	---	---	1.97	29
		80°	---	---	---	---	---	---	---	---	---	---	1.97	29

1. At 0 degrees, use maximum actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open															
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation												
			Size 1				Size 2				Size 3				
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	1x3/4	0°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	6.39	93	14.5	210	25.2	366	25.2	366	25.2	366
	1	0°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	---	---	14.5	210	28.9	419	39.0	565	41.4	600
4	1-1/4	0°	---	---	---	---	7.47	108	20.6	299	35.1	509	41.4	600
		10°	---	---	---	---	7.47	108	20.6	299	35.1	509	41.4	600
		80°	---	---	---	---	7.23	105	14.5	210	19.5	283	40.5	587
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	2.88	42	7.95	115	20.7	300
		10°	---	---	---	---	---	---	2.88	42	7.95	115	20.7	300
		80°	---	---	---	---	---	---	2.88	42	7.95	115	20.7	300
	1-1/2	0°	---	---	---	---	---	---	---	---	7.95	115	20.7	300
		10°	---	---	---	---	---	---	---	---	7.95	115	20.7	300
		80°	---	---	---	---	---	---	---	---	7.95	115	20.7	300
8	1-1/2	0°	---	---	---	---	---	---	---	---	3.71	54	9.90	144
		10°	---	---	---	---	---	---	---	---	3.71	54	9.90	144
		80°	---	---	---	---	---	---	---	---	3.71	54	8.94	130
10	1-3/4	0°	---	---	---	---	---	---	---	---	1.04	15	4.41	64
		10°	---	---	---	---	---	---	---	---	1.04	15	4.41	64
		80°	---	---	---	---	---	---	---	---	1.04	15	4.09	59
12	2-1/4x 2	0°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		10°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		80°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
	2-1/8	0°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		10°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33
		80°	---	---	---	---	---	---	---	---	0.18	2.7	2.29	33

1. At 0 degrees, use maximum actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	1x3/4	0°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	6.39	93	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	6.39	93	14.1	205	25.2	366	25.2	366	25.2	366
	1	0°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		10°	---	---	---	---	21.4	310	41.4	600	41.4	600	41.4	600
		80°	---	---	---	---	14.1	205	28.2	410	41.4	600	41.4	600
4	1-1/4	0°	---	---	---	---	7.47	108	20.6	299	29.3	425	41.4	600
		10°	---	---	---	---	7.47	108	20.6	299	29.3	425	40.5	587
		80°	---	---	---	---	7.06	102	14.1	205	21.9	317	40.5	587
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	2.88	42	5.93	86	19.2	278
		10°	---	---	---	---	---	---	2.88	42	5.93	86	19.2	278
		80°	---	---	---	---	---	---	2.88	42	5.93	86	19.2	278
	1-1/2	0°	---	---	---	---	---	---	---	---	5.93	86	19.2	278
		10°	---	---	---	---	---	---	---	---	5.93	86	19.2	278
		80°	---	---	---	---	---	---	---	---	5.93	86	19.2	278
8	1-1/2	0°	---	---	---	---	---	---	---	---	2.77	40	8.96	130
		10°	---	---	---	---	---	---	---	---	2.77	40	8.96	130
		80°	---	---	---	---	---	---	---	---	2.77	40	8.96	130
10	1-3/4	0°	---	---	---	---	---	---	---	---	0.52	7.6	3.90	57
		10°	---	---	---	---	---	---	---	---	0.52	7.6	3.90	57
		80°	---	---	---	---	---	---	---	---	0.52	7.6	3.90	57
12	2-1/4x 2	0°	---	---	---	---	---	---	---	---	---	---	1.97	29
		10°	---	---	---	---	---	---	---	---	---	---	1.97	29
		80°	---	---	---	---	---	---	---	---	---	---	1.97	29
	2-1/8	0°	---	---	---	---	---	---	---	---	---	---	1.97	29
		10°	---	---	---	---	---	---	---	---	---	---	1.97	29
		80°	---	---	---	---	---	---	---	---	---	---	1.97	29

1. At 0 degrees, use maximum actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open															
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation												
			Size 1				Size 2				Size 3				
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		
			90°		90°		90°		90°		90°		90°		
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	
3	1x3/4	0°	1.58	23	9.27	134	25.5	369	41.4	600	41.4	600	41.4	600	
		10°	1.58	23	9.27	134	25.5	369	41.4	600	41.4	600	41.4	600	
		80°	1.58	23	6.99	101	14.5	210	25.2	366	25.2	366	25.2	366	
	1	0°	---	---	---	---	25.5	369	41.4	600	41.4	600	41.4	600	
		10°	---	---	---	---	25.5	369	41.4	600	41.4	600	41.4	600	
		80°	---	---	---	---	14.5	210	28.9	419	39.0	565	41.4	600	
4	1-1/4	0°	---	---	---	---	9.61	139	23.8	345	39.5	573	41.4	600	
		10°	---	---	---	---	9.61	139	23.8	345	39.5	573	41.4	600	
		80°	---	---	---	---	7.23	105	14.5	210	19.5	283	40.5	587	
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	3.47	50	8.89	129	23.1	335	
		10°	---	---	---	---	---	---	3.47	50	8.89	129	23.1	335	
		80°	---	---	---	---	---	---	3.47	50	8.89	129	22.8	331	
	1-1/2	0°	---	---	---	---	---	---	---	---	8.89	129	23.1	335	
		10°	---	---	---	---	---	---	---	---	8.89	129	23.1	335	
		80°	---	---	---	---	---	---	---	---	8.89	129	22.8	331	
8	1-1/2	0°	---	---	---	---	---	---	---	---	3.88	56	10.1	146	
		10°	---	---	---	---	---	---	---	---	3.88	56	10.1	146	
		80°	---	---	---	---	---	---	---	---	3.88	56	8.94	130	
10	1-3/4	0°	---	---	---	---	---	---	---	---	1.28	19	4.79	69	
		10°	---	---	---	---	---	---	---	---	1.28	19	4.79	69	
		80°	---	---	---	---	---	---	---	---	1.28	19	4.09	59	
12	2-1/4x 2	0°	---	---	---	---	---	---	---	---	0.73	11	2.89	42	
		10°	---	---	---	---	---	---	---	---	0.73	11	2.89	42	
		80°	---	---	---	---	---	---	---	---	0.73	11	2.34	34	
	2-1/8	0°	---	---	---	---	---	---	---	---	0.73	11	2.89	42	
		10°	---	---	---	---	---	---	---	---	0.73	11	2.89	42	
		80°	---	---	---	---	---	---	---	---	0.73	11	2.34	34	

1. At 0 degrees, use maximum actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Close														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
3	1x3/4	0°	1.58	23	9.27	134	25.5	369	41.4	600	41.4	600	41.4	600
		10°	1.58	23	9.27	134	25.5	369	41.4	600	41.4	600	41.4	600
		80°	1.58	23	6.69	97	14.1	205	25.2	366	25.2	366	25.2	366
	1	0°	---	---	---	---	25.5	369	41.4	600	41.4	600	41.4	600
		10°	---	---	---	---	25.5	369	41.4	600	41.4	600	41.4	600
		80°	---	---	---	---	14.1	205	28.2	410	41.4	600	41.4	600
4	1-1/4	0°	---	---	---	---	9.61	139	23.8	345	33.2	482	41.4	600
		10°	---	---	---	---	9.61	139	23.8	345	33.2	482	40.5	587
		80°	---	---	---	---	7.06	102	14.1	205	21.9	317	40.5	587
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	3.47	50	6.73	98	20.9	303
		10°	---	---	---	---	---	---	3.47	50	6.73	98	20.9	303
		80°	---	---	---	---	---	---	3.47	50	6.73	98	20.9	303
	1-1/2	0°	---	---	---	---	---	---	---	---	6.73	98	20.9	303
		10°	---	---	---	---	---	---	---	---	6.73	98	20.9	303
		80°	---	---	---	---	---	---	---	---	6.73	98	20.9	303
8	1-1/2	0°	---	---	---	---	---	---	---	---	2.94	43	9.13	132
		10°	---	---	---	---	---	---	---	---	2.94	43	9.13	132
		80°	---	---	---	---	---	---	---	---	2.94	43	9.13	132
10	1-3/4	0°	---	---	---	---	---	---	---	---	0.75	11	4.25	62
		10°	---	---	---	---	---	---	---	---	0.75	11	4.25	62
		80°	---	---	---	---	---	---	---	---	0.75	11	4.25	62
12	2-1/4x 2	0°	---	---	---	---	---	---	---	---	0.40	6	2.56	37
		10°	---	---	---	---	---	---	---	---	0.40	6	2.56	37
		80°	---	---	---	---	---	---	---	---	0.40	6	2.45	36
	2-1/8	0°	---	---	---	---	---	---	---	---	0.40	6	2.56	37
		10°	---	---	---	---	---	---	---	---	0.40	6	2.56	37
		80°	---	---	---	---	---	---	---	---	0.40	6	2.45	36

1. At 0 degrees, use maximum actual shutoff pressure drop. At 10 or 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Size 60 & 70				
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0	---	---	---
	70	---	---	---
4	0	---	---	---
	70	---	---	---
6	0	---	---	---
	70	---	---	---
8	0	290	290	290
	70	62	65	135
10	0	290	290	290
	70	30	31	65
12	0	290	290	290
	70	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig		40 psig	55 psig
		10.1	14.7	10.1	10.1
		90°	60°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0	---	---	---	---
	70	---	---	---	---
4	0	---	---	---	---
	70	---	---	---	---
6	0	---	---	---	---
	70	---	---	---	---
8	0	290	290	290	290
	70	92	90(2)	162	164
10	0	290	290	290	290
	70	44	45(2)	78	79
12	0	290	290	290	290
	70	29	25(2)	51	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
4	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
6	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
8	0	290	290	290
	70	62	65	135
10	0	150	150	150
	70	30	31	65
12	0	135	150	150
	70	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig		40 psig	55 psig
		10.1	14.7	10.1	10.1
		90°	60°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
8	0 70	290 92	290 90(2)	290 162	290 164
10	0 70	150 44	150 45(2)	150 78	150 79
12	0 70	109 29	150 25(2)	109 51	109 63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -
8	0 70	290 63	290 65	290 137
10	0 70	290 30	290 31	290 65
12	0 70	290 192	290 20	290 43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig	40 psig		55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
8	0 70	290 95	290 165	290 144(2)	290 166
10	0 70	290 44	290 78	290 68(2)	290 79
12	0 70	290 29	262 51	290 45(2)	262 63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
4	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
6	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
8	0	290	290	290
	70	63	66	137
10	0	290	290	290
	70	30	31	65
12	0	290	290	290
	70	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig	40 psig		55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0	---	---	---	---
	70	---	---	---	---
4	0	---	---	---	---
	70	---	---	---	---
6	0	---	---	---	---
	70	---	---	---	---
8	0	290	290	290	290
	70	94	165	144[2]	166
10	0	290	290	290	290
	70	44	78	68[2]	79
12	0	290	262	290	290
	70	29	51	45[2]	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0	---	---	---
	70	---	---	---
4	0	---	---	---
	70	---	---	---
6	0	---	---	---
	70	---	---	---
8	0	290	290	290
	70	62	65	135
10	0	290	290	290
	70	30	31	65
12	0	290	290	290
	70	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig	40 psig		55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
8	0 70	290 92	290 162	290 189(2)	290 164
10	0 70	290 44	290 78	290 95(2)	290 79
12	0 70	290 29	290 51	290 53(2)	290 63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-to-Open or Push-Down-to-Close													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure(2)											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
1	0	740	740	740	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	740	740	740	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1-1/2	0	740	740	740	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	350	350	350	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2	0	290	290	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	290	290	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	290	290	290	290	290	290	290	290	290	290	290	290
4	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	139	290	290	290	290	290	290	290	290	290	290	290
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	- - -	- - -	- - -	- - -	250	290	290	290	290	290	290	290
	70	- - -	- - -	- - -	- - -	27	34	40	40	54	63	63	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-to-Open or Push-Down-to-Close													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure(2)											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
1	0	300	300	300	---	---	---	---	---	---	---	---	---
	70	300	300	300	---	---	---	---	---	---	---	---	---
1-1/2	0	300	300	300	---	---	---	---	---	---	---	---	---
	70	300	300	300	---	---	---	---	---	---	---	---	---
2	0	290	290	290	---	---	---	---	---	---	---	---	---
	70	290	290	290	---	---	---	---	---	---	---	---	---
3	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	290	290	290	290	290	290	290	290	290	290	290	290
4	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	147	221	290	290	290	290	290	290	290	290	290	290
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	75	122	150	150	150	150	150	150	150	150	150	150
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	---	---	---	57	86	114	143	143	150	150	150	150
	70	---	---	---	20	27	34	40	40	54	63	63	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown above.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	290	290	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	290	290	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0	290	290	290	290	290	290	290	- - -	- - -	- - -	- - -	- - -
	70	290	290	290	290	290	290	290	- - -	- - -	- - -	- - -	- - -
4	0	290	290	290	290	290	290	290	- - -	- - -	- - -	- - -	- - -
	70	160	177	177	177	177	177	177	- - -	- - -	- - -	- - -	- - -
6	0	290	290	290	290	290	290	290	290	290	290	- - -	- - -
	70	58	78	97	116	125	125	125	125	125	125	- - -	- - -
8	0	- - -	200	290	290	290	290	290	290	290	290	290	290
	70	- - -	43	54	65	87	108	130	130	166	166	166	166
10	0	- - -	22	130	239	290	290	290	290	290	290	290	290
	70	- - -	20	26	31	41	51	61	61	79	79	79	79
12	0	- - -	- - -	- - -	14	151	288	290	290	290	290	290	290
	70	- - -	- - -	- - -	14	27	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	290	290	290	---	---	---	---	---	---	---	---	---
	70	290	290	290	---	---	---	---	---	---	---	---	---
3	0	290	290	290	290	290	290	290	---	---	---	---	---
	70	290	290	290	290	290	290	290	---	---	---	---	---
4	0	290	290	290	290	290	290	290	---	---	---	---	---
	70	160	177	177	177	177	177	177	---	---	---	---	---
6	0	290	290	290	290	290	290	290	290	290	290	---	---
	70	58	78	97	116	125	125	125	125	125	125	---	---
8	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	33	43	54	65	87	108	130	130	166	166	166	166
10	0	43	152	261	290	290	290	290	290	290	290	290	290
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	---	---	---	137	274	290	290	290	290	290	290	290
	70	---	---	---	20	27	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Push-Down-to-Open or Push-Down-to-Close													
Valve Size, NPS	**Angle of Opening, Degrees**	**Actuator Size and Cylinder Pressure(2)**											
		Size 30			**Size 40**				**Size 60**			**Size 68**	
		60 psig	**80 psig**	**100 psig**	**60 psig**	**80 psig**	**100 psig**	**120 psig**	**60 psig**	**80 psig**	**100 psig**	**60 psig**	**80 psig**
1	0	1480	1480	1480	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	802	802	802	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1-1/2	0	1480	1480	1480	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	350	350	350	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
2	0	290	290	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	290	290	290	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	290	290	290	290	290	290	290	290	290	290	290	290
4	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	- - -	- - -	- - -	290	290	290	290	290	290	290	290	290
	70	- - -	- - -	- - -	20	27	34	40	40	54	63	63	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown above.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	52	750	52	750	---	---	---	---	---	---	---	---
	70°	52	750	52	750	---	---	---	---	---	---	---	---
1-1/2	0°	52	750	52	750	52	750	52	750	---	---	---	---
	70°	23	334	46	667	52	750	52	750	---	---	---	---
2	0°	19	268	52	750	52	750	52	750	---	---	---	---
	70°	11	153	21	306	35	510	35	510	---	---	---	---
3	0°	---	---	52	750	52	750	52	750	52	750	52	750
	70°	---	---	13	193	28	403	38	558	38	558	38	558
4	0°	---	---	50	730	52	750	52	750	52	750	52	750
	70°	---	---	2.8	41	5.9	85	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	16	239	52	750	52	750	52	750
	70°	---	---	---	---	2.9	43	5.9	85	7.9	115	7.9	115
8	0°	---	---	---	---	6.9	100	43	617	52	750	52	750
	70°	---	---	---	---	1.8	26	3.5	51	4.8	70	9.9	144
10	0°	---	---	---	---	---	---	23	339	40	583	40	583
	70°	---	---	---	---	---	---	1.7	25	2.3	33	4.8	69
12	0°	---	---	---	---	---	---	---	---	---	---	38	545
	70°	---	---	---	---	---	---	---	---	---	---	4.2	60

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	52	750	52	750	---	---	---	---	---	---	---	---
	70°	48	694	52	750	---	---	---	---	---	---	---	---
1-1/2	0°	52	750	52	750	52	750	52	750	---	---	---	---
	70°	21	303	42	606	52	750	52	750	---	---	---	---
2	0°	19	268	52	750	52	750	52	750	---	---	---	---
	70°	10	139	19	278	35	510	35	510	---	---	---	---
3	0°	---	---	52	750	52	750	52	750	52	750	52	750
	70°	---	---	12	176	26	379	38	558	38	558	38	558
4	0°	---	---	50	730	52	750	52	750	52	750	52	750
	70°	---	---	2.6	37	5.5	80	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	16	239	52	750	52	750	52	750
	70°	---	---	---	---	2.8	40	5.5	80	7.9	115	7.9	115
8	0°	---	---	---	---	6.9	100	43	617	52	750	52	750
	70°	---	---	---	---	1.7	24	3.3	48	5.1	74	10	144
10	0°	---	---	---	---	---	---	23	339	40	583	40	583
	70°	---	---	---	---	---	---	1.6	23	2.5	36	4.8	69
12	0°	---	---	---	---	---	---	---	---	---	---	37	543
	70°	---	---	---	---	---	---	---	---	---	---	4.2	61

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

EMERSON
Process Management

Maximum Allowable Pressure Drops (ΔP)[1,2] for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
1-1/2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
3	0°	0.7	11	11	164	21	300	21	300	21	300	21	300
	70°	0.7	11	11	164	21	300	21	300	21	300	21	300
4	0°	---	---	5.3	77	21	300	21	300	21	300	21	300
	70°	---	---	2.8	41	5.9	85	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	10	147	21	300	21	300	21	300
	70°	---	---	---	---	2.9	43	5.9	85	7.9	115	7.9	115
8	0°	---	---	---	---	4.4	63	14	200	21	300	21	300
	70°	---	---	---	---	1.8	26	3.5	51	4.8	70	9.9	144
10	0°	---	---	---	---	---	---	7.5	109	10	150	10	150
	70°	---	---	---	---	---	---	1.7	25	2.3	33	4.8	69
12	0°	---	---	---	---	---	---	---	---	---	---	9.0	131
	70°	---	---	---	---	---	---	---	---	---	---	4.2	60

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Maximum Rotation**											
		Size 1				**Size 2**				**Size 3**			
		2 barg / 29 Psig		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**	
		90°		**90°**		**90°**		**90°**		**90°**		**90°**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
1	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
1-1/2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
3	0°	0.7	11	11	164	21	300	21	300	21	300	21	300
	70°	0.7	11	11	164	21	300	21	300	21	300	21	300
4	0°	---	---	5.3	77	21	300	21	300	21	300	21	300
	70°	---	---	2.6	37	5.5	80	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	10	147	21	300	21	300	21	300
	70°	---	---	---	---	2.8	40	5.5	80	7.9	115	7.9	115
8	0°	---	---	---	---	4.4	63	14	200	20	291	21	300
	70°	---	---	---	---	1.7	24	3.3	48	5.1	74	10	144
10	0°	---	---	---	---	---	---	7.6	109	10	150	10	150
	70°	---	---	---	---	---	---	1.6	23	2.5	36	4.8	69
12	0°	---	---	---	---	---	---	---	---	---	---	8.2	119
	70°	---	---	---	---	---	---	---	---	---	---	4.2	61

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)[1,2] for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
1-1/2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
3	0°	0.5	6.7	7.0	101	17	246	17	246	17	246	17	246
	70°	0.5	6.7	7.0	101	17	246	17	246	17	246	17	246
4	0°	---	---	2.5	37	10	146	10	146	10	146	10	146
	70°	---	---	2.5	37	5.9	85	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	4.4	64	11	155	11	155	11	155
	70°	---	---	---	---	2.9	43	5.9	85	7.9	115	7.9	115
8	0°	---	---	---	---	2.0	29	6.3	91	11	154	11	154
	70°	---	---	---	---	1.8	26	3.5	51	4.8	70	9.9	144
10	0°	---	---	---	---	---	---	2.4	35	4.5	66	5.9	85
	70°	---	---	---	---	---	---	1.7	25	2.3	33	4.8	69
12	0°	---	---	---	---	---	---	---	---	2.4	35	5.5	80
	70°	---	---	---	---	---	---	---	---	2.0	29	4.2	60

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
1-1/2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
2	0°	---	---	---	---	---	---	---	---	---	---	---	---
	70°	---	---	---	---	---	---	---	---	---	---	---	---
3	0°	0.5	6.7	7.0	101	17	246	17	246	17	246	17	246
	70°	0.5	6.7	7.0	101	17	246	17	246	17	246	17	246
4	0°	---	---	2.5	37	10	146	10	146	10	146	10	146
	70°	---	---	2.5	37	5.5	80	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	4.4	64	11	155	11	155	11	155
	70°	---	---	---	---	2.8	40	5.5	80	7.9	115	7.9	115
8	0°	---	---	---	---	2.0	29	6.3	91	9.2	134	11	154
	70°	---	---	---	---	1.7	24	3.3	48	5.1	74	10	144
10	0°	---	---	---	---	---	---	2.4	35	3.7	54	5.9	85
	70°	---	---	---	---	---	---	1.6	23	2.5	36	4.8	69
12	0°	---	---	---	---	---	---	---	---	1.9	27	5.3	76
	70°	---	---	---	---	---	---	---	---	1.9	27	4.2	61

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)[1,2] for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Maximum Rotation**											
		Size 1				**Size 2**				**Size 3**			
		2 barg / 29 Psig		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**	
		90°		**90°**		**90°**		**90°**		**90°**		**90°**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
1	0°	103	1500	103	1500	---	---	---	---	---	---	---	---
	70°	53	765	74	1073	---	---	---	---	---	---	---	---
1-1/2	0°	103	1500	103	1500	103	1500	103	1500	---	---	---	---
	70°	23	334	46	667	77	1114	77	1114	---	---	---	---
2	0°	103	1500	103	1500	103	1500	103	1500	---	---	---	---
	70°	11	153	21	306	35	510	35	510	---	---	---	---
3	0°	34	487	86	1243	103	1500	103	1500	103	1500	103	1500
	70°	6.7	97	13	193	28	403	38	558	38	558	38	558
4	0°	8.7	127	35	505	72	1050	72	1050	72	1050	72	1050
	70°	1.4	20	2.8	41	5.9	85	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	36	525	75	1090	75	1090	75	1090
	70°	---	---	---	---	2.9	43	5.9	85	7.9	115	7.9	115
8	0°	---	---	---	---	16	230	44	635	74	1070	74	1070
	70°	---	---	---	---	1.8	26	3.5	51	4.8	70	9.9	144
10	0°	---	---	---	---	7.6	112	29	420	40	587	40	587
	70°	---	---	---	---	0.8	12	1.7	25	2.3	33	4.8	69
12	0°	---	---	---	---	---	---	---	---	38	547	38	547
	70°	---	---	---	---	---	---	---	---	2.0	29	4.2	60

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Maximum Rotation**											
		Size 1				**Size 2**				**Size 3**			
		2 barg / 29 Psig		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**	
		90°		**90°**		**90°**		**90°**		**90°**		**90°**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
1	0°	103	1500	103	1500	---	---	---	---	---	---	---	---
	70°	48	694	74	1073	---	---	---	---	---	---	---	---
1-1/2	0°	103	1500	103	1500	103	1500	103	1500	---	---	---	---
	70°	21	303	42	606	77	1114	77	1114	---	---	---	---
2	0°	103	1500	103	1500	103	1500	103	1500	---	---	---	---
	70°	10	139	19	278	35	510	35	510	---	---	---	---
3	0°	34	487	86	1243	103	1500	103	1500	103	1500	103	1500
	70°	6.0	88	12	176	26	379	38	558	38	558	38	558
4	0°	8.7	127	35	505	72	1050	72	1050	72	1050	72	1050
	70°	1.3	19	2.6	37	5.5	80	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	36	525	75	1090	75	1090	75	1090
	70°	---	---	---	---	2.8	40	5.5	80	7.9	115	7.9	115
8	0°	---	---	---	---	16	230	44	635	62	904	74	1070
	70°	---	---	---	---	1.7	24	3.3	48	5.1	74	10	144
10	0°	---	---	---	---	7.6	110	29	420	40	587	40	587
	70°	---	---	---	---	0.8	12	1.6	23	2.5	36	4.8	69
12	0°	---	---	---	---	---	---	---	---	33	480	38	547
	70°	---	---	---	---	---	---	---	---	2.1	31	4.2	61

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	74	1080	74	1080	---	---	---	---	---	---	---	---
	70°	53	765	74	1073	---	---	---	---	---	---	---	---
1-1/2	0°	46	660	50	720	50	720	50	720	---	---	---	---
	70°	23	334	46	667	50	720	50	720	---	---	---	---
2	0°	21	298	27	388	27	388	27	388	---	---	---	---
	70°	11	153	21	306	27	388	27	388	---	---	---	---
3	0°	8.4	122	19	273	19	273	19	273	19	273	19	273
	70°	6.7	97	13	193	19	273	19	273	19	273	19	273
4	0°	2.8	40	11	158	11	158	11	158	11	158	11	158
	70°	1.4	20	2.8	41	5.9	85	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	10	143	11	163	11	163	11	163
	70°	---	---	---	---	2.9	43	5.9	85	7.9	115	7.9	115
8	0°	---	---	---	---	4.3	62	11	161	11	161	11	161
	70°	---	---	---	---	1.8	26	3.5	51	4.8	70	9.9	144
10	0°	---	---	---	---	1.5	21	5.6	82	6.1	88	6.1	88
	70°	---	---	---	---	0.8	12	1.7	25	2.3	33	4.8	69
12	0°	---	---	---	---	---	---	---	---	5.1	74	5.7	82
	70°	---	---	---	---	---	---	---	---	2.0	29	4.2	60

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)[1,2] for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	74	1080	74	1080	---	---	---	---	---	---	---	---
	70°	48	694	74	1073	---	---	---	---	---	---	---	---
1-1/2	0°	46	660	50	720	50	720	50	720	---	---	---	---
	70°	21	303	42	606	50	720	50	720	---	---	---	---
2	0°	21	298	27	388	27	388	27	388	---	---	---	---
	70°	10	139	19	278	27	388	27	388	---	---	---	---
3	0°	8.4	122	19	273	19	273	19	273	19	273	19	273
	70°	6.0	88	12	176	19	273	19	273	19	273	19	273
4	0°	2.8	40	11	158	11	158	11	158	11	158	11	158
	70°	1.3	19	2.6	37	5.5	80	8.1	118	8.1	118	8.1	118
6	0°	---	---	---	---	10	143	11	163	11	163	11	163
	70°	---	---	---	---	2.8	40	5.5	80	7.9	115	7.9	115
8	0°	---	---	---	---	4.3	62	11	161	11	161	11	161
	70°	---	---	---	---	1.7	24	3.3	48	5.1	74	10	144
10	0°	---	---	---	---	1.5	21	5.6	82	6.1	88	6.1	88
	70°	---	---	---	---	0.8	12	1.6	23	2.5	36	4.8	69
12	0°	---	---	---	---	---	---	---	---	4.1	59	5.7	82
	70°	---	---	---	---	---	---	---	---	2.1	31	4.2	61

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	52	750	52	750	---	---	---	---	---	---	---	---
	70°	52	750	52	750	---	---	---	---	---	---	---	---
1-1/2	0°	52	750	52	750	52	750	52	750	---	---	---	---
	70°	23	334	46	667	52	750	52	750	---	---	---	---
2	0°	27	388	52	750	52	750	52	750	---	---	---	---
	70°	11	153	21	306	35	510	35	510	---	---	---	---
3	0°	7.8	113	52	750	52	750	52	750	52	750	52	750
	70°	4.5	65	8.9	129	19	270	26	374	26	374	26	374
4	0°	---	---	41	597	52	750	52	750	52	750	52	750
	70°	---	---	4.2	61	8.8	128	12	177	12	177	12	177
6	0°	---	---	---	---	52	750	52	750	52	750	52	750
	70°	---	---	---	---	3.2	46	6.4	93	8.6	125	8.6	125
8	0°	---	---	---	---	1.0	15	33	480	52	750	52	750
	70°	---	---	---	---	1.0	15	3.6	52	4.9	71	10	147
10	0°	---	---	---	---	---	---	8.4	122	24	346	41	593
	70°	---	---	---	---	---	---	1.4	20	1.9	27	3.8	56
12	0°	---	---	---	---	---	---	---	---	8.4	122	34	491
	70°	---	---	---	---	---	---	---	---	1.5	22	3.2	46

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	**Angle of Opening**	**Actuator Size, Air-to-Diaphragm, Maximum Rotation**											
		Size 1				**Size 2**				**Size 3**			
		2 barg / 29 Psig		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**		**2 barg / 29 Psig**		**4 barg / 58 Psig**	
		90°		**90°**		**90°**		**90°**		**90°**		**90°**	
		bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**
1	0°	52	750	52	750	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70°	48	694	52	750	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1-1/2	0°	52	750	52	750	52	750	52	750	- - -	- - -	- - -	- - -
	70°	21	303	42	606	52	750	52	750	- - -	- - -	- - -	- - -
2	0°	27	388	52	750	52	750	52	750	- - -	- - -	- - -	- - -
	70°	10	139	19	278	35	510	35	510	- - -	- - -	- - -	- - -
3	0°	7.8	113	52	750	52	750	52	750	52	750	52	750
	70°	4.0	59	8.1	118	18	254	26	374	26	374	26	374
4	0°	- - -	- - -	41	597	52	750	52	750	52	750	52	750
	70°	- - -	- - -	3.8	56	8.3	120	12	177	12	177	12	177
6	0°	- - -	- - -	- - -	- - -	52	750	52	750	52	750	52	750
	70°	- - -	- - -	- - -	- - -	3.0	44	6.0	87	8.6	125	8.6	125
8	0°	- - -	- - -	- - -	- - -	1.0	15	33	480	52	750	52	750
	70°	- - -	- - -	- - -	- - -	1.0	15	3.4	49	5.2	75	10	147
10	0°	- - -	- - -	- - -	- - -	- - -	- - -	8.5	122	18	256	41	593
	70°	- - -	- - -	- - -	- - -	- - -	- - -	1.3	19	2.0	29	3.9	56
12	0°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	4.5	66	30	435
	70°	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	1.6	24	3.2	46

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	41	593	52	750	---	---	---	---	---	---	---	---
	70°	41	593	52	750	---	---	---	---	---	---	---	---
1-1/2	0°	23	340	50	725	50	725	50	725	---	---	---	---
	70°	23	334	46	667	50	725	50	725	---	---	---	---
2	0°	6.7	97	22	315	26	373	26	373	---	---	---	---
	70°	6.7	97	21	306	26	373	26	373	---	---	---	---
3	0°	1.5	22	15	213	18	254	18	254	18	254	18	254
	70°	1.5	22	8.9	129	18	254	18	254	18	254	18	254
4	0°	---	---	7.5	109	11	160	11	160	11	160	11	160
	70°	---	---	4.2	61	8.8	128	11	160	11	160	11	160
6	0°	---	---	---	---	7.5	109	11	158	11	158	11	158
	70°	---	---	---	---	3.2	46	6.4	93	8.6	125	8.6	125
8	0°	---	---	---	---	0.2	3.5	7.8	113	11	163	11	163
	70°	---	---	---	---	0.2	3.5	3.6	52	4.9	71	10	147
10	0°	---	---	---	---	---	---	2.5	36	6.1	89	6.1	89
	70°	---	---	---	---	---	---	1.4	20	1.9	27	3.8	56
12	0°	---	---	---	---	---	---	---	---	2.2	31	5.7	83
	70°	---	---	---	---	---	---	---	---	1.5	22	3.2	46

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball™ product bulletin for pressure drop limitations of CL150 valve bodies.

Maximum Allowable Pressure Drops (ΔP)(1,2) for Forward Flow

Size 1, 2, and 3													
Valve Size, NPS	Angle of Opening	Actuator Size, Air-to-Diaphragm, Maximum Rotation											
		Size 1				Size 2				Size 3			
		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig		2 barg / 29 Psig		4 barg / 58 Psig	
		90°		90°		90°		90°		90°		90°	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	0°	41	593	52	750	---	---	---	---	---	---	---	---
	70°	41	593	52	750	---	---	---	---	---	---	---	---
1-1/2	0°	23	340	50	725	50	725	50	725	---	---	---	---
	70°	21	303	42	606	50	725	50	725	---	---	---	---
2	0°	6.7	97	22	315	26	373	26	373	---	---	---	---
	70°	6.7	97	19	278	26	373	26	373	---	---	---	---
3	0°	1.5	22	15	213	18	254	18	254	18	254	18	254
	70°	1.5	22	8.1	118	18	254	18	254	18	254	18	254
4	0°	---	---	7.5	109	11	160	11	160	11	160	11	160
	70°	---	---	3.8	56	8.3	120	11	160	11	160	11	160
6	0°	---	---	---	---	7.5	109	11	158	11	158	11	158
	70°	---	---	---	---	3.0	44	6.0	87	8.6	125	8.6	125
8	0°	---	---	---	---	0.2	3.5	7.8	113	11	163	11	163
	70°	---	---	---	---	0.2	3.5	3.4	49	5.2	75	10	147
10	0°	---	---	---	---	---	---	2.5	36	5.3	77	6.1	89
	70°	---	---	---	---	---	---	1.3	19	2.0	29	3.9	56
12	0°	---	---	---	---	---	---	---	---	1.2	17	5.7	83
	70°	---	---	---	---	---	---	---	---	1.2	17	3.2	46

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop based on trim. Consult the Vee-Ball product bulletin for pressure drop limitations of CL150 valve bodies.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
4	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
6	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
8	0	740	740	740
	70	62	65	135
10	0	290	290	290
	70	30	31	65

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig		40 psig	55 psig
		10.1	14.7	10.1	10.1
		90°	60°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
4	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
6	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
8	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
10	0	290	290	290	290
	70	44	32[2]	78	79

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -
8	0 70	300 62	300 65	300 135
10	0 70	150 30	150 31	150 65

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig		40 psig	55 psig
		10.1	14.7	10.1	10.1
		90°	60°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
8	0 70	300 92	300 68(2)	300 162	300 164
10	0 70	150 44	150 32(2)	150 78	150 79

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0 70	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -
8	0 70	740 63	740 66	740 137
10	0 70	290 30	290 31	290 65

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig	40 psig		55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R6760 27082			
3	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
4	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
6	0 70	- - - - - -	- - - - - -	- - - - - -	- - - - - -
8	0 70	740 94	740 165	740 144(2)	740 166
10	0 70	290 44	290 78	290 68(2)	290 79

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0°	---	---	---
	70°	---	---	---
4	0°	---	---	---
	70°	---	---	---
6	0°	---	---	---
	70°	---	---	---
8	0°	740	740	740
	70°	63	66	137
10	0°	290	290	290
	70°	30	31	65

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number			
		Size 70			
		33 psig	40 psig	40 psig	55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0°	---	---	---	---
	70°	---	---	---	---
4	0°	---	---	---	---
	70°	---	---	---	---
6	0°	---	---	---	---
	70°	---	---	---	---
8	0°	740	740	740	740
	70°	94	165	144(2)	166
10	0°	290	290	290	290
	70°	44	78	68(2)	79

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
4	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
6	0	- - -	- - -	- - -
	70	- - -	- - -	- - -
8	0	750	750	750
	70	62	65	135
10	0	290	290	290
	70	30	31	65

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
		Size 70			
		33 psig	40 psig		55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R6760 27082	1R6760 27082	1R6760 27082	1R6760 27082
3	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
4	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
6	0	- - -	- - -	- - -	- - -
	70	- - -	- - -	- - -	- - -
8	0	750	750	750	750
	70	92	162	189(2)	164
10	0	290	290	290	290
	70	44	78	68(2)	79

1. At 0 degrees, use maximum actual shutoff pressure drop. At 60 or 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

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Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	740	740	740	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	740	740	740	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	505	558	558	558	558	558	558	558	558	558	558	558
4	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	556	740	740	740	740	740	740	740	740	740	740	740
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	417	694	740	740	740	740	740	740	740	740	740	740
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	139	290	290	290	290	290	290	290	290	290	290	290
	70	15	20	26	31	41	51	61	61	79	79	79	79

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	300	300	300	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	300	300	300	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	300	300	300	300	300	300	300	300	300	300	300	300
4	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	147	221	294	300	300	300	300	300	300	300	300	300
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	75	122	150	150	150	150	150	150	150	150	150	150
	70	15	20	26	31	41	51	61	61	79	79	79	79

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	740	740	740	---	---	---	---	---	---	---	---	---
	70	526	526	526	---	---	---	---	---	---	---	---	---
3	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	333	368	368	368	368	368	368	368	368	368	368	368
4	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	160	177	177	177	177	177	177	177	177	177	177	177
6	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	58	78	97	116	125	125	125	125	125	125	125	125
8	0	---	200	450	700	740	740	740	740	740	740	740	740
	70	---	43	54	65	87	108	130	130	166	166	166	166
10	0	---	22	130	239	290	290	290	290	290	290	290	290
	70	---	20	26	31	41	51	61	61	79	79	79	79

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	740	740	740	---	---	---	---	---	---	---	---	---
	70	526	526	526	---	---	---	---	---	---	---	---	---
3	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	333	368	368	368	368	368	368	368	368	368	368	368
4	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	160	177	177	177	177	177	177	177	177	177	177	177
6	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	58	78	97	116	125	125	125	125	125	125	125	125
8	0	300	550	740	740	740	740	740	740	740	740	740	740
	70	33	43	54	65	87	108	130	130	166	166	166	166
10	0	43	152	261	290	290	290	290	290	290	290	290	290
	70	15	20	26	31	41	51	61	61	79	79	79	79

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Actuator Size and Cylinder Pressure											
		Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	750	750	750	---	---	---	---	---	---	---	---	---
	70	750	750	750	---	---	---	---	---	---	---	---	---
3	0	750	750	750	750	750	750	750	750	750	750	750	750
	70	505	558	558	558	558	558	558	558	558	558	558	558
4	0	750	750	750	750	750	750	750	750	750	750	750	750
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	750	750	750	750	750	750	750	750	750	750	750	750
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	478	696	750	750	750	750	750	750	750	750	750	750
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	290	290	290	290	290	290	290	290	290	290	290	290
	70	15	20	26	31	41	51	61	61	79	79	79	79

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R6760 27082	1R6760 27082	1R6760 27082
3	0°	---	---	---
	70°	---	---	---
4	0°	---	---	---
	70°	---	---	---
6	0°	---	---	---
	70°	---	---	---
8	0°	740	740	740
	70°	62	65	135
10	0°	740	740	740
	70°	30	31	65
12	0°	680	740	740
	70°	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number			
		Size 70			
		33 psig	33 psig	40 psig	55 psig
		10.1	14.7	10.1	10.1
		90°	60°	90°	90°
		1R676027082	1R676027082	1R676027082	1R676027082
3	0°	---	---	---	---
	70°	---	---	---	---
4	0°	---	---	---	---
	70°	---	---	---	---
6	0°	---	---	---	---
	70°	---	---	---	---
8	0°	740	740	740	740
	70°	92	68(2)	162	164
10	0°	740	740	740	740
	70°	44	32(2)	78	79
12	0°	453	740	453	453
	70°	29	21(2)	51	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R676027082	1R676027082	1R676027082
3	0°	---	---	---
	70°	---	---	---
4	0°	---	---	---
	70°	---	---	---
6	0°	---	---	---
	70°	---	---	---
8	0°	300	300	300
	70°	62	65	135
10	0°	150	150	150
	70°	30	31	65
12	0°	135	150	150
	70°	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number			
		Size 70			
		33 psig	33 psig	40 psig	55 psig
		10.1	14.7	10.1	10.1
		90°	60°	90°	90°
		1R676027082	1R676027082	1R676027082	1R676027082
3	0°	---	---	---	---
	70°	---	---	---	---
4	0°	---	---	---	---
	70°	---	---	---	---
6	0°	---	---	---	---
	70°	---	---	---	---
8	0°	300	300	300	300
	70°	92	68(2)	162	164
10	0°	150	150	150	150
	70°	44	32(2)	78	79
12	0°	109	150	109	109
	70°	29	21(2)	51	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R676027082	1R676027082	1R676027082
3	0°	---	---	---
	70°	---	---	---
4	0°	---	---	---
	70°	---	---	---
6	0°	---	---	---
	70°	---	---	---
8	0°	740	740	740
	70°	63	66	137
10	0°	740	740	740
	70°	30	31	65
12	0°	386	740	740
	70°	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number			
		Size 70			
		33 psig	40 psig	40 psig	55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R676027082	1R676027082	1R676027082	1R676027082
3	0°	---	---	---	---
	70°	---	---	---	---
4	0°	---	---	---	---
	70°	---	---	---	---
6	0°	---	---	---	---
	70°	---	---	---	---
8	0°	740	740	740	740
	70°	94	165	144(2)	166
10	0°	633	633	740	633
	70°	44	78	68(2)	79
12	0°	262	262	564	262
	70°	29	51	45(2)	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R676027082	1R676027082	1R676027082
3	0°	---	---	---
	70°	---	---	---
4	0°	---	---	---
	70°	---	---	---
6	0°	---	---	---
	70°	---	---	---
8	0°	740	740	740
	70°	63	66	137
10	0°	740	740	740
	70°	30	31	65
12	0°	510	740	740
	70°	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number			
		Size 70			
		33 psig	40 psig	40 psig	55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R676027082	1R676027082	1R676027082	1R676027082
3	0°	---	---	---	---
	70°	---	---	---	---
4	0°	---	---	---	---
	70°	---	---	---	---
6	0°	---	---	---	---
	70°	---	---	---	---
8	0°	740	740	740	740
	70°	94	165	144(2)	166
10	0°	740	740	740	740
	70°	44	78	68(2)	79
12	0°	385	385	688	385
	70°	29	51	45(2)	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(1) for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number		
		Size 70		
		33 psig	40 psig	55 psig
		3	3.3	10.1
		90°	90°	90°
		1R676027082	1R676027082	1R676027082
3	0°	---	---	---
	70°	---	---	---
4	0°	---	---	---
	70°	---	---	---
6	0°	---	---	---
	70°	---	---	---
8	0°	750	750	750
	70°	62	65	135
10	0°	750	750	750
	70°	30	31	65
12	0°	750	750	750
	70°	19	20	43

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less

Maximum Allowable Pressure Drops (ΔP)[1] for Forward Flow

Valve Size, NPS	Angle of Opening, Degrees	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, Spring Part Number			
		Size 70			
		33 psig	40 psig	40 psig	55 psig
		10.1	10.1	14.7	10.1
		90°	90°	60°	90°
		1R676027082	1R676027082	1R676027082	1R676027082
3	0°	---	---	---	---
	70°	---	---	---	---
4	0°	---	---	---	---
	70°	---	---	---	---
6	0°	---	---	---	---
	70°	---	---	---	---
8	0°	750	750	750	750
	70°	92	162	142[2]	164
10	0°	750	750	750	750
	70°	44	78	68[2]	79
12	0°	750	750	750	750
	70°	29	51	45[2]	63

1. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Maximum allowable pressure drop when limited to 60 degrees rotation.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close(3) (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	740	740	740	---	---	---	---	---	---	---	---	---
	70	740	740	740	---	---	---	---	---	---	---	---	---
3	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	505	558	558	558	558	558	558	558	558	558	558	558
4	0	740	740	740	740	740	740	740	740	740	740	740	740
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	556	740	740	740	740	740	740	740	740	740	740	740
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	417	694	740	740	740	740	740	740	740	740	740	740
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	139	417	694	740	740	740	740	740	740	740	740	740
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	---	---	---	0	250	500	740	740	740	740	740	740
	70	---	---	---	0	27	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close(3) (90° Maximum Rotation)													
Valve Size, NPS	**Angle of Opening, Degrees**	**Size 30**			**Size 40**				**Size 60**			**Size 68**	
		60 psig	**80 psig**	**100 psig**	**60 psig**	**80 psig**	**100 psig**	**120 psig**	**60 psig**	**80 psig**	**100 psig**	**60 psig**	**80 psig**
2	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	300	300	300	300	300	300	300	300	300	300	300	300
3	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	300	300	300	300	300	300	300	300	300	300	300	300
4	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	107	118	118	118	118	118	118	118	118	118	118	118
6	0	300	300	300	300	300	300	300	300	300	300	300	300
	70	49	66	82	98	106	106	106	106	106	106	106	106
8	0	147	221	294	300	300	300	300	300	300	300	300	300
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	75	122	150	150	150	150	150	150	150	150	150	150
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	- - -	- - -	- - -	57	86	114	143	143	150	150	150	150
	70	- - -	- - -	- - -	20	27	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close(3) (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	740	740	740	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
	70	526	526	526	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
3	0	740	740	740	740	740	740	740	740	- - -	- - -	- - -	- - -
	70	333	368	368	368	368	368	368	368	- - -	- - -	- - -	- - -
4	0	740	740	740	740	740	740	740	740	- - -	- - -	- - -	- - -
	70	160	177	177	177	177	177	177	177	- - -	- - -	- - -	- - -
6	0	740	740	740	740	740	740	740	740	740	740	- - -	- - -
	70	58	78	97	116	125	125	125	125	125	125	- - -	- - -
8	0	- - -	200	450	700	740	740	740	740	740	740	- - -	- - -
	70	- - -	43	54	65	87	108	130	130	166	166	- - -	- - -
10	0	- - -	22	130	239	457	674	740	740	740	740	740	740
	70	- - -	20	26	31	41	51	61	61	79	79	79	79
12	0	- - -	- - -	- - -	14	151	288	425	425	699	740	740	740
	70	- - -	- - -	- - -	14	27	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close(3) (90° Maximum Rotation)													
Valve Size, NPS	**Angle of Opening, Degrees**	**Size 30**			**Size 40**				**Size 60**			**Size 68**	
		60 psig	**80 psig**	**100 psig**	**60 psig**	**80 psig**	**100 psig**	**120 psig**	**60 psig**	**80 psig**	**100 psig**	**60 psig**	**80 psig**
2	0	740	740	740	---	---	---	---	---	---	---	---	---
	70	526	526	526	---	---	---	---	---	---	---	---	---
3	0	740	740	740	740	740	740	740	---	---	---	---	---
	70	333	368	368	368	368	368	368	---	---	---	---	---
4	0	740	740	740	740	740	740	740	---	---	---	---	---
	70	160	177	177	177	177	177	177	---	---	---	---	---
6	0	740	740	740	740	740	740	740	740	740	740	---	---
	70	58	78	97	116	125	125	125	125	125	125	---	---
8	0	300	550	740	740	740	740	740	740	740	740	740	740
	70	33	43	54	65	87	108	130	130	166	166	166	166
10	0	43	152	261	370	587	740	740	740	740	740	740	740
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	---	---	---	137	274	411	548	548	740	740	740	740
	70	---	---	---	20	29	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(2) for Forward Flow

Push-Down-To-Open or Push-Down-To-Close(3) (90° Maximum Rotation)													
Valve Size, NPS	Angle of Opening, Degrees	Size 30			Size 40				Size 60			Size 68	
		60 psig	80 psig	100 psig	60 psig	80 psig	100 psig	120 psig	60 psig	80 psig	100 psig	60 psig	80 psig
2	0	750	750	750	---	---	---	---	---	---	---	---	---
	70	750	750	750	---	---	---	---	---	---	---	---	---
3	0	750	750	750	750	750	750	750	---	---	---	---	---
	70	505	558	558	558	558	558	558	---	---	---	---	---
4	0	750	750	750	750	750	750	750	---	---	---	---	---
	70	107	118	118	118	118	118	118	---	---	---	---	---
6	0	750	750	750	750	750	750	750	750	750	750	---	---
	70	49	66	82	98	106	106	106	106	106	106	---	---
8	0	478	696	750	750	750	750	750	750	750	750	750	750
	70	32	43	53	64	85	107	128	128	164	164	164	164
10	0	300	467	633	750	750	750	750	750	750	750	750	750
	70	15	20	26	31	41	51	61	61	79	79	79	79
12	0	---	---	---	629	750	750	750	750	750	750	750	750
	70	---	---	---	20	27	34	40	40	54	63	63	63

1. These tables provide pressure drop values according to actuator size and cylinder pressure. Cylinder pressure equals supply pressure for an actuator without a positioner. When a positioner is used, supply pressure to the positioner should be 5 psi greater than the supply pressure shown in the table.
2. At 0 degrees, use maximum actual shutoff pressure drop. At 70 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drop (ΔP)[1] for Forward Flow

Valve Size, NPS	Shaft Diameter, Inch	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
			Size 70		
			0-33 Psig	0-40 Psig	0-55 Psig
			3.0 Psig	3.3 Psig	10.1 Psig
			90° Maximum Rotation		
			1R676027082	1R676027082	1R676027082
3	1 x 3/4[2]	0°	---	---	---
		60°	---	---	---
		90°	---	---	---
	1	0°	---	---	---
		60°	---	---	---
		90°	---	---	---
4	1-1/4	0°	1200	1200	1200
		60°	701	729	1150
		90°	353	390	1150
6	1-1/2 x 1-1/4[2]	0°	525	535	610
		60°	255	265	492
		90°	41	45	138
	1-1/2	0°	525	535	750
		60°	255	265	492
		90°	41	45	138
8	1-1/2	0°	245	250	350
		60°	112	117	217
		90°	44	49	149

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Shaft diameter x spline diameter.

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Maximum Allowable Pressure Drops, (ΔP)(1) for Reverse Flow

Valve Size, NPS	Shaft Dia-meter, Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
			Size 70			
			0-33 psig	0-40 psig	0-55 psig	3-30 psig
			10.1 psig	10.1 psig	10.1 psig	10.1 psig
			90° Maximum Rotation			
			1R676027082	1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0°	---	---	---	---
		60°	---	---	---	---
		90°	---	---	---	---
	1	0°	---	---	---	---
		60°	---	---	---	---
		90°	---	---	---	---
4	1-1/4	0°	1200	1200	1200	1200
		60°	988	1150	1150	722
		90°	553	1150	1150	215
6	1-1/2 x 1-1/4(2)	0°	561	561	561	334
		60°	359	496	496	263
		90°	64	156	282	25
	1-1/2	0°	561	561	561	334
		60°	359	561	561	263
		90°	64	156	345	25
8	1-1/2	0°	323	350	350	275
		60°	158	257	267	116
		90°	70	169	267	27

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

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Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Valve Size, NPS	Shaft Diameter, Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
			Size 70		
			0-33 Psig	0-40 Psig	0-55 Psig
			3.0 Psig	3.3 Psig	10.1 Psig
			90° Maximum Rotation		
			1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0° 60° 90°	--- --- ---	--- --- ---	--- --- ---
	1	0° 60° 90°	--- --- ---	--- --- ---	--- --- ---
4	1-1/4	0° 60° 90°	600 600 353	600 600 390	600 600 600
6	1-1/2 x 1-1/4(2)	0° 60° 90°	525 255 41	535 265 45	600 492 138
	1-1/2	0° 60° 90°	525 255 41	535 265 45	600 492 138
8	1-1/2	0° 60° 90°	245 112 44	250 117 49	350 217 149

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Valve Size, NPS	Shaft Diameter, Inch	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
			Size 70			
			0-33 Psig	0-40 Psig	0-55 Psig	3-30 Psig
			10.1 Psig	10.1 Psig	10.1 Psig	10.1 Psig
			90° Maximum Rotation			
			1R676027082	1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0°	---	---	---	---
		60°	---	---	---	---
		90°	---	---	---	---
	1	0°	---	---	---	---
		60°	---	---	---	---
		90°	---	---	---	---
4	1-1/4	0°	600	600	600	600
		60°	600	600	600	600
		90°	553	600	600	215
6	1-1/2 x 1-1/4(2)	0°	561	561	561	334
		60°	359	496	496	263
		90°	64	156	282	25
	1-1/2	0°	561	561	561	334
		60°	359	561	561	263
		90°	64	156	345	25
8	1-1/2	0°	323	350	350	275
		60°	158	257	267	116
		90°	70	169	267	27

1. At 0 degrees, use maximum actual shutoff pressure drop. At 20, 60, or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is less.
2. Shaft diameter x spline diameter.

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Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Valve Size, NPS	Shaft Diameter, Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number		
			Size 70		
			0-33 Psig	0-40 Psig	0-55 Psig
			3.0 Psig	3.3 Psig	10.1 Psig
			90° Maximum Rotation		
			1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0° 60° 90°	--- --- ---	--- --- ---	--- --- ---
	1	0° 60° 90°	--- --- ---	--- --- ---	--- --- ---
4	1-1/4	0° 60° 90°	600 600 353	600 600 390	600 600 600
6	1-1/2 x 1-1/4(2)	0° 60° 90°	300 255 41	300 265 45	300 300 138
	1-1/2	0° 60° 90°	300 255 41	300 265 45	300 300 138
8	1-1/2	0° 60° 90°	220 112 44	220 117 49	220 217 149

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Valve Size, NPS	Shaft Diameter, Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Initial Compression, Maximum Rotation, and Spring Part Number			
			Size 70			
			0-33 Psig	0-40 Psig	0-55 Psig	3-30 Psig
			10.1 Psig	10.1 Psig	10.1 Psig	10.1 Psig
			90° Maximum Rotation			
			1R676027082	1R676027082	1R676027082	1R676027082
3	1 x 3/4(2)	0° 60° 90°	--- --- ---	--- --- ---	--- --- ---	--- --- ---
	1	0° 60° 90°	--- --- ---	--- --- ---	--- --- ---	--- --- ---
4	1-1/4	0° 60° 90°	600 600 553	600 600 600	600 600 600	600 600 215
6	1-1/2 x 1-1/4(2)	0° 60° 90°	300 300 64	300 300 156	300 300 282	300 263 25
	1-1/2	0° 60° 90°	300 300 64	300 300 156	300 300 300	300 263 25
8	1-1/2	0° 60° 90°	220 158 70	220 220 169	220 220 220	220 116 27

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Shaft diameter x spline diameter.

EMERSON.
Process Management

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close														
Valve Size, NPS	Shaft Diameter, Inches	Angle of Opening	Actuator Size and Cylinder Pressure(2)											
			Size 30			Size 40				Size 60			Size 68	
			60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
1	1/2	0°	1500	1500	1500	---	---	---	---	---	---	---	---	---
		60°	1500	1500	1500	---	---	---	---	---	---	---	---	---
		90°	1500	1500	1500	---	---	---	---	---	---	---	---	---
1-1/2	5/8 x 1/2(3)	0°	964	964	964	---	---	---	---	---	---	---	---	---
		60°	964	964	964	---	---	---	---	---	---	---	---	---
		90°	964	964	964	---	---	---	---	---	---	---	---	---
	5/8	0°	1500	1500	1500	---	---	---	---	---	---	---	---	---
		60°	1500	1500	1500	---	---	---	---	---	---	---	---	---
		90°	1500	1500	1500	---	---	---	---	---	---	---	---	---
2	5/8	0°	1500	1500	1500	---	---	---	---	---	---	---	---	---
		60°	1203	1203	1203	---	---	---	---	---	---	---	---	---
		90°	1203	1203	1203	---	---	---	---	---	---	---	---	---
3	1 x 3/4(3)	0°	571	799	854	854	854	854	854	854	854	854	854	854
		60°	486	505	505	505	505	505	505	505	505	505	505	505
		90°	486	505	505	505	505	505	505	505	505	505	505	505
	1	0°	571	799	1027	1256	1500	1500	1500	1500	1500	1500	1500	1500
		60°	486	648	810	888	888	888	888	888	888	888	888	888
		90°	486	648	810	888	888	888	888	888	888	888	888	888
4	1-1/4	0°	225	327	429	532	736	941	1145	1145	1200	1200	1200	1200
		60°	225	327	429	532	736	941	1133	1142	1150	1150	1150	1150
		90°	225	327	429	532	736	941	1133	1142	1150	1150	1150	1150
6	1-1/2 x 1-1/4(3)	0°	16	52	88	123	195	266	338	338	480	610	595	610
		60°	16	52	88	123	195	266	338	338	480	496	496	496
		90°	16	52	72	86	115	144	172	172	230	282	276	282
	1-1/2	0°	---	---	---	123	195	266	338	338	480	623	595	750
		60°	---	---	---	123	195	266	338	338	480	606	595	606
		90°	---	---	---	86	115	144	172	172	230	287	276	345
8	1-1/2	0°	---	---	---	58	91	124	158	158	224	291	278	350
		60°	---	---	---	58	91	124	158	158	224	267	267	267
		90°	---	---	---	58	91	124	158	158	224	267	267	267

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close														
Valve Size, NPS	Shaft Diameter, Inches	Angle of Opening	Actuator Size and Cylinder Pressure(2)											
			Size 30			Size 40				Size 60			Size 68	
			60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
1	1/2	0°	1000	1000	1000	---	---	---	---	---	---	---	---	---
		60°	1000	1000	1000	---	---	---	---	---	---	---	---	---
		90°	1000	1000	1000	---	---	---	---	---	---	---	---	---
1-1/2	5/8 x 1/2(3)	0°	800	800	800	---	---	---	---	---	---	---	---	---
		60°	800	800	800	---	---	---	---	---	---	---	---	---
		90°	800	800	800	---	---	---	---	---	---	---	---	---
	5/8	0°	800	800	800	---	---	---	---	---	---	---	---	---
		60°	800	800	800	---	---	---	---	---	---	---	---	---
		90°	800	800	800	---	---	---	---	---	---	---	---	---
2	5/8	0°	600	600	600	---	---	---	---	---	---	---	---	---
		60°	600	600	600	---	---	---	---	---	---	---	---	---
		90°	600	600	600	---	---	---	---	---	---	---	---	---
3	1 x 3/4(3)	0°	571	600	600	600	600	600	600	600	600	600	600	600
		60°	486	505	505	505	505	505	505	505	505	505	505	505
		90°	486	505	505	505	505	505	505	505	505	505	505	505
	1	0°	571	600	600	600	600	600	600	600	600	600	600	600
		60°	486	600	600	600	600	600	600	600	600	600	600	600
		90°	486	600	600	600	600	600	600	600	600	600	600	600
4	1-1/4	0°	225	327	429	532	600	600	600	600	600	600	600	600
		60°	225	327	429	532	600	600	600	600	600	600	600	600
		90°	225	327	429	532	600	600	600	600	600	600	600	600
6	1-1/2 x 1-1/4(3)	0°	16	52	88	123	195	266	338	338	480	300	595	610
		60°	16	52	88	123	195	266	338	338	480	496	496	496
		90°	16	52	72	86	115	144	172	172	230	282	276	282
	1-1/2	0°	---	---	---	123	195	266	338	338	480	600	595	600
		60°	---	---	---	123	195	266	338	338	480	600	595	600
		90°	---	---	---	86	115	144	172	172	230	287	276	345
8	1-1/2	0°	---	---	---	58	91	124	158	158	224	291	278	350
		60°	---	---	---	58	91	124	158	158	224	267	267	267
		90°	---	---	---	58	91	124	158	158	224	267	267	267

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open or Push-Down-To-Close														
Valve Size, NPS	Shaft Diameter, Inches	Angle of Opening	Actuator Size and Cylinder Pressure(2)											
			Size 30			Size 40				Size 60			Size 68	
			60 Psig	80 Psig	100 Psig	60 Psig	80 Psig	100 Psig	120 Psig	60 Psig	80 Psig	100 Psig	60 Psig	80 Psig
1	1/2	0°	1000	1000	1000	---	---	---	---	---	---	---	---	---
		60°	1000	1000	1000	---	---	---	---	---	---	---	---	---
		90°	1000	1000	1000	---	---	---	---	---	---	---	---	---
1-1/2	5/8 x 1/2(3)	0°	800	800	800	---	---	---	---	---	---	---	---	---
		60°	800	800	800	---	---	---	---	---	---	---	---	---
		90°	800	800	800	---	---	---	---	---	---	---	---	---
	5/8	0°	800	800	800	---	---	---	---	---	---	---	---	---
		60°	800	800	800	---	---	---	---	---	---	---	---	---
		90°	800	800	800	---	---	---	---	---	---	---	---	---
2	5/8	0°	600	600	600	---	---	---	---	---	---	---	---	---
		60°	600	600	600	---	---	---	---	---	---	---	---	---
		90°	600	600	600	---	---	---	---	---	---	---	---	---
3	1 x 3/4(3)	0°	571	600	600	600	600	600	600	600	600	600	600	600
		60°	486	505	505	505	505	505	505	505	505	505	505	505
		90°	486	505	505	505	505	505	505	505	505	505	505	505
	1	0°	571	600	600	600	600	600	600	600	600	600	600	600
		60°	486	600	600	600	600	600	600	600	600	600	600	600
		90°	486	600	600	600	600	600	600	600	600	600	600	600
4	1-1/4	0°	225	327	429	532	600	600	600	600	600	600	600	600
		60°	225	327	429	532	600	600	600	600	600	600	600	600
		90°	225	327	429	532	600	600	600	600	600	600	600	600
6	1-1/2 x 1-1/4(3)	0°	16	52	88	123	195	266	300	300	300	300	300	300
		60°	16	52	88	123	195	266	300	300	300	300	300	300
		90°	16	52	72	86	115	144	172	172	230	282	276	282
	1-1/2	0°	---	---	---	123	195	266	300	300	300	300	300	300
		60°	---	---	---	123	195	266	300	300	300	300	300	300
		90°	---	---	---	86	115	144	172	172	230	287	276	300
8	1-1/2	0°	---	---	---	58	91	124	158	158	220	220	220	220
		60°	---	---	---	58	91	124	158	158	220	220	220	220
		90°	---	---	---	58	91	124	158	158	220	220	220	220

1. At 0 degrees, use actual shutoff pressure drop. At 60 or 90 degrees, use maximum effective or actual flowing pressure drop, whichever is lower.
2. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, supply pressure to the positioner should be 10% greater than the cylinder pressure shown above.
3. Shaft diameter x spline diameter.

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Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	1/2	0°	103	1492	103	1500	---	---	---	---	---	---	---	---
		60°	103	1492	103	1500	---	---	---	---	---	---	---	---
		90°	103	1492	103	1500	---	---	---	---	---	---	---	---
1-1/2	5/8x1/2	0°	2.39	35	66.5	964	---	---	---	---	---	---	---	---
		60°	2.39	35	66.5	964	---	---	---	---	---	---	---	---
		90°	2.39	35	66.5	964	---	---	---	---	---	---	---	---
	5/8	0°	2.39	35	86.8	1259	103	1500	103	1500	---	---	---	---
		60°	2.39	35	86.8	1259	103	1500	103	1500	---	---	---	---
		90°	2.39	35	86.8	1259	103	1500	103	1500	---	---	---	---
2	5/8	0°	---	---	39.6	575	103	1500	103	1500	---	---	---	---
		60°	---	---	39.6	575	83.0	1203	83.0	1203	---	---	---	---
		90°	---	---	39.6	575	83.0	1203	83.0	1203	---	---	---	---
3	1x3/4	0°	---	---	14.4	209	48.3	701	58.9	854	58.9	854	58.9	854
		60°	---	---	14.4	209	30.7	446	34.8	505	34.8	505	34.8	505
		90°	---	---	14.4	209	30.7	446	34.8	505	34.8	505	34.8	505
	1	0°	---	---	---	---	48.3	701	103	1500	103	1500	103	1500
		60°	---	---	---	---	30.7	446	61.2	888	61.2	888	61.2	888
		90°	---	---	---	---	30.7	446	61.2	888	61.2	888	61.2	888
4	1-1/4	0°	---	---	---	---	27.5	398	75.7	1098	82.7	1200	82.7	1200
		60°	---	---	---	---	17.9	260	35.8	520	49.3	716	79.3	1150
		90°	---	---	---	---	15.8	230	31.7	459	42.2	612	79.3	1150
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	6.40	93	17.7	256	42.1	610
		60°	---	---	---	---	---	---	6.40	93	17.7	256	34.2	496
		90°	---	---	---	---	---	---	3.68	53	4.91	71	10.2	149
	1-1/2	0°	---	---	---	---	---	---	---	---	17.7	256	47.2	684
		60°	---	---	---	---	---	---	---	---	17.7	256	37.0	537
		90°	---	---	---	---	---	---	---	---	4.91	71	10.2	149
8	1-1/2	0°	---	---	---	---	---	---	---	---	15.9	231	24.1	350
		60°	---	---	---	---	---	---	---	---	7.90	115	16.3	236
		90°	---	---	---	---	---	---	---	---	5.31	77	11.1	161

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	1/2	0°	103	1492	103	1500	---	---	---	---	---	---	---	---
		60°	103	1492	103	1500	---	---	---	---	---	---	---	---
		90°	103	1492	103	1500	---	---	---	---	---	---	---	---
1-1/2	5/8x1/2	0°	2.39	35	66.5	964	---	---	---	---	---	---	---	---
		60°	2.39	35	66.5	964	---	---	---	---	---	---	---	---
		90°	2.39	35	66.5	964	---	---	---	---	---	---	---	---
	5/8	0°	2.39	35	86.8	1259	103	1500	103	1500	---	---	---	---
		60°	2.39	35	86.8	1259	103	1500	103	1500	---	---	---	---
		90°	2.39	35	86.8	1259	103	1500	103	1500	---	---	---	---
2	5/8	0°	---	---	39.6	575	103	1500	103	1500	---	---	---	---
		60°	---	---	39.6	575	83.0	1203	83.0	1203	---	---	---	---
		90°	---	---	39.6	575	83.0	1203	83.0	1203	---	---	---	---
3	1x3/4	0°	---	---	12.3	178	40.9	594	58.9	854	58.9	854	58.9	854
		60°	---	---	12.3	178	27.3	396	34.8	505	34.8	505	34.8	505
		90°	---	---	12.3	178	27.3	396	34.8	505	34.8	505	34.8	505
	1	0°	---	---	---	---	40.9	594	89.8	1302	103	1500	103	1500
		60°	---	---	---	---	27.3	396	54.6	793	61.2	888	61.2	888
		90°	---	---	---	---	27.3	396	54.6	793	61.2	888	61.2	888
4	1-1/4	0°	---	---	---	---	16.2	235	38.1	552	63.9	927	82.7	1200
		60°	---	---	---	---	15.9	231	31.9	462	49.2	714	79.3	1150
		90°	---	---	---	---	15.8	230	31.7	459	49.2	714	79.3	1150
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	6.40	93	13.2	191	41.6	603
		60°	---	---	---	---	---	---	6.40	93	13.2	191	34.2	496
		90°	---	---	---	---	---	---	3.68	53	5.73	83	11.1	160
	1-1/2	0°	---	---	---	---	---	---	---	---	13.2	191	41.6	603
		60°	---	---	---	---	---	---	---	---	13.2	191	35.0	507
		90°	---	---	---	---	---	---	---	---	5.73	83	11.1	160
8	1-1/2	0°	---	---	---	---	---	---	---	---	8.41	122	19.4	282
		60°	---	---	---	---	---	---	---	---	7.87	114	15.4	223
		90°	---	---	---	---	---	---	---	---	6.19	90	12.0	173

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	1/2	0°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---
		60°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---
		90°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---
1-1/2	5/8x1/2	0°	2.39	35	55.2	800	---	---	---	---	---	---	---	---
		60°	2.39	35	55.2	800	---	---	---	---	---	---	---	---
		90°	2.39	35	55.2	800	---	---	---	---	---	---	---	---
	5/8	0°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---
		60°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---
		90°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---
2	5/8	0°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---
		60°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---
		90°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---
3	1x3/4	0°	---	---	14.4	209	41.4	600	41.4	600	41.4	600	41.4	600
		60°	---	---	14.4	209	30.7	446	34.8	505	34.8	505	34.8	505
		90°	---	---	14.4	209	30.7	446	34.8	505	34.8	505	34.8	505
	1	0°	---	---	---	---	41.4	600	41.4	600	41.4	600	41.4	600
		60°	---	---	---	---	30.7	446	41.4	600	41.4	600	41.4	600
		90°	---	---	---	---	30.7	446	41.4	600	41.4	600	41.4	600
4	1-1/4	0°	---	---	---	---	27.5	398	41.4	600	41.4	600	41.4	600
		60°	---	---	---	---	17.9	260	35.8	520	41.4	600	41.4	600
		90°	---	---	---	---	15.8	230	31.7	459	41.4	600	41.4	600
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	6.40	93	17.7	256	41.4	600
		60°	---	---	---	---	---	---	6.40	93	17.7	256	34.2	496
		90°	---	---	---	---	---	---	3.68	53	4.91	71	10.2	149
	1-1/2	0°	---	---	---	---	---	---	---	---	17.7	256	41.4	600
		60°	---	---	---	---	---	---	---	---	17.7	256	37.0	537
		90°	---	---	---	---	---	---	---	---	4.91	71	10.2	149
8	1-1/2	0°	---	---	---	---	---	---	---	---	15.9	231	24.1	350
		60°	---	---	---	---	---	---	---	---	7.90	115	16.3	236
		90°	---	---	---	---	---	---	---	---	5.31	77	11.1	161

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close															
Valve Size, NPS	**Shaft Dia., Inches**	**Angle of Opening**	**Actuator Size, Air to Diaphragm, Maximum Rotation**												
			Size 1				**Size 2**				**Size 3**				
			2 barg / 29 psig		**4 barg / 58 psig**		**2 barg / 29 psig**		**4 barg / 58 psig**		**2 barg / 29 psig**		**4 barg / 58 psig**		
			90°		**90°**		**90°**		**90°**		**90°**		**90°**		
			bar	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	**bar**	**psi**	
1	1/2	0°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---	
		60°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---	
		90°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---	
1-1/2	5/8x1/2	0°	2.39	35	55.2	800	---	---	---	---	---	---	---	---	
		60°	2.39	35	55.2	800	---	---	---	---	---	---	---	---	
		90°	2.39	35	55.2	800	---	---	---	---	---	---	---	---	
	5/8	0°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---	
		60°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---	
		90°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---	
2	5/8	0°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---	
		60°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---	
		90°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---	
3	1x3/4	0°	---	---	12.3	178	40.9	594	41.4	600	41.4	600	41.4	600	
		60°	---	---	12.3	178	27.3	396	34.8	505	34.8	505	34.8	505	
		90°	---	---	12.3	178	27.3	396	34.8	505	34.8	505	34.8	505	
	1	0°	---	---	---	---	40.9	594	41.4	600	41.4	600	41.4	600	
		60°	---	---	---	---	27.3	396	41.4	600	41.4	600	41.4	600	
		90°	---	---	---	---	27.3	396	41.4	600	41.4	600	41.4	600	
4	1-1/4	0°	---	---	---	---	16.2	235	38.1	552	41.4	600	41.4	600	
		60°	---	---	---	---	15.9	231	31.9	462	41.4	600	41.4	600	
		90°	---	---	---	---	15.8	230	31.7	459	41.4	600	41.4	600	
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	6.40	93	13.2	191	41.4	600	
		60°	---	---	---	---	---	---	6.40	93	13.2	191	34.2	496	
		90°	---	---	---	---	---	---	3.68	53	5.73	83	11.1	160	
	1-1/2	0°	---	---	---	---	---	---	---	---	13.2	191	41.4	600	
		60°	---	---	---	---	---	---	---	---	13.2	191	35.0	507	
		90°	---	---	---	---	---	---	---	---	5.73	83	11.1	160	
8	1-1/2	0°	---	---	---	---	---	---	---	---	8.41	122	19.4	282	
		60°	---	---	---	---	---	---	---	---	7.87	114	15.4	223	
		90°	---	---	---	---	---	---	---	---	6.19	90	12.0	173	

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Open														
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation											
			Size 1				Size 2				Size 3			
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig	
			90°		90°		90°		90°		90°		90°	
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
1	1/2	0°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---
		60°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---
		90°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---
1-1/2	5/8x1/2	0°	2.39	35	55.2	800	---	---	---	---	---	---	---	---
		60°	2.39	35	55.2	800	---	---	---	---	---	---	---	---
		90°	2.39	35	55.2	800	---	---	---	---	---	---	---	---
	5/8	0°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---
		60°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---
		90°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---
2	5/8	0°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---
		60°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---
		90°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---
3	1x3/4	0°	---	---	14.4	209	41.4	600	41.4	600	41.4	600	41.4	600
		60°	---	---	14.4	209	30.7	446	34.8	505	34.8	505	34.8	505
		90°	---	---	14.4	209	30.7	446	34.8	505	34.8	505	34.8	505
	1	0°	---	---	---	---	41.4	600	41.4	600	41.4	600	41.4	600
		60°	---	---	---	---	30.7	446	41.4	600	41.4	600	41.4	600
		90°	---	---	---	---	30.7	446	41.4	600	41.4	600	41.4	600
4	1-1/4	0°	---	---	---	---	27.5	398	75.7	1098	41.4	600	41.4	600
		60°	---	---	---	---	17.9	260	35.8	520	41.4	600	41.4	600
		90°	---	---	---	---	15.8	230	31.7	459	41.4	600	41.4	600
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	6.40	93	17.7	256	20.7	300
		60°	---	---	---	---	---	---	6.40	93	17.7	256	20.7	300
		90°	---	---	---	---	---	---	3.68	53	4.91	71	10.2	149
	1-1/2	0°	---	---	---	---	---	---	---	---	17.7	256	20.7	300
		60°	---	---	---	---	---	---	---	---	17.7	256	20.7	300
		90°	---	---	---	---	---	---	---	---	4.91	71	10.2	149
8	1-1/2	0°	---	---	---	---	---	---	---	---	15.2	220	15.2	220
		60°	---	---	---	---	---	---	---	---	7.90	115	15.2	220
		90°	---	---	---	---	---	---	---	---	5.31	77	11.1	161

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

Maximum Allowable Pressure Drops (ΔP)(1) for Reverse Flow

Push-Down-To-Close															
Valve Size, NPS	Shaft Dia., Inches	Angle of Opening	Actuator Size, Air to Diaphragm, Maximum Rotation												
			Size 1				Size 2				Size 3				
			2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		2 barg / 29 psig		4 barg / 58 psig		
			90°		90°		90°		90°		90°		90°		
			bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	
1	1/2	0°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---	
		60°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---	
		90°	68.9	1000	68.9	1000	---	---	---	---	---	---	---	---	
1-1/2	5/8x1/2	0°	2.39	35	55.2	800	---	---	---	---	---	---	---	---	
		60°	2.39	35	55.2	800	---	---	---	---	---	---	---	---	
		90°	2.39	35	55.2	800	---	---	---	---	---	---	---	---	
	5/8	0°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---	
		60°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---	
		90°	2.39	35	55.2	800	55.2	800	55.2	800	---	---	---	---	
2	5/8	0°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---	
		60°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---	
		90°	---	---	39.6	575	41.4	600	41.4	600	---	---	---	---	
3	1x3/4	0°	---	---	12.3	178	40.9	594	41.4	600	41.4	600	41.4	600	
		60°	---	---	12.3	178	27.3	396	34.8	505	34.8	505	34.8	505	
		90°	---	---	12.3	178	27.3	396	34.8	505	34.8	505	34.8	505	
	1	0°	---	---	---	---	40.9	594	41.4	600	41.4	600	41.4	600	
		60°	---	---	---	---	27.3	396	41.4	600	41.4	600	41.4	600	
		90°	---	---	---	---	27.3	396	41.4	600	41.4	600	41.4	600	
4	1-1/4	0°	---	---	---	---	16.2	235	38.1	552	41.4	600	41.4	600	
		60°	---	---	---	---	15.9	231	31.9	462	41.4	600	41.4	600	
		90°	---	---	---	---	15.8	230	31.7	459	41.4	600	41.4	600	
6	1-1/2x 1-1/4	0°	---	---	---	---	---	---	6.40	93	13.2	191	20.7	300	
		60°	---	---	---	---	---	---	6.40	93	13.2	191	20.7	300	
		90°	---	---	---	---	---	---	3.68	53	5.73	83	11.1	160	
	1-1/2	0°	---	---	---	---	---	---	---	---	13.2	191	20.7	300	
		60°	---	---	---	---	---	---	---	---	13.2	191	20.7	300	
		90°	---	---	---	---	---	---	---	---	5.73	83	11.1	160	
8	1-1/2	0°	---	---	---	---	---	---	---	---	8.41	122	15.2	220	
		60°	---	---	---	---	---	---	---	---	7.87	114	15.2	220	
		90°	---	---	---	---	---	---	---	---	6.19	90	12.0	173	

1. At 0 degrees, use maximum actual shutoff pressure drop. At 80 degrees, use maximum effective or actual flowing pressure drop, whichever is less.

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Table of Contents

Valve Torque Requirements

Actuator Torque Output

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Introduction

In selecting the most economical actuator for a rotary valve, the determining factors are the torque required to open and close the valve and the torque output of the actuator. The procedure in this section is a quick and easy method to determine actuator torque required in both the open (dynamic) and closed (breakout) position of rotary valves. Additional rotary actuator sizing information using only the valve pressure drop as a base can be found in section C of this catalog.

Note that the following method assumes the valve has been properly sized for the application and the application does not exceed pressure limitations for the valve.

Torque Equations

Rotary valve torque is actually the sum of a number of torque components. To avoid confusion, a number of these have been combined and a number of calculations have been performed in advance. Thus, the torques required for each valve type can be represented with two, simple and practical equations:

Breakout Torque	Dynamic Torque
$T_B = A\,(\Delta P_{shutoff}) + B$	$T_D = C(\Delta P_{eff})$

The specific A, B, and C factors for each valve design can be found on the following pages, arranged first by type number and then by design letter. The torque equations are repeated on each valve page for convenience.

Packing Friction

Fisher CV500, V150, V200, V300, and V500 valves are available with ENVIRO-SEAL™ packing. Actuator sizing for these valves with PTFE or graphite ENVIRO-SEAL packing does not require special considerations. The B torque factors in this section can be used for standard PTFE and graphite packing and for ENVIRO-SEAL PTFE and graphite packing.

How To Use the Torque Method

1. Turn to the page that covers the desired valve type.

2. Use the procedures on that page to calculate the valve torque requirements.

3. Each valve page also has a procedure for selecting a particular type of actuator. Use the procedure listed for the desired actuator type.

4. For a butterfly, eccentric disc, CV500, V150, V200, V300, or V500 valve, check the table for acceptable valve shaft diameter/actuator combinations to make sure the valve shaft will fit the actuator.

5. For a Fisher U valve body, make sure the actuator and valve body yoke boss and travel are the same.

Maximum Rotation

The term maximum rotation, as used in the tables and text of this section, is defined as the angle of valve disk or ball in the fully open position.

Normally, maximum rotation is 90 degrees. That is, the ball or disk rotates 90 degrees from the closed position to the wide open position.

Some of the pneumatic spring-return piston and pneumatic spring-and-diaphragm actuator tables in this section indicate torques at a maximum rotation of 60 degrees or 75 degrees. In these cases, valve rotation has been limited by travel stops in the actuator.

For the 1052 pneumatic spring-and-diaphragm actuator, limiting maximum rotation allows for higher initial spring compression, resulting in more actuator breakout torque. Additionally, the effective length of each actuator lever changes with valve rotation. Torques in the actuator tables, particularly for pneumatic piston actuators, reflect this changing lever length.

Torque Equations

Breakout Torque **Dynamic Torque**

$T_B = A(\Delta P_{shutoff}) + B$ $T_D = C\,(\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque). Use the actual pressure drop at shutoff ($\Delta P_{shutoff}$) and the A and B factors from table 1. Calculate T_B.

2. Find T_D (dynamic torque) for the maximum angle of rotation. First, refer to table 2 and use the appropriate equation to determine ΔP_{eff} (effective pressure drop) for the disk style and fluid at the maximum angle of rotation.

If the actual flowing pressure drop is known at the maximum angle of rotation, compare it to the calculated ΔP_{eff}. Use the smaller of the two values (actual ΔP or calculated ΔP_{eff}) as ΔP_{eff} in the dynamic torque equation. C factors are in table 1. Calculate T_D.

3. Table 1 lists the maximum allowable torques for 7600 butterfly valve bodies with S17400 (17-4 PH stainless steel) shafts at temperatures up to and including 300°F. For valve bodies that have other shaft materials or that operate at higher temperatures, multiply the maximum allowable torques in table 1 by the percentages listed in table 3. Both the breakout and dynamic torques must be less than the maximum allowable torque shown in table 1 or calculated according to the percentages in table 3.

Selecting 1051 or 1052 Spring-and-Diaphragm or 1066SR Spring-Return Piston Actuator

Turn to the pages covering these actuators and refer to the available actuator torque tables on those pages. Choose either push-down-to-close or push-down-to-open construction. Select an actuator size and spring combination that supplies more breakout torque and more dynamic torque at the maximum angle of rotation than required by the valve body.

If the 7600 butterfly valve body has the required capacity at 60° rotation, calculate T_D at 60° and check the actuator torque tables under 60° rotation to see if limiting the actuator maximum rotation allows the selection of a smaller actuator.

Note that the springs listed in 1052 table 2, Actuator Torques for 60° Limited Maximum Rotation, yield higher breakout torques for the specific actuator size and air-to-diaphragm combination than the springs listed in 1052 table 1.

Selecting 1061 or 1066 Piston Actuator

Turn to the appropriate actuator page and use the procedure given there.

Selecting Manual Actuator

Select an actuator that supplies more torque than the largest of the valve body torque requirements.

Table 1. Torque Characteristics

VALVE SIZE NPS	SHAFT DIAMETER, INCH & (SHAFT CLASS)	BEARING MATERIAL	A	B	C FISHTAIL™ Disk 60 Degrees	C FISHTAIL™ Disk 90 Degrees	MAXIMUM ALLOWABLE TORQUE, LBF•INCH
2	5/8 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	0.057 0.200 0.400	50	0.150	0.240	943
3	3/4 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	0.150 0.525 1.05	65	1.14	1.67	1630
	1 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	0.200 0.700 1.40	100	0.486	0.812	3865
4	1 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	0.366 1.28 2.56	100	3.69	5.19	3865
	1-1/4 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	0.457 1.60 3.20	140	1.83	2.69	7550
6	1 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	0.800 2.80 5.60	100	17.1	29.4	3865
	1-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	1.20 4.20 8.40	184	6.81	10.0	12,000
8	1-1/4 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	1.79 6.26 12.5	140	42.3	74.4	7550
	1-3/4 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	2.50 8.74 17.5	232	27.6	41.4	20,717
10	1-3/4 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	3.93 13.7 27.5	232	69.0	108	20,717
	2-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	5.61 19.6 39.3	396	39.0	57.0	55,762
12	1-3/4 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	5.75 20.1 40.3	232	145	269	20,717
	2-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	8.21 28.8 57.5	396	109	164	55,762
14	2 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	8.23 28.8 57.6	282	201	381	23,524
	3 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	12.3 43.2 86.4	520	141	216	104,372
16	2 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	10.7 37.6 75.2	282	311	639	23,524
	3 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	16.1 56.4 113	520	231	354	104,372

-continued-

Table 1. Torque Characteristics (Continued)

VALVE SIZE NPS	SHAFT DIAMETER, INCH & (SHAFT CLASS)	BEARING MATERIAL	A	B	C FISHTAIL Disk 60 Degrees	C FISHTAIL Disk 90 Degrees	MAXIMUM ALLOWABLE TORQUE, LBF•INCH
18	2-1/2 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	17.2 60.1 120	396	419	794	55,762
	3-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	24.0 83.9 168	660	309	464	165,738
20	2-1/2 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	21.0 73.5 147	396	597	1200	55,762
	3-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	29.3 103 205	660	494	801	165,738
24	3 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	36.9 129 258	520	1060	2310	104,372
	4 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	49.4 173 346	800	932	1560	228,406(1)
30	3-1/2 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	67.8 237 474	660	2190	4980	165,738
	4-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	87.1 305 610	960	2060	3740	228,406(1)
36	3-1/2 (3-5)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	96.0 336 672	660	3990	10,200	165,738
	4-1/2 (5-7)	PTFE-lined fiberglass or PTFE-lined 316 stainless steel Graphite-impregnated bronze R30006 (alloy 6)	123 432 864	960	3740	7770	228,406(1)

1. Based on shaft with 3-1/2 inch diameter at splined end.

Table 2. Effective Pressure Drop (ΔP_{eff}), Psi

Disk Style	Service	For 60° Maximum Angle of Rotation	For 90° Maximum Angle of Rotation
FISHTAIL	Liquid	$\Delta P_{eff} = 0.600\ P_{1\ abs}$	$\Delta P_{eff} = 0.450\ P_{1\ abs}$
	Gaseous	$\Delta P_{eff} = 0.180\ P_{1\ abs}$	$\Delta P_{eff} = 0.090\ P_{1\ abs}$

Note: Use absolute inlet pressure at maximum angle of rotation.

Table 3. Relative Strengths of Shaft Materials

SHAFT MATERIAL	TEMPERATURE, °F: -423 to -20	-19 to 100	101 to 200	201 to 300	301 to 400	401 to 500	501 to 600	601 to 650	651 to 700	701 to 750	751 to 800	801 to 850	851 to 900	901 to 950	951 to 1000
	Relative Strength (Percent of Maximum Allowable Torque Listed in Table 1)														
S17400 (17-4PH H1075 stainless steel)		100			98	95	93	92	90	88	86	84	81	76	71
S31600 or S31700 stainless steel (annealed)		53		52	51		49	47		46	45			44	
N05500		93											71		23
N10276		63	57					56	54				51		
N08020 (annealed)		65	60	58	57	55	53		52	51	50				
S20910		71									70				65
R30016		105						104	102	100	99	97	95	94	92
R30605		104	101	98	95	92	89		87		84		81		78

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Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque.

Use the appropriate table for soft, NOVEX, and Phoenix III seals and bearing materials. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

For flow in the preferred direction, calculate the ΔP_{eff} effective pressure drop at 10, 60, 75, and 80 degrees. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

For flow in the nonpreferred direction, calculate the pressure drop at 10, 60, 75, and 90 degrees of rotation.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation

to ΔP_{actual} at each angle of rotation. Use the **smaller** of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only

  $\Delta P_{eff} = F_L^2\ (P_{1abs} - F_F\ P_v)$

- Gas only

  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables

$\Delta P_{shutoff}$ = Actual pressure at shutoff

ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
κ = Valve torque tends to close the valve (kappa)
θ = Valve torque beyond this degree of opening tends to open the valve (theta)

CL150 K Values for Effective Pressure Drop for Gas, Preferred and Non-Preferred Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES				
	10	60	75	80	90
14-24	0.227	0.203	0.155	0.136	0.103

CL300 K Values for Effective Pressure Drop for Gas Preferred and Non-Preferred Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES				
	10	60	75	80	90
14-24	0.230	0.181	0.132	0.117	0.103

CL150 Torque Characteristics

PTFE Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque (Lbf•in)
			PTFE	UHMWPE	10°	45°	60°	75°	80°	
14	1-1/4	12.15	1499	2838	35	186	358	856	1010	11388
16	1-1/4x1-1/2	17.30	1892	3666	50	271	534	1297	1549	13972
18	1-9/16x1-3/4	25.51	2351	4704	69	365	733	1793	2165	19396
20	1-3/4	35.86	2853	5870	93	478	975	2403	2931	22616
24	2-1/4x2-1/2	69.00	4225	9135	168	838	1761	4403	5457	61826

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

NOVEX Metal Seal / PEEK Bearing									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°	80°	
14	1-1/4	21.33	3006	35	186	358	856	1010	11388
16	1-1/4x1-1/2	28.53	3529	50	271	534	1297	1549	13972
18	1-9/16x1-3/4	38.91	4176	69	365	733	1793	2165	19396
20	1-3/4	51.54	4866	93	478	975	2403	2931	22618
24	2-1/4x2-1/2	90.74	6597	168	838	1761	4403	5457	61826
NOVEX Metal Seal / Metal Bearing									
14	1-1/4	25.95	3253	35	186	358	856	1010	11388
16	1-1/4x1-1/2	35.11	3829	50	271	534	1296	1549	13972
18	1-9/16x1-3/4	48.60	4600	69	365	733	1793	2165	19396
20	1-3/4	65.16	5436	93	478	975	2403	2930	22616
24	2-1/4x2-1/2	116.95	7535	168	838	1761	4403	5457	61826
Phoenix III Seal / PEEK Bearing									
14	1-1/4	18.79	4111	35	186	358	856	1010	11388
16	1-1/4x1-1/2	27.08	5327	50	271	534	1297	1549	13972
18	1-9/16x1-3/4	39.21	6801	69	365	733	1793	2165	19396
20	1-3/4	54.37	8450	93	478	975	2403	2931	22616
24	2-1/4x2-1/2	103.59	13106	168	838	1761	4403	5457	61826
Phoenix III Seal / Metal Bearing									
14	1-1/4	23.41	4358	35	186	358	856	1010	11388
16	1-1/4x1-1/2	33.65	5628	50	271	534	1296	1549	13972
18	1-9/16x1-3/4	48.90	7225	69	365	733	1793	2165	19396
20	1-3/4	67.99	9020	93	478	975	2403	2931	22616
24	2-1/4x2-1/2	129.80	14044	168	838	1761	4403	5457	61826

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Note: These values are based on S17400 H1025 stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

CL300 Torque Characteristics

Soft Seal / PEEK Bearing

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque (Lbf•in)
			PTFE	UHMWPE	10°	45°	60°	75°	80°	
14	1-3/4	15.77	1509	3116	43	188	325	591	642	22616
16	1-3/4	23.00	1910	4044	57	233	408	744	821	25849
18	2-1/4x2-1/2	32.86	2392	5173	88	392	710	1317	1471	61826
20	3	49.62	3047	6891	115	452	821	1520	1714	76315
24	3	79.30	4082	9532	165	586	1079	2007	2302	156701

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

NOVEX Metal Seal / PEEK Bearing

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque (Lbf•in)
			S31600	S21800	10°	45°	60°	75°	80°	
14	1-3/4	24.18	3379	4610	43	188	325	591	642	22616
16	1-3/4	33.24	4062	5493	57	233	408	744	821	25849
18	2-1/4x2-1/2	45.25	4835	6491	88	392	710	1317	1471	61826
20	3	64.38	6087	7982	115	452	821	1520	1714	76315
24	3	98.01	7803	10078	165	586	1079	2007	2302	156701
NOVEX Metal Seal / Metal Bearing										
14	1-3/4	30.17	3950	5180	43	188	325	591	642	22616
16	1-3/4	41.98	4803	6235	57	233	408	744	821	25849
18	2-1/4x2-1/2	57.74	5773	7430	88	392	710	1317	1471	61828
20	3	83.23	7494	9388	115	452	821	1520	1714	76315
24	3	128.14	9787	12061	165	586	1079	2007	2302	156701

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Phoenix III Seal / PEEK Bearing

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°	80°	
14	1-3/4	21.39	4251	43	188	325	591	642	22616
16	1-3/4	31.19	5515	57	233	408	744	821	25849
18	2-1/4x2-1/2	44.66	7065	88	392	710	1317	1471	61826
20	3	66.10	9272	115	452	821	1520	1714	76315
24	3	105.28	12792	165	586	1079	2007	2304	156701
Phoenix III Seal / Metal Bearing									
14	1-3/4	27.38	4821	43	188	325	591	642	22616
16	1-3/4	39.93	6256	57	233	408	744	821	25849
18	2-1/4x2-1/2	57.14	8003	88	392	710	1317	1471	61826
20	3	84.95	10678	115	452	821	1520	1714	76315
24	3	135.40	14776	165	586	1079	2007	2304	156701

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Note: These values are based on H1025 stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

CL150 Torque Characteristics

Soft Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C						Maximum Allowable Torque (Lbf•in)
					10°	45°	60°	75°		90°	
			PTFE	UHMWPE	Value	Value	Value	Torque	Value	Value	
14	1-1/4	12.15	1499	2838	34	124	244	θ	24	1047	11388
16	1-1/4x1-1/2	17.30	1892	3666	47	185	374	θ	78	1582	13972
18	1-9/16x1-3/4	25.51	2351	4704	65	254	527	θ	161	2184	19396
20	1-3/4	35.86	2853	5870	86	340	718	θ	274	2923	22616
24	2-1/4x2-1/2	69.00	4225	9135	152	616	1349	θ	677	5338	61826

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Phoenix III Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C						Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°		90°	
				Value	Value	Value	Torque	Value	Value	
14	1-1/4	18.79	4111	34	124	244	θ	24	1047	11388
16	1-1/4x1-1/2	27.08	5327	47	185	374	θ	78	1582	13972
18	1-9/16x1-3/4	39.21	6801	65	254	527	θ	161	2184	19396
20	1-3/4	54.37	8450	86	340	718	θ	274	2923	22616
24	2-1/4x2-1/2	103.59	13106	152	616	1349	θ	677	5338	61826
Phoenix III Seal / Metal Bearing										
14	1-1/4	23.41	4358	34	124	244	θ	24	1047	11388
16	1-1/4x1-1/2	33.65	5628	47	185	374	θ	78	1582	13972
18	1-9/16x1-3/4	48.90	7225	65	254	527	θ	161	2184	19396
20	1-3/4	67.99	9020	86	340	718	θ	274	2923	22616
24	2-1/4x2-1/2	129.80	14044	152	616	1349	θ	677	5338	61826

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Note: These values are based on S17400 H1025 stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

CL300 Torque Characteristics

Soft Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C						Maximum Allowable Torque (Lbf•in)
					10°	45°	60°	75°		90°	
			PTFE	UHMWPE	Value	Value	Value	Torque	Value	Value	
14	1-3/4	15.77	1509	3116	42	128	224	θ	44	555	22616
16	1-3/4	23.00	1910	4044	54	163	290	θ	84	699	25849
18	2-1/4x2-1/2	32.86	2392	5173	82	276	514	θ	176	1237	61826
20	3	49.62	3047	6891	107	329	612	θ	253	1428	76315
24	3	79.30	4082	9532	153	444	839	θ	428	1885	156701

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Phoenix III Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C						Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°		90°	
				Value	Value	Value	Torque	Value	Value	
14	1-3/4	21.39	4251	42	128	224	θ	44	555	22616
16	1-3/4	31.19	5515	54	163	290	θ	84	699	25849
18	2-1/4x2-1/2	44.66	7065	82	276	514	θ	176	1237	61826
20	3	66.10	9272	107	329	612	θ	253	1428	76315
24	3	105.28	12792	153	444	839	θ	428	1885	156701
Phoenix III Seal / Metal Bearing										
14	1-3/4	27.38	4821	42	128	224	θ	44	555	22616
16	1-3/4	39.93	6256	54	163	290	θ	84	699	25849
18	2-1/4x2-1/2	57.14	8003	82	276	514	θ	176	1237	61826
20	3	84.95	10678	107	329	612	θ	253	1428	76315
24	3	135.40	14776	153	444	839	θ	428	1885	156701

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Note: These values are based on S17400 H1025 stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

For NACE constructions, the Maximum Torque limits to be used in calculating valve breakout and dynamic torque are different from standard constructions. The NACE limits are listed in the following tables.

CL150

Soft Seal (PTFE) / PEEK Bearing		
VALVE SIZE, NPS	**SHAFT DIAMETER, INCHES(1)**	**Maximum Allowable Torque (Lbf•in)**
14	1-1/4	6676
16	1-1/4x1-1/2	8191
18	1-9/16x1-3/4	11370
20	1-3/4	13258
24	2-1/4x2-1/2	36243
NOVEX Seal / PEEK or Metal Bearing		
14	1-1/4	6676
16	1-1/4x1-1/2	8191
18	1-9/16x1-3/4	11370
20	1-3/4	13258
24	2-1/4x2-1/2	36243
Phoenix III Seal / PEEK or Metal Bearing		
14	1-1/4	6676
16	1-1/4x1-1/2	8191
18	1-9/16x1-3/4	11370
20	1-3/4	13258
24	2-1/4x2-1/2	36243

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

CL300

Soft Seal / PEEK Bearing		
VALVE SIZE, NPS	**SHAFT DIAMETER, INCHES(1)**	**Maximum Allowable Torque (Lbf•in)**
14	1-3/4	13258
16	1-3/4	15153
18	2-1/4x2-1/2	36243
20	3	44736
24	3	91859
NOVEX Seal / PEEK or Metal Bearing		
14	1-3/4	13258
16	1-3/4	15153
18	2-1/4x2-1/2	36243
20	3	44736
24	3	91859
Phoenix III Seal / PEEK or Metal Bearing		
14	1-3/4	13258
16	1-3/4	15153
18	2-1/4x2-1/2	36243
20	3	44736
24	3	91859

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Note: These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque.

Use the appropriate table for soft, metal, NOVEX, and Phoenix III seals and bearing materials. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).
   Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)
   Calculate the ΔP_{eff} effective pressure drop at the angles listed in the tables. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the smaller of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in the tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only
  $\Delta P_{eff} = F_L^2 (P_{1abs} - F_F P_v)$

- Gas only
  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables
$\Delta P_{shutoff}$ = Actual pressure at shutoff
ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Valve torque tends to close the valve (kappa)
θ = Valve torque beyond this degree of opening tends to open the valve (theta)

CL150

Forward Flow				
Valve Size, NPS	Angle of Opening			
	10°	60°	75°	90°
2(1)	- - -	0.224	0.238	0.199
3	0.165	0.208	0.124	0.128
4	0.210	0.139	0.106	0.093
6	0.173	0.147	0.105	0.090
8	0.163	0.139	0.098	0.085
10	0.279	0.170	0.104	0.075
12	0.235	0.144	0.088	0.062
Reverse Flow				
Valve Size, NPS	Angle of Opening			
	10°	60°	75°	90°
3	0.122	0.161	0.096	0.103
4	0.197	0.123	0.091	0.087
6	0.197	0.140	0.088	0.081
8	0.184	0.131	0.082	0.076
10	0.241	0.169	0.095	0.069
12	0.219	0.153	0.086	0.062

1. For NPS 2, flow is recommended in the forward direction only. Also, NPS 2 is multirated to CL150/300/600.

CL300

Forward Flow				
Valve Size, NPS	Angle of Opening			
	10°	60°	75°	90°
2(1)	- - -	0.224	0.238	0.199
3	0.165	0.208	0.164	0.128
4	0.202	0.161	0.115	0.093
6	0.187	0.132	0.107	0.089
8	0.163	0.116	0.094	0.078
10	0.206	0.149	0.093	0.070
12	0.187	0.134	0.084	0.064
Reverse Flow				
Valve Size, NPS	Angle of Opening			
	10°	60°	75°	90°
3	0.122	0.161	0.099	0.103
4	0.183	0.145	0.089	0.091
6	0.194	0.130	0.106	0.083
8	0.180	0.119	0.098	0.077
10	0.224	0.150	0.093	0.069
12	0.200	0.135	0.083	0.062

1. For NPS 2, flow is recommended in the forward direction only. Also, NPS 2 is multirated to CL150/300/600.

CL150 Torque Characteristics

Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
Soft Seal / PEEK/PTFE Bearing (Forward Flow)(2)										
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
2(3)	1/2	**0.3**	100	- - -	0.64	θ	1.6	2.4	345	515
3	1/2	**0.50**	136	- - -	0.8	θ	1.8	8	280	515
4	5/8	**0.91**	217	- - -	3.1	θ	4.7	25	476	1225
6	3/4	**1.97**	403	- - -	30	K	24	70	965	2120
8	1	**4.2**	665	- - -	65	K	47	165	1860	4140
10	1-1/4	**7.3**	1012	- - -	125	K	90	310	3095	9820
12	1-1/2	**11.4**	1422	- - -	216	K	140	580	4670	12,000
Soft Seal / PEEK/PTFE Bearing (Reverse Flow)(2)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
2(3)	1/2	**0.3**	100	- - -	- - -	- - -	- - -	- - -	345	515
3	1/2	**0.50**	136	1.2	6.7	K	14	14.7	280	515
4	5/8	**0.91**	217	1.8	19	K	33	33	476	1225
6	3/4	**1.97**	403	7.7	52	K	106	106	965	2120
8	1	**4.2**	665	12	113	K	212	213	1860	4140
10	1-1/4	**7.3**	1012	25	216	K	406	409	3095	9820
12	1-1/2	**11.4**	1422	35	360	K	687	695	4670	12,000
Metal Seal / PEEK/PTFE Bearing (Forward Flow)(2)(3)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
2	1/2	**0.23**	297	- - -	0.64	θ	1.6	2.4	467	515
Metal Seal / Metal Bearing (Forward Flow)(2)(3)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
2	1/2	**0.77**	297	- - -	0.64	θ	1.6	2.4	515	515

1. Use 80° for units with greater than 80° maximum rotation.
2. Forward flow is the preferred direction.
3. The 2-inch size is multirated to Classes 150/300/600.

CL150 Torque Characteristics

Novex Metal Seal / PEEK/PTFE Bearing (Reverse Flow)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	1/2	**0.41**	335	1.2	6.7	K	14	14.7	450	515
4	5/8	**1.65**	700	1.8	19	K	33	33	1170	1225
6	3/4	**1.85**	1400	7.7	52	K	106	106	1925	2120
8	1	**3.8**	1500	12	113	K	212	213	2585	4140
10	1-1/4	**8**	3950	25	216	K	406	409	6230	9820
12	1-1/2	**10.5**	5847	35	360	K	687	695	8840	12,000
Novex Metal Seal / Metal Bearing (Reverse Flow)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	1/2	**1.42**	353	1.2	6.7	K	14	14.7	515	515
4	5/8	**2.85**	800	1.8	19	K	33	33	1225	1225
6	3/4	**6.3**	1490	7.7	52	K	106	106	2120	2120
8	1	**15.1**	1650	12	113	K	212	213	4140	4140
10	1-1/4	**23**	4250	25	216	K	406	409	9820	9820
12	1-1/2	**47.7**	5847	35	360	K	687	695	12,000	12,000

1. Use 80° for units with greater than 80° maximum rotation.

CL300 Torque Characteristics

Valve Size, NPS	Shaft Diameter, Inches	A	B	C 10° Value	C 60° Value	C 75° Torque	C 75° Value	C 90° Value	Maximum Torque, In-lbs Breakout T_B	Maximum Torque, In-lbs Dynamic T_D
Soft Seal / PEEK/PTFE Bearing (Forward Flow)(2)										
2(3)	1/2	0.3	100	- - -	0.64	θ	1.6	2.4	345	515
3	5/8	0.56	150	- - -	0.9	θ	2.0	9	565	1225
4	3/4	0.99	232	- - -	3.0	θ	6.5	25	965	2120
6	1	2.3	438	- - -	13.7	K	11	60	2140	4140
8	1-1/4	4.8	705	- - -	56	K	56	150	4260	9820
10	1-1/2	8.1	1056	- - -	107	K	106	280	7050	12,000
12	1-3/4	12.5	1470	- - -	182	K	180	460	10,720	23,524
Soft Seal / PEEK/PTFE Bearing (Reverse Flow)(2)										
Valve Size, NPS	**Shaft Diameter, Inches**	**A**	**B**	**C 10° Value**	**C 60° Value**	**C 75° Torque**	**C 75° Value**	**C 80°(1) Value**	**Breakout T_B**	**Dynamic T_D**
2(3)	1/2	0.3	100	- - -	- - -	– – –	- - -	- - -	345	515
3	5/8	0.56	150	1.2	6.7	K	14	14.7	565	1225
4	3/4	0.99	232	2.0	12	K	27.5	27.9	965	2120
6	1	2.3	438	2.5	52	K	83	83	2140	4140
8	1-1/4	4.8	705	12	119	K	209	229	4260	9820
10	1-1/2	8.1	1056	24	228	K	400	438	7050	12,000
12	1-3/4	12.5	1470	41	386	K	675	741	10,720	23,524
Metal Seal / PEEK/PTFE Bearing (Forward Flow)(2)(3)										
Valve Size, NPS	**Shaft Diameter, Inches**	**A**	**B**	**C 10° Value**	**C 60° Value**	**C 75° Torque**	**C 75° Value**	**C 90° Value**	**Breakout T_B**	**Dynamic T_D**
2	1/2	0.23	297	- - -	0.64	θ	1.6	2.4	467	515
Metal Seal / Metal Bearing (Forward Flow)(2)(3)										
Valve Size, NPS	**Shaft Diameter, Inches**	**A**	**B**	**C 10° Value**	**C 60° Value**	**C 75° Torque**	**C 75° Value**	**C 90° Value**	**Breakout T_B**	**Dynamic T_D**
2	1/2	0.77	297	- - -	0.64	θ	1.6	2.4	515	515

1. Use 80° for units with greater than 80° maximum rotation.
2. Forward flow is the preferred direction.
3. The 2-inch size is multirated to Classes 150/300/600.

CL300 Torque Characteristics

Novex Metal Seal / PEEK/PTFE Bearing (Reverse Flow)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	5/8	0.46	510	1.2	6.7	K	14	14.7	865	1225
4	3/4	1.72	750	2.0	12	K	27.5	27.9	2040	2120
6	1	1.99	1672	2.5	52	K	83	83	3165	4140
8	1-1/4	5.33	1900	12	119	K	209	229	5900	9820
10	1-1/2	7.37	4100	24	228	K	400	438	9630	12,000
12	1-3/4	11.6	5880	41	386	K	675	741	14,580	23,524
Novex Metal Seal / Metal Bearing (Reverse Flow)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	5/8	1.71	525	1.2	6.7	K	14	14.7	1225	1225
4	3/4	3.35	849	2.0	12	K	27.5	27.9	2120	2120
6	1	7.8	1795	2.5	52	K	83	83	4140	4140
8	1-1/4	17.1	2000	12	119	K	209	229	9820	9820
10	1-1/2	25	4200	24	228	K	400	438	12,000	12,000
12	1-3/4	52.4	5919	41	386	K	675	741	23,524	23,524

1. Use 80° for units with greater than 80° maximum rotation.

CL150 Torque Characteristics

Phoenix III Seal / PEEK/PTFE Bearing (Reverse Flow)[2]

Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°[1]		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	1/2	0.81	270	1.2	6.7	K	14	14.7	500	515
4	5/8	1.14	800	1.8	19	K	33	33	1125	1225
6	3/4	1.75	1500	7.7	52	K	106	106	2000	2120
8	1	4.87	1400	12	113	K	212	213	2790	4140
10	1-1/4	7.5	2150	25	216	K	406	409	4290	9820
12	1-1/2	13.1	4200	35	360	K	687	695	7935	12,000

Phoenix III Seal / PEEK/PTFE Bearing (Forward Flow)[2]

Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	1/2	0.81	270	- - -	0.8	θ	1.8	8	500	515
4	5/8	1.14	800	- - -	3.1	θ	4.7	25	1125	1225
6	3/4	1.75	1500	- - -	30	K	24	70	2000	2120
8	1	4.87	1400	- - -	65	K	47	165	2790	4140
10	1-1/4	7.5	2150	- - -	125	K	90	310	4290	9820
12	1-1/2	13.1	4200	- - -	216	K	140	580	7935	12,000

Phoenix III Seal / Metal Bearing (Reverse Flow)[2]

Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°[1]		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	1/2	1.2	350	1.2	6.7	K	14	14.7	515	515
4	5/8	1.9	900	1.8	19	K	33	33	1225	1225
6	3/4	4	1700	7.7	52	K	106	106	2120	2120
8	1	11.5	1950	12	113	K	212	213	4140	4140
10	1-1/4	14.6	3500	25	216	K	406	409	7661	9820
12	1-1/2	27.3	5200	35	360	K	687	695	12,000	12,000

Phoenix III Seal / Metal Bearing (Forward Flow)[2]

Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	1/2	1.2	350	- - -	0.8	θ	1.8	8	515	515
4	5/8	1.9	900	- - -	3.1	θ	4.7	25	1225	1225
6	3/4	4	1700	- - -	30	K	24	70	2120	2120
8	1	11.5	1950	- - -	65	K	47	165	4140	4140
10	1-1/4	14.6	3500	- - -	125	K	90	310	7661	9820
12	1-1/2	27.3	5200	- - -	216	K	140	580	12,000	12,000

1. Use 80° for valve units with greater than 80° maximum rotation.
2. Reverse flow is the preferred direction

EMERSON.
Process Management

CL300 Torque Characteristics

Phoenix III Seal / PEEK/PTFE Bearing (Reverse Flow)(2)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	5/8	0.85	270	1.2	6.7	K	14	14.7	910	1225
4	3/4	1.20	800	2.0	12	K	27.5	27.9	1700	2120
6	1	1.99	1600	2.5	52	K	83	83	3095	4140
8	1-1/4	5.27	1500	12	119	K	209	229	5455	9820
10	1-1/2	8.1	2150	24	228	K	400	438	8225	12,000
12	1-3/4	14	4200	41	386	K	675	741	14,700	23,524
Phoenix III Seal / PEEK/PTFE Bearing (Forward Flow)(2)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	5/8	0.85	270	- - -	0.9	θ	2.0	9	910	1225
4	3/4	1.20	800	- - -	3.0	θ	6.5	25	1700	2120
6	1	1.99	1600	- - -	13.7	K	11	60	3095	4140
8	1-1/4	5.27	1500	- - -	56	K	56	150	5455	9820
10	1-1/2	8.1	2150	- - -	107	K	106	280	8225	12,000
12	1-3/4	14	4200	- - -	182	K	180	460	14,700	23,524
Phoenix III Seal / Metal Bearing (Reverse Flow)(2)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		80°(1)		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	5/8	1.3	350	1.2	6.7	K	14	14.7	1225	1225
4	3/4	2.24	1000	2.0	12	K	27.5	27.9	2120	2120
6	1	5.4	1750	2.5	52	K	83	83	4140	4140
8	1-1/4	13	2000	12	119	K	209	229	9820	9820
10	1-1/2	16.1	3500	24	228	K	400	438	12,000	12,000
12	1-3/4	29.5	5200	41	386	K	675	741	23,524	23,524
Phoenix III Seal / Metal Bearing (Forward Flow)(2)										
Valve Size, NPS	Shaft Diameter, Inches	A	B	C					Maximum Torque, In-lbs	
				10°	60°	75°		90°		
				Value	Value	Torque	Value	Value	Breakout T_B	Dynamic T_D
3	5/8	1.3	350	- - -	0.9	θ	2.0	9	1225	1225
4	3/4	2.24	1000	- - -	3.0	θ	6.5	25	2120	2120
6	1	5.4	1750	- - -	13.7	K	11	60	4140	4140
8	1-1/4	13	2000	- - -	56	K	56	150	9820	9820
10	1-1/2	16.1	3500	- - -	107	K	106	280	12,000	12,000
12	1-3/4	29.5	5200	- - -	182	K	180	460	23,524	23,524

1. Use 80° for valve units with greater than 80° maximum rotation.
2. Reverse flow is the preferred direction.

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).
   Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)
   Calculate the ΔP_{eff} effective pressure drop at the angles listed in the tables. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the smaller of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in the tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only
  $\Delta P_{eff} = F_L^2\ (P_{1abs} - F_F\ P_v)$

- Gas only
  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables
$\Delta P_{shutoff}$ = Actual pressure at shutoff
ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Torque tends to CLOSE the valve
θ = Torque tends to OPEN the valve

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PEEK/PTFE Bearings with PTFE Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			60° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.30	100	1.05	2.45	515	515
3	5/8	0.56	150	3.59	10.8	1225	1225
4	3/4	0.99	232	7.65	21.2	2120	2120
6	1	2.30	438	17.5	46.7	4140	4140
8	1-1/4	4.80	705	33.4	223	9820	9820
10	1-1/4	8.10	1056	82.2	358	9820	9820
12	1-1/2	12.5	1470	106	626	12000	12000

PEEK/PTFE Bearings with Metal Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			60° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.23	297	1.05	2.45	515	515
3	5/8	0.46	510	3.59	10.8	1225	1225
4	3/4	1.72	750	7.65	21.2	2120	2120
6	1	1.99	1672	17.5	46.7	4140	4140
8	1-1/4	5.33	1900	33.4	223	9820	9820
10	1-1/4	7.37	4100	82.2	358	9820	9820
12	1-1/2	11.6	5880	106	626	12000	12000

PEEK/PTFE Bearings with No Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			60° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.30	36.2	1.05	2.45	515	515
3	5/8	0.60	78.4	3.59	10.8	1225	1225
4	3/4	1.00	101	7.65	21.2	2120	2120
6	1	2.41	187	17.5	46.7	4140	4140
8	1-1/4	4.82	276	33.4	223	9820	9820
10	1-1/4	8.08	276	82.2	358	9820	9820
12	1-1/2	12.4	389	106	626	12000	12000

Metal Bearings with Metal Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			60° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.77	297	1.05	2.45	515	515
3	5/8	1.71	525	3.59	10.8	1225	1225
4	3/4	3.35	849	7.65	21.2	2120	2120
6	1	7.80	1795	17.5	46.7	4140	4140
8	1-1/4	17.1	2000	33.4	223	9820	9820
10	1-1/4	25.0	4200	82.2	358	9820	9820
12	1-1/2	52.4	5919	106	626	12000	12000

Metal Bearings with No Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			60° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.82	134	1.05	2.45	515	515
3	5/8	1.76	202	3.59	10.8	1225	1225
4	3/4	3.43	389	7.65	21.2	2120	2120
6	1	8.00	815	17.5	46.7	4140	4140
8	1-1/4	17.3	886	33.4	223	9820	9820
10	1-1/4	25.3	1414	82.2	358	9820	9820
12	1-1/2	52.8	2017	106	626	12000	12000

K VALUES FOR EFFECTIVE PRESSURE DROP, ΔP_{eff}		
Valve Size, NPS	Angle of Opening	
	60°	90°
2	0.23	0.16
3	0.17	0.10
4	0.18	0.10
6	0.16	0.10
8	0.16	0.06
10	0.14	0.07
12	0.13	0.07

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\,(\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\,(\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

Calculate the ΔP_{eff} effective pressure drop at the angles listed in the tables. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the smaller of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in the tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only

  $\Delta P_{eff} = F_L^2\,(P_{1abs} - F_F\,P_v)$

- Gas only

  $\Delta P_{eff} = K\,P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables

$\Delta P_{shutoff}$ = Actual pressure at shutoff

ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Torque tends to CLOSE the valve
θ = Torque tends to OPEN the valve

K VALUES FOR EFFECTIVE PRESSURE DROP, ΔP_{eff}	
Valve Size, NPS	**Angle of Opening, 90°**
3	0.13
4	0.11
6	0.15
8	0.10
10	0.11
12	0.10
14	0.10
16	0.11
18	0.09
20	0.10
24	0.08

ETFE Seal with PEEK Bearings											
Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	0.40	229	0	2	2	6	6	1424	939	- - -
4	3/4	0.76	364	1	3	4	7	8	2460	1953	- - -
6	1-1/4	2.27	923	4	10	19	42	48	11388	7673	- - -
8	1-1/2	5.03	1543	10	42	68	105	103	13972	14247	- - -
10	1-3/4	10.31	2710	19	86	148	233	235	27289	33890	- - -
12	2	15.97	3638	31	122	214	337	347	27289	33890	- - -
14	2-1/2	21.16	4504	38	143	264	403	421	64685	- - -	57096
16	2-1/2	32.24	6343	57	202	363	579	613	64685	- - -	105279
18	3	48.86	8701	83	272	491	785	841	177497	- - -	105279
20	3	66.37	11220	107	304	542	862	931	177497	- - -	105279
24	3	112.32	13945	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

ETFE Seal with Metal Bearings											
Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	0.50	229	0	2	2	6	6	1424	939	- - -
4	3/4	0.97	364	1	3	4	7	8	2460	1953	- - -
6	1-1/4	2.97	923	4	10	19	42	48	11388	7673	- - -
8	1-1/2	6.63	1543	10	42	68	105	103	13972	14247	- - -
10	1-3/4	13.73	2710	19	86	148	233	235	27289	33890	- - -
12	2	21.35	3638	31	122	214	337	347	27289	33890	- - -
14	2-1/2	28.37	4504	38	143	264	403	421	64685	- - -	57096
16	2-1/2	43.41	6343	57	202	363	579	613	64685	- - -	105279
18	3	66.01	8701	83	272	491	785	841	177497	- - -	105279
20	3	89.88	11220	107	304	542	862	931	177497	- - -	105279
24	3	152.41	13945	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Phoenix III Seal with PEEK Bearings											
Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	0.36	659	0	2	2	6	6	1424	939	- - -
4	3/4	0.73	948	1	3	4	7	8	2460	1953	- - -
6	1-1/4	2.34	1762	4	10	19	42	48	11388	7673	- - -
8	1-1/2	5.48	2570	10	42	68	105	103	13972	14247	- - -
10	1-3/4	11.50	4355	19	86	148	233	235	27289	33890	- - -
12	2	18.21	5936	31	122	214	337	347	27289	33890	- - -
14	2-1/2	24.28	7275	38	143	264	403	421	64685	- - -	57096
16	2-1/2	37.10	9922	57	202	363	579	613	64685	- - -	105279
18	3	56.60	13409	83	272	491	785	841	177497	- - -	105279
20	3	76.83	16870	107	304	542	862	931	177497	- - -	105279
24	3	132.82	24024	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Phoenix III Seal with Metal Bearings											
Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	0.46	659	0	2	2	6	6	1424	939	- - -
4	3/4	0.93	948	1	3	4	7	8	2460	1953	- - -
6	1-1/4	3.04	1762	4	10	19	42	48	11388	7673	- - -
8	1-1/2	7.08	2570	10	42	68	105	103	13972	14247	- - -
10	1-3/4	14.92	4355	19	86	148	233	235	27289	33890	- - -
12	2	23.58	5936	31	122	214	337	347	27289	33890	- - -
14	2-1/2	31.49	7275	38	143	264	403	421	64685	- - -	57096
16	2-1/2	48.27	9922	57	202	363	579	613	64685	- - -	105279
18	3	73.74	13409	83	272	491	785	841	177497	- - -	105279
20	3	100.34	16870	107	304	542	862	931	177497	- - -	105279
24	3	172.92	24024	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Metal Seal with PEEK Bearings

Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	0.43	463	0	2	2	6	6	1424	939	- - -
4	3/4	0.83	756	1	3	4	7	8	2460	1953	- - -
6	1-1/4	2.49	1716	4	10	19	42	48	11388	7673	- - -
8	1-1/2	5.58	3057	10	42	68	105	103	13972	14247	- - -
10	1-3/4	11.3.6	4382	19	86	148	233	235	27289	33890	- - -
12	2	17.64	5363	31	122	214	337	347	27289	33890	- - -
14	2-1/2	23.31	6222	38	143	264	403	421	64685	- - -	57096
16	2-1/2	35.25	7990	57	202	363	579	613	64685	- - -	105279
18	3	53.19	10159	83	272	491	785	841	177497	- - -	105279
20	3	71.87	12466	107	304	542	862	931	177497	- - -	105279
24	3	121.75	15847	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Metal Seal with Metal Bearings

Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	0.53	463	0	2	2	6	6	1424	939	- - -
4	3/4	1.04	756	1	3	4	7	8	2460	1953	- - -
6	1-1/4	3.19	1716	4	10	19	42	48	11388	7673	- - -
8	1-1/2	7.18	3057	10	42	68	105	103	13972	14247	- - -
10	1-3/4	14.79	4382	19	86	148	233	235	27289	33890	- - -
12	2	23.02	5363	31	122	214	337	347	27289	33890	- - -
14	2-1/2	30.51	6222	38	143	264	403	421	64685	- - -	57096
16	2-1/2	46.42	7990	57	202	363	579	613	64685	- - -	105279
18	3	70.34	10159	83	272	491	785	841	177497	- - -	105279
20	3	95.38	12466	107	304	542	862	931	177497	- - -	105279
24	3	161.84	15847	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

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HPS Seal with PEEK Bearings												
Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	1.21	792	0	2	2	6	6	1424	939	- - -
4	3/4	1.94	1087	1	3	4	7	8	2460	1953	- - -
6	1-1/4	4.21	1914	4	10	19	42	48	11388	7673	- - -
8	1-1/2	8.07	2809	10	42	68	105	103	13972	14247	- - -
10	1-3/4	14.51	4165	19	86	148	233	235	27289	33890	- - -
12	2	21.24	5190	31	122	214	337	347	27289	33890	- - -
14	2-1/2	27.14	6084	38	143	264	403	421	64685	- - -	57096
16	2-1/2	39.32	7917	57	202	363	579	613	64685	- - -	105279
18	3	57.34	10180	83	272	491	785	841	177497	- - -	105279
20	3	75.91	12567	107	304	542	862	931	177497	- - -	105279
24	3	124.74	16196	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

HPS Seal with Metal Bearings											
Valve Size	Shaft Diameter (1)	A	B	C					Maximum Allowable Torque, lbf•in		
				ANGLE OF OPENING					S17400 H1025 Shaft Materials		
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Square Shaft	Keyed Shaft
3	5/8	1.31	792	0	2	2	6	6	1424	939	- - -
4	3/4	2.14	1087	1	3	4	7	8	2460	1953	- - -
6	1-1/4	4.91	1914	4	10	19	42	48	11388	7673	- - -
8	1-1/2	9.67	2809	10	42	68	105	103	13972	14247	- - -
10	1-3/4	17.93	4165	19	86	148	233	235	27289	33890	- - -
12	2	26.62	5190	31	122	214	337	347	27289	33890	- - -
14	2-1/2	34.35	6084	38	143	264	403	421	64685	- - -	57096
16	2-1/2	50.49	7917	57	202	363	579	613	64685	- - -	105279
18	3	74.49	10180	83	272	491	785	841	177497	- - -	105279
20	3	99.42	12567	107	304	542	862	931	177497	- - -	105279
24	3	164.84	16196	193	643	1226	2006	2213	177497	- - -	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Valve Size	Shaft Diameter(1)	Maximum Allowable Torque, lbf • in					
		Spline Shaft					
NPS	Inch	S17400 H1025	S20910	N07718	N05500	N10276	S31803
3	5/8	1424	1031	1178	1080	403	638
4	3/4	2460	1781	2036	1866	696	1103
6	1-1/4	11388	8247	9425	8639	3220	5105
8	1-1/2	13972	10118	11563	10599	3951	6263
10	1-3/4	27289	19761	22584	20702	7716	12233
12	2	27289	14115	22584	20702	7716	12233
14	2-1/2	64685	33458	53533	49072	18290	28997
16	2-1/2	64685	33458	53533	49072	18290	28997
18	3	177497	73447	146894	134653	50189	79567
20	3	177497	73447	146894	134653	50189	79567
24	3	177497	73447	146894	134653	50189	79567

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Valve Size	Square Size	Maximum Allowable Torque, lbf • in					
		Square Shaft					
NPS	mm	S17400 H1025	S20910	N07718	N05500	N10276	S31803
3	11	939	680	777	713	266	421
4	14	1953	1414	1616	1482	552	875
6	22	7673	5557	6350	5821	2170	3440
8	27	14247	10317	11790	10808	4028	6386
10	36	33890	24541	28047	25710	9583	15192
12	36	33890	17529	28047	25710	9583	15192

Valve Size	Shaft Diameter(1)	Maximum Allowable Torque, lbf • in					
		Keyed Shaft					
NPS	Inch	S17400 H1025	S20910	N07718	N05500	N10276	S31803
14	2-1/4	57096	57096	57096	57096	36533	57096
16	2-3/4	105279	105279	105279	105279	66750	105279
18	2-3/4	105279	97683	105279	105279	66750	105279
20	2-3/4	105279	97683	105279	105279	66750	105279
24	2-3/4	105279	97683	105279	105279	66750	105279

1. Nominal diameter of shaft at the key. For more dimensions, see Fisher bulletin 51.6:8590 (D104017X012)

Torque Equations

Breakout Torque

$T_B = A\,(\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\,(\Delta P_{eff})$

Valve Body Torque Requirements

1. Determine T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from table 1. Use the correct B factor. Calculate T_B.

2. Determine T_D (dynamic torque) for the maximum angle of opening.

First, refer to table 2 and use the appropriate equation to determine ΔP_{eff} for the disk style and fluid at the maximum angle of rotation.

If the actual flowing pressure drop is known at the maximum angle of rotation, compare it to the calculated ΔP_{eff}. Use the smaller of the two values (actual ΔP or calculated ΔP_{eff}) as ΔP_{eff} in the dynamic torque equation. C factors are in table 1. Calculate T_D.

3. Table 1 list the maximum allowable torques for Fisher® 9500 butterfly valve bodies with 17-4PH stainless steel shafts. For valve bodies that have other shaft materials, multiply the maximum allowable torques in table 1 by the percentages listed in table 3. Both the breakout and dynamic torques must be less than the maximum allowable torque shown in table 1 or calculated according to the percentages in table 3.

Selecting Fisher 1051 or 1052 Spring- and-Diaphragm or 1066SR Spring-Return Piston Actuator

Turn to the pages covering these actuators and refer to the available actuator torque tables on those pages. Select either a push-down-to-close (PDTC) or push-down-to-open (PDTO) construction and an actuator size and spring combination that supplies more breakout torque and more dynamic torque at the maximum angle of rotation than required by the valve body.

If the 9500 butterfly valve body has the required capacity at 60° rotation, calculate T_D at 60° and check the actuator torque tables under 60° rotation to see if limiting the actuator maximum rotation allows the selection of a smaller actuator.

Note that the springs listed in 1052 table 2, Actuator Torques for 60° Limited Maximum Rotation, yield higher breakout torques for the specific actuator size and air-to-diaphragm combination than the springs listed in 1052 table 1.

Selecting Fisher 1061 or 1066 Piston Actuator

Turn to the appropriate actuator page and use the procedure given there.

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Table 1. Torque Characteristics

VALVE SIZE, NPS	SHAFT DIAMETER, INCH	A	B		C				MAXIMUM ALLOWABLE TORQUE, LBF•INCH
			Nitrile Liner	PTFE Liner	Conventional Disk		FISHTAIL™ Disc		
					60°	90°	60°	90°	
2	1/2	0.050	110	110	1.20	3.83	0.450	0.645	483
3	5/8	0.125	300	215	4.05	12.9	1.41	2.19	943
4	5/8	0.230	700	370	9.60	30.6	5.28	9.32	943
6	3/4	0.600	1000	730	32.3	104	18.8	38.0	1630
8	1	1.47	1500	1500	76.5	245	44.6	89.7	3865
10	1	2.20	2500	2100	150	480	93.0	230	3865
12	1-1/4	4.13	4000	3100	260	822	158	389	7550

Table 2. Effective Pressure Drop (ΔP_{eff}), Psi

Disc Style	Service	For 60° Maximum Angle of Rotation	For 90° Maximum Angle of Rotation
Conventional	Liquid	$\Delta P_{eff} = 0.450\ P_{1\ abs}$	$\Delta P_{eff} = 0.350\ P_{1\ abs}$
	Gaseous	$\Delta P_{eff} = 0.200\ P_{1\ abs}$	$\Delta P_{eff} = 0.140\ P_{1\ abs}$
FISHTAIL	Liquid	$\Delta P_{eff} = 0.600\ P_{1\ abs}$	$\Delta P_{eff} = 0.450\ P_{1\ abs}$
	Gaseous	$\Delta P_{eff} = 0.180\ P_{1\ abs}$	$\Delta P_{eff} = 0.090\ P_{1\ abs}$

Note: Use absolute inlet pressure at maximum angle of rotation.

Table 3. Relative Strengths of Shaft Materials

SHAFT MATERIAL	TEMPERATURE, °F			
	- 423 to - 20	- 19 to 100	101 to 200	201 to 300
	Relative Strength (Percent of Maximum Allowable Torque Listed in Table 1)			
S17400 (17-4PH stainless steel) H1075	- - -	100	100	100
S31600 or S31700 (316 or 317 stainless steel (annealed)	53	53	53	52
N05500	93	93	93	93
S20910	- - -	71	71	71

Selecting Manual Actuator

Select an actuator that supplies more torque than the largest of the valve body torque requirements.

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque.

Use the appropriate table for soft, NOVEX, metal, HPS, Phoenix III, and cryogenic seals and bearing materials. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\,(\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\,(\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

For flow in the preferred direction, calculate the ΔP_{eff} effective pressure drop at 10, 60, 75, and 80 degrees. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

For flow in the nonpreferred direction, calculate the pressure drop at 10, 60, 75, and 90 degrees of rotation.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the **smaller** of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- **Liquid only**

$\Delta P_{eff} = F_L^2\,(P_{1abs} - F_F\,P_v)$

- **Gas only**

$\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables
$\Delta P_{shutoff}$ = Actual pressure at shutoff
ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
κ = Valve torque tends to close the valve (kappa)
θ = Valve torque beyond this degree of opening tends to open the valve (theta)

K Values for Effective Pressure Drop for Gas Reverse and Forward Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES				
	10	60	75	80	90
CL150					
30-42	0.227	0.203	0.155	0.136	0.103
CL300					
30-42	0.231	0.181	0.132	0.117	0.103
CL600					
3-48	0.231	0.166	0.123	0.114	0.103
CL900					
6-36	0.234	0.140	0.112	0.106	0.102
CL1500					
10-20	0.242	0.121	0.106	0.102	0.102

CL150/150 Torque Characteristics

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque, Lbf•in
					10°	45°	60°	75°	80°	
			PTFE Seal	UHMWPE Seal	Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing										
30	2-1/4	110	6165	13610	317	1914	4289	11078	14026	57096
36	2-1/4	175	8490	19364	501	3087	7172	18871	24275	57096
42	2-3/4	283	11279	26663	722	4125	9777	26013	33878	105279
48	2-3/4	425	14343	34945	1036	5760	13944	37544	49424	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
NOVEX[(1)] Metal Seal / PTFE Packing / PEEK Bearing									
30	2-1/4	141	8158	317	1914	4289	11078	14026	57096
36	2-1/4	216	10111	501	3087	7172	18871	24275	57096
42	2-3/4	335	12621	722	4125	9777	26013	33878	105279
48	2-3/4	489	15312	1036	5760	13944	37544	49424	105279
NOVEX[(1)] Metal Seal / Graphite Packing / Metal Bearing									
30	2-1/4	182	9096	317	1914	4289	11078	14026	57096
36	2-1/4	282	11271	501	3087	7172	18871	24275	57096
42	2-3/4	442	14303	722	4125	9777	26013	33878	105279
48	2-3/4	650	17626	1036	5760	13944	37544	49424	105279
Phoenix III Seal / PTFE Packing / PEEK Bearing									
30	2-1/4	178	16871	317	1914	4289	11078	14026	57096
36	2-1/4	291	24083	501	3087	7172	18871	24275	57096
42	2-3/4	466	33121	722	4125	9777	26013	33878	105279
48	2-3/4	693	43359	1036	5760	13944	37544	49424	105279
Phoenix III Seal / Graphite Packing / Metal Bearing									
30	2-1/4	219	17809	317	1914	4289	11078	14026	57096
36	2-1/4	357	25243	501	3087	7172	18871	24275	57096
42	2-3/4	573	34803	722	4125	9777	26013	33878	105279
48	2-3/4	855	45673	1036	5760	13944	37544	49424	105279

1. NOVEX style seals are available in NPS 36 and 38. Metal seals are available in NPS 42 and 48.

Note: Values are based on S17400 H1025 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150M Seal	Value	Value	Value	Value	Value	
NOVEX(1) Metal Seal / PTFE Packing / PTFE Rexnord Bearings											
30	2-1/4	113.36	11502	11502	15578	317	1914	4289	11078	14026	54123
36	2-1/4	172.16	14256	14256	19311	501	3087	7172	18871	24275	57096
42	2-3/4	264.13	17598	17598	23666	764	4601	10972	29276	38142	105279
48	2-3/4	382.55	21118	21118	28196	1036	5760	13944	37544	49424	90136

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
CTFE (no backup ring) / PTFE Packing / PTFE Rexnord Bearings									
30	2-1/4	95.17	13108	317	1914	4289	11078	14026	54123
36	2-1/4	149.66	18638	501	3087	7172	18871	24275	57096
42	2-3/4	237.43	25669	764	4601	10972	29276	38142	105279
48	2-3/4	351.96	33650	1036	5760	13944	37544	49424	90136

Note: Values are based on S17400 H1150 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque, Lbf•in
					10°	45°	60°	75°	80°	
			PTFE Seal	UHMWPE Seal	Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing										
30	2-3/4	131	6350	14341	297	1414	3074	7821	9883	76373
36	2-3/4	238	9007	21302	509	2298	5125	13222	16962	105279
42	2-3/4	347	11701	28270	755	3579	8270	21745	28273	105279
48	2-3/4	507	14783	36683	1043	4652	10904	28935	38012	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
NOVEX(1) Metal Seal / PTFE Packing / PEEK Bearing									
30	2-3/4	162	8928	297	1414	3074	7821	9883	76373
36	2-3/4	279	12044	509	2298	5125	13222	16962	105279
42	2-3/4	399	14267	755	3579	8270	21745	28273	105279
48	2-3/4	570	17212	1043	4652	10904	28935	38012	105279
NOVEX(1) Metal Seal / Graphite Packing / Metal Bearing									
30	2-3/4	212	10336	297	1414	3074	7821	9883	76373
36	2-3/4	370	14358	509	2298	5125	13222	16962	105279
42	2-3/4	531	16939	755	3579	8270	21745	28273	105279
48	2-3/4	763	20686	1043	4652	10904	28935	38012	105279
Phoenix III Seal / PTFE Packing / PEEK Bearing									
30	2-3/4	199	17586	297	1414	3074	7821	9883	76373
36	2-3/4	354	26022	509	2298	5125	13222	16962	105279
42	2-3/4	530	34714	755	3579	8270	21745	28273	105279
48	2-3/4	773	45042	1043	4652	10904	28935	38012	105279
Phoenix III Seal / Graphite Packing / Metal Bearing									
30	2-3/4	248	18994	297	1414	3074	7821	9883	76373
36	2-3/4	445	28336	509	2298	5125	13222	16962	105279
42	2-3/4	662	37386	755	3579	8270	21745	28273	105279
48	2-3/4	965	48516	1043	4652	10904	28935	38012	105279

1. NOVEX style seals are available in NPS 36 and 38. Metal seals are available in NPS 42 and 48.

Note: Values are based on S17400 H1025 shaft material.

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VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
			S20910 Seal	S21800 Seal	H1150M Seal	10°	45°	60°	75°	80°	
						Value	Value	Value	Value	Value	
NOVEX(1) Metal Seal / PTFE Packing / PTFE Rexnord Bearings											
30	2-1/4	129.29	12262	12262	16327	297	1414	3074	7821	9882	67277
36	2-1/4	219.92	16191	16191	21246	509	2298	5125	13222	16962	105279
42	2-3/4	312.54	19238	19238	25298	755	3579	8270	21745	28273	105279
48	2-3/4	443.61	22995	22995	30046	1043	4652	10904	28935	38012	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
CTFE (no backup ring) / PTFE Packing / PTFE Rexnord Bearings									
30	2-1/4	111.14	13841	297	1414	3074	7821	9882	67277
36	2-1/4	197.42	20576	509	2298	5125	13222	16962	105279
42	2-3/4	285.87	27279	755	3579	8270	21745	28273	105279
48	2-3/4	413.13	35397	1043	4652	10904	28935	38012	105279

Note: Values are based on S17400 H1150 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque, Lbf•in
					10°	45°	60°	75°	80°	
			PTFE Seal	UHMWPE Seal	Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing										
30	2-3/4	177	6754	16580	374	1401	2709	5159	6050	105279
36	3-3/4	297	9468	23634	626	2394	4796	9294	11092	231216
42	4	394	11422	28768	927	4155	8781	17460	21184	274656
48	5-3/4	776	17201	45953	1422	4448	8986	17524	21396	603120

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque, Lbf•in
					10°	45°	60°	75°	80°	
			S31600 Seal	S21800 Seal	Value	Value	Value	Value	Value	
NOVEX[1] Metal Seal / PTFE Packing / PEEK Bearing										
30	2-3/4	205	11989	15121	374	1401	2709	5159	6050	105279
36	3-3/4	336	15207	19192	626	2394	4796	9294	11092	231216
42	4	440	17197	21764	927	4155	8781	17460	21184	274656
48	5-3/4	839	26859	32590	1422	4448	8986	17524	21396	603120
NOVEX[1] Metal Seal / Graphite Packing / Metal Bearing										
30	2-3/4	272	15464	18596	374	1401	2709	5159	6050	105279
36	3-3/4	449	19599	23585	626	2394	4796	9294	11092	231216
42	4	590	22094	26661	927	4155	8781	17460	21184	274656
48	5-3/4	1134	36155	41886	1422	4448	8986	17524	21396	603120
1. NOVEX style seals are not available in sizes over 36 inches.										

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing									
30	2-3/4	234	19494	374	1401	2709	5159	6050	105279
36	3-3/4	402	28042	626	2394	4796	9294	11092	231216
42	4	542	34339	927	4155	8781	17460	21184	274656
48	5-3/4	1036	54182	1422	4448	8986	17524	21396	603120
Phoenix III Seal / Graphite Packing / Metal Bearing									
30	2-3/4	302	22,968	374	1401	2709	5159	6050	105279
36	3-3/4	515	32,435	626	2394	4796	9294	11092	231216
42	4	691	39,236	927	4155	8781	17460	21184	274656
48	5-3/4	1331	63,478	1422	4448	8986	17524	21396	603120

Note: Values are based on S17400 H1025 shaft material.

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VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150M Seal	Value	Value	Value	Value	Value	
NOVEX[1] Metal Seal / PTFE Packing / PTFE Rexnord Bearings											
30	2-1/4	161.06	15121	15121	18940	374	1401	2709	5159	6050	105279
36	2-1/4	261.82	19192	19192	24051	626	2394	4796	9294	11092	231216
42	2-3/4	342.21	21764	21764	27331	927	4155	8782	17461	21184	274656
48	2-3/4	645.13	32590	32590	39577	1422	4448	8986	17524	21396	765101

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
CTFE (no backup ring) / PTFE Packing / PTFE Rexnord Bearings									
30	2-1/4	144.04	16131	374	1401	2709	5159	6050	105279
36	2-1/4	240.16	22956	626	2394	4796	9294	11092	231216
42	2-3/4	317.55	27912	927	4155	8782	17461	21184	274656
48	2-3/4	614.88	44687	1422	4448	8986	17524	21396	765101

Note: Values are based on S17400 H1150 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B		C					Maximum Allowable Torque, Lbf•in
		ETFE Seal	UHMWPE Seal	ETFE Seal	UHMWPE Seal	10° Value	45° Value	60° Value	75° Value	80° Value	
Soft Seal / PTFE Packing / PEEK Bearing											
3	13/32	0.37	0.24	171	176	0	2	2	6	6	790
4	5/8	0.76	0.55	299	307	1	3	4	7	8	2794
6	7/8	2.09	1.66	652	669	4	10	19	42	48	7040
8	1	5.03	4.21	1241	1273	10	42	68	105	103	11956
10	1-3/8	9.18	7.87	1892	1943	19	86	148	233	235	31157
12	1-3/8	16.0	14.2	2894	2966	31	122	214	337	347	31157
14	2-1/4	21.2	19.0	3563	3650	38	143	264	403	421	57096
16	2-3/4	32.2	29.4	4928	5040	57	202	363	579	613	78671
18	2-3/4	48.8	45.1	6707	6854	83	272	491	785	841	105279
20	2-3/4	66.3	61.9	8536	8712	107	304	542	862	931	105279
24	2-3/4	112	105	10457	12241	193	643	1226	2006	2213	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
			S20910 Seal	S21800 Seal	H1150M Seal	10° Value	45° Value	60° Value	75° Value	80° Value	
Metal Seal / PTFE Packing / PEEK Bearings											
3	13/32	0.40	404	404	550	0	2	2	6	6	790
4	5/8	0.83	691	691	936	1	3	4	7	8	2794
6	7/8	2.30	1445	1445	1939	4	10	19	42	48	7040
8	1	5.57	2756	2756	3694	10	42	68	105	103	11956
10	1-3/8	10.2	3564	3564	4753	19	86	148	233	235	31157
12	1-3/8	17.6	4619	4619	6025	31	122	214	337	347	31157
14	2-1/4	23.3	5281	5281	6826	38	143	254	403	421	57096
16	2-3/4	35.2	6575	6575	8332	57	202	363	579	613	78671
18	2-3/4	53.2	8165	8165	10181	83	272	491	785	841	105279
20	2-3/4	71.8	9782	9782	11992	107	304	542	862	931	105279
24	2-3/4	122	12359	12359	15082	193	643	1226	2006	2213	105279
Metal Seal / Graphite Packing / Metal Bearing											
3	13/32	0.49	438	438	584	0	2	2	6	6	790
4	5/8	1.04	755	755	1000	1	3	4	7	8	2858
6	7/8	2.93	1603	1603	2097	4	10	19	42	48	7198
8	1	7.17	3056	3056	3994	10	42	68	105	103	11956
10	1-3/8	13.2	3987	3987	5176	19	86	148	233	235	31157
12	1-3/8	23.0	5361	5361	6767	31	122	214	337	347	31157
14	2-1/4	30.5	6220	6220	7765	38	143	254	403	421	57096
16	2-3/4	46.4	7982	7982	9738	57	202	363	579	613	80078
18	2-3/4	70.3	10149	10149	12165	83	272	491	785	841	105279
20	2-3/4	95.3	12454	12454	14664	107	304	542	862	931	105279
24	2-3/4	162	15833	15833	18557	193	643	1226	2006	2213	105279

Note: NPS 3 through 12 valves have square shafts and show dimension at the square connection. NPS 14 through 24 valves have keyed shafts and show diameter at keyway. Values are based on S17400 H1025 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing									
3	13/32	0.33	601	0	2	2	6	6	790
4	5/8	0.73	883	1	3	4	7	8	2794
6	7/8	2.15	1491	4	10	19	42	48	7040
8	1	5.47	2268	10	42	68	105	103	11956
10	1-3/8	10.4	3536	19	86	148	233	235	31157
12	1-3/8	18.2	5192	31	122	214	337	347	31157
14	2-1/4	24.3	6334	38	143	254	403	421	57096
16	2-3/4	37.1	8507	57	202	363	579	613	78671
18	2-3/4	56.6	11415	73	272	491	785	841	105279
20	2-3/4	76.8	14186	107	304	542	862	931	105279
24	2-3/4	133	20536	193	643	1226	2006	2213	105279
Phoenix III Seal / Graphite Packing / Metal Bearing									
3	13/32	0.42	635	0	2	2	6	6	790
4	5/8	0.93	947	1	3	4	7	8	2858
6	7/8	2.78	1649	4	10	19	42	48	7198
8	1	7.07	2568	10	42	68	105	103	11956
10	1-3/8	13.4	3960	19	86	148	233	235	31157
12	1-3/8	23.6	5934	31	122	214	337	347	31157
14	2-1/4	31.5	7273	38	143	254	403	421	57096
16	2-3/4	48.2	9914	57	202	363	579	613	80078
18	2-3/4	73.7	13399	73	272	491	785	841	105279
20	2-3/4	100	16858	107	304	542	862	931	105279
24	2-3/4	173	24010	193	643	1226	2006	2213	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150M Seal	Value	Value	Value	Value	Value	
High-Pressure Seal / PTFE Packing / PEEK Bearings											
3	13/32	1.18	734	734	1012	0	2	2	6	6	790
4	5/8	1.93	1022	1022	1398	0	3	4	7	8	2794
6	7/8	4.02	1643	1643	2209	4	10	19	42	48	7040
8	1	8.07	2508	2508	3331	10	42	68	105	103	11956
10	1-3/8	13.38	3346	3346	4429	19	87	148	233	235	31157
12	1-3/8	21.24	4446	4446	5761	31	122	214	338	347	31157
14	2-1/4	27.13	5144	5144	6611	38	143	254	403	421	57096
16	2-3/4	39.29	6502	6502	8204	57	202	363	579	613	78671
18	2-3/4	57.3	8186	8186	10183	83	272	491	785	841	105279
20	2-3/4	75.86	9883	9883	12103	107	304	543	862	931	105279
24	2-3/4	124.67	12708	12708	15535	194	643	1226	2006	2213	105279
High-Pressure Seal / Graphite Packing / Metal Bearings											
3	13/32	1.28	767	767	1045	0	2	2	6	6	790
4	5/8	2.14	1086	1086	1462	0	3	4	7	8	2858
6	7/8	4.65	1801	1801	2367	4	10	19	42	48	7198
8	1	9.67	2808	2808	3631	10	42	68	105	103	11956
10	1-3/8	16.37	3770	3770	4853	19	87	148	233	235	31157
12	1-3/8	26.61	5188	5188	6503	31	122	214	338	347	31157
14	2-1/4	34.34	6082	6082	7549	38	143	254	403	421	57096
16	2-3/4	50.45	7909	7909	9611	57	202	363	579	613	80078
18	2-3/4	74.43	10170	10170	12167	83	272	491	785	841	105279
20	2-3/4	99.36	12555	12555	14775	107	304	543	862	931	105279
24	2-3/4	164.74	16182	16182	19010	194	643	1226	2006	2213	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150M Seal	Value	Value	Value	Value	Value	
High-Pressure Seal / PTFE Packing / PTFE Rexnord Bearings											
3	13/32	1.19	734	734	1012	0	2	2	6	6	671
4	5/8	1.91	1022	1022	1398	0	3	4	7	8	2391
6	7/8	3.83	1643	1643	2209	4	10	19	42	48	6023
8	1	7.31	2508	2508	3331	10	42	68	105	103	10162
10	1-3/8	11.41	3346	3346	4429	19	87	148	233	235	26483
12	1-3/8	17.71	4446	4446	5761	31	122	214	338	347	26483
14	2-1/4	22.41	5144	5144	6611	38	143	254	403	421	54123
16	2-3/4	31.97	6502	6502	8204	57	202	363	579	613	67224
18	2-3/4	48.06	8186	8186	10183	83	272	491	785	841	105279
20	2-3/4	60.45	9883	9883	12103	107	304	543	862	931	105279
24	2-3/4	98.38	12708	12708	15535	194	643	1226	2006	2213	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
CTFE Seal (without Backup Ring) / PTFE Packing / PTFE Rexnord Bearings									
3	13/32	0.37	171	0	2	2	6	6	671
4	5/8	0.73	299	0	3	4	7	8	2391
6	7/8	1.89	652	4	10	19	42	48	6023
8	1	4.27	1241	10	42	68	105	103	10162
10	1-3/8	7.21	1892	19	87	148	233	235	26483
12	1-3/8	12.44	2894	31	122	214	338	347	26483
14	2-1/4	16.43	3563	38	143	254	403	421	54123
16	2-3/4	24.89	4928	57	202	363	579	613	67224
18	2-3/4	37.58	6707	83	272	491	785	841	105279
20	2-3/4	50.91	8536	107	304	543	862	931	105279
24	2-3/4	85.96	11973	194	643	1226	2006	2213	105279

Note: Values are based on S17400 H1150 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing									
6	7/8	1.9	883	4	18	21	26	24	7040
8	1-3/8	4.66	2018	9	33	41	50	48	31157
10	1-3/8	8.72	2911	16	63	82	103	100	31157
12	2-1/4	15.39	5216	24	66	86	106	105	57096
14	2-1/4	19.51	5572	38	162	225	289	292	57096
16	2-3/4	24.99	6696	49	205	293	378	387	78548
18	2-3/4	34.47	8198	67	281	408	531	550	105279
20	2-3/4	48.49	10903	88	332	486	633	663	105279
24	3-3/4	79.89	13728	146	566	857	1133	1209	176951
Phoenix III Seal / PTFE Packing / PEEK Bearing									
6	7/8	1.95	1755	4	18	21	26	24	7040
8	1-3/8	4.93	2853	9	33	41	50	48	31157
10	1-3/8	9.58	4303	16	63	82	103	100	31157
12	2-1/4	16.88	7066	24	66	86	106	105	57096
14	2-1/4	21.82	7917	38	162	225	289	292	57096
16	2-3/4	28.13	9476	49	205	293	378	387	78548
18	2-3/4	39.29	11755	67	281	408	531	550	105279
20	2-3/4	55.36	15290	88	332	486	633	663	105279
24	3-3/4	92.81	21297	146	566	857	1133	1209	176951
Phoenix III Seal / Graphite Packing / Metal Bearing									
6	7/8	2.52	2071	4	18	21	26	24	7198
8	1-3/8	6.45	3700	9	33	41	50	48	31157
10	1-3/8	12.47	5444	16	63	82	103	100	31157
12	2-1/4	22.17	9387	24	66	86	106	105	57096
14	2-1/4	28.53	10238	38	162	225	289	292	57096
16	2-3/4	36.78	12281	49	205	293	378	387	79950
18	2-3/4	51.31	15123	67	281	408	531	550	105279
20	2-3/4	72.46	19917	88	332	486	633	663	105279
24	3-3/4	121.22	27414	146	566	857	1133	1209	176951

Note: NPS 6 through 10 valves have square shafts and show dimension at the square connection. NPS 12 through 24 valves have keyed shafts and show diameter at keyway. Values are based on S17400 H1025 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150 M Seal	Value	Value	Value	Value	Value	
High-Pressure Seal / PTFE Packing / PEEK Bearings											
6	7/8	3.72	1836	1836	2372	4	18	21	26	24	7040
8	1-3/8	7.29	3195	3195	3925	9	33	41	50	48	31157
10	1-3/8	12.47	4304	4304	5286	16	63	82	103	100	31157
12	2-1/4	19.94	6711	6711	7870	24	66	86	106	105	57096
14	2-1/4	24.85	7128	7128	8459	38	162	225	289	292	57096
16	2-3/4	30.97	8277	8277	9746	49	205	293	378	387	78548
18	2-3/4	41.52	9772	9772	11468	67	281	408	531	550	105279
20	2-3/4	56.58	12418	12418	14334	88	332	486	633	663	105279
24	3-3/4	90.25	16076	16076	18470	146	566	857	1133	1209	176951
High-Pressure Seal / Graphite Packing / Metal Bearings											
6	7/8	4.29	2151	2151	2688	4	18	21	26	24	7198
8	1-3/8	8.8	4042	4042	4772	9	33	41	50	48	23852
10	1-3/8	15.36	5445	5445	6427	16	63	82	103	100	31157
12	2-1/4	25.23	9031	9031	10191	24	66	86	106	105	57096
14	2-1/4	31.55	9449	9449	10780	38	162	225	289	292	57096
16	2-3/4	39.63	11082	11082	12551	49	205	293	378	387	79950
18	2-3/4	53.55	13140	13140	14836	67	281	408	531	550	105279
20	2-3/4	73.69	17045	17045	18961	88	332	486	633	663	105279
24	3-3/4	118.67	22194	22194	24587	146	566	857	1133	1209	176951

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150M Seal	Value	Value	Value	Value	Value	
High-Pressure Seal / PTFE Packing / PTFE Rexnord Bearings											
6	7/8	3.56	1836	1836	2372	4	18	21	26	24	6023
8	1-3/8	6.65	3195	3195	3925	9	33	41	50	48	26483
10	1-3/8	10.57	4304	4304	5286	16	63	82	103	100	26483
12	2-1/4	16.47	6711	6711	7870	24	66	86	106	105	57096
14	2-1/4	20.45	7128	7128	8459	38	162	225	289	292	57096
16	2-3/4	25.3	8277	8277	9746	49	205	293	378	387	67118
18	2-3/4	33.64	9772	9772	11486	67	281	408	531	550	105279
20	2-3/4	45.36	12418	12418	14334	88	332	486	633	663	105279
24	3-3/4	71.61	16076	16076	18470	146	566	857	1133	1209	176951

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VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing									
10	2-1/4	8.29	3923	15	41	41	45	43	33772
12	2-1/2	13.88	5444	26	83	84	95	92	71008
14	2-3/4	18.03	6548	31	81	85	95	93	60091
16	2-3/4	28.47	9601	47	116	123	139	138	105279
18	4	39.55	11939	70	201	219	250	251	224998
20	3-3/4	53.35	14563	92	254	281	322	327	226104
Phoenix III Seal / PTFE Packing / PEEK Bearing									
10	2-1/4	8.8	5009	15	41	41	45	43	33772
12	2-1/2	15.02	7047	26	83	84	95	92	71008
14	2-3/4	19.65	8478	31	81	85	95	93	60091
16	2-3/4	31.2	12176	47	116	123	139	138	105279
18	4	43.72	15212	70	201	219	250	251	224998
20	3-3/4	59.41	18633	92	254	281	322	327	226104
Phoenix III Seal / Graphite Packing / Metal Bearing									
10	2-1/4	11.62	6885	15	41	41	45	43	34710
12	2-1/2	19.81	9609	26	83	84	95	92	71008
14	2-3/4	25.91	11560	31	81	85	95	93	60091
16	2-3/4	41.24	16804	47	116	123	139	138	105279
18	4	57.76	20935	70	201	219	250	251	224998
20	3-3/4	78.45	25582	92	254	281	322	327	226104

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
			S20910 Seal	S21800 Seal	H1150M Seal	10°	45°	60°	75°	80°	
						Value	Value	Value	Value	Value	
High-Pressure Seal / PTFE Packing / PEEK Bearings											
10	2-1/4	11.45	5214	5214	6064	15	41	41	45	43	33772
12	2-1/2	18.01	6889	6889	7956	26	83	84	95	92	71008
14	2-3/4	22.71	8055	8055	9243	31	81	85	95	93	60091
16	2-3/4	34.15	11174	11174	12579	47	116	123	139	138	105279
18	4	46.22	13522	13522	15138	70	201	219	250	251	224998
20	3-3/4	61.06	16106	16106	17940	92	254	281	322	327	226104
High-Pressure Seal / Graphite Packing / Metal Bearings											
10	2-1/4	14.27	7090	7090	7940	15	41	41	45	43	34710
12	2-1/2	22.8	9452	9452	10518	26	83	84	95	92	71008
14	2-3/4	28.98	11137	11137	12325	31	81	85	95	93	60091
16	2-3/4	44.19	15801	15801	17207	47	116	123	139	138	105279
18	4	60.26	19245	19245	20861	70	201	219	250	251	224998
20	3-3/4	80.1	23055	23055	24889	92	254	281	322	327	226104

Note: NPS 10 through 20 valves have keyed shafts and show diameter at keyway. Values are based on S17400 H1025 shaft material.

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B			C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
			S20910 Seal	S21800 Seal	H1150M Seal	Value	Value	Value	Value	Value	
High-Pressure Seal / PTFE Packing / PTFE Rexnord Bearings											
10	2-1/4	9.59	5214	5214	6064	15	41	41	45	43	28942
12	2-1/2	14.87	6889	6889	7956	26	83	84	95	92	71008
14	2-3/4	18.6	8055	8055	9243	31	81	85	95	93	60091
16	2-3/4	27.57	11174	11174	12579	47	116	123	139	138	105279
18	4	37.01	13522	13522	15138	70	201	219	250	251	224998
20	3-3/4	48.56	16106	16106	17940	92	254	281	322	327	226104

VALVE SIZE, NPS	SHAFT DIAMETER, INCH	A	B		C						Maximum Allowable Torque, Lbf•in
					10°	45°	60°	75°		90°	
			PTFE Seal	UHMWPE Seal	Value	Value	Value	Torque	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing											
30	2-1/4	110	6165	13610	272	1440	3427	θ	2130	13391	57096
36	2-1/4	175	8490	19364	418	2394	5960	θ	4292	22723	57096
42	2-3/4	283	11279	26663	604	3301	8411	θ	6744	31194	105279
48	2-3/4	425	14343	34945	862	4725	12351	θ	10734	44861	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°		90°	
				Value	Value	Value	Torque	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing										
30	2-1/4	178	16871	272	1440	3427	θ	2130	13391	57096
36	2-1/4	291	24083	418	2394	5960	θ	4292	22723	57096
42	2-3/4	466	33121	604	3301	8411	θ	6744	31194	105279
48	2-3/4	693	43359	862	4725	12351	θ	10734	44861	105279
Phoenix III Seal / Graphite Packing / Metal Bearing										
30	2-1/4	219	17809	272	1440	3427	θ	2130	13391	57096
36	2-1/4	357	25243	418	2394	5960	θ	4292	22723	57096
42	2-3/4	573	34803	604	3301	8411	θ	6744	31194	105279
48	2-3/4	855	45673	862	4725	12351	θ	10734	44861	105279

VALVE SIZE, NPS	SHAFT DIAMETER INCHES	A	B		C						Maximum Allowable Torque, Lbf•in
					10°	45°	60°	75°		90°	
			PTFE Seal	UHMWPE Seal	Value	Value	Value	Torque	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing											
30	2-3/4	131	6350	14341	265	1082	2471	θ	1564	9438	76373
36	2-3/4	238	9007	21302	451	1819	4286	θ	3132	15888	105279
42	2-3/4	347	11701	28270	657	2896	7136	θ	5753	26046	105279
48	2-3/4	507	14783	36683	910	3861	9688	θ	8452	34526	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°		90°	
				Value	Value	Value	Torque	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing										
30	2-3/4	199	17586	265	1082	2471	θ	1564	9438	76373
36	2-3/4	354	26022	451	1819	4286	θ	3132	15888	105279
42	2-3/4	530	34714	657	2896	7136	θ	5753	26046	105279
48	2-3/4	773	45042	910	3861	9688	θ	8452	34526	105279
Phoenix III Seal / Graphite Packing / Metal Bearing										
30	2-3/4	248	18994	265	1082	2471	θ	1564	9438	76373
36	2-3/4	445	28336	451	1819	4286	θ	3132	15888	105279
42	2-3/4	662	37386	657	2896	7136	θ	5753	26046	105279
48	2-3/4	965	48516	910	3861	9688	θ	8452	34526	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C						Maximum Allowable Torque, Lbf•in
			PTFE Seal	UHMWPE Seal	10° Value	45° Value	60° Value	75° Torque	75° Value	90° Value	
Soft Seal / PTFE Packing / PEEK Bearing											
30	2-3/4	176	6754	16580	338	1091	2195	θ	1305	4833	105279
36	3-3/4	297	9468	23634	556	1913	4029	θ	2673	8687	231216
42	4	394	11422	28768	789	3361	7583	θ	5412	16270	274656
48	5-3/4	776	17201	45953	1285	3775	8043	θ	6286	16333	603088

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Allowable Torque, Lbf•in
				10° Value	45° Value	60° Value	75° Torque	75° Value	90° Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing										
30	2-3/4	234	19494	338	1091	2195	θ	1305	4833	105279
36	3-3/4	402	28042	556	1913	4029	θ	2673	8687	231216
42	4	542	34339	789	3361	7583	θ	5412	16270	274656
48	5-3/4	1036	54182	1285	3775	8043	θ	6286	16333	603088
Phoenix III Seal / Graphite Packing / Metal Bearing										
30	2-3/4	302	22968	338	1091	2195	θ	1305	4833	105279
36	3-3/4	515	32435	556	1913	4029	θ	2673	8687	231216
42	4	691	39236	789	3361	7583	θ	5412	16270	274656
48	5-3/4	1331	63478	1285	3775	8043	θ	6286	16333	603088

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B		C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
		ETFE Seal	UHMWPE Seal	ETFE Seal	UHMWPE Seal	Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing											
3	13/32	0.37	0.24	171	176	0	1	1	2	6	790
4	5/8	0.76	0.55	299	307	1	2	3	3	8	2794
6	7/8	2.09	1.66	652	669	2	12	14	11	49	7040
8	1	5.03	4.21	1241	1273	11	26	42	18	87	11956
10	1-3/8	9.18	7.87	1892	1943	20	56	96	20	194	31157
12	1-3/8	16.0	14.2	2894	2966	31	83	144	24	281	31157
14	2-1/4	21.2	19.0	3563	3650	38	100	178	47	337	57096
16	2-3/4	32.2	29.4	4928	5040	56	145	262	88	484	78671
18	2-3/4	48.8	45.1	6707	6854	81	201	365	147	658	105279
20	2-3/4	66.3	61.9	8536	8712	104	233	415	196	725	105279
24	2-3/4	112	105	10457	12241	183	493	959	487	1679	105279

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing									
3	13/32	0.33	601	0	1	1	2	6	790
4	5/8	0.73	883	1	2	3	3	8	2794
6	7/8	2.15	1491	2	12	14	11	49	7040
8	1	5.47	2268	11	26	42	18	87	11956
10	1-3/8	10.4	3536	20	56	96	20	194	31157
12	1-3/8	18.2	5192	31	83	144	24	281	31157
14	2-1/4	24.3	6334	38	100	178	47	337	57096
16	2-3/4	37.7	8507	56	145	262	88	484	78671
18	2-3/4	56.6	11415	81	201	365	147	658	105279
20	2-3/4	76.8	14186	104	233	415	196	725	105279
24	2-3/4	133	20536	183	493	959	487	1679	105279
Phoenix III Seal / Graphite Packing / Metal Bearing									
3	13/32	0.42	635	0	1	1	2	6	790
4	5/8	0.93	947	1	2	3	3	8	2858
6	7/8	2.78	1649	2	12	14	11	49	7198
8	1	7.07	2568	11	26	42	18	87	11956
10	1-3/8	13.4	3960	20	56	96	20	194	31157
12	1-3/8	23.6	5934	31	83	144	24	281	31157
14	2-1/4	31.5	7273	38	100	178	47	337	57096
16	2-3/4	48.2	9914	56	145	262	88	484	80078
18	2-3/4	73.7	13399	81	201	365	147	658	105279
20	2-3/4	100	16858	104	233	415	196	725	105279
24	2-3/4	173	24010	183	493	959	487	1679	105279

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VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B		C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
		ETFE Seal	UHMWPE Seal	ETFE Seal	UHMWPE Seal	Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing											
6	7/8	1.9	1.51	883	898	4	11	13	-7	-19	7040
8	1-3/8	4.66	4	2018	2044	9	21	26	-10	-28	31157
10	1-3/8	8.72	7.62	2911	2955	16	42	55	-13	-47	31157
12	2-1/4	15.39	13.93	5216	5274	24	49	62	21	-48	57096
14	2-1/4	19.51	17.65	5572	5645	38	112	158	42	-97	57096
16	2-3/4	24.99	22.79	6696	6783	47	145	211	67	-113	78548
18	2-3/4	34.47	31.65	8198	8309	64	202	301	107	-144	105279
20	2-3/4	48.49	45.02	10903	11040	84	245	368	151	-167	105279
24	3-3/4	79.89	74.8	13728	15068	137	428	671	306	-257	176951

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing									
6	7/8	1.95	1755	4	11	13	-7	-19	7040
8	1-3/8	4.93	2853	9	21	26	-10	-28	31157
10	1-3/8	9.58	4303	16	42	55	-13	-47	31157
12	2-1/4	16.88	7066	24	49	62	21	-48	57096
14	2-1/4	21.82	7917	38	112	158	42	-97	57096
16	2-3/4	28.13	9476	47	145	211	67	-113	78548
18	2-3/4	39.29	11755	64	202	301	107	-144	105279
20	2-3/4	55.36	15290	84	245	368	151	-167	105279
24	3-3/4	92.81	21297	137	428	671	306	-257	176951
Phoenix III Seal / Graphite Packing / Metal Bearing									
6	7/8	2.52	2071	4	11	13	-7	-19	7198
8	1-3/8	6.45	3700	9	21	26	-10	-28	31157
10	1-3/8	12.47	5444	16	42	55	-13	-47	31157
12	2-1/4	22.17	9387	24	49	62	21	-48	57096
14	2-1/4	28.53	10238	38	112	158	42	-97	57096
16	2-3/4	36.78	12281	47	145	211	67	-113	79950
18	2-3/4	51.31	15123	64	202	301	107	-144	105279
20	2-3/4	72.46	19917	84	245	368	151	-167	105279
24	3-3/4	121.22	27414	137	428	671	306	-257	176951

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B		C					Maximum Allowable Torque, Lbf•in
						10°	45°	60°	75°	80°	
		ETFE Seal	UHMWPE Seal	ETFE Seal	UHMWPE Seal	Value	Value	Value	Value	Value	
Soft Seal / PTFE Packing / PEEK Bearing											
10	1-3/8	8.29	7.43	3923	3957	15	29	29	-11	-24	33772
12	1-3/8	13.88	12.62	5444	5494	26	59	61	20	-42	71008
14	2-1/4	18.03	16.5	6548	6609	30	61	64	29	-42	60091
16	2-3/4	28.47	26.43	9601	9682	46	89	96	48	-60	105279
18	2-3/4	39.55	36.96	11939	12041	68	153	169	79	-91	224998
20	2-3/4	53.35	50.13	14563	14690	89	197	222	112	-114	226104

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque, Lbf•in
				10°	45°	60°	75°	80°	
				Value	Value	Value	Value	Value	
Phoenix III Seal / PTFE Packing / PEEK Bearing									
10	1-3/8	8.8	5009	15	29	29	-11	-24	33772
12	1-3/8	15.02	7047	26	59	61	20	-42	71008
14	2-1/4	19.65	8478	30	61	64	29	-42	60091
16	2-3/4	31.2	12176	46	89	96	48	-60	105279
18	2-3/4	43.72	15212	68	153	169	79	-91	224998
20	2-3/4	59.41	18633	89	197	222	112	-114	226104
Phoenix III Seal / Graphite Packing / Metal Bearing									
10	1-3/8	11.62	6885	15	29	29	-11	-24	34710
12	1-3/8	19.81	9609	26	59	61	20	-42	71008
14	2-1/4	25.91	11560	30	61	64	29	-42	60091
16	2-3/4	41.24	16804	46	89	96	48	-60	105279
18	2-3/4	57.76	20935	68	153	169	79	-91	224998
20	2-3/4	78.45	25582	89	197	222	112	-114	226104

For NACE constructions, the Maximum Torque limits to be used in calculating valve breakout and dynamic torque are different from standard constructions. The NACE limits are listed in the following tables.

Soft Seal / PTFE Packing / PEEK Bearing			
VALVE SIZE, NPS	CL150/150	CL150	CL300
	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in
30	36243	44771	105279
36	57096	99523	209558
42	105279	105279	264541
48	105279	105279	575772

NOVEX Seal / PEEK or Metal Bearing			
VALVE SIZE, NPS	CL150/150	CL150	CL300
	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in
30	36243	44771	105279
36	57096	99523	209558
42	105279	105279	264541
48	105279	105279	575772

Phoenix III Seal / PEEK or Metal Bearing			
VALVE SIZE, NPS	CL150/150	CL150	CL300
	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in
30	36243	44771	105279
36	57096	99523	209558
42	105279	105279	264541
48	105279	105279	575772

Soft Seal / PEEK Bearing			
VALVE SIZE, NPS	CL600	CL900	CL1500
	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in	Maximum Allowable Torque, Lbf•in
3	463	- - -	- - -
4	1682	- - -	- - -
6	4236	4236	- - -
8	7009	18264	- - -
10	18264	18264	20448
12	18264	57096	66937
14	37814	56256	49449
16	47092	47017	105279
18	95181	105279	224998
20	105279	103398	226104
24	105279	176951	- - -

Metal Seal / PEEK or Metal Bearing		
VALVE SIZE, NPS	CL600	
	Maximum Allowable Torque, Lbf•in	
	PEEK Bearing	Metal Bearing
3	463	463
4	1682	1702
6	4236	4394
8	7009	7009
10	18264	18264
12	18264	18264
14	37814	38752
16	47092	48499
18	95181	97165
20	105279	105279
24	105279	105279

Phoenix III Seal / PEEK or Metal Bearing						
VALVE SIZE, NPS	CL600		CL900		CL1500	
	Maximum Allowable Torque, Lbf•in		Maximum Allowable Torque, Lbf•in		Maximum Allowable Torque, Lbf•in	
	PEEK Bearing	Metal Bearing	PEEK Bearing	Metal Bearing	PEEK Bearing	Metal Bearing
3	463	463	---	---	---	---
4	1682	1702	---	---	---	---
6	4236	4394	4236	4394	---	---
8	7009	7009	18264	18264	---	---
10	18264	18264	18264	18264	20448	21386
12	18264	18264	57096	57096	66937	68218
14	37814	38752	56256	57096	49449	50990
16	47092	48499	47017	48420	105279	105279
18	95181	97165	105279	105279	224998	224998
20	105279	105279	103398	105279	226104	226104
24	105279	105279	176951	176951	---	---

High-Pressure Seal / PEEK or Metal Bearing						
VALVE SIZE, NPS	CL600		CL900		CL1500	
	Maximum Allowable Torque, Lbf•in		Maximum Allowable Torque, Lbf•in		Maximum Allowable Torque, Lbf•in	
	PEEK Bearing	Metal Bearing	PEEK Bearing	Metal Bearing	PEEK Bearing	Metal Bearing
3	463	463	- - -	- - -	- - -	- - -
4	1682	1702	- - -	- - -	- - -	- - -
6	4236	4394	4236	4394	- - -	- - -
8	7009	7009	18264	18264	- - -	- - -
10	18264	18264	18264	18264	20448	21386
12	18264	18264	57096	57096	66937	68218
14	37814	38752	56256	57096	49449	50990
16	47092	48499	47017	48420	105279	105279
18	95181	97165	105279	105279	224998	224998
20	105279	105279	103398	105279	226104	226104
24	105279	105279	176951	176951	- - -	- - -

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Process Management

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque.

Use the appropriate table for soft, NOVEX, and Phoenix III seals and bearing materials. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

For flow in the preferred direction, calculate the ΔP_{eff} effective pressure drop at 10, 60, 75, and 80 degrees. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

For flow in the nonpreferred direction, calculate the pressure drop at 10, 60, 75, and 90 degrees of rotation.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the **smaller** of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- **Liquid only**

  $\Delta P_{eff} = F_L^2 (P_{1abs} - F_F P_v)$

- **Gas only**

  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables

$\Delta P_{shutoff}$ = Actual pressure at shutoff

ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
κ = Valve torque tends to close the valve (kappa)
θ = Valve torque beyond this degree of opening tends to open the valve (theta)

CL150 K Values for Effective Pressure Drop for Gas Preferred and Non-Preferred Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES				
	10	60	75	80	90
14-24	0.227	0.203	0.155	0.136	0.103

CL300 K Values for Effective Pressure Drop for Gas Preferred and Non-Preferred Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES				
	10	60	75	80	90
14-24	0.230	0.181	0.132	0.117	0.103

CL150 Torque Characteristics

PTFE Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque (Lbf•in)
			PTFE	UHMWPE	10°	45°	60°	75°	80°	
14	1-3/16	12.15	1499	2838	35	186	358	856	1010	14534
16	1-1/4	17.30	1892	3666	50	271	534	1297	1549	16151
18	1-1/2	25.51	2351	4704	69	365	733	1793	2165	19396
20	1-3/4	35.86	2853	5870	93	478	975	2403	2931	22616
24	2-1/4	69.00	4225	9135	168	838	1761	4403	5457	61826

NOVEX Metal Seal / PEEK Bearing									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°	80°	
14	1-3/16	21.33	3006	35	186	358	856	1010	14534
16	1-1/4	28.53	3529	50	271	534	1297	1549	16151
18	1-1/2	38.91	4176	69	365	733	1793	2165	19396
20	1-3/4	51.54	4866	93	478	975	2403	2931	22616
24	2-1/4	90.74	6597	168	838	1761	4403	5457	61826
NOVEX Metal Seal / Metal Bearing									
14	1-3/16	25.95	3253	35	186	358	856	1010	14534
16	1-1/4	35.11	3829	50	271	534	1296	1549	16151
18	1-1/2	48.60	4600	69	365	733	1793	2165	19396
20	1-3/4	65.16	5436	93	478	975	2403	2930	22616
24	2-1/4	116.95	7535	168	838	1761	4403	5457	61826
Phoenix III Seal / PEEK Bearing									
14	1-3/16	18.79	4111	35	186	358	856	1010	14534
16	1-1/4	27.08	5327	50	271	534	1297	1549	16151
18	1-1/2	39.21	6801	69	365	733	1793	2165	19396
20	1-3/4	54.37	8450	93	478	975	2403	2931	22616
24	2-1/4	103.59	13106	168	838	1761	4403	5457	61826
Phoenix III Seal / Metal Bearing									
14	1-3/16	23.41	4358	35	186	358	856	1010	14534
16	1-1/4	33.65	5628	50	271	534	1296	1549	16151
18	1-1/2	48.90	7225	69	365	733	1793	2165	19396
20	1-3/4	67.99	9020	93	478	975	2403	2931	22616
24	2-1/4	129.80	14044	168	838	1761	4403	5457	61826

Note: These values are based on S17400 H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

EMERSON. Process Management

CL300 Torque Characteristics

Soft Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque (Lbf•in)
			PTFE	UHMWPE	10°	45°	60°	75°	80°	
14	1-3/4	15.77	1509	3116	43	188	325	591	642	22616
16	1-3/4	23.00	1910	4044	57	233	408	744	821	25849
18	2-1/4	32.86	2392	5173	88	392	710	1317	1471	61826
20	2-3/4	49.62	3047	6891	115	452	821	1520	1714	76315
24	2-3/4	79.30	4082	9532	165	586	1079	2007	2302	156701

NOVEX Metal Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C					Maximum Allowable Torque (Lbf•in)
			S31600	S21800	10°	45°	60°	75°	80°	
14	1-3/4	24.18	3379	4610	43	188	325	591	642	22616
16	1-3/4	33.24	4062	5493	57	233	408	744	821	25849
18	2-1/4	45.25	4835	6491	88	392	710	1317	1471	61826
20	2-3/4	64.38	6087	7982	115	452	821	1520	1714	76315
24	2-3/4	98.01	7803	10078	165	586	1079	2007	2302	156701
NOVEX Metal Seal / Metal Bearing										
14	1-3/4	30.17	3950	5180	43	188	325	591	642	22616
16	1-3/4	41.98	4803	6235	57	233	408	744	821	25849
18	2-1/4	57.74	5773	7430	88	392	710	1317	1471	61828
20	2-3/4	83.23	7494	9388	115	452	821	1520	1714	76315
24	2-3/4	128.14	9787	12061	165	586	1079	2007	2302	156701

Phoenix III Seal / PEEK Bearing									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°	80°	
14	1-3/4	21.39	4251	43	188	325	591	642	22616
16	1-3/4	31.19	5515	57	233	408	744	821	25849
18	2-1/4	44.66	7065	88	392	710	1317	1471	61826
20	2-3/4	66.10	9272	115	452	821	1520	1714	76315
24	2-3/4	105.28	12792	165	586	1079	2007	2304	156701
Phoenix III Seal / Metal Bearing									
14	1-3/4	27.38	4821	43	188	325	591	642	22616
16	1-3/4	39.93	6256	57	233	408	744	821	25849
18	2-1/4	57.14	8003	88	392	710	1317	1471	61826
20	2-3/4	84.95	10678	115	452	821	1520	1714	76315
24	2-3/4	135.40	14776	165	586	1079	2007	2304	156701

Note: These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

CL150 Torque Characteristics

Soft Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C						Maximum Allowable Torque (Lbf•in)
					10°	45°	60°	75°		90°	
			PTFE	UHMWPE	Value	Value	Value	Torque	Value	Value	
14	1-3/16	12.15	1499	2838	34	124	244	θ	24	1047	14534
16	1-1/4	17.30	1892	3666	47	185	374	θ	78	1582	16151
18	1-1/2	25.51	2351	4704	65	254	527	θ	161	2184	19396
20	1-3/4	35.86	2853	5870	86	340	718	θ	274	2923	22616
24	2-1/4	69.00	4225	9135	152	616	1349	θ	677	5338	61826

Phoenix III Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°		90°	
				Value	Value	Value	Torque	Value	Value	
14	1-3/16	18.79	4111	34	124	244	θ	24	1047	14534
16	1-1/4	27.08	5327	47	185	374	θ	78	1582	16151
18	1-1/2	39.21	6801	65	254	527	θ	161	2184	19396
20	1-3/4	54.37	8450	86	340	718	θ	274	2923	22616
24	2-1/4	103.59	13106	152	616	1349	θ	677	5338	61826
Phoenix III Seal / Metal Bearing										
14	1-3/16	23.41	4358	34	124	244	θ	24	1047	14534
16	1-1/4	33.65	5628	47	185	374	θ	78	1582	16151
18	1-1/2	48.90	7225	65	254	527	θ	161	2184	19396
20	1-3/4	67.99	9020	86	340	718	θ	274	2923	22616
24	2-1/4	129.80	14044	152	616	1349	θ	677	5338	61826

Note: These values are based on S17400 H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

CL300 Torque Characteristics

Soft Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B		C						Maximum Allowable Torque (Lbf•in)
					10°	45°	60°	75°		90°	
			PTFE	UHMWPE	Value	Value	Value	Torque	Value	Value	
14	1-3/4	15.77	1509	3116	42	128	224	θ	44	555	22616
16	1-3/4	23.00	1910	4044	54	163	290	θ	84	699	25849
18	2-1/4	32.86	2392	5173	82	276	514	θ	176	1237	61826
20	2-3/4	49.62	3047	6891	107	329	612	θ	253	1428	76315
24	2-3/4	79.30	4082	9532	153	444	839	θ	428	1885	156701

Phoenix III Seal / PEEK Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Allowable Torque (Lbf•in)
				10°	45°	60°	75°		90°	
				Value	Value	Value	Torque	Value	Value	
14	1-3/4	21.39	4251	42	128	224	θ	44	555	22616
16	1-3/4	31.19	5515	54	163	290	θ	84	699	25849
18	2-1/4	44.66	7065	82	276	514	θ	176	1237	61826
20	2-3/4	66.10	9272	107	329	612	θ	253	1428	76315
24	2-3/4	105.28	12792	153	444	839	θ	428	1885	156701
Phoenix III Seal / Metal Bearing										
14	1-3/4	27.38	4821	42	128	224	θ	44	555	22616
16	1-3/4	39.93	6256	54	163	290	θ	84	699	25849
18	2-1/4	57.14	8003	82	276	514	θ	176	1237	61826
20	2-3/4	84.95	10678	107	329	612	θ	253	1428	76315
24	2-3/4	135.40	14776	153	444	839	θ	428	1885	156701

Note: These values are based on S17400 H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.

For NACE constructions, the Maximum Torque limits to be used in calculating valve breakout and dynamic torque are different from standard constructions. The NACE limits are listed in the following tables.

CL150

Soft Seal / PEEK Bearing		
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	Maximum Allowable Torque (Lbf•in)
14	1-3/4	8520
16	1-3/4	9468
18	2-1/4	11370
20	2-3/4	13258
24	2-3/4	36243
NOVEX Seal / PEEK or Metal Bearing		
14	1-3/4	8520
16	1-3/4	9468
18	2-1/4	11370
20	2-3/4	13258
24	2-3/4	36243
Phoenix III Seal / PEEK or Metal Bearing		
14	1-3/4	8520
16	1-3/4	9468
18	2-1/4	11370
20	2-3/4	13258
24	2-3/4	36243

CL300

Soft Seal / PEEK Bearing		
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	Maximum Allowable Torque (Lbf•in)
14	1-3/4	13258
16	1-3/4	15153
18	2-1/4	36243
20	2-3/4	44736
24	2-3/4	91859
NOVEX Seal / PEEK or Metal Bearing		
14	1-3/4	13258
16	1-3/4	15153
18	2-1/4	36243
20	2-3/4	44736
24	2-3/4	91859
Phoenix III Seal / PEEK or Metal Bearing		
14	1-3/4	13258
16	1-3/4	15153
18	2-1/4	36243
20	2-3/4	44736
24	2-3/4	91859

NOVEX Seal / PTFE Packing / PTFE Rexnord Bearings										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Torque (In Lbs)	
				10°	45°	60°	75°	80°	Breakout (T_B)	Dynamic (T_D)
3	5/8	3.09	470	3	5	6	9	10	877	877
4	3/4	5.11	668	6	8	11	20	22	1709	1709
6	1	10.33	1065	11	21	37	70	78	3904	4244
8	1	13.65	1456	19	53	114	230	261	4244	4244
10	1-5/8	20.92	1943	30	99	169	375	427	7523	7523
12	1-1/4	27.62	2377	43	165	295	677	784	9631	9631
14	1-3/16	33.82	2702	52	203	375	873	1027	10360	10360
16	1-1/4	42.16	3160	68	289	553	1315	1567	10911	10911
18	1-1/2	55.31	3655	89	385	753	1813	2185	16487	16487
20	1-3/4	70.10	4165	113	499	996	2424	2951	19224	19224
24	2-1/4	108.73	5445	182	851	1775	4417	5471	35347	52552

NOVEX Seal / Graphite Packing / PTFE Rexnord Bearings										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Torque (In Lbs)	
				10°	45°	60°	75°	80°	Breakout (T_B)	Dynamic (T_D)
3	5/8	3.09	544	3	5	6	9	10	877	877
4	3/4	5.11	785	6	8	11	20	22	1709	1709
6	1	10.33	1299	11	21	37	70	78	3904	4244
8	1	13.65	1690	19	53	114	230	261	4244	4244
10	1-5/8	20.92	2295	30	99	169	375	427	7523	7523
12	1-1/4	27.62	2822	43	165	295	677	784	9631	9631
14	1-3/16	33.82	3253	52	203	375	873	1027	10360	10360
16	1-1/4	42.16	3829	68	289	553	1315	1567	10911	10911
18	1-1/2	55.31	4600	89	385	753	1813	2185	16487	16487
20	1-3/4	70.10	5436	113	499	996	2424	2951	19224	19224
24	2-1/4	108.73	7535	182	851	1775	4417	5471	37437	52552

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

Kel F Seal (without Backup Ring) / PTFE Packing / PTFE Rexnord Bearings										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Torque (In Lbs)	
				10°	45°	60°	75°	80°	Breakout (T_B)	Dynamic (T_D)
3	5/8	0.38	132	3	5	6	9	10	406	877
4	3/4	0.76	236	6	8	11	20	22	783	1709
6	1	1.95	513	11	21	37	70	78	1917	4244
8	1	3.60	808	19	53	114	230	261	3400	9669
10	1-5/8	6.59	1307	30	99	169	375	427	6052	20194
12	1-1/4	10.91	1910	43	165	295	677	784	9765	36619
14	1-3/16	11.68	2433	52	203	375	873	1027	5645	10360
16	1-1/4	16.33	3166	68	289	553	1315	1567	7657	10911
18	1-1/2	23.37	4017	89	385	753	1813	2185	10444	16487
20	1-3/4	32.11	4965	113	499	996	2424	2951	13795	19224
24	2-1/4	59.79	7667	182	851	1775	4417	5471	24109	52552

Kel F Seal (with Backup Ring) / PTFE or Graphite Packing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B	C					Maximum Torque (In Lbs)		
					10°	45°	60°	75°	80°	Breakout (T_B)		Dynamic (T_D)
		TFE Bearing	Bronze Bearing							TFE Bearing	Bronze Bearing	
3	5/8	0.28	0.43	800	3	5	6	9	10	877	877	877
4	3/4	0.61	0.93	1400	6	8	11	20	22	1709	1709	1709
6	1	1.89	2.86	3000	11	21	37	70	78	4244	4244	4244
8	1	4.49	6.80	5700	19	53	114	230	261	8933	9669	9669
10	1-5/8	9.09	13.77	8000	30	99	169	375	427	14545	17914	20194
12	1-1/4	15.15	22.95	10000	43	165	295	677	784	20908	26524	36619
14	1-3/16	26.68	40.43	13000	52	203	375	873	1027	10360	10360	10360
16	1-1/4	38.02	57.60	19000	68	289	553	1315	1567	10911	10911	10911
18	1-1/2	56.13	85.05	28000	89	385	753	1813	2185	16487	16487	16487
20	1-3/4	79.20	120.00	39600	113	499	996	2424	2951	19224	19224	19224
24	2-1/4	142.56	216.00	30000	182	851	1775	4417	5471	52552	52552	52552

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

NOVEX Seal / PTFE Packing / PTFE Rexnord Bearings											
VALVE SIZE, NPS	**SHAFT DIAMETER, INCHES**	**A**	**B**	**C**						**Maximum Torque (In Lbs)**	
				10°	**45°**	**60°**	**75°**		**90°**	**Breakout (T_B)**	**Dynamic (T_D)**
				Value	**Value**	**Value**	**Torque**	**Value**	**Value**		
3	5/8	3.09	470	0	2	2	Θ	0	8	877	877
4	3/4	5.11	668	1	3	5	Θ	1	19	1709	1709
6	1	10.33	1065	3	8	15	Θ	9	71	3904	4244
8	1	13.65	1456	6	18	50	Θ	37	208	4244	4244
10	1-5/8	20.92	1943	17	55	99	Θ	41	443	7523	7523
12	1-1/4	27.62	2377	28	97	184	Θ	35	810	9631	9631
14	1-3/16	33.82	2702	34	124	244	Θ	24	1047	10360	10360
16	1-1/4	42.16	3160	47	185	314	Θ	78	1582	10911	10911
18	1-1/2	55.31	3655	65	254	527	Θ	161	2184	16487	16487
20	1-3/4	70.10	4165	86	340	718	Θ	274	2923	19224	19224
24	2-1/4	108.73	5445	152	616	1349	Θ	677	5338	35347	52552

NOVEX Seal / Graphite Packing / PTFE Rexnord Bearings											
VALVE SIZE, NPS	**SHAFT DIAMETER, INCHES**	**A**	**B**	**C**						**Maximum Torque (In Lbs)**	
				10°	**45°**	**60°**	**75°**		**90°**	**Breakout (T_B)**	**Dynamic (T_D)**
				Value	**Value**	**Value**	**Torque**	**Value**	**Value**		
3	5/8	3.09	544	0	2	2	Θ	0	8	877	877
4	3/4	5.11	785	1	3	5	Θ	1	19	1709	1709
6	1	10.33	1299	3	8	15	Θ	9	71	3904	4244
8	1	13.65	1690	6	18	50	Θ	37	208	4244	4244
10	1-5/8	20.92	2295	17	55	99	Θ	41	443	7523	7523
12	1-1/4	27.62	2822	28	97	184	Θ	35	810	9631	9631
14	1-3/16	33.82	3253	34	124	244	Θ	24	1047	10360	10360
16	1-1/4	42.16	3829	47	185	314	Θ	78	1582	10911	10911
18	1-1/2	55.31	4600	65	254	527	Θ	161	2184	16487	16487
20	1-3/4	70.10	5436	86	340	718	Θ	274	2923	19224	19224
24	2-1/4	108.73	7535	152	616	1349	Θ	677	5338	37437	52552

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

Kel F Seal (without Backup Ring) / PTFE Packing / PTFE Rexnord Bearings											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Torque (In Lbs)	
				10°	45°	60°	75°		90°	Breakout (T_B)	Dynamic (T_D)
				Value	Value	Value	Torque	Value	Value		
3	5/8	0.38	132	0	2	2	Θ	0	8	406	877
4	3/4	0.76	236	1	3	5	Θ	1	19	783	1709
6	1	1.95	513	3	8	15	Θ	9	71	1917	4244
8	1	3.60	808	6	18	50	Θ	37	208	3400	9669
10	1-5/8	6.59	1307	17	55	99	Θ	41	443	6052	20194
12	1-1/4	10.91	1910	28	97	184	Θ	35	810	9765	36619
14	1-3/16	11.68	2433	34	124	244	Θ	24	1047	5645	10360
16	1-1/4	16.33	3166	47	185	314	Θ	78	1582	7657	10911
18	1-1/2	23.37	4017	65	254	527	Θ	161	2184	10444	16487
20	1-3/4	32.11	4965	86	340	718	Θ	274	2923	13795	19224
24	2-1/4	59.79	7667	152	616	1349	Θ	677	5338	24109	52552

Kel F Seal (with Backup Ring) / PTFE or Graphite Packing													
VALVE SIZE, NPS	SHAFT DIAM-ETER, INCH	A		B	C						Maximum Torque (In Lbs)		
					10°	45°	60°	75°		90°	Breakout (T_B)		Dynamic (T_D)
		PTFE Bearing	Bronze Bearing		Value	Value	Value	Torque	Value	Value	PTFE Bearing	Bronze Bearing	
3	5/8	0.28	0.43	800	0	2	2	Θ	0	8	877	877	877
4	3/4	0.61	0.93	1400	1	3	5	Θ	1	19	1709	1709	1709
6	1	1.89	2.86	3000	3	8	15	Θ	9	71	4244	4244	4244
8	1	4.49	6.80	5700	6	18	50	Θ	37	208	8933	9669	9669
10	1-5/8	9.09	13.77	8000	17	55	99	Θ	41	443	14545	17914	20194
12	1-1/4	15.15	22.95	10000	28	97	184	Θ	35	810	20908	26524	36619
14	1-3/16	26.68	40.43	13000	34	124	244	Θ	24	1047	10360	10360	10360
16	1-1/4	38.02	57.60	19000	47	185	314	Θ	78	1582	10911	10911	10911
18	1-1/2	56.13	85.05	28000	65	254	527	Θ	161	2184	16487	16487	16487
20	1-3/4	79.20	120.00	39600	86	340	718	Θ	274	2923	19224	19224	19224
24	2-1/4	142.56	216.00	30000	152	616	1349	Θ	677	5338	52552	52552	52552

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

NOVEX Seal / PTFE Packing / PTFE Rexnord Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B		C					Maximum Torque (In Lbs)	
		Up to 300 psi	Above 300 psi	Up to 300 psi	Above 300 psi	10°	45°	60°	75°	80°	Breakout (T_B)	Dynamic (T_D)
3	5/8	3.09	0.54	470	1237	3	5	6	9	10	877	877
4	3/4	5.11	0.89	668	1933	6	8	11	20	22	1709	1709
6	1	10.33	1.79	1065	3624	11	21	37	70	78	4244	4244
8	1	17.10	2.97	1399	5638	19	41	56	108	121	9669	9669
10	1-5/8	28.10	4.88	1879	8844	39	111	169	286	299	20194	20194
12	1-1/4	39.35	6.83	2373	12128	58	183	294	511	545	30705	36619
14	1-3/16	46.48	8.07	2679	14201	67	213	349	615	667	28708	28708
16	1-1/4	59.55	10.34	3151	17912	85	260	436	772	849	28708	28708
18	1-1/2	75.04	13.03	3683	22284	118	422	740	1347	1501	52552	52552
20	1-3/4	100.98	17.54	4360	29393	147	485	854	1552	1746	64868	64868
24	2-1/4	137.90	23.95	5367	39550	193	614	1108	2036	2331	104652	133196

NOVEX Seal / Graphite Packing / PTFE Rexnord Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B		C					Maximum Torque (In Lbs)	
		Up to 300 psi	Above 300 psi	Up to 300 psi	Above 300 psi	10°	45°	60°	75°	80°	Breakout (T_B)	Dynamic (T_D)
3	5/8	3.09	0.54	544	1311	3	5	6	9	10	877	877
4	3/4	5.11	0.89	785	2051	6	8	11	20	22	1709	1709
6	1	10.33	1.79	1299	3859	11	21	37	70	78	4244	4244
8	1	17.10	2.97	1844	6084	19	41	56	108	121	9669	9669
10	1-5/8	28.10	4.88	2679	9644	39	111	169	286	299	20194	20194
12	1-1/4	39.35	6.83	3474	13228	58	183	294	511	545	31805	36619
14	1-3/16	46.48	8.07	3950	15472	67	213	349	615	667	28708	28708
16	1-1/4	59.55	10.34	4803	19565	85	260	436	772	849	28708	28708
18	1-1/2	75.04	13.03	5773	24374	118	422	740	1347	1501	52552	52552
20	1-3/4	100.98	17.54	7494	32527	147	485	854	1552	1746	64868	64868
24	2-1/4	137.90	23.95	9787	43971	193	614	1108	2036	2331	109073	133196

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

Kel F Seal (without Backup Ring) / PTFE Packing / PTFE Rexnord Bearing										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C					Maximum Torque (In Lbs)	
				10°	45°	60°	75°	80°	Breakout (T_B)	Dynamic (T_D)
3	5/8	0.38	132	3	5	6	9	10	406	877
4	3/4	0.76	236	6	8	11	20	22	783	1709
6	1	1.95	513	11	21	37	70	78	1917	4244
8	1	3.60	808	19	41	56	108	121	3400	9669
10	1-5/8	6.59	1307	39	111	169	286	299	6052	20194
12	1-1/4	10.91	1910	58	183	294	511	545	9765	36619
14	1-3/16	14.12	2326	67	213	349	615	667	12492	19224
16	1-1/4	20.22	3016	85	260	436	772	849	17574	21972
18	1-1/2	28.47	3871	118	422	740	1347	1501	24369	52552
20	1-3/4	42.04	4974	147	485	854	1552	1746	35243	64868
24	2-1/4	66.09	6837	193	614	1108	2036	2331	54422	133196

Kel F Seal (with Backup Ring) / PTFE or Graphite Packing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A		B	C					Maximum Torque (In Lbs)		
										Breakout (T_B)		Dynamic (T_D)
		PEEK Bearing	Bronze Bearing		10°	45°	60°	75°	80°	PEEK Bearing	Bronze Bearing	
3	5/8	0.28	0.43	800	3	5	6	9	10	877	877	877
4	3/4	0.61	0.93	1400	6	8	11	20	22	1709	1709	1709
6	1	1.89	2.86	3000	11	21	37	70	78	4244	4244	4244
8	1	4.49	6.80	5700	19	41	56	108	121	8933	9669	9669
10	1-5/8	9.09	13.77	8000	39	111	169	286	299	14545	17914	20194
12	1-1/4	15.15	22.95	10000	58	183	294	511	545	20908	26524	36619
14	1-3/16	21.99	33.32	19000	67	213	349	615	667	19224	19224	19224
16	1-1/4	32.31	48.96	26000	85	260	436	772	849	21972	21972	21972
18	1-1/2	45.44	68.85	31000	118	422	740	1347	1501	52552	52552	52552
20	1-3/4	67.32	102.00	40000	147	485	854	1552	1746	64868	64868	64868
24	2-1/4	113.10	171.36	51000	193	614	1108	2036	2331	132432	133196	133196

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

NOVEX Seal / PTFE Packing / PTFE Rexnord Bearing

VALVE SIZE, NPS	SHAFT DIAMETER, INCH	A		B		C						Maximum Torque (In Lbs)	
		Up to 300 psi	Above 300 psi	Up to 300 psi	Above 300 psi	10°	45°	60°	75°		90°	Breakout (T_B)	Dynamic (T_D)
						Value	Value	Value	Torque	Value	Value		
3	5/8	3.09	0.54	470	1237	0	2	2	θ	0	8	877	877
4	3/4	5.11	0.89	668	1933	1	3	5	θ	1	19	1709	1709
6	1	10.33	1.79	1065	3624	3	8	15	θ	9	71	4244	4244
8	1	17.10	2.97	1399	5638	7	23	26	θ	10	112	9669	9669
10	1-5/8	28.10	4.88	1879	8844	22	60	97	θ	25	252	20194	20194
12	1-1/4	39.35	6.83	2373	12128	36	106	180	θ	18	459	30705	36619
14	1-3/16	46.48	8.07	2679	14201	42	128	224	θ	44	555	28708	28708
16	1-1/4	59.55	10.34	3151	17912	54	163	290	θ	84	699	28708	28708
18	1-1/2	75.04	13.03	3683	22284	82	276	514	θ	176	1237	52552	52552
20	1-3/4	100.98	17.54	4360	29393	107	329	612	θ	253	1428	64868	64868
24	2-1/4	137.90	23.95	5367	39550	153	444	839	θ	428	1885	104652	133196

NOVEX Seal / Graphite Packing / PTFE Rexnord Bearing

VALVE SIZE, NPS	SHAFT DIAMETER, INCH	A		B		C						Maximum Torque (In Lbs)	
		Up to 300 psi	Above 300 psi	Up to 300 psi	Above 300 psi	10°	45°	60°	75°		90°	Breakout (T_B)	Dynamic (T_D)
						Value	Value	Value	Torque	Value	Value		
3	5/8	3.09	0.54	544	1311	0	2	2	θ	0	8	877	877
4	3/4	5.11	0.89	785	2051	1	3	5	θ	1	19	1709	1709
6	1	10.33	1.79	1299	3859	3	8	15	θ	9	71	4244	4244
8	1	17.10	2.97	1844	6084	7	23	26	θ	10	112	9669	9669
10	1-5/8	28.10	4.88	2679	9644	22	60	97	θ	25	252	20194	20194
12	1-1/4	39.35	6.83	3474	13228	36	106	180	θ	18	459	31805	36619
14	1-3/16	46.48	8.07	3950	15472	42	128	224	θ	44	555	28708	28708
16	1-1/4	59.55	10.34	4803	19565	54	163	290	θ	84	699	28708	28708
18	1-1/2	75.04	13.03	5773	24374	82	276	514	θ	176	1237	52552	52552
20	1-3/4	100.98	17.54	7494	32527	107	329	612	θ	253	1428	64868	64868
24	2-1/4	137.90	23.95	9787	43971	153	444	839	θ	428	1885	109073	133196

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

Kel F Seal (without Backup Ring) / PTFE Packing / PTFE Rexnord Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES	A	B	C						Maximum Torque (In Lbs)	
				10°	45°	60°	75°		90°	Breakout (T_B)	Dynamic (T_D)
				Value	Value	Value	Torque	Value	Value		
3	5/8	0.38	132	0	2	2	θ	0	8	406	877
4	3/4	0.76	236	1	3	5	θ	1	19	783	1709
6	1	1.95	513	3	8	15	θ	9	71	1917	4244
8	1	3.60	808	7	23	26	θ	10	112	3400	9669
10	1-5/8	6.59	1307	22	60	97	θ	25	252	6052	20194
12	1-1/4	10.91	1910	36	106	180	θ	18	459	9765	36619
14	1-3/16	14.12	2326	42	128	224	θ	44	555	12492	19224
16	1-1/4	20.22	3016	54	163	290	θ	84	699	17574	21972
18	1-1/2	28.47	3871	82	276	514	θ	176	1237	24369	52552
20	1-3/4	42.04	4974	107	329	612	θ	253	1428	35243	64868
24	2-1/4	66.09	6837	153	444	839	θ	428	1885	54422	133196

Kel F Seal (with Backup Ring) / PTFE or Graphite Packing													
VALVE SIZE, NPS	SHAFT DIA-METER, INCHES	A		B	C						Maximum Torque (In Lbs)		
					10°	45°	60°	75°		90°	Breakout (T_B)		Dynamic (T_D)
		PEEK Bearing	Bronze Bearing		Value	Value	Value	Torque	Value	Value	PEEK Bearing	Bronze Bearing	
3	5/8	0.28	0.43	800	0	2	2	θ	0	8	877	877	877
4	3/4	0.61	0.93	1400	1	3	5	θ	1	19	1709	1709	1709
6	1	1.89	2.86	3000	3	8	15	θ	9	71	4244	4244	4244
8	1	4.49	6.80	5700	7	23	26	θ	10	112	8933	9669	9669
10	1-5/8	9.09	13.77	8000	22	60	97	θ	25	252	14545	17914	20194
12	1-1/4	15.15	22.95	10000	36	106	180	θ	18	459	20908	26524	36619
14	1-3/16	21.99	33.32	19000	42	128	224	θ	44	555	19224	19224	19224
16	1-1/4	32.31	48.96	26000	54	163	290	θ	84	699	21972	21972	21972
18	1-1/2	45.44	68.85	31000	82	276	514	θ	176	1237	52552	52552	52552
20	1-3/4	67.32	102.00	40000	107	329	612	θ	253	1428	64868	64868	64868
24	2-1/4	113.10	171.36	51000	153	444	839	θ	428	1885	132432	133196	133196

Note:
These values are based on H1150M stem material at 285 psid (CL150) and 740 psid (CL300). Consult factory for stem materials with a higher pressure rating.
NPS 3 through 8 valves have Double D Shafts and show diameter through packing box. NPS 10 through 24 valves have Keyed shafts and show diameter at keyway.

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque.

Use the appropriate table for soft, NOVEX, and Phoenix III seals and bearing materials. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A(\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C(\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

For flow in the Reverse (preferred) direction, calculate the ΔP_{eff} effective pressure drop at 10, 45, 60, 75, and 80 degrees. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening. 45 degree calculation only necessary for Type 1031 actuator.

For flow in the Forward (nonpreferred) direction, calculate the pressure drop at 10, 45, 60, 75, and 90 degrees of rotation. 45 degree calculation only necessary for Type 1031 actuator.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the **smaller** of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- **Liquid only**

  $\Delta P_{eff} = F_L^2 (P_{1abs} - F_F P_v)$

- **Gas only**

  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables

$\Delta P_{shutoff}$ = Actual pressure at shutoff

ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Valve torque tends to close the valve (kappa)
θ = Valve torque beyond this degree of opening tends to open the valve (theta)

CL150 K Values for Effective Pressure Drop for Gas Reverse and Forward Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES					
	10	45	60	75	80	90
3-6	0.230	0.224	0.181	0.132	0.117	0.103
8-24	0.227	0.238	0.203	0.155	0.136	0.103

CL300 K Values for Effective Pressure Drop for Gas Reverse and Forward Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES					
	10	45	60	75	80	90
3-24	0.230	0.224	0.181	0.132	0.117	0.103

CL300 K Values for Effective Pressure Drop for Gas Reverse and Forward Directions

VALVE SIZE, NPS	ANGLE OF OPENING IN DEGREES					
	10	45	60	75	80	90
3-24	0.230	0.224	0.181	0.132	0.117	0.103

CL150 Torque Characteristics

Soft Seal / PEEK Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B		C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline		PTFE	UHMWPE	10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	9/16	0.25	95	178	1	2	3	6	7	1032	1032
4	11/16	5/8	0.55	168	310	1	3	7	15	18	2011	1424
6	15/16	7/8	1.66	362	663	3	13	29	62	70	4993	4804
8	15/16	7/8	2.90	596	1027	9	44	104	220	251	4993	4804
10	1-1/8	1-1/8	5.69	918	1652	17	87	156	362	413	8850	8850
12	1-1/4	1-1/4	8.91	1238	2291	27	149	279	661	768	9850	11331
14	1-3/16	1-1/4	12.15	1499	2838	35	186	358	856	1010	14534	11388
16	1-1/4	1-1/4	17.30	1892	3666	50	271	534	1297	1549	16151	13972
18	1-1/2	1-9/16	25.51	2351	4704	69	365	733	1793	2165	19396	19396
20	1-3/4	1-3/4	35.86	2853	5870	93	478	975	2403	2931	22616	22616
24	2-1/4	2-1/4	69.00	4225	9135	168	838	1761	4403	5457	61826	61826

NOVEX Metal Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline			10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	5/8	1.20	544	1	2	3	6	7	1032	1032
4	11/16	5/8	2.05	785	1	3	7	15	18	2011	1424
6	15/16	7/8	4.38	1299	3	13	29	62	70	4993	4804
8	15/16	7/8	7.06	1690	9	44	104	220	251	4993	4804
10	1-1/8	1-1/8	11.7	2295	17	87	156	362	413	8850	8850
12	1-1/4	1-1/4	16.7	2822	27	149	279	661	768	9850	11331
14	1-3/16	1-1/4	21.3	3006	35	186	358	856	1010	14534	11388
16	1-1/4	1-1/4	28.5	3529	50	271	534	1297	1549	16151	13972
18	1-1/2	1-9/16	38.9	4176	69	365	733	1793	2165	19396	19396
20	1-3/4	1-3/4	51.5	4866	93	478	975	2403	2931	22616	22616
24	2-1/4	2-1/4	90.7	6597	168	838	1761	4403	5457	61826	61826

NOVEX Metal Seal / Metal Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline			10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	5/8	1.30	544	1	2	3	6	7	1032	1032
4	11/16	5/8	2.26	785	1	3	7	15	18	2011	1424
6	15/16	7/8	5.01	1299	3	13	29	62	70	4993	4804
8	15/16	7/8	8.16	1690	9	44	104	220	251	4993	4804
10	1-1/8	1-1/8	13.86	2295	17	87	156	362	413	8850	8850
12	1-1/4	1-1/4	20.10	2822	27	149	279	661	768	9850	11331
14	1-3/16	1-1/4	25.95	3253	35	186	358	856	1010	14534	11388
16	1-1/4	1-1/4	35.11	3829	50	271	534	1297	1549	16151	13972
18	1-1/2	1-9/16	48.60	4600	69	365	733	1793	2165	19396	19396
20	1-3/4	1-3/4	65.16	5436	93	478	975	2403	2931	22616	22616
24	2-1/4	2-1/4	116.95	7535	168	838	1761	4403	5457	61826	61826

Phoenix III Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline			10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	5/8	0.34	453	1	2	3	6	7	1032	1032
4	11/16	5/8	0.76	658	1	3	7	15	18	2011	1424
6	15/16	7/8	2.31	1099	3	13	29	62	70	4993	4804
8	15/16	7/8	4.36	1578	9	44	104	220	251	4993	4804
10	1-1/8	1-1/8	8.64	2538	17	87	156	362	413	8850	8850
12	1-1/4	1-1/4	13.8	3518	27	149	279	661	768	9850	11331
14	1-3/16	1-1/4	18.8	4111	35	186	358	856	1010	14534	11388
16	1-1/4	1-1/4	27.1	5327	50	271	534	1297	1549	16151	13972
18	1-1/2	1-9/16	39.2	6801	69	365	733	1793	2165	19396	19396
20	1-3/4	1-3/4	54.4	8450	93	478	975	2403	2931	22616	22616
24	2-1/4	2-1/4	104	13106	168	838	1761	4403	5457	61826	61826

Phoenix III Seal / Metal Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline			10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	5/8	0.43	453	1	2	3	6	7	1032	1032
4	11/16	5/8	0.97	658	1	3	7	15	18	2011	1424
6	15/16	7/8	2.94	1099	3	13	29	62	70	4993	4804
8	15/16	7/8	5.46	1578	9	44	104	220	251	4993	4804
10	1-1/8	1-1/8	10.80	2538	17	87	156	362	413	8850	8850
12	1-1/4	1-1/4	17.17	3518	27	149	279	661	768	9850	11331
14	1-3/16	1-1/4	23.41	4358	35	186	358	856	1010	14534	11388
16	1-1/4	1-1/4	33.65	5628	50	271	534	1297	1549	16151	13972
18	1-1/2	1-9/16	48.90	7225	69	365	733	1793	2165	19396	19396
20	1-3/4	1-3/4	67.99	9020	93	478	975	2403	2931	22616	22616
24	2-1/4	2-1/4	129.80	14044	168	838	1761	4403	5457	61826	61826

CL300 Torque Characteristics

Soft Seal / PEEK Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B		C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline		PTFE	UHMWPE	10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	9/16	0.25	95	178	1	2	3	6	7	1032	1032
4	11/16	5/8	0.55	168	310	1	3	7	15	18	2011	1424
6	15/16	7/8	1.66	362	663	3	13	29	62	70	5006	4804
8	1-1/4	1-1/4	3.42	581	1085	7	29	44	95	109	9846	11376
10	1-5/8	1-1/2	7.09	904	1798	21	93	151	268	281	23758	13972
12	1-7/8	1-3/4	12.05	1268	2590	35	161	271	489	523	43082	27289
14	1-3/4	1-3/4	15.77	1504	3116	43	188	325	591	642	22616	22616
16	1-3/4	1-3/4	23.00	1910	4044	57	233	408	744	821	25849	25849
18	2-1/4	2-1/4	32.86	2392	5173	88	392	710	1317	1471	61826	61826
20	2-3/4	3	49.62	3047	6891	115	452	821	1520	1714	76315	76315
24	2-3/4	3	79.30	4082	9532	165	586	1079	2007	2302	156701	156701

NOVEX Metal Seal / PEEK Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B		C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline		S31600	S21800	10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	9/16	1.20	544	775	1	2	3	6	7	1032	1032
4	11/16	5/8	2.05	785	1112	1	3	7	15	18	2011	1424
6	15/16	7/8	4.38	1299	1816	3	13	29	62	70	5006	4804
8	1-1/4	1-1/4	7.19	1844	2509	7	29	44	95	109	9846	11376
10	1-5/8	1-1/2	12.5	2679	3551	21	93	151	268	281	23758	13972
12	1-7/8	1-3/4	19.3	3474	4567	35	161	271	489	523	43082	27289
14	1-3/4	1-3/4	24.2	3379	4610	43	188	325	591	642	22616	22616
16	1-3/4	1-3/4	33.2	4062	5493	57	233	408	744	821	25849	25849
18	2-1/4	2-1/4	45.3	4835	6491	88	392	710	1317	1471	61826	61826
20	2-3/4	3	64.4	6087	7982	115	452	821	1520	1714	76315	76315
24	2-3/4	3	98.0	7803	10078	165	586	1079	2007	2302	156701	156701

NOVEX Metal Seal / Metal Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B		C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline		S31600	S21800	10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	9/16	1.30	544	775	1	2	3	6	7	1032	1032
4	11/16	5/8	2.26	785	1112	1	3	7	15	18	2011	1424
6	15/16	7/8	5.01	1299	1816	3	13	29	62	70	5006	4804
8	1-1/4	1-1/4	8.49	1844	2509	7	29	44	95	109	9846	11376
10	1-5/8	1-1/2	15.17	2679	3551	21	93	151	268	281	23758	13972
12	1-7/8	1-3/4	23.84	3474	4567	35	161	271	489	523	43082	27289
14	1-3/4	1-3/4	30.17	3950	5180	43	188	325	591	642	22616	22616
16	1-3/4	1-3/4	41.98	4803	6235	57	233	408	744	821	25849	25849
18	2-1/4	2-1/4	57.74	5773	7430	88	392	710	1317	1471	61826	61826
20	2-3/4	3	83.23	7494	9388	115	452	821	1520	1714	76315	76315
24	2-3/4	3	128.14	9787	12061	165	586	1079	2007	2302	156701	156701

EMERSON. Process Management

Phoenix III Seal / PEEK Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline			10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	9/16	0.34	453	1	2	3	6	7	1032	1032
4	11/16	5/8	0.76	658	1	3	7	15	18	2011	1424
6	15/16	7/8	2.31	1099	3	13	29	62	70	5006	4804
8	1-1/4	1-1/4	4.63	1679	7	29	44	95	109	9846	11376
10	1-5/8	1-1/2	9.48	2785	21	93	151	268	281	23758	13972
12	1-7/8	1-3/4	16.2	4009	35	161	271	489	523	43082	27289
14	1-3/4	1-3/4	21.4	4251	43	188	325	591	642	22616	22616
16	1-3/4	1-3/4	31.2	5515	57	233	408	744	821	25849	25849
18	2-1/4	2-1/4	44.7	7065	88	392	710	1317	1471	61826	61826
20	2-3/4	3	66.1	9272	115	452	821	1520	1714	76315	76315
24	2-3/4	3	105	12792	165	586	1079	2007	2302	156701	156701

Phoenix III Seal / Metal Bearing											
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C					Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline			10°	45°	60°	75°	80°	Keyed	Spline
3	9/16	9/16	0.43	453	1	2	3	6	7	1032	1032
4	11/16	5/8	0.97	658	1	3	7	15	18	2011	1424
6	15/16	7/8	2.94	1099	3	13	29	62	70	5006	4804
8	1-1/4	1-1/4	5.93	1679	7	29	44	95	109	9846	11376
10	1-5/8	1-1/2	12.18	2785	21	93	151	268	281	23758	13972
12	1-7/8	1-3/4	20.82	4009	35	161	271	489	523	43082	27289
14	1-3/4	1-3/4	27.38	4821	43	188	325	591	642	22616	22616
16	1-3/4	1-3/4	39.93	6256	57	233	408	744	821	25849	25849
18	2-1/4	2-1/4	57.14	8003	88	392	710	1317	1471	61826	61826
20	2-3/4	3	84.95	10678	115	452	821	1520	1714	76315	76315
24	2-3/4	3	135.40	14776	165	586	1079	2007	2302	156701	156701

CL150 Torque Characteristics

PTFE Seal / PEEK Bearing													
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B		C						Maximum Allowable Torque (Lbf•in)	
						10°	45°	60°	75°		90°		
	Keyed	Spline		PTFE	UHMWPE	Value	Value	Value	Torque	Value	Value	Keyed	Spline
3	9/16	9/16	0.25	95	178	0	2	2	θ	0	8	1032	1032
4	11/16	5/8	0.55	168	310	1	3	5	θ	1	19	2011	1424
6	15/16	7/8	1.66	362	663	3	8	15	θ	9	71	4993	4804
8	15/16	7/8	2.90	596	1027	6	18	50	θ	37	208	4993	4804
10	1-1/8	1-1/8	5.69	918	1652	17	55	99	θ	41	443	8850	8850
12	1-1/4	1-1/4	8.91	1238	2291	28	97	184	θ	35	810	9850	11331
14	1-3/16	1-1/4	12.15	1499	2838	34	124	244	θ	24	1047	14534	11388
16	1-1/4	1-1/4	17.30	1892	3666	47	185	374	θ	78	1582	16151	13972
18	1-1/2	1-9/16	25.51	2351	4704	65	254	527	θ	161	2184	19396	19396
20	1-3/4	1-3/4	35.86	2853	5870	86	340	718	θ	274	2923	22616	22616
24	2-1/4	2-1/4	69.00	4225	9135	152	616	1349	θ	677	5338	61826	61826

Phoenix III Seal / Metal Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C						Maximum Allowable Torque (Lbf•in)	
					10°	45°	60°	75°		90°		
	Keyed	Spline			Value	Value	Value	Torque	Value	Value	Keyed	Spline
3	9/16	9/16	0.43	453	0	2	2	θ	0	8	1032	1032
4	11/16	5/8	0.97	658	1	3	5	θ	1	19	2011	1424
6	15/16	7/8	2.94	1099	3	8	15	θ	9	71	4993	4804
8	15/16	7/8	5.46	1578	6	18	50	θ	37	208	4993	4804
10	1-1/8	1-1/8	10.80	2538	17	55	99	θ	41	443	8850	8850
12	1-1/4	1-1/4	17.17	3518	28	97	184	θ	35	810	9850	11331
14	1-3/16	1-1/4	23.41	4358	34	124	244	θ	24	1047	14534	11388
16	1-1/4	1-1/4	33.65	5628	47	185	374	θ	78	1582	16151	13972
18	1-1/2	1-9/16	48.90	7225	65	254	527	θ	161	2184	19396	19396
20	1-3/4	1-3/4	67.99	9020	86	340	718	θ	274	2923	22616	22616
24	2-1/4	2-1/4	129.80	14044	152	616	1349	θ	677	5338	61826	61826

CL300 Torque Characteristics

Soft Seal / PEEK Bearing													
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B		C						Maximum Allowable Torque (Lbf•in)	
						10°	45°	60°	75°		90°		
	Keyed	Spline		PTFE	UHMWPE	Value	Value	Value	Torque	Value	Value	Keyed	Spline
3	9/16	9/16	0.25	95	178	0	2	2	θ	0	8	1032	1032
4	11/16	5/8	0.55	168	310	1	3	5	θ	1	19	2011	1424
6	15/16	7/8	1.66	362	663	3	8	15	θ	9	71	5006	4804
8	1-1/4	1-1/4	3.42	581	1085	7	23	26	θ	10	112	9846	11376
10	1-5/8	1-1/2	7.09	904	1798	22	60	97	θ	25	252	23758	13972
12	1-7/8	1-3/4	12.05	1268	2590	36	106	180	θ	18	459	43082	27289
14	1-3/4	1-3/4	15.77	1509	3116	42	128	224	θ	44	555	22616	22616
16	1-3/4	1-3/4	23.00	1910	4044	54	163	290	θ	84	699	25849	25849
18	2-1/4	2-1/4	32.86	2392	5173	82	276	514	θ	176	1237	61826	61826
20	2-3/4	3	49.62	3047	6891	107	329	612	θ	253	1428	76315	76315
24	2-3/4	3	79.30	4082	9532	153	444	839	θ	428	1885	156701	156701

Phoenix III Seal / Metal Bearing												
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		A	B	C						Maximum Allowable Torque (Lbf•in)	
					10°	45°	60°	75°		90°		
	Keyed	Spline			Value	Value	Value	Torque	Value	Value	Keyed	Spline
3	9/16	9/16	0.43	453	0	2	2	θ	0	8	1032	1032
4	11/16	5/8	0.97	658	1	3	5	θ	1	19	2011	1424
6	15/16	7/8	2.94	1099	3	8	15	θ	9	71	5006	4804
8	1-1/4	1-1/4	5.93	1679	7	23	26	θ	10	112	9846	11376
10	1-5/8	1-1/2	12.18	2785	22	60	97	θ	25	252	23758	13972
12	1-7/8	1-3/4	20.82	4009	36	106	180	θ	18	459	43082	27289
14	1-3/4	1-3/4	27.38	4821	42	128	224	θ	44	555	22616	22616
16	1-3/4	1-3/4	39.93	6256	54	163	290	θ	84	699	25849	25849
18	2-1/4	2-1/4	57.14	8003	82	276	514	θ	176	1237	61826	61826
20	2-3/4	3	84.95	10678	107	329	612	θ	253	1428	76315	76315
24	2-3/4	3	135.40	14776	153	444	839	θ	428	1885	156701	156701

The following tables show the Maximum Breakout and Dynamic Torques for the NACE A31D valves. The tables are in In•Lbs.

CL150

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		SOFT SEAL/PEEK BEARINGS Maximum Allowable Torque (Lbf•in)		NOVEX SEAL/METAL BEARINGS Maximum Allowable Torque (Lbf•in)		PHOENIX SEAL/METAL BEARINGS Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline	Keyed	Spline	Keyed	Spline	Keyed	Spline
3	9/16	9/16	605	605	605	605	605	605
4	11/16	5/8	1179	834	1179	834	1179	834
6	15/16	7/8	2927	2816	2927	2816	2927	2816
8	15/16	7/8	2927	2816	2927	2816	2927	2816
10	1-1/8	1-1/8	5188	5188	5188	5188	5188	5188
12	1-1/4	1-1/4	6642	6642	6642	6642	6642	6642
14	1-3/16	1-1/4	8520	6676	8520	6676	8520	6676
16	1-1/4	1-1/4	9468	8191	9468	8191	9468	8191
18	1-1/2	1-9/16	11370	11370	11370	11370	11370	11370
20	1-3/4	1-3/4	13258	13258	13258	13258	13258	13258
24	2-1/4	2-1/4	36243	36243	36243	36243	36243	36243

CL300

VALVE SIZE, NPS	SHAFT DIAMETER, INCHES		SOFT SEAL/PEEK BEARINGS Maximum Allowable Torque (Lbf•in)		NOVEX SEAL/METAL BEARINGS Maximum Allowable Torque (Lbf•in)		PHOENIX SEAL/METAL BEARINGS Maximum Allowable Torque (Lbf•in)	
	Keyed	Spline	Keyed	Spline	Keyed	Spline	Keyed	Spline
3	9/16	9/16	605	605	605	605	605	605
4	11/16	5/8	1179	834	1179	834	1179	834
6	15/16	7/8	2927	2816	2927	2816	2927	2816
8	1-1/4	1-1/4	6669	6669	6669	6669	6669	6669
10	1-5/8	1-1/2	13927	8191	13927	8191	13927	8191
12	1-7/8	1-3/4	25255	15997	25255	15997	25255	15997
14	1-3/4	1-3/4	13258	13258	13258	13258	13258	13258
16	1-3/4	1-3/4	15153	15153	15153	15153	15153	15153
18	2-1/4	2-1/4	36243	36243	36243	36243	36243	36243
20	2-3/4	3	44736	44736	44736	44736	44736	44736
24	2-3/4	3	91859	91859	91859	91859	91859	91859

1.0 Bettis™ Definitions

Over the years many different terms have been used in describing quarter-turn actuator fundamentals. To clarify and standardize terminology, Bettis offers the following definitions for terms commonly used. Please become familiar with and use the following standard definitions when referring to Bettis quarter-turn actuators.

General Definitions

A. **Quarter-turn:** A device which rotates a minimum of 90 degrees. All Bettis quarter-turn actuators will rotate more than 90 degrees.

B. **Position:** That degree of rotation describing an actuator's current location. The mid position of a quarter-turn actuator is generally at forty-five (45) degrees.

C. **CW:** Clockwise rotation.

D. **CCW:** Counterclockwise rotation.

E. **Stroke:** A continuous, ninety (90) degree rotation of a quarter-turn actuator. Bettis spring-return actuators have two (2) different strokes, a pressure stroke and a spring stroke. Bettis double-acting actuators have two (2) pressure strokes. Note that rack and pinion actuators have common torque values for both pressure strokes, while scotch-yoke actuators have different torque values depending on which side of the piston is doing the work.

F. **Cycle:** The collective reference to two (2) strokes, one (1) for clockwise (CW) rotation and one (1) for counterclockwise (CCW) rotation. Bettis actuators must rotate through two (2) strokes to complete one (1) cycle.

G. **Safety Factor:** Represents a protection component (an adjustment to torque requirement) sometimes added to a valve's required torque value. Often used when the user/specifier is not certain of the valve's torque requirement, or because of other application concerns.

1.1 Definitions Specific to the Pressure Stroke of Quarter-Turn Actuator Torque Charts

A. **Start:** (starting) That torque output position, at which an actuator produces its greatest torque output. The starting torque outputs listed in Bettis scotch-yoke torque output charts are the lesser of the two (2) pressure strokes, when there is a difference (different areas).

B. **Minimum:** (min.) That torque output, at an intermediate position, at which an actuator produces its lowest torque output. The minimum torque outputs shown on Bettis pressure torque output charts are the lowest torque values produced during the pressure stroke(s). For double-acting actuators, this is also the mid position.

C. **End:** (ending) That torque output position, at which an actuator has reached the limit of a pressure stroke. For double-acting actuators the end torque output is equal to the start torque output.

1.2 Definitions Specific to the Spring Stroke of Quarter-Turn Actuator Torque Charts

Note: Spring-return, quarter-turn actuators use pressure and spring(s) to produce torque.

A. **Start:** (starting) That torque output position, at which a spring-return actuator produces its greatest torque output during the spring stroke. The starting torque output listed in Bettis spring-return torque output charts is that torque output position, where the spring is fully compressed, and capable of transferring its maximum force.

B. **Minimum:** (min.) That torque output, at an intermediate position, at which an actuator produces its lowest torque output. The minimum torque outputs listed on the Bettis spring torque output charts are the lowest value of torque output produced at any position, during either stroke (pressure or spring).

C. **End:** (ending) That torque output position, at which an actuator has reached the limit of the spring stroke. The spring ending torque output values listed on Bettis spring-return torque output charts is torque output value where the spring is fully extended, and is transferring its lowest force value.

2.0 Initial Data Concerns for Sizing Bettis Actuators

The following information is generally the minimum required for sizing Bettis quarter-turn pneumatic and hydraulic actuators for specific valve requirements.

A. An accurate maximum torque requirement must be obtained before actuator sizing begins. Normal maximum stem torque for a properly applied and maintained valve is usually defined as: The maximum starting torque required to rotate the valve element (ball, disc, plug, etc.) from a fully closed position (unseating), against the maximum normal valve rated differential pressure. Most valve manufacturers make adjustments in the form of torque amendments under various operating conditions. Application operating conditions such as temperature extremes, actual differential pressure, unusual loading, high flow rates, operating speeds, etc. are some of the most common causes for adjustment(s).

Bettis recommends that the valve manufacturer supply the maximum required torque value(s) (including any adjustments or suggested safety factor). Additionally, the valve manufacturer should identify at which position(s) and direction(s) of rotation (CCW or CW) these maximum requirements occur.

B. Bettis actuator include stops which will resist the maximum rated torque output of the actuator. The possibility exists, that should the valve become immobilized during rotation, the actuator could exceed the maximum stem torque rating. If this possibility is a concern, your application needs further review.

Once the maximum torque requirement, its position, and direction of rotation are identified, the appropriate Bettis actuator can be selected from torque output charts. Note that all start, minimum, and end torque outputs shown in this book are guaranteed minimum values.

3.0 Bettis Initial Actuator Selection Procedures

A. Determine the type of Bettis actuator required: double-acting or spring-return; and then, rack and pinion or scotch-yoke.

B. Determine the power supply media: pneumatic or hydraulic, and the minimum/maximum supply pressure(s) at the actuator.

C. Using this information, select the applicable torque rating table and see the appropriate following examples.

4.0 Specific Sizing Information (Read the following carefully)

The following information is designed to aid in sizing Bettis quarter-turn pneumatic actuators for specific valve requirements. The following examples assume a valve/device which closes in a CLOCKWISE DIRECTION (CW) and has a maximum torque requirement at the unseating (Start) position.

4.1 BETTIS Scotch-Yoke, Double-Acting Actuators (example assumes CW to close)

Note: The valve's torque requirements must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation. Bettis has included Start, Minimum, and End pressure torque outputs for your use.

A. Using your minimum operating pressure, select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. Move down the column until both starting and minimum output torques are found which exceed the valve's maximum and minimum torque requirements. Determine the Bettis model number at the left, under the model number column.

B. Once a Bettis actuator model has been selected, use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

4.2 Bettis™ Scotch-Yoke, Spring-Return, Fail CLOCKWISE Actuators (example assumes CW to close)

Note: The valve's maximum torque requirement must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation.

Bettis has included Start, Minimum and End Spring Torque outputs, as well as Start, Minimum and End Pressure Torque Outputs for your use. The minimum torque outputs listed on the Spring-Return torque charts are the lowest value of torque output available at any position, during either stroke (pressure or spring).

1. Select from the Spring Torque column a Spring Ending torque output which exceeds that of the valve's maximum seating requirement.

2. Proceed to the right using your minimum operating pressure and select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. The Pressure Start torque output must exceed the valve's torque requirement at this position (unseating). The Pressure End torque output must exceed the valve's torque requirement at this position (full flow) and direction of rotation (CCW).

3. Once a Bettis actuator model has been selected, use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

4.3 Bettis Scotch-Yoke, Spring-Return, Fail COUNTER CLOCKWISE Actuators (example assumes CW to close)

Note: The valve's maximum torque requirement must be exceeded by the actuator's torque output at all corresponding positions and directions of rotation.

Bettis has included Start, Minimum and End Spring Torque outputs, as well as Start, Minimum and End Pressure Torque Outputs for your use. The minimum torque outputs listed on the Spring Return torque charts are the least amount of torque output available at any position, during either stroke (pressure or spring).

1. Select from the Spring Torque column a Spring Start torque output which exceeds that of the valve's maximum unseating requirement.

2. Proceed to the right using your minimum operating pressure and select an operating pressure column from the Pressure Torque Rating Section of less than or equal pressure. The Pressure End torque output must exceed the valve's torque requirement at this position (seating). The Pressure Start torque output must exceed the valve's torque requirement at this position (full flow) and direction of rotation (CW).

3. Once a Bettis actuator model has been selected, use the performance data tables to ensure your maximum supply pressure does not exceed the maximum operating pressure (M.O.P.) for your Bettis actuator. If the actuator selected is not rated for your maximum supply pressure, either the maximum supply pressure must be reduced or an actuator rated for a higher M.O.P. must be selected.

5.0 Performance Data

1. To determine the displacement per stroke, maximum operating pressure (M.O.P), maximum allowable working pressure (M.A.W.P.) or the approximate weight and dimensions, refer to PS Sheet 62.1:Bettis. Locate your model number in the far left Actuator Model column and proceed to the right until you have located the desired information block.

2. **Be certain to read and understand all of the applicable notes.**

For torque ratings for Bettis G Series Actuators, go to one of the following links:

Spring Return

Imperial
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/Bettis/Data_sheets/VA−DC−000−0175−01_GPI−SR.pdf

Metric
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/Bettis/Data_sheets/VA−DC−000−0176−01−GPM−SR.pdf

Double Acting

Imperial
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/Bettis/Data_sheets/VA−DC−000−0175−01_GPI−DA.pdf

Metric
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/Bettis/Data_sheets/VA−DC−000−0190−02_GTDM−DA.pdf

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

Calculate the ΔP_{eff} effective pressure drop at the angles listed in the tables. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the smaller of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in the tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only

  $\Delta P_{eff} = F_L^2\ (P_{1abs} - F_F\ P_v)$

- Gas only

  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables

$\Delta P_{shutoff}$ = Actual pressure at shutoff

ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Torque tends to <u>CLOSE</u> the valve
θ = Torque tends to <u>OPEN</u> the valve

PEEK/PTFE Bearings with PTFE Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			80° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.30	100	1.31	0.69	515	515
3	5/8	0.56	150	2.12	1.01	1225	1225
4	3/4	0.99	232	6.95	3.64	2120	2120
6	1	2.30	438	18.4	15.9	4140	4140
8	1-1/4	4.80	705	45.8	36.6	9820	9820
10	1-1/4	8.10	1056	143	120	9820	9820
12	1-1/2	12.5	1470	159	133	12000	12000

PEEK/PTFE Bearings with Metal Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			80° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.23	297	1.31	0.69	515	515
3	5/8	0.46	510	2.12	1.01	1225	1225
4	3/4	1.72	750	6.95	3.64	2120	2120
6	1	1.99	1672	18.4	15.9	4140	4140
8	1-1/4	5.33	1900	45.8	36.6	9820	9820
10	1-1/4	7.37	4100	143	120	9820	9820
12	1-1/2	11.6	5880	159	133	12000	12000

PEEK/PTFE Bearings with No Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			80° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.30	36.2	1.31	0.69	515	515
3	5/8	0.60	78.4	2.12	1.01	1225	1225
4	3/4	1.00	101	6.95	3.64	2120	2120
6	1	2.41	187	18.4	15.9	4140	4140
8	1-1/4	4.82	276	45.8	36.6	9820	9820
10	1-1/4	8.08	276	143	120	9820	9820
12	1-1/2	12.4	389	159	133	12000	12000

Metal Bearings with Metal Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			80° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.77	297	1.31	0.69	515	515
3	5/8	1.71	525	2.12	1.01	1225	1225
4	3/4	3.35	849	6.95	3.64	2120	2120
6	1	7.80	1795	18.4	15.9	4140	4140
8	1-1/4	17.1	2000	45.8	36.6	9820	9820
10	1-1/4	25.0	4200	143	120	9820	9820
12	1-1/2	52.4	5919	159	133	12000	12000

Metal Bearings with No Seal							
Valve Size	Shaft Diameter	A	B	C		Maximum Allowable Torque	
				ANGLE OF OPENING		S17400 H1075	S20910
NPS	Inch			80° (K)	90° (θ)	lbf•in	lbf•in
2	1/2	0.82	134	1.31	0.69	515	515
3	5/8	1.76	202	2.12	1.01	1225	1225
4	3/4	3.43	389	6.95	3.64	2120	2120
6	1	8.00	815	18.4	15.9	4140	4140
8	1-1/4	17.3	886	45.8	36.6	9820	9820
10	1-1/4	25.3	1414	143	120	9820	9820
12	1-1/2	52.8	2017	159	133	12000	12000

K VALUES FOR EFFECTIVE PRESSURE DROP, ΔP_{eff}		
Valve Size, NPS	Angle of Opening	
	80°	90°
2	0.23	0.20
3	0.20	0.14
4	0.13	0.12
6	0.14	0.11
8	0.14	0.09
10	0.11	0.09
12	0.15	0.09

EMERSON.
Process Management

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque.

Use the appropriate table for soft, NOVEX, and Phoenix III seals and bearing materials. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

Calculate the effective pressure drop (ΔP_{eff}) of the angles listed in the tables. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the smaller of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only

$\Delta P_{eff} = F_L^2\ (P_{1abs} - F_F\ P_v)$

- Gas only

$\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables

$\Delta P_{shutoff}$ = Actual pressure at shutoff

ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Torque tends to <u>close</u> the valve
θ = Torque tends to <u>open</u> the valve

TRAVEL (DEGREES)	K VALUES FOR EFFECTIVE PRESSURE DROP, ΔP_{eff}	
	NPS 14 through NPS 36	
	CL150	CL300
10	0.07	0.06
45	0.22	0.21
60	0.18	0.19
75	0.12	0.13
80	0.09	0.11

PEEK Bearings with Soft Seal, CL150										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque
			PTFE	UHMWPE	10° (K)	45° (K)	60° (K)	75° (K)	80° (K)	S17400 H1025 (Lbf•in)
14	1-1/4	12.2	1499	2838	19	123	229	473	709	11388
16	1-1/4 x 1-1/2	17.3	1892	3666	28	183	342	706	1058	13972
18	1-9/16 x 1-3/4	25.5	2351	4704	40	260	485	1001	1500	19396
20	1-3/4	35.9	2853	5870	55	355	662	1366	2048	22616
24	2-1/4 x 2-1/2	69.0	4225	9135	105	678	1263	2608	3910	61826
30	2-3/4	131	6350	14341	209	1352	2519	5200	7796	76373
36	2-3/4	238	9007	21302	367	2372	4419	9122	13676	105279

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

PEEK Bearings with NOVEX Seal, CL150									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque
				10° (K)	45° (K)	60° (K)	75° (K)	80° (K)	S17400 H1025 (Lbf•in)
14	1-1/4	21.3	3006	19	123	229	473	709	11388
16	1-1/4 x 1-1/2	28.5	3529	28	183	342	706	1058	13972
18	1-9/16 x 1-3/4	38.9	4176	40	260	485	1001	1500	19396
20	1-3/4	51.5	4866	55	355	662	1366	2048	22616
24	2-1/4 x 2-1/2	90.7	6597	105	678	1263	2608	3910	61826
30	2-3/4	162	8928	209	1352	2519	5200	7796	76373
36	2-3/4	279	12044	367	2372	4419	9122	13676	105279

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

PEEK Bearings with Phoenix III Seal, CL150									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque
				10° (K)	45° (K)	60° (K)	75° (K)	80° (K)	S17400 H1025 (Lbf•in)
14	1-1/4	18.8	4111	19	123	229	473	709	11388
16	1-1/4 x 1-1/2	27.1	5327	28	183	342	706	1058	13972
18	1-9/16 x 1-3/4	39.2	6801	40	260	485	1001	1500	19396
20	1-3/4	54.4	8450	55	355	662	1366	2048	22616
24	2-1/4 x 2-1/2	104	13106	105	678	1263	2608	3910	61826
30	2-3/4	199	17586	209	1352	2519	5200	7796	76373
36	2-3/4	354	26022	367	2372	4419	9122	13676	105279

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Metal Bearings with NOVEX Seal, CL150									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque
				10° (K)	45° (K)	60° (K)	75° (K)	80° (K)	S17400 H1025 (Lbf•in)
14	1-1/4	26.0	3253	19	123	229	473	709	11388
16	1-1/4 x 1-1/2	35.1	3829	28	183	342	706	1058	13972
18	1-9/16 x 1-3/4	48.6	4600	40	260	485	1001	1500	19396
20	1-3/4	65.2	5436	55	355	662	1366	2048	22616
24	2-1/4 x 2-1/2	117	7535	105	678	1263	2608	3910	61826
30	2-3/4	212	10336	209	1352	2519	5200	7796	76373
36	2-3/4	370	14358	367	2372	4419	9122	13676	105279

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Metal Bearings with Phoenix III Seal, CL150									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque
				10° (K)	45° (K)	60° (K)	75° (K)	80° (K)	S17400 H1025 (Lbf•in)
14	1-1/4	23.4	4358	19	123	229	473	709	11388
16	1-1/4 x 1-1/2	33.7	5628	28	183	342	706	1058	13972
18	1-9/16 x 1-3/4	48.9	7225	40	260	485	1001	1500	19396
20	1-3/4	68.0	9020	55	355	662	1366	2048	22616
24	2-1/4 x 2-1/2	130	14044	105	678	1263	2608	3910	61826
30	2-3/4	248	18994	209	1352	2519	5200	7796	76373
36	2-3/4	445	28336	367	2372	4419	9122	13676	105279

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

PEEK Bearings with Soft Seal, CL300										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque
			PTFE	UHMWPE	10° (K)	45° (K)	60° (K)	75° (K)	85° (K)	S17400 H1025 (Lbf•in)
14	1-3/4	15.8	1509	3116	16	104	193	398	597	22616
16	1-3/4	23.0	1910	4044	24	153	285	588	881	25849
18	2-1/4 x 2-1/2	32.9	2392	5173	35	223	415	857	1285	61826
20	3	49.6	3047	6891	49	315	587	1211	1815	76315
24	3-1/2	79.3	4082	9532	78	505	940	1940	2909	156701
30	2-3/4	177	6754	16580	178	1151	2144	4426	6636	105279
36	3-3/4	297	9468	23634	331	2141	3989	8235	12346	231216

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

PEEK Bearings with NOVEX, CL300										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque
			S31600	S21800	10° (K)	45° (K)	60° (K)	75° (K)	85° (K)	S17400 H1025 (Lbf•in)
14	1-3/4	24.2	3379	4610	16	104	193	398	597	22616
16	1-3/4	33.2	4062	5493	24	153	285	588	881	25849
18	2-1/4 x 2-1/2	45.3	4835	6491	35	223	415	857	1285	61826
20	3	64.4	6087	7982	49	315	587	1211	1815	76315
24	3-1/2	98.0	7803	10078	78	505	940	1940	2909	156701
30	2-3/4	205	11989	15121	178	1151	2144	4426	6636	105279
36	3-3/4	336	15207	19192	331	2141	3989	8235	12346	231216

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

PEEK Bearings with Phoenix III, CL300									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque
				10° (K)	45° (K)	60° (K)	75° (K)	85° (K)	S17400 H1025 (Lbf•in)
14	1-3/4	21.4	4251	16	104	193	398	597	22616
16	1-3/4	31.2	5515	24	153	285	588	881	25849
18	2-1/4 x 2-1/2	44.7	7065	35	223	415	857	1285	61826
20	3	66.1	9272	49	315	587	1211	1815	76315
24	3-1/2	105	12792	78	505	940	1940	2909	156701
30	2-3/4	234	19494	178	1151	2144	4426	6636	105279
36	3-3/4	402	28042	331	2141	3989	8235	12346	231216

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Metal Bearings with NOVEX, CL300										
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B		C					Maximum Allowable Torque
			S31600	S21800	10° (K)	45° (K)	60° (K)	75° (K)	85° (K)	S17400 H1025 (Lbf•in)
14	1-3/4	30.2	3950	5180	16	104	193	398	597	22616
16	1-3/4	42.0	4803	6235	24	153	285	588	881	25849
18	2-1/4 x 2-1/2	57.7	5773	7430	35	223	415	857	1285	61826
20	3	83.2	7494	9388	49	315	587	1211	1815	76315
24	3-1/2	128	9787	12061	78	505	940	1940	2909	156701
30	2-3/4	272	15464	18596	178	1151	2144	4426	6636	105279
36	3-3/4	449	19599	23585	331	2141	3989	8235	12346	231216

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Metal Bearings with Phoenix III, CL300									
VALVE SIZE, NPS	SHAFT DIAMETER, INCHES(1)	A	B	C					Maximum Allowable Torque
				10° (K)	45° (K)	60° (K)	75° (K)	85° (K)	S17400 H1025 (Lbf•in)
14	1-3/4	27.4	4821	16	104	193	398	597	22616
16	1-3/4	39.9	6256	24	153	285	588	881	25849
18	2-1/4 x 2-1/2	57.1	8003	35	223	415	857	1285	61826
20	3	85.0	10678	49	315	587	1211	1815	76315
24	3-1/2	135	14776	78	505	940	1940	2909	156701
30	2-3/4	302	22968	178	1151	2144	4426	6636	105279
36	3-3/4	515	32435	331	2141	3989	8235	12346	231216

1. When two dimensions are indicated, the first is the shaft diameter to mate with the actuator yoke bearing and the second references the Fisher spline size.

Use the Torque Equation and Valve Body Torque Requirements to calculate valve breakout and dynamic torque. Definition of variables can be found below.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables. Calculate T_B.

2. Find T_D (dynamic torque)

Calculate the ΔP_{eff} effective pressure drop at the angles listed in the tables. If the maximum rotation is limited to less than 90 degrees, calculate only to the limited degree of opening.

If ΔP_{actual} (actual pressure drop at the angle of rotation) is known, compare ΔP_{eff} at the angle of rotation to ΔP_{actual} at each angle of rotation. Use the smaller of ΔP_{eff} or ΔP_{actual} and the C factor from the following tables to calculate dynamic torque at each angle of rotation listed in the tables. Calculate torque.

Formulas for calculating ΔP_{eff} for liquid and gas

- Liquid only

  $\Delta P_{eff} = F_L^2\ (P_{1abs} - F_F\ P_v)$

- Gas only

  $\Delta P_{eff} = K\ P_{1abs}$

3. The breakout and dynamic torques must not exceed the maximum torques listed in the following tables.

Where:
A, B, C, and K = Values from the following tables
$\Delta P_{shutoff}$ = Actual pressure at shutoff
ΔP_{eff} = Effective pressure drop
F_L = Valve recovery coefficient
P_{1abs} = Valve inlet pressure, absolute
P_v = Liquid vapor pressure, psia
F_F = Critical pressure ratio
K = Values for effective pressure drop
K = Torque tends to CLOSE the valve
θ = Torque tends to OPEN the valve

K VALUES FOR EFFECTIVE PRESSURE DROP, ΔP_{eff}	
Valve Size, NPS	**Angle of Opening, 90°**
3	0.15
4	0.12
6	0.17
8	0.12
10	0.14
12	0.11
14	0.13
16	0.14
18	0.12
20	0.12
24	0.10

ETFE Seal with PEEK Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	0.40	229	0	2	2	6	6	1424	- - -
4	3/4	0.76	364	1	3	4	7	8	2460	- - -
6	1-1/4	2.27	923	4	10	19	42	48	11388	- - -
8	1-1/2	5.03	1543	10	42	68	105	103	13972	- - -
10	1-3/4	10.31	2710	19	86	148	233	235	27289	- - -
12	2	15.97	3638	31	122	214	337	347	27289	- - -
14	2-1/2	21.16	4504	38	143	264	403	421	64685	57096
16	2-1/2	32.24	6343	57	202	363	579	613	64685	105279
18	3	48.86	8701	83	272	491	785	841	177497	105279
20	3	66.37	11220	107	304	542	862	931	177497	105279
24	3	112.32	13945	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

ETFE Seal with Metal Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	0.50	229	0	2	2	6	6	1424	- - -
4	3/4	0.97	364	1	3	4	7	8	2460	- - -
6	1-1/4	2.97	923	4	10	19	42	48	11388	- - -
8	1-1/2	6.63	1543	10	42	68	105	103	13972	- - -
10	1-3/4	13.73	2710	19	86	148	233	235	27289	- - -
12	2	21.35	3638	31	122	214	337	347	27289	- - -
14	2-1/2	28.37	4504	38	143	264	403	421	64685	57096
16	2-1/2	43.41	6343	57	202	363	579	613	64685	105279
18	3	66.01	8701	83	272	491	785	841	177497	105279
20	3	89.88	11220	107	304	542	862	931	177497	105279
24	3	152.41	13945	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

Phoenix III Seal with PEEK Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	0.36	659	0	2	2	6	6	1424	- - -
4	3/4	0.73	948	1	3	4	7	8	2460	- - -
6	1-1/4	2.34	1762	4	10	19	42	48	11388	- - -
8	1-1/2	5.48	2570	10	42	68	105	103	13972	- - -
10	1-3/4	11.50	4355	19	86	148	233	235	27289	- - -
12	2	18.21	5936	31	122	214	337	347	27289	- - -
14	2-1/2	24.28	7275	38	143	264	403	421	64685	57096
16	2-1/2	37.10	9922	57	202	363	579	613	64685	105279
18	3	56.60	13409	83	272	491	785	841	177497	105279
20	3	76.83	16870	107	304	542	862	931	177497	105279
24	3	132.82	24024	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

Phoenix III Seal with Metal Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	0.46	659	0	2	2	6	6	1424	- - -
4	3/4	0.93	948	1	3	4	7	8	2460	- - -
6	1-1/4	3.04	1762	4	10	19	42	48	11388	- - -
8	1-1/2	7.08	2570	10	42	68	105	103	13972	- - -
10	1-3/4	14.92	4355	19	86	148	233	235	27289	- - -
12	2	23.58	5936	31	122	214	337	347	27289	- - -
14	2-1/2	31.49	7275	38	143	264	403	421	64685	57096
16	2-1/2	48.27	9922	57	202	363	579	613	64685	105279
18	3	73.74	13409	83	272	491	785	841	177497	105279
20	3	100.34	16870	107	304	542	862	931	177497	105279
24	3	172.92	24024	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

Metal Seal with PEEK Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	0.43	463	0	2	2	6	6	1424	- - -
4	3/4	0.83	756	1	3	4	7	8	2460	- - -
6	1-1/4	2.49	1716	4	10	19	42	48	11388	- - -
8	1-1/2	5.58	3057	10	42	68	105	103	13972	- - -
10	1-3/4	11.3.6	4382	19	86	148	233	235	27289	- - -
12	2	17.64	5363	31	122	214	337	347	27289	- - -
14	2-1/2	23.31	6222	38	143	264	403	421	64685	57096
16	2-1/2	35.25	7990	57	202	363	579	613	64685	105279
18	3	53.19	10159	83	272	491	785	841	177497	105279
20	3	71.87	12466	107	304	542	862	931	177497	105279
24	3	121.75	15847	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

Metal Seal with Metal Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	0.53	463	0	2	2	6	6	1424	- - -
4	3/4	1.04	756	1	3	4	7	8	2460	- - -
6	1-1/4	3.19	1716	4	10	19	42	48	11388	- - -
8	1-1/2	7.18	3057	10	42	68	105	103	13972	- - -
10	1-3/4	14.79	4382	19	86	148	233	235	27289	- - -
12	2	23.02	5363	31	122	214	337	347	27289	- - -
14	2-1/2	30.51	6222	38	143	264	403	421	64685	57096
16	2-1/2	46.42	7990	57	202	363	579	613	64685	105279
18	3	70.34	10159	83	272	491	785	841	177497	105279
20	3	95.38	12466	107	304	542	862	931	177497	105279
24	3	161.84	15847	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

HPS Seal with PEEK Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	1.21	792	0	2	2	6	6	1424	- - -
4	3/4	1.94	1087	1	3	4	7	8	2460	- - -
6	1-1/4	4.21	1914	4	10	19	42	48	11388	- - -
8	1-1/2	8.07	2809	10	42	68	105	103	13972	- - -
10	1-3/4	14.51	4165	19	86	148	233	235	27289	- - -
12	2	21.24	5190	31	122	214	337	347	27289	- - -
14	2-1/2	27.14	6084	38	143	264	403	421	64685	57096
16	2-1/2	39.32	7917	57	202	363	579	613	64685	105279
18	3	57.34	10180	83	272	491	785	841	177497	105279
20	3	75.91	12567	107	304	542	862	931	177497	105279
24	3	124.74	16196	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

HPS Seal with Metal Bearings										
Valve Size	Shaft Diameter(1)	A	B	C					Maximum Allowable Torque, lbf•in	
				ANGLE OF OPENING					S17400 H1025 Shaft Materials	
NPS	Inch			10°	45°	60°	75°	80°	Spline Shaft	Keyed Shaft
3	5/8	1.31	792	0	2	2	6	6	1424	- - -
4	3/4	2.14	1087	1	3	4	7	8	2460	- - -
6	1-1/4	4.91	1914	4	10	19	42	48	11388	- - -
8	1-1/2	9.67	2809	10	42	68	105	103	13972	- - -
10	1-3/4	17.93	4165	19	86	148	233	235	27289	- - -
12	2	26.62	5190	31	122	214	337	347	27289	- - -
14	2-1/2	34.35	6084	38	143	264	403	421	64685	57096
16	2-1/2	50.49	7917	57	202	363	579	613	64685	105279
18	3	74.49	10180	83	272	491	785	841	177497	105279
20	3	99.42	12567	107	304	542	862	931	177497	105279
24	3	164.84	16196	193	643	1226	2006	2213	177497	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control- Disk CL600 (D104025X012)

Valve Size	Shaft Diameter(1)	Maximum Allowable Torque, lbf • in					
		Spline Shaft					
NPS	Inch	S17400 H1025	S20910	N07718	N05500	N10276	S31803
3	5/8	1424	1031	1178	1080	403	638
4	3/4	2460	1781	2036	1866	696	1103
6	1-1/4	11388	8247	9425	8639	3220	5105
8	1-1/2	13972	10118	11563	10599	3951	6263
10	1-3/4	27289	19761	22584	20702	7716	12233
12	2	27289	14115	22584	20702	7716	12233
14	2-1/2	64685	33458	53533	49072	18290	28997
16	2-1/2	64685	33458	53533	49072	18290	28997
18	3	177497	73447	146894	134653	50189	79567
20	3	177497	73447	146894	134653	50189	79567
24	3	177497	73447	146894	134653	50189	79567

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control−Disk CL600 (D104025X012)

Valve Size	Shaft Diameter(1)	Maximum Allowable Torque, lbf • in					
		Keyed Shaft					
NPS	Inch	S17400 H1025	S20910	N07718	N05500	N10276	S31803
14	2-1/4	57096	57096	57096	57096	36533	57096
16	2-3/4	105279	105279	105279	105279	66750	105279
18	2-3/4	105279	97683	105279	105279	66750	105279
20	2-3/4	105279	97683	105279	105279	66750	105279
24	2-3/4	105279	97683	105279	105279	66750	105279

1. Nominal diameter of spline shaft used for selecting Fisher actuators. For more dimensions, see Fisher bulletin 51.3:Control−Disk CL600 (D104025X012)

Torque Sizing

The torque output from a Double-Acting actuator is controlled by the supply air pressure. The torque output from a Spring-Return actuator is controlled by the supply air pressure and the spring load. The valve torque requirements **must be lower** than the torque output of the actuator.

When sizing Spring-Return Actuators, remember the **Fail Close valves will require** the Air Start force to unseat the disk and Spring End torque to fully re-seat the disk. ***Fail Open valves will require*** the Air End force to seat the disk and the Spring Start torque to un-seat the disk.

To size a Spring-Return actuator on a CW to Close, Fail Close valve, select from the Spring Start column an output torque that exceeds the valve's torque requirement. Then, using your minimum operating pressure, compare the torque outputs.

Both torque outputs (for Fail Open valves air end and spring start, or for Fail Close valves air start and spring end) should have values as close as possible at the closed position for correct sizing and optimal performance.

For torque ratings for FieldQ Series Actuators, go to one of the following links:

Spring-Return

Imperial
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/FieldQ/data_sheets/english/160203.pdf

Metric
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/FieldQ/data_sheets/english/160202.pdf

Double-Acting

Imperial and Metric
http://www2.emersonprocess.com/siteadmincenter/PM%20Valve%20Automation%20Documents/FieldQ/data_sheets/english/160201.pdf

Table 1. Torque Characteristics - Forward Flow

Metal Seat-Forward Flow										
Valve Size, NPS	Shaft Diameter, Inches(1)	A				B		C(2)		Maximum Allowable Torque, Lbf•in
		Metal Bearings		PTFE-Lined Bearings		Metal Bearings	PTFE-Lined Bearings	Rotation		
		Seating	Unseating	Seating	Unseating			10 Degree	80 Degree	
3	1 x 3/4	2.19	0.97	2.03	0	250	180	-0.45	5.8	2120
3	1	2.19	0.97	2.03	0	250	180	-0.45	5.8	3730
4	1-1/4	4.89	1.33	4.52	0	400	300	-1.88	11.6	8280
6	1-1/2 x 1-1/4	14	6.3	13.1	1.71	1275	1200	-4.95	20.6	9815
6	1-1/2	14	6.3	13.1	1.71	1275	1200	-4.95	20.6	12,000
8	1-1/2	30	6.41	30	0	1275	1200	-13.8	52.5	12,000
10	1-3/4	55	13.8	53	0	2063	1905	-25.2	114.8	23,525
12	2-1/8 x 2	88	20.3	86	0	2655	1980	-39.0	201	23,525
12	2-1/8	88	20.3	86	0	2655	1980	-39.0	201	55,762

1. Two numbers indicate shaft diameter x spline diameter.
2. Positive values indicate dynamic torque tends to close the valve. Negative values indicate dynamic torque tends to open the valve.

Table 2. Torque Characteristics - Reverse Flow

Metal Seat-Reverse Flow										
Valve Size, NPS	Shaft Diameter, Inches(1)	A				B		C(2)		Maximum Allowable Torque, Lbf•in
		Metal Bearings		PTFE-Lined Bearings		Metal Bearings	PTFE-Lined Bearings	Rotation		
		Seating	Unseating	Seating	Unseating			10 Degree	60 Degree	
3	1 x 3/4	0.97	2.19	0	2.03	250	180	1.14	7.40	2120
3	1	0.97	2.19	0	2.03	250	180	1.14	7.40	3730
4	1-1/4	1.33	4.89	0	4.52	400	300	7.35	12.4	8280
6	1-1/2 x 1-1/4	6.3	14	1.71	13.1	1275	1200	6.90	22.2	9815
6	1-1/2	6.3	14	1.71	13.1	1275	1200	6.90	22.2	12,000
8	1-1/2	6.41	30	0	30	1275	1200	12.0	37.2	12,000
10	1-3/4	13.8	55	0	53	2063	1905	36.8	88.6	23,525
12	2-1/8 x 2	20.3	88	0	86	2655	1980	78.8	155	23,525
12	2-1/8	20.3	88	0	86	2655	1980	78.8	155	55,762

1. Two numbers indicate shaft diameter x spline diameter.
2. Dynamic torque tends to close the valve.

Table 3. K Values for Effective Pressure Drop

Valve Size, NPS	Forward Flow		Reverse Flow	
	Full Port		Full Port	
	Rotation		Rotation	
	10 Degree	80 Degree	10 Degree	60 Degree
3	0.133	0.173	0.261	0.155
4	0.118	0.139	0.196	0.151
6	0.126	0.102	0.300	0.164
8	0.057	0.123	0.404	0.159
10	0.136	0.124	0.270	0.142
12	0.321	0.119	0.438	0.164

Pneumatic actuators typically used for three-way butterfly valve applications are the

- size 30, 33, 40, or 60 Fisher 1051 spring-and-diaphragm actuator,
- size 30, 33, 40, 60, or 70 Fisher 1052 spring-and-diaphragm actuator, and the
- size 30, 40, 60, or 68 Fisher 1061 piston actuator.

One actuator, mounted on the power valve body, operates both the power valve body and the other, or second, valve body. The available actuator torque must be greater than the combined torques of both valve bodies.

Determine the combined valve body torques as follows:

1. Calculate T_B and T_D for both the power and second valve, using the appropriate valve data.

2. Add the valve torques as shown:

Where both valve bodies open or close together

Actuator T_B = T_B of power valve body (T_{Bp}) + T_B of second valve body (T_{Bs})

Actuator T_D = T_D of power valve (T_{Dp}) + T_D of second valve body (T_{Ds})

Where one valve body opens while the other valve body closes

Actuator T_B = T_B of power valve body (T_{Bp}) + T_D of second valve body (T_{Ds})

Actuator T_D = T_D of power valve body (T_{Dp}) + T_B of second valve body (T_{Bs})

3. Select the desired actuator construction (push-down-to-close or push-down-to-open) based on the desired power valve body operation.

4. Turn to the page covering the desired actuator, refer to the available actuator torque table(s) on that page, and select an actuator that supplies more torque than the sum of the valve body torques.

The following example illustrates actuator sizing only for a typical three-way butterfly valve application. It is assumed that both valve bodies are properly sized.

Given Service Conditions

Valve Type: Two NPS 6 Fisher 7800 valve bodies with Fishtail™ disks
Operation: One valve body opens while the other closes; both open 60°
$\Delta P_{shutoff}$: 100 Psi
Actual ΔP at 60°: 7 psi
Fluid: Water at 70°F
Actuator Type: Spring-and-diaphragm 1052
Air-to-Diaphragm: 0 to 18 psig
Desired power valve body action: Push-Down-to-Open

1. Solve the torque equations for each valve body.

a) Power Valve Body

$$\begin{aligned} T_{Bp} &= A\,(\Delta P_{shutoff}) + B \\ &= 0.400\,(100\text{ psi}) + 36 \\ &= 40 + 36 \\ &= 76 \text{ pound-force inches} \end{aligned}$$

$$\begin{aligned} T_{Dp} &= C\,(\Delta P_{eff}) \\ &= 19.8\,(7.0\text{ psi}) \\ &= 139 \text{ pound-force inches} \end{aligned}$$

$$\begin{aligned} \Delta P_{eff} &= 0.600\,P_{1abs} \\ &= 0.600\,(10 + 14.7) \\ &= 14.8 \text{ psi} \end{aligned}$$

$\Delta P_{actual} \leq \Delta P_{eff}$; use ΔP_{actual}

b) Second Valve Body

$$\begin{aligned} T_{Bs} &= A\,(\Delta P_{shutoff}) + B \\ &= 0.400\,(100\text{ psi}) + 36 \\ &= 40 + 36 \\ &= 76 \text{ pound-force inches} \end{aligned}$$

$$\begin{aligned} T_{Ds} &= C\,(\Delta P_{eff}) \\ &= 19.8\,(7.0\text{ psi}) \\ &= 139 \text{ pound-force inches} \end{aligned}$$

$$\begin{aligned} \Delta P_{eff} &= 0.600\,P_{1abs} \\ &= 0.600\,(10 + 14.7) \\ &= 14.8 \text{ psi} \end{aligned}$$

$\Delta P_{actual} \leq \Delta P_{eff}$; use ΔP_{actual}

2. Add torques to calculate the required actuator torque.

$$\begin{aligned} \text{Actuator } T_B &= T_{Bp} + T_{Ds} \\ &= 76 + 139 \\ &= 215 \text{ pound-force inches} \end{aligned}$$

$$\begin{aligned} \text{Actuator } T_D &= T_{Dp} + T_{Bs} \\ &= 139 + 76 \\ &= 215 \text{ pound-force inches} \end{aligned}$$

1. Turn to the page for the 1052 spring-and-diaphragm actuator used with a 7600, 7800, or 9500 valve body. Select a push-down-to-open actuator that supplies more T_B and T_D—with 0 to 18 psig air-to-diaphragm—than required by the valve bodies.

A size 33 Fisher 1052 actuator with spring 10B1523 X012 and 3.7 psig initial spring compression has 256 inch-pounds of T_B (256 > 215) and 493 inch-pounds of T_D at 60° maximum actuator rotation (493 > 215).

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

2. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from table 1. Calculate T_B.

3. Find T_D (dynamic torque).

First, calculate ΔP_{eff} (effective pressure drop) at only 70° rotation for valve bodies with 90° maximum rotation. For valve bodies with 60° maximum rotation, calculate ΔP_{eff} at only 60° rotation. Use one of the following equations:

- Liquid only

$\Delta P_{eff} = F_L^2\ (P_{1abs} - F_F\ P_v)$ Definition of variables can be found in the valve sizing for flashing and cavitating liquids procedure in section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = K\ P_{1(abs)}$. See table 2 for K values.

If ΔP_{actual} (actual pressure drop at either 70° or 60° valve rotation) is known, compare ΔP_{actual} to ΔP_{eff}. Use the smaller of ΔP_{actual} or ΔP_{eff} and the 70° or 60° C factor from table 1 to calculate T_D.
Calculate T_D.

4. T_D must not exceed the maximum T_D listed in table 1.

5. If the required valve travel is not listed in table 1, multiply T_B and T_D by the correct multiplier from table 2 to calculate T_B and T_D at the nonstandard travel.

Selecting 657-8 Actuator

Turn to the available actuator torque page. Select either a push-down-to-close (PDTC) or a push-down-to-open (PDTO) construction. Choose an actuator size and spring combination with T_B than required by the valve. The actuator T_D must also exceed the valve T_D. Check that the actuator and valve yoke boss and travel match.

Selecting 478 or 320 Piston Actuator

Turn to the appropriate actuator page. Select an actuator size that supplies more torque than the larger of valve body breakout or dynamic torque. Check that the actuator and valve yoke boss and travel match.

Selecting Manual Actuator

Select an actuator that supplies more torque than the largest of the valve body torque requirements.

Table 1. Torque Characteristics

CL150														
Valve Size, NPS	TCM Ball Seal		Metal Ball Seal				Flow Ring				C[(1)]	Travel, Inch	Yoke Boss Diameter, Inch	Maximum T_D, Inch-Pounds
	PTFE Bearing		PTFE Bearing		Metal Bearing		PTFE Bearing		Metal Bearing					
	A	B	A	B	A	B	A	B	A	B				
16	46.36	2426	75.16	4852	162.8	4852	17.5	2426	105.2	2426	295	4.125	3-9/16	17000
24	107.1	4712	163	9418	419.2	9418	51.2	4712	307.3	4712	800	8.125	3-9/16	33700
													5	56800
CL300														
16	54.57	2442	84.36	4950	212.2	4950	25.6	2442	153.5	2442	295	8.125	3-9/16	33700
													5	56800

Table 2. Torque Multipliers for Non-Standard Travels

Standard Travel, Inches	Non-Standard Travel, Inches (90 Rotation)			
	2.125	3.125	4.125	8.125
2.125	1.0	0.7	0.5	0.25
3.125	1.5	1.0	0.75	0.4
4.125	1.9	1.3	1.0	0.5

Table 3. Dynamic Torque (C) Factor with Cavitrol® V Trim

Valve Size, NPS	C
16	115.0

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from table 1. Calculate T_B.

2. Find T_D (dynamic torque).

First, calculate ΔP_{eff} (effective pressure drop) at only 70° rotation for valve bodies with 90° maximum rotation. For valve bodies with 60° maximum rotation, calculate ΔP_{eff} at only 60° rotation. Use one of the following equations:

- Liquid only

$\Delta P_{eff} = \Delta P_{allowable} = F_L^2\ (P_{1abs} - F_F\ P_v)$ Definition of variables can be found in the valve sizing for flashing and cavitating liquids procedure in section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = K\ P_{1(abs)}$. See table 2 for K values.

If ΔP_{actual} (actual pressure drop at either 70° or 60° valve rotation) is known, compare ΔP_{actual} to ΔP_{eff}. Use the smaller of ΔP_{actual} or ΔP_{eff} and the 70° or 60° C factor from table 1 to calculate T_D.
Calculate T_D.

3. T_D must not exceed the maximum T_D listed in table 1.

Selecting 1051 or 1052 Spring-and-Diaphragm or 1066SR Spring-Return Piston Actuator

Turn to the pages covering these actuators and refer to the appropriate available actuator torque tables on those pages. Select either a push-down-to-close (PDTC) or a push-down-to-open (PDTO) construction. Choose an actuator size and spring combination with T_B or T_D than required by the valve body.

If the V100 valve body has the required capacity at 60° maximum valve rotation, calculate T_D at 60° and check the actuator tables under 60° maximum rotation to see if limiting the actuator maximum rotation allows the selection of a smaller actuator.

Note that the springs listed in 1052 table 2, Actuator Torques for 60° Limited Maximum Rotation, yield higher breakout torques for a specific actuator size and air-to-diaphragm combination that the springs listed in 1052 table 1.

Selecting 1061 or 1066 Piston Actuator

Turn to the appropriate actuator page and use the procedure given there.

Selecting Manual Actuator

Select an actuator that supplies more torque than the largest of the valve body torque requirements.

Table 1. Torque Characteristics

Valve Size, NPS	Shaft Size, Inch	A: PTFE Bearing	A: Metal Bearing	B	C(1): 60 Deg	C(1): 70 Deg	Maximum T_D, Inch-Pounds
TCM or TCM III Ball Seal							
1	1/2	0.039	0.149	23	0.38	0.48	385
1-1/2	1/2	0.087	0.347	49	1.1	1.1	385
2	1/2	0.146	0.621	83	1.3	2.4	515
3	3/4	0.367	1.84	209	4.5	8.3	2120
4	7/8	0.637	3.58	361	11	18	4140
6	1	1.80	7.60	678	20	32	4140
8	1-1/4	3.24	14.8	1218	53	84	9820
10	1-1/4	5.69	20.7	2137	110	180	9820
12	1-1/4	5.69	20.7	2137	74	110	9820
	1-1/2	9.81	27.3	3690	210	230	12000
Bidirectional Metal Ball Seal							
1	1/2	0.039	0.149	48	0.38	0.48	385
1-1/2	1/2	0.087	0.347	93	1.1	1.1	385
2	1/2	0.146	0.621	155	1.3	2.4	515
3	3/4	0.367	1.84	209	4.5	8.3	2120
4	7/8	0.637	3.58	361	11	18	4140
6	1	1.80	7.60	678	20	32	4140
8	1-1/4	3.24	14.8	1218	53	84	9820
10	1-1/4	5.69	20.7	2137	110	180	9820
12	1-1/4	5.69	20.7	2137	74	110	9820
	1-1/2	9.81	27.3	3690	210	230	12000
Metal Ball Seal							
1	1/2	0.23	0.34	32	0.38	0.48	385
1-1/2	1/2	0.45	0.71	62	1.1	1.1	385
2	1/2	0.75	1.23	103	1.3	2.4	515
3	3/4	1.91	3.38	264	4.5	8.3	2120
4	7/8	3.24	6.19	444	11	18	4140
6	1	5.94	11.8	822	20	32	4140
8	1-1/4	10.88	22.4	1500	53	84	9820
10	1-1/4	20.70	35.7	1750	110	180	9820
12	1-1/4	20.70	35.7	1750	74	110	9820
	1-1/2	34.7	52.2	2500	210	230	12000
Flow Ring							
1	1/2	0.022	0.132	13	0.38	0.48	385
1-1/2	1/2	0.052	0.312	28	1.1	1.1	385
2	1/2	0.095	0.570	47	1.3	2.4	515
3	3/4	0.294	1.76	80	4.5	8.3	2120
4	7/8	0.589	3.53	150	11	18	4140
6	1	1.16	6.96	300	20	32	4140
8	1-1/4	2.30	13.8	400	53	84	9820
10	1-1/4	3.0	18.0	600	110	180	9820
12	1-1/4	3.0	18.0	600	74	110	9820
	1-1/2	3.5	21.0	800	210	230	12000

1. See table 3 for C factors with Cavitrol™ V trim.

Table 2. K Values for Effective Pressure Drop, ΔP_{eff}

Valve Size, NPS		K: 60 Deg	K: 70 Deg
1		0.275	0.263
1-1/2		0.235	0.179
2		0.258	0.222
3		0.219	0.194
4		0.222	0.203
6		0.227	0.190
8		0.245	0.194
10	CL150	0.217	0.194
	CL300	0.217	0.194
12	Reduced Bore	0.250	0.225
	Full-Sized	0.224	0.180

Table 3. Dynamic Torque (C) Factor with Cavitrol V Trim

Valve Size, NPS	C
6	8.4
8	17
10	40
12	77

Note

The NPS 14 and larger sizes are available in Fisher® V150 and V300 only. Refer to the product bulletin for specific availability of materials.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from table 1 for composition ball seals, flat metal ball seals, and flow-ring constructions or table 2 for HD (heavy-duty) metal ball seals. Calculate T_B.

2. Find T_D (dynamic torque).

First, calculate ΔP_{eff} (effective pressure drop) at only 70 degrees rotation for valves with 90 degrees maximum rotation. For valves with 60 degrees maximum rotation, calculate ΔP_{eff} at only 60 degrees rotation.

a. Use one of the following equations:

- Liquid only

$\Delta P_{eff} = \Delta P_{allowable} = F_L^2\ (P_{1abs} - F_F\ P_v)$. The definition of variables can be found in the *Valve Sizing for Flashing and Cavitation Liquids* procedure in Section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = K\ P_{1(abs)}$. See table 3 for K values.

b. If ΔP_{actual} (actual pressure drop at either 70 degrees or 60 degrees of valve rotation) is known, compare ΔP_{actual} to ΔP_{eff}. Use the smaller of ΔP_{actual} or ΔP_{eff} and the 70 degrees or 60 degrees C factor from table 1 or table 2 to calculate T_D. Calculate T_D.

3. T_D must not exceed the maximum T_D listed in table 1 or table 2.

Selecting Fisher 1051 or 1052 Spring- and-Diaphragm or 1066SR Spring-Return Piston Actuator

Turn to the pages covering these actuators and refer to the appropriate available actuator torque tables on those pages. Select either a push-down-to-close (PDTC) or a push-down-to-open (PDTO) construction. Choose an actuator size and spring combination with more T_B and more T_D than required by the valve.

If the V150, V200, or V300 valve has the required capacity at 60 degrees maximum valve rotation, calculate T_D at 60 degrees, and check the actuator tables under 60 degrees maximum rotation to see if limiting the actuator maximum rotation allows the selection of a smaller actuator.

Note that the springs listed in Fisher 1052 table 2, Actuator Torques for 60 degrees Limited Maximum Rotation, yield higher breakout torques for a specific actuator size and air-to-diaphragm combinations than the springs listed in 1052 table 1.

Selecting Fisher 1061 or 1066 Piston Actuator

Turn to the appropriate actuator page and use the procedure given there.

Selecting Manual Actuators

Select an actuator that supplies more torque than the highest of the valve torque requirements.

Table 1. Torque Characteristics for Composition Seal, Flat Metal Seal, and Flow-Ring Construction

Fisher TCM Plus Ball Seal

Valve Size, NPS	Valve Shaft Diameter, Inches	A	B	C		Maximum T_D, Lbf•In.
		Composition Bearings[1]		60 Degrees	70 Degrees	
1	1/2	0.07	50	0.38	0.48	515
1-1/2	5/8	0.12	100	1.10	1.10	1225
2	5/8	0.19	175	1.30	2.40	1225
3	3/4	0.10	280	0.15	3.80	2120
4	3/4	0.10	380	1.10	18.0	2120
6	1	1.80	500	1.10	36.0	4140
8	1-1/4	1.80	750	3.80	60.0	9820
10	1-1/4	1.80	1250	3.80	125	9820
12	1-1/2	4.00	3000	11.0	143	12000
14	1-3/4	42	2400	75	413	23525
16	2	60	2800	105	578	23525
16	2-1/8	60	2800	105	578	55762
20	2-1/2	97	5200	190	1044	55762

Flat Metal Ball Seal

Valve Size, NPS	Valve Shaft Diameter, Inches	A		B	C		Maximum T_D, Lbf•In.
		Composition Bearings[1]	Metal Bearings		60 Degrees	70 Degrees	
3	3/4	1.48	2.40	210	1.15	3.80	2120
4	3/4	1.72	3.60	320	1.10	18.0	2120
6	1	3.60	8.30	400	1.10	36.0	4140
8	1-1/4	6.80	14.90	500	3.80	60.0	9820
10	1-1/4	10.67	33.20	700	3.80	125	9820
12	1-1/2	35.00	54.7	1000	11.0	143	12000

Flow-Ring Construction

Valve Size, NPS	Valve Shaft Diameter, Inches	A		B	C		Maximum T_D, Lbf•In.
		Composition Bearings[1]	Metal Bearings		60 Degrees	70 Degrees	
1	1/2	0.03	0.14	13	0.38	0.48	515
1-1/2	5/8	0.05	0.30	28	1.10	1.10	1225
2	5/8	0.10	0.60	47	1.30	2.40	1225
3	3/4	0.30	1.20	80	4.50	6.80	2120
4	3/4	0.60	1.90	150	8.30	18.0	2120
6	1	1.20	4.40	300	20.0	36.0	4140
8	1-1/4	2.30	8.50	400	45.0	60.0	9820
10	1-1/4	3.00	15.4	600	86.0	125	9820
12	1-1/2	3.50	28.4	800	160	190	12000
14	1-3/4	29	51	1200	75	413	23525
16	2	43	75	1700	105	578	23525
16	2-1/8	43	75	1700	105	578	55762
20	2-1/2	65	122	2600	190	1044	55762

1. PEEK/PTFE or metal/PTFE bearings.

Table 2. Torque Characteristics for HD (Heavy-Duty) Metal Ball Seal

HD (Heavy-Duty) Metal Ball Seal								
Valve Size, NPS	Valve Shaft Diameter, Inches	A		B		C		Maximum T_D, Lbf•In.
		Composition(1) Bearings	Metal Bearings	Lubricated Service(2)	Non-Lubricated Service(2)	60 Degrees	70 Degrees	
1	1/2	0.07	0.28	60	75	0.38	0.48	515
1-1/2	5/8	0.10	0.40	90	100	1.10	1.10	1225
2	5/8	0.26	1.04	125	140	1.30	2.40	1225
3	3/4	0.23	1.19	200	300	4.89	5.67	2120
4	3/4	0.34	1.86	250	350	7.64	12.0	2120
6	1	0.62	4.42	450	650	21.0	33.0	4140
8	1-1/4	2.00	8.46	900	1600	42.0	59.0	9820
10	1-1/4	4.60	15.4	1300	1900	100	155	9820
12	1-1/2	7.30	28.4	2000	2900	150	188	12000
14	1-3/4	36	68	2900	3200	75	413	23525
16	2	50	100	3900	4300	105	578	23525
16	2-1/8	50	100	3900	4300	105	578	55762
20	2-1/2	112	245	5400	6000	190	1044	55762

1. PEEK/PTFE or metal/PTFE bearings.
2. With lubricated service, the process fluid provides lubrication to the seal. With non-lubricated service (such as superheated steam or filtered air), the process fluid provides no lubrication to the seal.

Table 3. K Values for Effective Pressure Drops, ΔP_{eff}

VALVE SIZE, NPS	COMPOSITION BALL SEALS, FLAT METAL BALL SEALS, AND FLOW-RING CONSTRUCTION		HD (HEAVY-DUTY) METAL BALL SEALS	
	60 Degrees	70 Degrees	60 Degrees	70 Degrees
2	0.238	0.222	0.279	0.211
3	0.225	0.200	0.253	0.225
4	0.233	0.194	0.272	0.219
6	0.233	0.216	0.245	0.220
8	0.241	0.219	0.219	0.181
10	0.213	0.177	0.213	0.177
12	0.220	0.189	0.220	0.189
14	0.240	0.208	0.240	0.208
16	0.240	0.208	0.240	0.208
20	0.240	0.208	0.240	0.208

The Dynamic Torque (T_D) values for Vee-Ball™ valves with attenuators is higher than the dynamic torque of a valve without an attenuator.

It is necessary to determine at what angle of opening the maximum dynamic torque occurs.

Due to a more linear shape of the dynamic torque curve for attenuators, it is necessary to check the dynamic torque between 30 and 90 degrees of rotation when sizing the valve and actuator. Testing has shown that the dynamic torque for some valve sizes with attenuators is larger than the breakout torque required. Use the following steps to determine the maximum torque required at each 10 degrees of rotation (refer to summary on page D-22.8).

The V-Line attenuator should only be used in the forward flow direction. The effect of the attenuator is negated in the reverse flow direction. For a Vee-Ball valve with or without an attenuator, dynamic torque always tends to close the valve.

Valve Actuator Torque Requirements

1. Find Breakout Torque (T_B):
   $T_B = A(\Delta P_{shutoff}) + B$

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from table 1.

2. Find dynamic torque (T_D):
   $T_D = C(\Delta P_{effective})$

Calculate the maximum ΔP_{eff} (effective pressure drop) at each ten degree increment[1] up through 90 degrees of rotation. Use one of the following equations:

- Liquid Service

$$\Delta P_{eff} = \Delta P_{allowable} = F_L^2 (P_{1abs} - F_F P_v)$$

Definition of variables can be found in the *Valve Sizing for Cavitation and Flashing Liquid*, procedure in Section 2 of Catalog 12.

- Gas Service

$$\Delta P_{eff} = K P_{1(abs)} \text{ (See table 2)}$$

If ΔP_{actual} (actual pressure drop) is known, compare ΔP_{actual} to ΔP_{eff} at each ten degree increment[1] of rotation. Use the smaller of ΔP_{actual} or ΔP_{eff} and the C factor from table 3 to calculate T_D.

3. T_D must not exceed the maximum allowable torque (due to the spline limit) listed in the right column of table 3 as Maximum (T_D), Lbf•in.

4. Determine if your application uses push-down-to-open (PDTO) or push-down-to-close (PDTC) valve action. Use table 4 for PDTO, or table 5 for PDTC values.

5. Verify that your actuator selection will meet or exceed the dynamic torque generated by the valve.

6. If the available actuator torque from table 4 or 5 is higher than the breakout torque calculated in step 1 and the dynamic torque calculated in step 2, then the actuator is sized correctly.

Note

See sample calculations on page 4.

Actuator Selection

For 1052 actuators, see tables 4 and 5. For certain spring sizes not listed here, turn to the appropriate page in Catalog 14, Section D, and use the procedure given in PS Sheet Catalog 14, Page D-31(A) (March 1998).

For 1051 and 1061 actuators, refer to Catalog 14, Section D, or consult your Emerson Process Management sales office for an alternate selection.

Table 1. Breakout Torque (T_B) Characteristics for Composition[1] (TCM) Seal and Bearing for Attenuated Valves

Valve Size. NPS	Shaft Size, Inches	A	B
4	3/4	0.10	380
6	1	1.80	500
8	1-1/4	1.80	750
10	1-1/4	1.80	1250
12	1-1/2	4.00	3000
14	1-3/4	42	2400
16	2	60	2800
16	2-1/8	60	2800
20	2-1/2	97	5200

1. For other seal materials, see Catalog 14, Section D.

Table 2. K Factor (T_D) for Attenuated Valves

VALVE SIZE, NPS	VALVE ROTATION IN DEGREES								
	10°	20°	30°	40°	50°	60°	70°	80°	90°
4	0.31	0.34	0.33	0.29	0.26	0.23	0.19	0.15	0.15
6	- - -	0.17	0.22	0.23	0.23	0.20	0.16	0.13	0.14
8	0.30	0.42	0.35	0.30	0.29	0.26	0.20	0.14	0.13
10	0.37	0.32	0.33	0.33	0.28	0.24	0.19	0.16	0.14
12	0.40	0.29	0.34	0.33	0.31	0.25	0.22	0.17	0.13
14	- - -	0.35	0.30	0.29	0.25	0.23	0.18	0.15	0.13
16	- - -	0.38	0.29	0.26	0.22	0.21	0.16	0.12	0.09
20	- - -	0.35	0.30	0.30	0.25	0.23	0.18	0.15	0.13

Table 3. V-Notch Ball Characteristics (C Factors) for Attenuated Valves

VALVE SIZE, NPS	SHAFT DIA., INCHES	DEGREE OF ROTATION									MAXIMUM (T_D), Lbf•in.[1]
		10	20	30	40	50	60	70	80	90	
4	3/4	- - -	0.9	1.4	2.9	4.8	7.4	7.8	9.0	9.0	2120
6	1	- - -	2.9	6.0	10.8	13.2	16.8	19.5	25	25	4140
8	1-1/4	- - -	6.7	18	30	33	49	56	61	61	9820
10	1-1/4	- - -	25	48	68	85	111	130	156	156	9820
12	1-1/2	- - -	25	59	113	154	216	265	320	332	12000
14	1-3/4	14.4	45	102	156	217	297	360	372	372	23525
16	2-1/8	19.8	62	141	215	300	410	497	499	499	55762
20	2-1/2	37	117	266	406	566	772	936	940	940	55762

1. This value is the maximum allowable spline torque.

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Table 4. 1052 Actuator Torque Net Output Lbf•in with PDTO Attenuated Valve Action (Fail Closed)

AIR TO DIA-PHRAGM PSI	INITIAL COM-PRESSION, PSIG	DEGREES OF VALVE ROTATION										SPRING PART NUMBER	ACTUATOR SIZE
		0 Closed	10	20	30	40	50	60	70	80	90 Open		
0-33	4.3	4922	4723	4525	4298	4029	3762	3435	3047	2573	2024	1P6371 27082	40
	6.0	4630	4289	3929	3527	3098	2690	2260	1820	1359	880	1L2173 27042	
	7.0	11510	10239	9631	8868	8082	7053	5958	4756	3543	2368	1K1628 27082	60
	3.5	13060	12259	12134	11842	11462	10756	9858	8688	7338	5869	1N9373 27082	
	10.1	10962	11473	11509	11062	10049	8699	7081	5511	3845	2240	1R6760 27082	70
0-40	6.0	5831	5506	5165	4779	4348	3930	3462	2954	2380	1753	1L2173 27042	40
	7.0	14609	13308	12831	12170	11456	10409	9216	7805	6286	4724	1K1628 27082	60
	10.1	14312	15387	15711	15554	14668	13308	11538	9702	7602	5448	1R6760 27082	70
0-55	4.4	8677	8350	7975	7508	6945	6374	5705	4954	4086	3126	1N8440 27082	40
	10.1	21493	23459	24714	25182	24566	23185	21090	18684	15653	12323	1R6760 27082	70

Table 5. 1052 Actuator Spring Output Torque in Lbf•in with PDTC Attenuated Valve Action (Fail Open)

AIR TO DIA-PHRAGM, PSI	INITIAL COM-PRESSION, PSIG	DEGREES OF VALVE ROTATION										SPRING PART NUMBER	ACTUATOR SIZE
		0 Closed	10	20	30	40	50	60	70	80	90 Open		
0-33	3.0	3213	3377	3355	3159	2815	2365	1858	1349	887	513	1N8440 27082	40
	4.3	1970	2118	2168	2122	1990	1789	1540	1267	992	735	1P6371 27082	
	3.0	8503	8961	8908	8380	7456	6248	4894	3538	2313	1321	1P2702 27042	60
	3.0	6426	6808	6817	6475	5837	4981	4005	3010	2091	1321	1K1628 27082	
	3.0	8621	9092	9050	8532	7613	6407	5048	3682	2442	1431	1R6760 27082	70
0-40	3.0	3213	3377	3355	3159	2815	2365	1858	1349	887	513	1N8440 27082	40
	3.0	2506	2647	2646	2513	2266	1935	1557	1170	812	513	1L2173 27042	
	3.1	6471	6860	6874	6535	5899	5044	4066	3067	2142	1365	1K1628 27082	60
	3.3	8768	9261	9236	8730	7818	6612	5247	3869	2610	1574	1R6760 27082	70
0-55	3.5	3301	3479	3467	3277	2938	2488	1977	1461	988	598	1N8440 27082	40
	10.1	12105	13081	13443	13211	12448	11253	9756	8098	6414	4819	1R6760 27082	70

Table 6. Fisher 2052 Actuator Torque Net Output Lbf•in with PDTO Attenuated Valve Action (Fail Closed)

AIR TO DIAPHRAGM	ACTUATOR SIZE	PUSH-DOWN-TO-OPEN (PDTO)									
		Tb	Tn OPEN								
			10°	20°	30°	40°	50°	60°	70°	80°	90°
2 barg (29 psig)	1	226	746	708	656	592	520	443	367	294	226
	2	930	3252	3074	2833	2542	2215	1871	1533	1216	930
	3	2890	8487	8337	7831	7066	6142	5153	4179	3277	2479
3 barg (44 psig)(1)	1	226	1295	1269	1216	1140	1041	925	798	666	533
	2	930	5605	5484	5257	4922	4493	3992	3447	2884	2319
	3	2890	15143	15401	15069	14253	13075	11653	10087	8464	6841
4 barg (58 psig)	1	453	1493	1416	1312	1184	1040	887	734	588	453
	2	1860	6504	6147	5666	5084	4429	3743	3066	2432	1860
	3	5583	17299	17021	16019	14486	12624	10626	8649	6809	5173
4.7 barg (68 psig)(2)	1	453	1879	1811	1706	1570	1408	1226	1038	850	668
	2	1860	8161	7847	7374	6762	6035	5237	4415	3608	2839
	3	5583	21966	21976	21095	19527	17489	15188	12795	10451	8236

1. This is an optional operating pressure for the 1- spring design.
2. This is an optional operating pressure for the 2- spring design.

Table 7. Fisher 2052 Actuator Torque Net Output Lbf•in with PDTC Attenuated Valve Action (Fail Open)

AIR TO DIAPHRAGM	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)									
		Tb	Ts OPEN								
			10°	20°	30°	40°	50°	60°	70°	80°	90°
2 barg (29 psig)	1	226	374	410	428	428	410	378	333	281	226
	2	930	1777	1921	1979	1949	1840	1665	1440	1188	930
	3	2479	5597	6008	6155	6040	5688	5140	4448	3678	2890
3 barg (44 psig)(1)	1	320	374	410	428	428	410	378	333	281	226
	2	1551	1777	1921	1979	1949	1840	1665	1440	1188	930
	3	4933	5597	6008	6155	6040	5688	5140	4448	3678	2890
4 barg (58 psig)	1	453	747	820	857	856	821	756	667	563	453
	2	1860	3554	3842	3957	3899	3681	3329	2880	2376	1860
	3	5173	11022	11822	12095	11852	11140	10041	8665	7137	5583
4.7 barg (68 psig)(2)	1	641	747	820	857	856	821	756	667	563	453
	2	2839	3554	3842	3957	3899	3681	3329	2880	2376	1860
	3	8236	11022	11822	12095	11852	11140	10041	8665	7137	5583

1. This is an optional operating pressure for the 1- spring design.
2. This is an optional operating pressure for the 2- spring design.

Sample Calculations

Example problem based on an actual application:

From page 1, the following example is provided to assist in your calculations.

Assume a V300, NPS 12 valve with a 1052, Size 70 actuator operating on a 0 to 55 psi air to diaphragm, PDTC, and 10.1 psig initial spring compression. Also, assume an application for flowing water at 100 degrees Fahrenheit with P_1 equal to 440 psig and P_2 equals 0 psig. The flowing ΔP for this example is:

Degrees of Rotation	Flowing ΔP, Psi
10	= 400
20	= 350
30	= 250
40	= 150
50	= 100
60	= 70
70	= 50
80	= 40
90	= 30

1. If $\Delta P_{shutoff}$ is not known, assume $\Delta P_{shutoff} = P_1$.
   $T_B = A(\Delta P) + B = 4(440) + 3000 = 4{,}760$ Lbf • ft. Since shaft spline limit is 12,000 Lbf • in (from table 3 right column) breakout torque is smaller than the spline limit.

2. $T_D = C(\Delta P)$ or $\Delta P_{effective}$ whichever is less
   $\Delta P_{effective} = K_M (P_{1\ absolute} - r_c \bullet P_v)$
   Given water at 100° F
   Assume $r_c = 0.95$ and $P_v = 1$
   obtain K_m from Catalog 12

Calculation Procedures	
1.	Calculate breakout torque.
2.	Determine dynamic torque at every 10 degrees of rotation.
3.	Be sure the actuator capability exceeds the required valve torque.
4.	Be sure the breakout and/or dynamic torques are less than the shaft spline limit.

Summary

We realize that application information is often <u>not</u> available at every 10 degrees of rotation. However, you must check the application at several degrees of rotation to verify that the actuator spline strength will be able to handle the dynamic torque throughout the full range of travel. Note, in Table 7 in the following example, the dynamic torque at 40 degrees is the largest value. The dynamic torque at 30 degrees is greater than at 70, 80, or 90 degrees of travel. Also note that the 1052 actuator dynamic output torque (spring torque) decreases on PDTC valves as the valve approaches full open.

Table 6. Sample Values for Valve in Example Problem on Page D-113

Degrees of Rotation	10	20	30	40	50	60	70	80	90
K_M value =	**0.76**	**0.64**	**0.69**	**0.61**	**0.62**	**0.51**	**0.53**	**0.47**	**0.40**
$\Delta P_{effective}$ =	345	290	313	277	281	231	240	213	181
ΔP_{actual} =	400	350	250	150	100	70	50	40	30

Use the smaller value from $\Delta P_{effective}$ or ΔP_{actual} in calculations below.

Table 7. Sample Calculations - Dynamic Torque

Degrees of Rotation	10	20	30	40	50	60	70	80	90
C factors from table 3	- - -	25	59	113	154	216	265	320	332
T_D =	- - -	290 x 25 = 7250	250 x 59 = 14750	150 x 113 = 16950	100 x 154 = 15400	70 x 216 = 15120	50 x 265 = 13250	40 x 320 = 12800	30 x 332 = 9960

Note, Since these values exceed 12,000 Lbf-in spline limit, a different valve size or style must be selected.

3. Be sure actuator torque exceeds valve torque.

Actuator Operating Specifications: 1052 Size 70, 0-55 psid air supply, 10.1 spring set, and PDTC valve action.

Table 8. Sample Values

Degrees of Rotation	0	10	20	30	40	50	60	70	80	90
Actuator Torque(1)	12,130	13,087	13,488	13,240	12,445	11,267	9,795	8,107	6,425	4,835
Valve Torque(2)	- - -	- - -	7250	14750	16950	15400	15120	13250	12800	9960

1. Values obtained from table 5.
2. Values obtained from table 7.

4. These values of valve dynamic torque exceed available actuator torque and shaft spline torque limits. The solution would be to use a valve and actuator with greater capability. A possible solution would be a V300 NPS 14 with a 1061 or 1031 actuator for this application.

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from table 1.

2. Find T_D (dynamic torque).

Calculate the maximum ΔP_{eff} (effective pressure drop) at each ten degree increment up through maximum rotation. Use one of the following equations:

- Liquid only

$\Delta P_{eff} = \Delta P_{allowable} = F_L^2\ (P_{1abs} - F_F\ P_V)$. Definition of variables can be found in the valve sizing for flashing and cavitating liquids procedure in section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = KP_{1(abs)}$. See table 3 for K values.

If ΔP_{actual} (actual pressure drop) is known, compare ΔP_{actual} to ΔP_{eff} at each ten degree increment of rotation. Use the smaller of ΔP_{actual} or ΔP_{eff} and the C factor from table 2 to calculate T_D.

3. T_D must not exceed the maximum T_D listed in table 2.

Selecting 1061 or 1069 Piston Actuator

Turn to the appropriate 1061 actuator page and use the procedure given there. If the 1061 actuator is not suitable for the application, consider the 1069 actuator.

Selecting 321, 329, or 354 Electrohydraulic Actuator

Select an actuator that supplies more torque than the largest of the valve body torque requirements.

Table 1. Torque Characteristics, A and B Factors

Single or Dual Seal Construction					
Valve Body Size, NPS	Shaft Spline Size, Inches	Up to 800 Psid		Over 800 Psid	
		A	B	A	B
4	1-1/4	2.4	800	1.4	1620
6	2	3.9	1030	2.7	1990
8	2-1/2	13.5	4100	6.6	9620
10	2-1/2	20.8	7140	12.6	14700
12	2-1/2	22.2	10300	12.9	17800
		Up to 400 Psid		Over 400 Psid	
		A	B	A	B
16	2-1/2	47.2	12000	27.8	19760
	3-1/2	47.2	12000	27.8	19760
20	3-1/2	87.4	25000	50.0	40000
24	3-1/2	112	33300	63.0	52900
Flow Ring Construction					
		A		B	
4	1-1/4	0.1		10	
6	2	0.2		20	
8	2-1/2	0.3		40	
10	2-1/2	0.4		60	
12	2-1/2	0.5		100	
16	2-1/2	0.6		200	
	3-1/2	0.6		200	
20	2-1/2	0.7		400	
24	3-1/2	0.8		500	

Table 2. Torque Characteristics, C Factors

Single Seal, Dual Seal, or Flow Ring Construction												
Valve Body Size, NPS	Shaft Spline Size, Inches	Angle of Opening, Degrees									Maximum Allowable Torque, Inch-Pounds	
		10	20	30	40	50	60	70	80	90	S17400 Shaft	S20910 Shaft
4	1-1/4	---	3.71	5.47	6.61	7.18	7.52	9.18	13.9	2.85	6710	6710
6	2	---	3.13	4.70	6.00	6.26	7.05	10.6	20.5	3.13	15537	15537
8	2-1/2	13.6	26.8	39.6	47.9	52.0	54.5	66.4	101	20.6	38227	38227
10	2-1/2	7.55	18.1	27.2	34.7	36.2	40.7	61.1	118	18.1	47399	41823
12	2-1/2	13.2	31.7	47.6	60.8	63.4	71.3	107	207	31.7	47399	41823
16	2-1/2 3-1/2	27.4	65.8	98.7	126	132	148	222	431	65.8	47399 194145	33458 137043
20	3-1/2	55.9	134	201	257	268	302	453	878	134	194145	137043
24	3-1/3	88.4	212	318	407	425	478	716	1390	212	194145	137043

Table 3. K values for Effective Pressure Drop, ΔP_{eff}

Valve Body Size, NPS	Angle of Opening, Degrees								
	10	20	30	40	50	60	70	80	90
4	---	.299	.346	.340	.319	.265	.211	.117	.075
6	---	.445	.372	.406	.342	.290	.241	.126	.075
8	.158	.383	.366	.381	.284	.262	.214	.129	.062
10	.150	.265	.337	.325	.304	.255	.193	.131	.067
12	.109	.397	.395	.350	.270	.222	.170	.102	.045
16	.208	.319	.393	.375	.297	.230	.187	.119	.058
20	.129	.317	.368	.385	.303	.228	.187	.119	.057
24	.129	.321	.370	.389	.306	.230	.190	.120	.058

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop at shutoff) and the A and B factors from tables 1 and 2.

2. Find T_D (dynamic torque).

Calculate the maximum ΔP_{eff} (effective pressure drop) at each ten degree increment up through maximum rotation. Use one of the following equations:

- Liquid only

$\Delta P_{eff} = \Delta P_{allowable} = F_L^2\ (P_{1abs} - F_F\ P_V)$. Definition of variables can be found in the valve sizing for flashing and cavitating liquids procedure in section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = KP_{1(abs)}$. See tables 5 and 7 for K values.

If ΔP_{actual} (actual pressure drop) is known, compare ΔP_{actual} to ΔP_{eff} at each ten degree increment of rotation. Use the smaller of ΔP_{actual} or ΔP_{eff} and the C factor from tables 3, 4 and 6 to calculate T_D.

3. T_D must not exceed the maximum T_D listed in tables 3, 4 and 6.

Selecting 1061 or 1069 Piston Actuator

Turn to the appropriate 1061 actuator page and use the procedure given there. If the 1061 actuator is not suitable for the application, consider the 1069 actuator.

Selecting 321, 329, or 354 Electrohydraulic Actuator

Select an actuator that supplies more torque than the largest of the valve body torque requirements.

Tables 1 & 2. Breakout Torque Characteristics (A & B Factors)

SINGLE COMPOSITION SEAL		
Valve Size, NPS	A	B
8	10.5	3080
10	20.0	4180
12	30.0	5000
16	75.7	7200
20	144	9150
24	235	11200

DUAL COMPOSITION SEAL		
Valve Size, NPS	A	B
8	10.5	4620
10	20.0	6270
12	30.0	7500
16	75.7	10800
20	144	13700
24	235	16800

Tables 3 & 4. Dynamic Torque Characteristics (C Factor) For V260A & B (V260C on next page)

CHARACTERIZED ATTENUATOR										
Valve Size, NPS	Valve Angle									
	10	20	30	40	50	60	70	80	90	Max Torque, in•lbs
8	11	29	41	42	46	46	66	87	87	23500
10	21	56	80	82	89	89	128	169	169	55800
12	37	97	137	140	154	154	220	290	290	55800
16	90	236	334	342	374	374	537	708	708	153000
20	173	456	644	660	723	723	1037	1370	1370	228000
24	297	782	1110	1130	1240	1240	1780	2350	2350	228000

HIGH DENSITY ATTENUATOR										
Valve Size, NPS	Valve Angle									
	10	20	30	40	50	60	70	80	90	Max Torque, in•lbs
8	9	19	27	31	40	43	48	59	59	23500
10	17	37	52	60	78	84	93	115	115	55800
12	30	63	90	103	134	144	160	197	197	55800
16	73	155	220	252	326	350	391	480	480	153000
20	142	299	424	487	629	676	755	927	927	228000
24	243	512	728	836	1080	1160	1290	1590	1590	228000

Table 5. K-Values for Effective Pressure Drop for V260A & B (V260C on next page)

Valve Angle, Degrees								
10	20	30	40	50	60	70	80	90
CHARACTERIZED ATTENUATOR								
0.16	0.34	0.26	0.23	0.22	0.21	0.21	0.19	0.18
HIGH DENSITY ATTENUATOR								
0.33	0.28	0.24	0.22	0.20	0.19	0.17	0.17	0.16

Table 6. Dynamic Torque Characteristics (C Factor)

VALVE SIZE, NPS	VALVE ANGLE, DEGREES									
	10	20	30	40	50	60	70	80	90	Max Torque, in•lbs
8	19	24	26	30	45	75	206	372	372	23500
10	36	46	49	58	87	146	399	723	723	55800
12	62	80	85	99	150	250	686	1,240	1,240	55800
16	150	194	206	242	366	610	1,670	3,030	3,030	153000
20	289	375	398	467	707	1,180	3,230	5,850	5,850	228000
24	496	643	684	801	1,210	2,020	5,540	10,000	10,000	228000

Table 7. K-Values for Effective Pressure Drop

VALVE ANGLE, DEGREES								
10	20	30	40	50	60	70	80	90
.20	.28	.34	.34	.30	.23	.17	.09	.06

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop) and the A and B factors from tables 1 and 2.

2. Find T_D (dynamic torque).

Calculate ΔP_{eff} (effective pressure drop) at 10 degree increment up through maximum rotation. Use one of the following equations:

- Liquid only

$\Delta P_{eff} = \Delta P_{allowable} = F_L{}^2\ (P_{1abs} - F_F\ P_v)$. Definition of variables can be found in the valve sizing for flashing and cavitating and liquids procedure in section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = KP_{1(abs)}$. See tables 5 and 7 for K values.

If ΔP_{actual} (actual pressure drop) is known, compare ΔP_{actual} to ΔP_{eff} at each 10 degree increment of rotation. Use the smaller of ΔP_{actual} or ΔP_{eff} and the C factor from tables 3, 4 and 6 to calculate T_D.

3. T_D must not exceed the maximum T_D listed in tables 3, 4 and 6.

Table 1. Breakout Torque Characteristics (A & B Factors)

DUAL COMPOSITION SEAL		
Valve Size, NPS	**A**	**B**
6	5.9	1129
8	10.5	4620
10	20.0	6270
12	30.0	7500
14	50.5	9176
16	75.7	10800
20	144	13700
24	235	16800

Table 2. Dynamic Torque Characteristics (C Factor)

V270 GAS OR LIQUID FLOW											
VALVE SIZE, NPS	PRESSURE CLASS	**VALVE ROTATION, DEGREES**									**Max Torque, in•lbs**
		10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	
6	150	6	6	14	19	27	44	95	181	181	17142
	300										26256
	600										26256
8	150	19	24	26	30	45	75	206	372	372	26256
	300										26256
	600										26256
10	150	36	46	49	58	87	146	399	723	723	35387
	300										35387
	600										44405
12	150	62	80	85	99	150	250	686	1240	1240	35387
	300										35387
	600										56350
14	150	90	117	124	145	219	365	998	1808	1808	43439
	300										43439
	600										104145
16	150	150	194	206	242	366	610	1670	3030	3030	43439
	300										81592
	600										104145
20	150	289	375	398	467	707	1180	3230	5850	5850	104145
	300										168225
	600										173255
24	150	496	643	684	801	1210	2020	5540	10000	10000	104145
	300										199476
	600										347241

Table 3. K Values for Effective Pressure Drop

Valve Size, NPS	**VALVE ROTATION, DEGREES**								
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**
6	0.24	0.38	0.36	0.44	0.34	0.25	0.17	0.08	0.04
8	0.20	0.29	0.35	0.35	0.30	0.22	0.16	0.07	0.01
10	0.20	0.29	0.35	0.35	0.30	0.22	0.16	0.07	0.02
12	0.20	0.29	0.35	0.35	0.30	0.22	0.16	0.07	0.02
14	0.20	0.29	0.35	0.35	0.30	0.22	0.16	0.07	0.02
16	0.20	0.29	0.35	0.35	0.30	0.22	0.16	0.07	0.01
20	0.20	0.28	0.34	0.34	0.29	0.22	0.16	0.07	0.01
24	0.20	0.28	0.34	0.34	0.29	0.22	0.16	0.07	0.02

Torque Equations

Breakout Torque

$T_B = A\ (\Delta P_{shutoff}) + B$

Dynamic Torque

$T_D = C\ (\Delta P_{eff})$

Valve Body Torque Requirements

1. Find T_B (breakout torque).

Use $\Delta P_{shutoff}$ (actual pressure drop) and the A and B factors from the appropriate torque characteristics table and calculate the breakout torque for seating and unseating the valve plug.

2. Find T_D (dynamic torque).

Refer to the appropriate equation below. For 90 degree maximum valve plug rotation, calculate ΔP_{eff} (effective pressure drop) at 60 degrees and at 90 degrees. For 60 degree maximum valve plug rotation, calculate the ΔP_{eff} at 60 degrees rotation only. If the actual ΔP is known for the degree of rotation desired, compare with the calculated ΔP_{eff} and use the smaller of the two values in the dynamic torque calculation.

- Liquid only

$\Delta P_{eff} = \Delta P_{allowable} = F_L{}^2\ (P_{1abs} - F_F\ P_v)$. Definition of terms can be found in the valve sizing for cavitating and flashing liquids procedure in section 2 of Catalog 12.

- Gas only

$\Delta P_{eff} = KP_{1(abs)}$. See table 1 for K values.

3. The breakout and dynamic torque must not exceed the maximum allowable torque listed in table 2 or table 3.

Selecting 1051 or 1052 Spring-and-Diaphragm or 1066SR Spring-Return Piston Actuator

Reference the appropriate actuator tables for the V500 valve body and select the push-down-to-open (PDTO) or push-down-to-close (PDTC) construction that supplies greater breakout torque than is needed for both seating and unseating the plug, and greater dynamic torque than is required by the valve body.

Selecting the 1061 or 1066 Piston Actuator

Reference the 1061 or 1066 actuator tables and use the procedure given there.

Metal Seat Forward Flow									Level 1, 2, 3 or 4 Trim	
Valve Size, NPS	Shaft Diameter, Inches(1)	A				B		C(2)		Maximum Allowable Torque, In•lb
		Metal Bearings		PTFE Lined Bearings		Metal Bearings	PTFE Lined Bearings	Rotation		
		Seating	Unseating	Seating	Unseating			60°	90°	
1	1-1/1/2	0.133	0.078	0.125	0	110	90	0.38	-0.04	468
1.5	5/8 X 1/2 5/8	0.306 0.306	0.185 0.185	0.286 0.286	0.032 0.032	220 220	100 100	0.12 0.12	-0.03 -0.03	515 1035
2	5/8	0.507	0.353	0.490	0.130	250	150	0.32	-0.39	1035
3	1 X 3/4 1	2.19 2.19	0.970 0.970	2.03 2.03	0 0	250 250	180 180	0.90 0.90	-1.20 -1.20	2120 3730
4	1-1/4	4.89	1.33	4.52	0	400	300	2.10	-3.30	8280
6	1-1/2X1-1/4 1-1/2	14.0 14.0	6.30 6.30	13.1 13.1	1.71 1.71	1275 1275	1200 1200	9.00 9.00	-15.90 -15.90	9815 12000
8	1-1/2	30.0	6.41	30.0	0	1275	1200	16.50	-26.20	12000

1. Two numbers indicate shaft diameter X spline diameter.
2. Positive values indicate dynamic torque tends to close valve; negative values indicate dynamic torque tends to open valve.

Metal Seat Reverse Flow									Level 1, 2, 3 or 4 Trim	
Valve Size, NPS	Shaft Diameter, Inches(1)	A				B		C(2)		Maximum Allowable Torque, In•lb
		Metal Bearings		PTFE Lined Bearings		Metal Bearings	PTFE Lined Bearings	Rotation		
		Seating	Unseating	Seating	Unseating			60°	90°	
1	1-1/1/2	0.078	0.133	0	0.125	110	90	0.12	0.06	468
1.5	5/8 X 1/2 5/8	0.185 0.185	0.306 0.306	0.032 0.032	0.286 0.286	220 220	100 100	0.48 0.48	0.18 0.18	515 1035
2	5/8	0.353	0.507	0.130	0.490	250	150	0.86	0.48	1035
3	1 X 3/4 1	0.970 0.970	2.19 2.19	0 0	2.03 2.03	250 250	180 180	4.20 4.20	1.65 1.65	2120 3730
4	1-1/4	1.33	4.89	0	4.52	400	300	7.20	4.05	8280
6	1-1/2X1-1/4 1-1/2	6.30 6.30	14.0 14.0	1.71 1.71	13.1 13.1	1275 1275	1200 1200	19.80 19.80	34.80 34.80	9815 12000
8	1-1/2	6.41	30.0	0	30.0	1275	1200	45.00	32.20	12000

1. Two numbers indicate shaft diameter X spline diameter.
2. Dynamic torque tends to close valve.

K Values for Effective Pressure Drop						Level 1, 2, 3 or 4 Trim		
Valve Size, NPS	Forward Flow				Reverse Flow			
	Full Port		Reduced Port		Full Port		Reduced Port	
	Rotation							
	60°	90°	60°	90°	60°	90°	60°	90°
1	0.284	0.267	0.197	0.189	0.145	0.128	0.157	0.154
1.5	0.286	0.265	0.228	0.220	0.162	0.161	0.187	0.187
2	0.208	0.199	0.208	0.208	0.119	0.119	0.162	0.159
3	0.236	0.205	0.199	0.193	0.170	0.161	0.129	0.126
4	0.220	0.199	0.208	0.192	0.183	0.187	0.145	0.144
6	0.194	0.187	0.208	0.184	0.174	0.098	0.179	0.116
8	0.181	0.162	0.186	0.176	0.154	0.163	0.174	0.140

EMERSON.
Process Management

Table 1. Actuator Torque, lbf•in

AIR TO DIAPHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)				SPRING PART NUMBER	ACTUATOR SIZE
	Initial Compres-sion, Psig	T_B	T_D 60° Maximum Rotation(1)(2)	T_D 90° Maximum Rotation(3)	Initial Compres-sion, Psig	T_B	T_D 60° Maximum Rotation(4)	T_D 90° Maximum Rotation(5)		
0-18	3.0	130	160	70	3.9	90	260	110	16A4660X012	20
	3.0	172	497	216	4.9	336	260	34	10B1524X012	33
	3.0	300	609	210	3.7	256	493	247	10B1523X012	
	2.7	440	362	182	2.7	184	702	438	10B1522X012	
	3.0	380	1230	520	4.3	730	870	160	1P637127082	40
	3.0	770	1080	520	3.0	520	1520	770	1L217427042	
	3.0	2140	2840	1330	3.7	1630	3780	1830	1K162727082	60
0-33	3.0	280	210	70	6.8	160	470	190	16A4659X012	20
	4.9	807	664	335	4.9	335	1293	808	10B1524X012	33
	3.0	1410	1560	520	6.0	1030	2270	870	1L217327042	40
	4.3	1960	1540	730	4.3	730	3450	2020	1P637127082	
	3.0	4160	4010	1330	7.0	3090	5950	2360	1K162827082	60
	3.5	4880	3560	1540	3.5	1540	9860	5860	1N937327082	
	3.0	5720	5050	1430	10.1	4810	7110	2240	1R676027082	70
0-40	4.9	370	270	110	6.8	160	680	320	16A4659X012	20
	4.9	808	666	336	4.9	336	1773	1167	10B1524X012	33
	3.0	2280	1560	520	6.0	1030	3470	1750	1L217327042	40
	3.1	6460	4090	1380	7.0	3090	9210	4710	1K162827082	60
	3.3	8770	5250	1580	10.1	4810	11560	5440	1R676027082	70
0-55	6.3	1166	918	440	6.3	440	2392	1542	10B1525X012	33
	3.5	3280	1980	600	4.4	750	5730	3120	1N844027082	40
	10.1	12,100	9750	4810	10.1	4810	21110	12300	1R676027082	70
3-15	3.0	70	60	0	---	---	---	---	16A4660X012	20
	3.0	145	227	19	3.7	65	287	92	10B1523X012	33
	3.0	400	550	0	---	---	---	---	1L217427042	40
	3.0	1130	1420	0	3.7	300	2380	820	1K162727082	60
3-30	3.0	220	120	0	6.8	90	390	130	16A4659X012	20
	4.9	652	450	145	4.9	145	1085	652	10B1524X012	33
	3.0	1030	1030	0	6.0	520	1750	500	1L217327042	40
	4.3	1580	1000	220	4.3	220	2940	1650	1P637127082	
	3.0	3150	2600	0	7.0	1770	4560	1350	1K162827082	60
	3.5	3870	2150	210	3.5	210	8460	4860	1N937327082	
	3.0	4350	3130	0	10.1	3380	5200	870	1R676027082	70

1. Maximum rotation limited to 60° with adjustable up travel stop.
2. The numbers in this column reflect the net spring torque output (in•lbs) at 60°, valve torque tending to close.
3. The numbers in this column reflect the net spring torque output (in•lbs) at 90°, valve torque tending to close.
4. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 60°, valve torque tending to close.
5. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 90°, valve torque tending to close.

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Table 1. Actuator Torque[1], lbf•in

AIR TO DIA-PHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)					PUSH-DOWN-TO-OPEN (PDTO)					SPRING PART NUMBER	ACTUA-TOR SIZE
	Initial Compres-sion, Psig	T_B	T_D[2]			Initial Compres-sion, Psig	T_B	T_D[2]				
			10° Rotation[3]	60° Rotation[4]	90° Rotation[5]			10° Rotation[6]	60° Rotation[7]	90° Rotation[8]		
0-18	3.0	130	180	160	350	---	---	---	---	---	16A4660X012	20
	3.0	300	383	442	913	3.7	256	339	493	615	10B1523X012	33
	2.7	440[1]	475	362	943	---	---	---	---	---	10B1522X012	
	---	---	---	---	---	4.9	336	445	260	808	10B1524X012	
	3.0	380	650	1230	2570	4.3	730	990	870	1960	1P637127082	40
	3.0	770	1050	1080	2570	3.0	520	700	1520	1380	1L217427042	
	3.0	2140	2860	2840	6630	3.7	1630	2150	3780	3970	1K162727082	60
	---	---	---	---	---	3.5	1540	2160	2880	4880	1N937327082	
0-33	3.0	280	380	210	700	6.8	160	210	470	410	16A4659X012	20
	3.0	652[1]	827	623	1845	6.3	440	594	880	1166	10B1525X012	33
	4.9	807[1]	870	664	1728	4.9	335	444	1293	807	10B1524X012	
	3.0	630	1160	1860	5150	4.4	750	1170	1940	3440	1N844027082	40
	3.0	1410	1960	1560	5150	6.0	1030	1420	2270	3030	1L217327042	
	4.3	1960[1]	2580	1540	4930	4.3	730	990	3450	1960	1P637127082	
	3.0	1870	3240	4900	13,260	6.8	3000	4280	3980	10,170	1P270227042	60
	3.0	4160	5620	4010	13,260	7.0	3090	4170	5950	8200	1K162827082	
	3.5	4880[1]	7360	3560	13,050	---	---	---	---	---	1N937327082	
	3.0	5720	7850	5050	14,340	10.1	4810	6410	7110	12,100	1R676027082	70
0-40	4.9	370[1]	480	270	820	6.8	160	210	680	410	16A4659X012	20
	3.5	977[1]	1040	666	2256	6.3	440	594	1361	1166	10B1525X012	33
	3.0	1500	2180	1860	6350	4.4	750	1170	3150	3440	1N844027082	40
	3.0	2280[1]	2990	1560	6350	6.0	1030	1420	3470	3030	1L217327042	
	3.0	4230	5990	4900	16,360	6.8	3000	4280	7240	10,170	1P270227042	60
	3.1	6460[1]	8300	4090	16,300	7.0	3090	4170	9210	8200	1K162827082	
	3.3	8770[1]	11,440	5250	17,540	10.1	4810	6410	11,560	12,100	1R676027082	70
0-55	6.3	1166[1]	1253	918	3011	6.3	440	594	2392	1166	10B1525X012	33
	3.5	3280[1]	4280	1980	8840	4.4	750	1170	5730	3440	1N844027082	40
	10.1	12,100[1]	15,690	9750	21,480	10.1	4810	6410	21,110	12,100	1R676027082	70
3-15	3.0	145	433	227	722	3.7	65	135	287	461	10B1523X012	33
	3.0	400	610	550	2060	---	---	---	---	---	1L217427042	40
	3.0	1130	1680	1420	5300	3.7	300	840	2380	2970	1K162727082	60
3-30	3.0	220	310	120	630	---	---	---	---	---	16A4659X012	20
	3.0	498	651	408	1654	6.3	249	390	674	1012	10B1525X012	33
	4.9	652[1]	695	450	1536	4.9	145	241	1085	653	10B1524X012	
	3.0	1030	1530	1030	4630	6.0	520	900	1750	2650	1L217327042	40
	4.3	1580[1]	2140	1000	4420	---	---	---	---	---	1P637127082	
	3.0	3150	4440	2600	11,940	7.0	1770	2860	4560	7190	1K162827082	60
	3.5	3870[1]	6180	2150	11,720	---	---	---	---	---	1N937327082	
	3.0	4350	6240	3130	12,910	10.1	3380	4770	5200	10,730	1R676027082	70

1. If selecting actuator for throttling valve with metal bushings and metal seal, reduce this torque by one-third.
2. T_D actuator torque at 90° for all types listed; at 60° for all except NPS 2 8560.
3. The numbers in this column reflect the net spring torque output (in•lbs) at 10°, valve torque tending to close.
4. The numbers in this column reflect the net spring torque output (in•lbs) at 60°, valve torque tending to close.
5. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 90°, valve torque tending to open.
6. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 10°, valve torque tending to close.
7. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 60°, valve torque tending to close.
8. The numbers in this column reflect the net spring torque output (in•lbs) at 90°, valve torque tending to open.

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Table 2. Actuator Torques for 60° or 75° Limited Maximum Rotation, lb•in

AIR TO DIAPHRAGM, PSIG	MAXIMUM ROTATION	INITIAL COMPRESSION, PSIG	PUSH-DOWN-TO-OPEN (PDTO)					SPRING PART NUMBER	ACTUATOR SIZE
			T_B	T_D(1)					
				10° Rotation(2)	60° Rotation(3)	75° Rotation(4)	75° Rotation(5)		
0-33	60°	9.7	655	848	550	---	---	10B1525X012	33
	60°	9.2	1570	2130	810	---	---	1N844027082	40
	60° 75°	11.4 9.1	5040 4020	6670 5480	1170 ---	--- 640	--- 12300	1P270227042	60
	60° 75°	14.7 12.2	7020 5840	8990 7610	4060 ---	--- 3490	--- 14600	1R676027082	70
0-40	60°	9.7	655	848	1031	---	---	10B1525X012	33
	60°	9.2	1570	2130	2010	---	---	1N844027082	40
	60° 75°	11.4 9.1	5040 4020	6670 5480	4430 ---	--- 3550	--- 12300	1P270227042	60
	60° 75°	14.7 12.2	7020 5840	8990 7610	8520 ---	--- 7490	--- 14600	1R676027082	70
0-55	60°	9.2	1570	2130	4600	---	---	1N844027082	40
	60° 75°	14.7 12.2	7020 5840	8990 7610	18060 ---	--- 16070	14600	1R676027082	70

1. T_D actuator torque at 75° use T_N for all 8532 and NPS 3 to 12 8560 and use T_S for NPS 2 8560; at 60° for all except NPS 2 8560.
2. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 10°, valve torque tending to close.
3. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 60°, valve torque tending to close.
4. The numbers in this column reflect the net diaphragm torque output (in•lbs) at 75°, valve torque tending to close.
5. The numbers in this column reflect the net spring torque output (in•lbs) at 75°, valve torque tending to open.

Table 3. Actuator/Valve Body Shaft Combinations

SHAFT DIAMETER, INCH	ACTUATOR SIZE				
	20	33	40	60	70
1/2	X	X	X	---	---
5/8	---	X	X	---	---
3/4	---	X	X	X	---
7/8	---	---	X	X	---
1	---	---	X	X	---
1-1/4	---	---	X	X	X
1-1/2	---	---	---	X	X
1-3/4	---	---	---	X	X

X—available construction.

Table 1. Actuator Torque, lbf•in

AIR TO DIAPHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)				SPRING PART NUMBER	ACTUATOR SIZE
	Initial Compression, psig	T_B	T_D 80° Rotation	T_D 90° Rotation	Initial Compression, psig	T_B	T_D 80° Rotation	T_D 90° Rotation		
0-18	3.0	130	100	350	- - -	- - -	- - -	- - -	16A4660X012	20
	3.0	300	285	913	3.7	256	323	615	10B1523X012	33
	2.7	440[1]	242	943	- - -	- - -	- - -	- - -	10B1522X012	
	- - -	- - -	- - -	- - -	4.9	336	93	808	10B1524X012	
	3.0	380	734	2570	4.3	730	390	1960	1P637127082	40
	3.0	770	696	2570	3.0	520	1045	1380	1L217427042	
	3.0	2140	1803	6630	3.7	1630	2510	3970	1K162727082	60
	- - -	- - -	- - -	- - -	3.5	1540	1471	4880	1N937327082	
0-33	3.0	280	110	700	6.8	160	275	410	16A4659X012	20
	3.0	652[1]	346	1845	6.3	440	551	1166	10B1525X012	33
	4.9	807[1]	444	1728	4.9	335	870	807	10B1524X012	
	3.0	630	891	5150	4.4	750	882	3440	1N844027082	40
	3.0	1410	815	5150	6.0	1030	1356	3030	1L217327042	
	4.3	1960[1]	990	4930	4.3	730	2580	1960	1P637127082	
	3.0	1870	2321	13260	6.8	3000	1291	10170	1P270227042	60
	3.0	4160	2098	13260	7.0	3090	3551	8200	1K162827082	
	3.5	4880[1]	2161	13050	- - -	- - -	- - -	- - -	1N937327082	
	3.0	5720	2446	14340	10.1	4810	3870	12100	1R676027082	70
0-40	4.9	370[1]	162	820	6.8	160	434	410	16A4659X012	20
	3.5	977[1]	383	2256	6.3	440	962	1166	10B1525X012	33
	3.0	1500	891	6350	4.4	750	1904	3440	1N844027082	40
	3.0	2280[1]	815	6350	6.0	1030	2378	3030	1L217327042	
	3.0	4230	2321	16360	6.8	3000	4041	10170	1P270227042	60
	3.1	6460[1]	2163	16300	7.0	3090	6300	8200	1K162827082	
	3.3	8770[1]	2614	17540	10.1	4810	7630	12100	1R676027082	70
0-55	6.3	1166[1]	594	3011	6.3	440	1842	1166	10B1525X012	33
	3.5	3280[1]	986	8840	4.4	750	4093	3440	1N844027082	40
	10.1	12100[1]	6407	21480	10.1	4810	15687	12100	1R676027082	70
3-15	3.0	145	81	722	3.7	65	147	461	10B1523X012	33
	3.0	400	174	2060	- - -	- - -	- - -	- - -	1L217427042	40
	3.0	1130	492	5300	3.7	300	1332	2970	1K162727082	60
3-30	3.0	220	31	630	- - -	- - -	- - -	- - -	16A4659X012	20
	3.0	498	142	1654	6.3	249	375	1012	10B1525X012	33
	4.9	652[1]	241	1536	4.9	145	797	653	10B1524X012	
	3.0	1030	294	4630	6.0	520	918	2650	1L217327042	40
	4.3	1580[1]	469	4420	- - -	- - -	- - -	- - -	1P637127082	
	3.0	3150	787	11940	7.0	1770	2373	7190	1K162827082	60
	3.5	3870[1]	850	11720	- - -	- - -	- - -	- - -	1N937327082	
	3.0	4350	810	12910	10.1	3380	2259	10730	1R676027082	70

1. If selecting actuator for throttling valve with metal bearings, reduce this torque by one-third.

Table 1. Actuator Torque, Lbf•In.

AIR TO DIA-PHRAGM, PSIG	PDTC Initial Com-pression, Psig	PDTC T_B Seating	PDTC T_B Unseating	PDTC T_D 10 Degree Rotation	PDTC T_D 80 Degree Rotation	PDTO Initial Com-pression, Psig	PDTO T_B Seating	PDTO T_B Unseating	PDTO T_D 10 Degree Rotation	PDTO T_D 80 Degree Rotation	SPRING PART NUMBER	ACTUA-TOR SIZE
0-18	3.0	130	200	175	97	3.9	90	330	120	152	16A4660X012	20
	3.0	172	682	275	300	4.9	336	773	440	130	10B1524X012	33
	3.0	300	567	350	340	3.7	256	861	280	410	10B1523X012	
	2.7	440	440	550	240	2.7	184	941	240	550	10B1522X012	
	3.0	380	1730	1850	730	4.3	730	2360	990	2110	1P637127082	40
	3.0	770	1380	1050	700	3.0	520	2570	700	1050	1L217427042	
	3.0	1040	4660	1720	1910	3.5	1540	6420	2160	1470	1N937327082	60
	3.0	2140	3670	2860	1800	3.7	1630	6330	2150	2510	1K162727082	
0-33	3.0	280	320	380	110	6.8	160	610	210	275	16A4659X012	20
	3.0	652	947	850	345	6.3	440	1612	590	600	10B1525X012	33
	4.9	808	807	1010	440	4.9	335	1728	440	1010	10B1524X012	
	3.0	630	3200	1160	890	4.4	750	4910	1170	880	1N844027082	40
	3.0	1410	2500	1960	815	6.0	1030	4630	1420	1360	1L217327042	
	4.3	2020	1960	2580	990	4.3	730	4930	990	2580	1P637127082	
	3.0	1870	8470	3250	2320	6.8	3000	11590	4280	1290	1P270227042	60
	3.0	4160	6400	5620	2100	7.0	3090	11490	4170	3550	1K162827082	
	3.5	5860	4880	7360	2160	3.5	1540	13050	2160	7360	1N937327082	
	3.0	5720	8620	7850	2450	10.1	4810	10960	6410	3870	1R676027082	70
0-40	4.9	370	370	480	160	6.8	160	780	210	430	16A4659X012	20
	3.5	977	979	1220	380	6.3	440	2057	590	1010	10B1525X012	33
	3.0	1500	3200	2180	890	4.4	750	6110	1170	1900	1N844027082	40
	3.0	2280	2500	2990	820	6.0	1030	5830	1420	2380	1L217327042	
	3.0	4230	8470	6000	2320	6.8	3000	14680	4280	4040	1P270227042	60
	3.1	6460	6460	8300	2160	7.0	3090	14590	4170	6300	1K162827082	
	3.3	8770	8770	11440	2610	10.1	4810	14310	6410	7630	1R676027082	70

-continued-

Table 1. Actuator Torque, Lbf•In. (Continued)

AIR TO DIA-PHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)					PUSH-DOWN-TO-OPEN (PDTO)					SPRING PART NUMBER	ACTUA-TOR SIZE
	Initial Com-pression, Psig	T_B		T_D		Initial Com-pression, Psig	T_B		T_D			
		Seating	Unseating	10 Degree Rotation	80 Degree Rotation		Seating	Unseating	10 Degree Rotation	80 Degree Rotation		
0-55	6.3	1542	1166	1890	590	6.3	440	3011	590	1890	10B1525X012	33
	3.5	3280	3280	4280	990	4.4	750	8690	1170	4090	1N844027082	40
	10.1	12300	12100	15690	6410	10.1	4810	21480	6410	15690	1R676027082	70
3-15	3.7	92	461	180	130	3.0	65	671	80	230	10B1523X012	33
	3.0	400	1010	610	170	---	---	---	---	---	1L217427042	40
	3.0	1130	2660	1680	490	3.7	300	5000	840	1330	1K162727082	60
3-30	3.0	220	260	310	30	7.0	88	540	130	210	16A4659X012	20
	3.0	255	1012	670	140	6.3	249	1421	390	430	10B1525X012	33
	3.0	652	653	980	100	6.3	145	1536	345	730	10B1524X012	
	3.0	250	2830	720	370	4.4	240	4400	650	440	1N844027082	40
	3.0	1030	2120	1530	300	6.0	520	4120	900	920	1L217327042	
	4.3	1650	1580	2140	470	4.3	220	4420	470	2140	1P637127082	
	3.0	870	7460	2070	1010	---	---	---	---	---	1P270227042	60
	3.0	3150	5390	4440	790	7.0	1770	10170	2860	2370	1K162827082	
	3.5	4860	3870	6180	850	3.5	210	11720	850	6180	1N937327082	
	3.0	4350	7250	6240	810	10.1	3380	9530	4770	2260	1R676027082	70

Table 2. Actuator/Valve Shaft Combinations

SHAFT DIAMETER, INCH	ACTUATOR SIZE				
	20	33	40	60	70
1/2	X	X	X	---	---
5/8	---	X	X	---	---
3/4	---	X	X	X	---
1	---	---	X	X	---
1-1/4	---	---	X	X	X
1-1/2	---	---	---	X	X
1-3/4	---	---	---	X	X
2	---	---	---	X	X

X—Available construction.

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Table 1. Actuator Torque, Lbf•In.

AIR TO DIA-PHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)					PUSH-DOWN-TO-OPEN (PDTO)					SPRING PART NUMBER	ACTUA-TOR SIZE
	Initial Com-pression, Psig	T_B		T_D		Initial Com-pression, Psig	T_B		T_D			
		Seating	Unseating	10 Degree	60 Degree		Seating	Unseating	10 Degree	60 Degree		
0-18	3.0	130	200	220	160	3.9	90	330	350	260	16A4660X012	20
	3.0	172	682	730	500	4.9	336	773	770	260	10B1524X012	33
	3.0	300	567	660	506	3.7	256	861	880	530	10B1523X012	
	2.7	440	440	480	370	2.7	184	941	970	720	10B1522X012	
	3.0	380	1730	1850	1230	4.3	730	2360	2150	870	1P637127082	40
	3.0	770	1380	1460	1080	3.0	520	2570	2420	1520	1L217427042	
	3.0	1040	4660	4990	3260	3.5	1540	6420	5670	2880	1N937327082	60
	3.0	2140	3670	3960	2840	3.7	1630	6330	5690	3780	1K162727082	
0-33	3.0	280	320	340	210	6.8	160	610	660	470	16A4659X012	20
	3.0	652	947	1000	620	6.3	440	1612	1630	935	10B1525X012	33
	4.9	808	807	870	670	4.9	335	1728	1780	1330	10B1524X012	
	3.0	630	3200	3370	1860	4.4	750	4910	4540	1940	1N844027082	40
	3.0	1410	2500	2640	1560	6.0	1030	4630	4290	2270	1L217327042	
	4.3	2020	1960	2100	1540	4.3	730	4930	4730	3450	1P637127082	
	3.0	1870	8470	8940	4910	6.8	3000	11590	10060	3980	1P270227042	60
	3.0	4160	6400	6790	4010	7.0	3090	11490	10190	5950	1K162827082	
	3.5	5860	4880	5240	3560	3.5	1540	13050	12220	9860	1N937327082	
	3.0	5720	8620	9100	5050	10.1	4810	10960	11500	7110	1R676027082	70
0-40	4.9	370	370	390	270	6.8	160	780	840	675	16A4659X012	20
	3.5	977	979	1040	670	6.3	440	2057	2110	1420	10B1525X012	33
	3.0	1500	3200	3370	1860	4.4	750	6110	5760	3150	1N844027082	40
	3.0	2280	2500	2640	1560	6.0	1030	5830	5510	3470	1L217327042	
	3.0	4230	8470	8940	4910	6.8	3000	14680	13120	7240	1P270227042	60
	3.1	6460	6460	6860	4090	7.0	3090	14590	13250	9210	1K162827082	
	3.3	8770	8770	9270	5250	10.1	4810	14310	15310	11560	1R676027082	70
0-55	6.3	1542	1166	1250	920	6.3	440	3011	3120	2440	10B1525X012	33
	3.5	3280	3280	3460	1980	4.4	750	8690	8370	5730	1N844027082	40
	10.1	12300	12100	13080	9750	10.1	4810	21480	23490	21110	1R676027082	70
3-15	3.7	1130	2660	2780	1420	3.7	300	5000	4380	2380	1K162727082	60
3-30	4.9	652	653	690	450	4.9	145	1536	1580	1130	10B1524X012	33
	---	---	---	---	---	6.0	520	4120	3770	1750	1L217327042	40
	4.3	1650	1580	1680	1000	4.3	220	4420	4210	2940	1P637127082	
	---	---	---	---	---	7.0	1770	10170	8880	4560	1K162827082	60
	3.5	4860	3870	4060	2150	3.5	210	11720	10910	8460	1N937327082	
	10.1	870	10,730	7480	3130	10.1	3380	9530	9860	5200	1R676027082	70

Table 2. Actuator/Valve Shaft Combinations

SHAFT DIAMETER, INCH	ACTUATOR SIZE				
	20	33	40	60	70
1/2	X	X	X	---	---
5/8	---	X	X	---	---
3/4	---	X	X	X	---
1	---	---	X	X	---
1-1/4	---	---	X	X	X
1-1/2	---	---	---	X	X
1-3/4	---	---	---	X	X
2	---	---	---	X	X

X—Available construction.

FISHER

EMERSON.
Process Management

Table 1. Actuator Torque, Lbf•In.

AIR TO DIAPHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)			PUSH-DOWN-TO-OPEN (PDTO)			SPRING PART NUMBER	ACTUATOR SIZE
	Initial Compression, Psig	T_B	T_D at 70° (1)	Initial Compression, Psig	T_B	T_D at 70° (1)		
0-18	3.0	130	130	3.9	90	200	16A4660X012	20
	3.0 3.0 2.7	172 300 440	399 364 303	4.9 3.7 2.7	336 256 184	170 406 618	10B1524X012 10B1523X012 10B1522X012	33
	3.0 3.0	380 770	980 890	4.3 3.0	730 520	620 1290	1P637127082 1L217427042	40
	3.0 3.0	1040 2140	2570 2320	--- 3.7	--- 1630	--- 3160	1N937327082 1K162727082	60
0-33	3.0	280	160	6.8	160	370	16A4659X012	20
	3.0 4.9	652 807	481 556	6.3 4.9	440 335	711 1139	10B1525X012 10B1524X012	33
	3.0 4.3 ---	630 1960 ---	1350 1260 ---	--- 4.3 6.0	--- 730 1030	--- 3050 1820	1N844027082 1P637127082 1L217327042	40
	3.0 3.0 3.5	1870 4160 4880	3550 3020 2850	--- 7.0 3.5	--- 3090 1540	--- 4760 8700	1P270227042 1K162827082 1N937327082	60
	3.0	5720	3690	10.1	4810	5540	1R676027082	70
0-40	4.9	370	220	6.8	160	560	16A4659X012	20
	3.5	977	521	6.3	440	1162	10B1525X012	33
	3.0 3.0	1500 2280	1350 1170	--- 6.0	--- 1030	--- 2950	1N844027082 1L217327042	40
	3.0 3.1	4230 6460	3550 3090	--- 7.0	--- 3090	--- 7800	1P270227042 1K162827082	60
	3.3	8770	3870	10.1	4810	9720	1R676027082	70
0-55	6.3	1166	757	6.3	440	2130	10B1525X012	33
	3.5	3280	1460	4.4	750	4960	1N844027082	40
	10.1	12100	8090	10.1	4810	18690	1R676027082	70
3-15	3.0	70	40	---	---	---	16A4660X012	20
	3.0	145	153	3.7	65	213	10B1523X012	33
	3.0	400	360	---	---	---	1L217427042	40
	3.0	1130	940	3.7	300	1850	1K162727082	60
3-30	3.0	220	70	6.8	90	300	16A4659X012	20
	3.0 4.9	498 652	270 346	6.3 4.9	249 145	517 944	10B1525X012 10B1524X012	33
	3.0 4.3 ---	250 1580 ---	820 740 ---	--- 4.3 6.0	--- 220 520	--- 2570 1330	1N844027082 1P637127082 1L217327042	40
	3.0 3.0 3.5	870 3150 3870	2180 1640 1480	--- 7.0 ---	--- 1770 ---	--- 3450 ---	1P270227042 1K162827082 1N937327082	60
	3.0	4350	1890	10.1	3380	3740	1R676027082	70

1. For V150, V200 or V300 with attenuator, see page D-109 through D-114.

Table 2. Actuator Torques for 60-Degree LImited Maximum Rotation, Lbf•In.

AIR TO DIAPHRAGM, PSIG	MAXIMUM ROTATION, DEGREES	INITIAL COMPRESSION, PSIG	PUSH-DOWN-TO-OPEN (PDTO)		SPRING PART NUMBER	ACTUATOR SIZE
			T_B	T_D		
0-33	60	9.7	655	550	10B1525X012	33
	60	9.2	1570	810	1N844027082	40
	60	11.4	5040	1170	1P270227042	60
	60	14.7	7020	4060	1R676027082	70
0-40	60	9.7	655	1031	10B1525X012	33
	60	9.2	1570	2010	1N844027082	40
	60	11.4	5040	4430	1P270227042	60
	60	14.7	7020	8520	1R676027082	70
0-55	60	9.7	655	2062	10B1525X012	33
	60	9.2	1570	4600	1N844027082	40
	60	14.7	7020	18060	1R676027082	70

Table 3. Acceptable Valve Shaft Diameter/Actuator Combinations

SHAFT DIAMETER, INCH	ACTUATOR SIZE				
	20	33	40	60	70
1/2	X	X	X	---	---
5/8	---	X	X	---	---
3/4	---	X	X	X	---
7/8	---	---	X	X	---
1	---	---	X	X	---
1-1/4	---	---	X	X	X
1-1/2	---	---	---	X	X
1-3/4	---	---	---	X	X
2	---	---	---	X	X

X—available construction.

Table 1. Actuator Torque, Lbf•In.

AIR TO DIA-PHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)					PUSH-DOWN-TO-OPEN (PDTO)					SPRING PART NUMBER	ACTU-ATOR SIZE
	Initial Com-pression Psig	T_B		T_D		Initial Com-pression, Psig	T_B		T_D			
		Seating	Unseating	60 Degree Rotation	90 Degree Rotation		Seating	Unseating	60 Degree Rotation	90 Degree Rotation		
0-18	3.0	172	682	497	906	4.9	336	773	260	808	10B1524X012	33
	3.0	300	567	442	913	3.7	256	861	493	615	10B1523X012	
	2.7	440	440	362	943	2.7	184	941	702	442	10B1522X012	
	3.0	380	1730	1230	2570	4.3	730	2360	870	1960	1P637127082	40
	3.0	770	1380	1080	2570	3.0	520	2570	1520	1380	1L217427042	
	3.0	1040	4660	3260	6630	3.5	1540	6420	2880	4880	1N937327082	60
	3.0	2140	3670	2840	6630	3.7	1630	6330	3780	3970	1K162727082	
0-33	3.0	652	947	623	1845	6.3	440	1612	880	1166	10B1525X012	33
	4.9	808	807	664	1728	4.9	335	1728	1293	807	10B1524X012	
	3.0	630	3200	1860	5150	4.4	750	4910	1940	3440	1N844027082	40
	3.0	1410	2500	1560	5150	6.0	1030	4630	2270	3030	1L217327042	
	4.3	2020	1960	1540	4930	4.3	730	4930	3450	1960	1P637127082	
	3.0	1870	8470	4910	13260	6.8	3000	11590	3980	10170	1P270227042	60
	3.0	4160	6400	4010	13260	7.0	3090	11490	5950	8200	1K162827082	
	3.5	5860	4880	3560	13050	3.5	1540	13050	9860	4880	1N937327082	
	3.0	5720	8620	5050	14340	10.1	4810	10960	7110	12100	1R676027082	70
0-40	3.5	977	979	666	2256	6.3	440	2057	1361	1166	10B1525X012	33
	3.0	1500	3200	1860	6350	4.4	750	6110	3150	3440	1N844027082	40
	3.0	2280	2500	1560	6350	6.0	1030	5830	3470	3030	1L217327042	
	3.0	4230	8470	4910	16360	6.8	3000	14680	7240	10170	1P270227042	60
	3.1	6460	6460	4090	16300	7.0	3090	14590	9210	8200	1K162827082	
	3.3	8770	8770	5250	17540	10.1	4810	14310	11560	12100	1R676027082	70
0-55	6.3	1542	1166	918	3011	6.3	440	3011	2392	1166	10B1525X012	33
	3.5	3280	3280	1980	8840	4.4	750	8690	5730	3440	1N844027082	40
	10.1	12300	12100	9750	21480	10.1	4810	21480	21110	12100	1R676027082	70
3-15	3.7	92	461	292	671	3.0	65	671	287	461	10B1523X012	33
	3.0	400	1010	547	2060	---	---	---	---	---	1L217427042	40
	3.0	1130	2660	1420	5300	3.7	300	5000	2380	2970	1K162727082	60
3-30	3.0	255	1012	702	1421	6.3	249	1421	674	1012	10B1525X012	33
	4.9	652	653	450	1536	4.9	145	1536	1085	653	10B1524X012	
	3.0	250	2830	1330	4630	4.4	240	4400	---	3070	1N844027082	40
	3.0	1030	2120	1030	4630	6.0	520	4120	1750	2650	1L217327042	
	4.3	1650	1580	1000	4420	4.3	220	4420	2940	1580	1P637127082	
	3.0	870	7460	3490	11940	---	---	---	---	---	1P270227042	60
	3.0	3150	5390	2600	11940	7.0	1770	10170	4560	7190	1K162827082	
	3.5	4860	3870	2150	11720	---	---	---	---	---	1N937327082	
	3.0	4350	7250	3130	12910	10.1	3380	9530	5200	10730	1R676027082	70

Table 2. Actuator Torque, Lbf•In.

AIR TO DIA-PHRAGM, PSIG	PUSH-DOWN-TO-CLOSE (PDTC)					PUSH-DOWN-TO-OPEN (PDTO)					SPRING PART NUMBER	ACTUA-TOR SIZE
	Initial Com-pression, Psig	T_B		T_D		Initial Com-pression, Psig	T_B		T_D			
		Seating	Unseating	60 Degree	90 Degree		Seating	Unseating	60 Degree	90 Degree		
0-18	3.0	172	682	497	216	4.9	336	773	260	34	10B1524X012	33
	3.0	300	567	442	210	3.7	256	861	493	247	10B1523X012	
	2.7	440	440	362	182	2.7	184	941	702	438	10B1522X012	
	3.0	380	1730	1230	520	4.3	730	2360	870	160	1P637127082	40
	3.0	770	1380	1080	520	3.0	520	2570	1520	770	1L217427042	
	3.0	1040	4660	3260	1330	3.5	1540	6420	2880	820	1N937327082	60
	3.0	2140	3670	2840	1330	3.7	1630	6330	3780	1830	1K162727082	
0-33	3.0	652	947	623	230	6.3	440	1612	880	410	10B1525X012	33
	4.9	808	807	664	335	4.9	335	1728	1293	808	10B1524X012	
	3.0	630	3200	1860	520	4.4	750	4910	1940	380	1N844027082	40
	3.0	1410	2500	1560	520	6.0	1030	4630	2270	870	1L217327042	
	4.3	2020	1960	1540	730	4.3	730	4930	3450	2020	1P637127082	
	3.0	1870	8470	4910	1330	6.8	3000	11590	3980	170	1P270227042	60
	3.0	4160	6400	4010	1330	7.0	3090	11490	5950	2360	1K162827082	
	3.5	5860	4880	3560	1540	3.5	1540	13050	9860	5860	1N937327082	
	3.0	5720	8620	5050	1430	10.1	4810	10960	7110	2240	1R676027082	70
0-40	3.5	977	979	666	260	6.3	440	2057	1361	770	10B1525X012	33
	3.0	1500	3200	1860	520	4.4	750	6110	3150	1260	1N844027082	40
	3.0	2280	2500	1560	520	6.0	1030	5830	3470	1750	1L217327042	
	3.0	4230	8470	4910	1330	6.8	3000	14680	7240	2520	1P270227042	60
	3.1	6460	6460	4090	1380	7.0	3090	14590	9210	4710	1K162827082	
	3.3	8770	8770	5250	1580	10.1	4810	14310	11560	5440	1R676027082	70
0-55	6.3	1542	1166	918	440	6.3	440	3011	2392	1542	10B1525X012	33
	3.5	3280	3280	1980	600	4.4	750	8690	5730	3120	1N844027082	40
	10.1	12300	12100	9750	4810	10.1	4810	21480	21110	12300	1R676027082	70
3-15	---	---	---	---	---	3.7	300	5000	2380	820	1K162727082	60
3-30	4.9	652	653	450	145	4.9	145	1536	1085	652	10B1524X012	33
	---	---	---	---	---	6.0	520	4120	1750	500	1L217327042	40
	4.3	1650	1580	1000	220	4.3	220	4420	2940	1650	1P637127082	
	---	---	---	---	---	7.0	1770	10170	4560	1350	1K162827082	60
	3.5	4860	3870	2150	210	---	---	---	---	---	1N937327082	
	---	---	---	---	---	10.1	3380	9530	5200	870	1R676027082	70

Table 3. Acceptable Valve Shaft Diameter/Actuator Combinations

SHAFT DIAMETER, INCH	ACTUATOR SIZE			
	33	40	60	70
1/2	X	X	---	---
5/8	X	X	---	---
3/4	X	X	X	---
1	---	X	X	---
1-1/4	---	X	X	X
1-1/2	---	---	X	X

X—Available construction.

The 1061 piston actuator delivers the same torque per psig of cylinder pressure at 0° and 90° rotation. At intermediate degrees of rotation—for instance, at 10°, 60°, or 70° rotation—more torque per psig of cylinder pressure is available (see figure 1 and table 1) as a result of changes in effective actuator lever length.

The actuator can be sized with one of the following two procedures. The first procedure is quicker and compares the lowest actuator torque to the largest required valve body torque. The second procedure is more detailed as it compares actuator and valve body torques at each angle of opening.

Use one of the following procedures:

- Compare the largest valve body torque requirement to the 0° and 90° available actuator torque shown in figure 1. Select an actuator size that provides more torque than required by the valve body. Refer to table 2 and check the valve body/actuator shaft compatibility.

or

- Refer to table 1. Use the following equation to calculate the available actuator torque at each required angle of opening:

Torque = Cylinder pressure, psig X Torque per psig Cylinder pressure from table 1

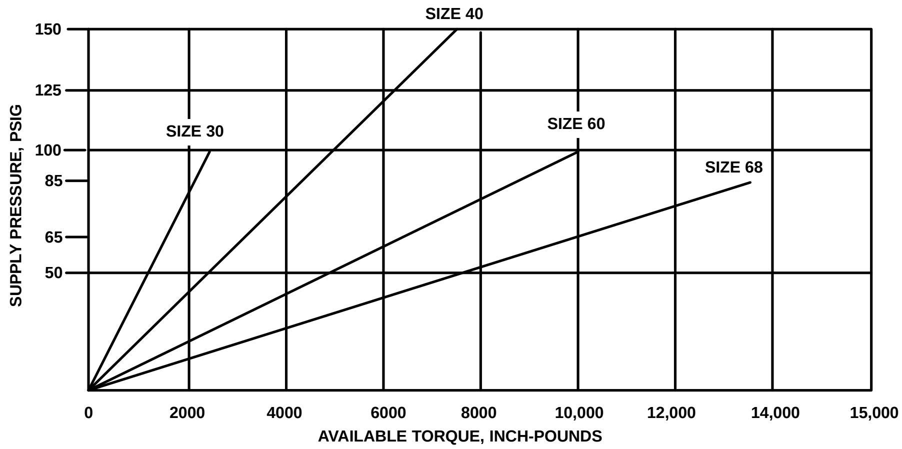
Compare the valve body torque requirement for each required angle of opening to the available actuator torque. Select an actuator size that satisfies all the valve body requirements with the required cylinder pressure. Refer to table 2 and check the valve body/actuator shaft compatibility.

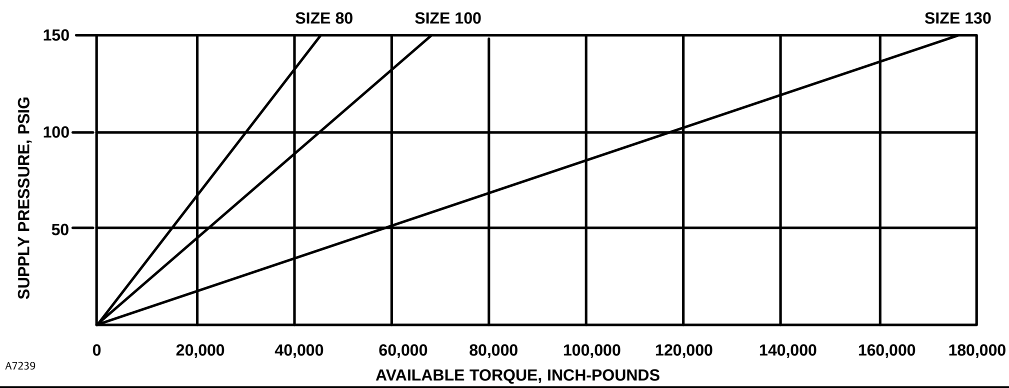
Table 1. Actuator Torque per Psig Cylinder Pressure[1], In•lbs/psig

ACTUATOR SIZE	TORQUE PER PSIG CYLINDER PRESSURE, IN•LBS/PSIG — Degrees of Valve Rotation				MAXIMUM ALLOWABLE CYLINDER PRESSURE, PSIG
	0 or 90	10 or 80	20 or 70	30 or 60	
30	25	29	32	34	100
40	50	58	64	68	150
60	100	116	128	137	100
68	160	185	205	219	85
80	300	347	---	411	150
100	450	521	---	616	150
130	1170	1410	1560	1660	150

1. Cylinder pressure equals supply pressure for an actuator without a positioner or for a 3610JP positioner and actuator combination. When another positioner is used, assume cylinder pressure is 90% of supply pressure.

Figure 1. Available Actuator Torques at 0° and 90°





NOTE:
CYLINDER PRESSURE EQUALS SUPPLY PRESSURE FOR AN ACTUATOR WITHOUT A POSITIONER OR FOR A 3610JP POSITIONER AND ACTUATOR COMBINATION WHEN ANOTHER POSITIONER IS USED. ASSUME CYLINDER PRESSURE IS 90% OF SUPPLY PRESSURE.

Table 2. Actuator/Valve Body Shaft Combinations

SHAFT			ACTUATOR SIZE						
DIAMETER, INCH(1)	Valve Shaft Spline Torque Limits, In•lbs(2)		30	40	60	68	80	100	130
	H1075 17-4	Nit 50							
1/2	517	517	X	---	---	---	---	---	---
5/8	1230	1230	X	---	---	---	---	---	---
3/4	2120	2120	X	X	X	X	---	---	---
7/8	4140	4140	X	X	X	X	---	---	---
1	4140	4140	X	X	X	X	---	---	---
1-1/4	9810	9810	X	X	X	X	---	---	---
1-1/2	12,000	12,000	---	X	X	X	---	---	---
1-3/4	23,500	23,500	---	X	X	X	X	X	---
2	23,500	23,500	---	X	X	X	X	X	---
2-1/8	55,700	42,000	---	---	---	---	X	X	---
2-1/2	55,700	55,700	---	---	---	---	X	X	---
3	153,000	115,000	---	---	---	---	---	---	X
3-1/2	228,000	137,000	---	---	---	---	---	---	X

X = available construction.
1. The Shaft Diameters used in this table are standard F Mounting sizes. If the valve you are sizing has a necked down shaft, use the reduced diameter.
2. Available actuator output torque can exceed these values but valve TB or TD cannot.

Table 1. Actuator Torque, lbf•in - Forward Flow

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)			
		T_B	T_D			T_B	T_D		
			10° Rotation	60° Rotation	90° Rotation		10° Rotation	60° Rotation	90° Rotation
2 barg (29 psig)	1	226(1)	374	378	767	226	746	443	320
	2	930	1777	1665	3342	930	3252	1871	1551
	3	2479	5597	5140	8198	2890	8487	5153	4933
3 barg (44 psig)	1	320(1)	374	378	1293	226	1295	925	320
	2	1551(1)	1777	1665	5586	930	5605	3992	1551
	3	4933(1)	5597	5140	14212	2890	15143	11653	4933
4 barg (58 psig)	1	453(1)	747	756	1533	453	1493	887	641
	2	1860	3554	3329	6684	1860	6504	3743	3101
	3	5173	11022	10041	16688	5583	17299	10626	9722
4.7 barg (68 psig)	1	641(1)	747	756	1904	453	1879	1226	641
	2	2839(1)	3554	3329	8263	1860	8161	5237	3101
	3	8236(1)	11022	10041	29004	5583	21966	15188	9722

1. If selecting actuator for throttling valve with metal bushings and metal seat, reduce this torque by one-third.

Table 2. Actuator Torque, lbf•in - Reverse Flow

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)			PUSH-DOWN-TO-OPEN (PDTO)		
		T_B	T_D		T_B	T_D	
			60° Rotation	90° Rotation		60° Rotation	90° Rotation
2 barg (29 psig)	1	226	378	226	226	443	226
	2	930	1665	930	930	1871	930
	3	2479	5140	2890	2890	5153	2479
3 barg (44 psig)	1	320	378	226	226	925	533
	2	1551	1665	930	930	3992	2319
	3	4933	5140	2890	2890	11653	6841
4 barg (58 psig)	1	453	756	453	453	887	453
	2	1860	3329	1860	1860	3743	1860
	3	5173	10041	5583	5583	10626	5173
4.7 barg (68 psig)	1	641	756	453	453	1226	668
	2	2839	3329	1860	1860	5237	2839
	3	8236	10041	5583	5583	15188	8236

Table 3. Actuator / Valve Body Shaft Combinations

SHAFT DIAMETER, INCHES	ACTUATOR SIZE		
	1	2	3
1/2	x	---	---
5/8	x	x	---
3/4	x	x	x
1	---	x	x
1-1/4	---	x	x
1-1/2	---	---	x
1-3/4	---	---	x
2	---	---	x

x = available construction

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Table 1. Actuator Torque, lbf•in - Forward Flow

AIR TO DIAPHRAGM PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)						PUSH-DOWN-TO-OPEN (PDTO)					
		T_B	T_D					T_B	T_D				
			10° Rotation	45° Rotation	60° Rotation	75° Rotation	80° Rotation		10° Rotation	45° Rotation	60° Rotation	75° Rotation	80° Rotation
2 barg (29 psig)	1	226(1)	374	421	378	729	746	226	746	557	443	394	374
	2	930	1777	1904	1665	3172	3252	930	3252	2382	1871	1860	1777
	3	2479	5597	5892	5140	8462	8487	2890	8487	6618	5153	5835	5597
3 barg (44 psig)	1	320(1)	374	421	378	1286	1295	226	1295	1092	925	394	374
	2	1551(1)	1777	1904	1665	5561	5605	930	5605	4718	3992	1860	1777
	3	4933(1)	5597	5892	5140	15351	15143	2890	15143	13704	11653	5835	5597
4 barg (58 psig)	1	453(1)	747	843	756	1458	1493	453	1493	1114	887	788	747
	2	1860	3554	3808	3329	6343	6504	1860	6504	4763	3743	3719	3554
	3	5173	11022	11550	10041	17262	17299	5583	17299	13584	10626	11487	11022
4.7 barg (68 psig)	1	641(1)	747	843	756	1851	1879	453	1879	1491	1226	788	747
	2	2839(1)	3554	3808	3329	8027	8161	1860	8161	6409	5237	3719	3554
	3	8236(1)	11022	11550	10041	22092	21966	5583	21966	18555	15188	11487	11022

1. If selecting actuator for throttling valve with metal bushings and metal seat, reduce this torque by one-third.

Table 2. Actuator Torque, lbf•in - Reverse Flow

AIR TO DIAPHRAGM PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)						PUSH-DOWN-TO-OPEN (PDTO)					
		T_B	T_D					T_B	T_D				
			10° Rotation	45° Rotation	60° Rotation	75° Rotation	80° Rotation		10° Rotation	45° Rotation	60° Rotation	75° Rotation	80° Rotation
2 barg (29 psig)	1	226	374	421	378	308	281	226	746	557	443	330	294
	2	930	1777	1904	1665	1316	1188	930	3252	2382	1871	1371	1216
	3	2479	5597	5892	5140	4069	3678	2890	8487	6618	5153	3717	3277
3 barg (44 psig)	1	320	374	421	378	308	281	226	1295	1092	925	733	666
	2	1551	1777	1904	1665	1316	1188	930	5605	4718	3992	3167	2884
	3	4933	5597	5892	5140	4069	3678	2890	15143	13704	11653	9279	8464
4 barg (58 psig)	1	453	747	843	756	616	563	453	1493	1114	887	660	588
	2	1860	3554	3808	3329	2632	2376	1860	6504	4763	3743	2742	2432
	3	5173	11022	11550	10041	7912	7137	5583	17299	13584	10626	7707	6809
4.7 barg (68 psig)	1	641	747	843	756	616	563	453	1879	1491	1226	944	850
	2	2839	3554	3808	3329	2632	2376	1860	8161	6409	5237	4008	3608
	3	8236	11022	11550	10041	7912	7137	5583	21966	18555	15188	11612	10451

Table 3. Actuator / Valve Body Shaft Combinations

SHAFT DIAMETER, INCHES	ACTUATOR SIZE		
	1	2	3
9/16 x 5/8	x	x	---
5/8	x	x	---
3/4	x	x	x
1	---	x	x
1-1/4	---	x	x
1-1/2	---	---	x
1-3/4	---	---	x
2	---	---	x

x = available construction

Table 1. Actuator Torque, lbf•in

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)			PUSH-DOWN-TO-OPEN (PDTO)		
		T_B	T_D		T_B	T_D	
			80° Rotation	90° Rotation		80° Rotation	90° Rotation
2 barg (29 psig)	1	226(1)	281	767	226	294	320
	2	930	1188	3342	930	1216	1551
	3	2479	3678	8198	2890	3277	4933
3 barg (44 psig)	1	320(1)	281	1293	226	666	320
	2	1551(1)	1188	5586	930	2884	1551
	3	4933(1)	3678	14212	2890	8464	4933
4 barg (58 psig)	1	453(1)	563	1533	453	588	641
	2	1860	2376	6684	1860	2432	3101
	3	5173	7137	16688	5583	6809	9722
4.7 barg (68 psig)	1	641(1)	563	1904	453	850	641
	2	2839(1)	2376	8263	1860	3608	3101
	3	8236(1)	7137	20904	5583	10451	9722

1. If selecting actuator for throttling valve with metal bushings and metal seat, reduce this torque by one-third.

Table 2. Actuator / Valve Body Shaft Combinations

SHAFT DIAMETER, INCHES	ACTUATOR SIZE		
	1	2	3
1/2	x	---	---
5/8	x	x	---
3/4	x	x	x
1	---	x	x
1-1/4	---	x	x
1-1/2	---	---	x

x = available construction

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Table 1. Actuator Torque, lbf•in - Forward Flow

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)			
		T_B		T_D		T_B		T_D	
		Seating	Unseating	10°	80°	Seating	Unseating	10°	80°
2 barg (29 psig)	1	226	320	294	281	226	767	281	294
	2	930	1551	1216	1188	930	3342	1188	1216
	3	2479	4933	3277	3678	2890	8198	3678	3277
3 barg (44 psig)	1	533	320	666	281	226	1293	281	666
	2	2319	1551	2884	1188	930	5586	1188	2884
	3	6841	4933	8464	3678	2890	14212	3678	8464
4 barg (58 psig)	1	453	641	588	563	453	1533	563	588
	2	1860	3101	2432	2376	1860	6684	2376	2432
	3	5173	9722	6809	7137	5583	16688	7137	6809
4.7 barg (68 psig)	1	668	641	850	563	453	1904	563	850
	2	2839	3101	3608	2376	1860	8263	2376	3608
	3	8236	9722	10451	7137	5583	20904	7137	10451

Table 2. Actuator Torque, lbf•in - Reverse Flow

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)			
		T_B		T_D		T_B		T_D	
		Seating	Unseating	10°	60°	Seating	Unseating	10°	60°
2 barg (29 psig)	1	226	320	374	378	226	767	746	443
	2	930	1551	1777	1665	930	3342	3252	1871
	3	2479	4933	5597	5140	2890	8198	8487	5153
3 barg (44 psig)	1	533	320	374	378	226	1293	1295	925
	2	2319	1551	1777	1665	930	5586	5605	3992
	3	6841	4933	5597	5140	2890	14212	15143	11653
4 barg (58 psig)	1	453	641	747	756	453	1533	1493	887
	2	1860	3101	3554	3329	1860	6684	6504	3743
	3	5173	9722	11022	10041	5583	16688	17299	10626
4.7 barg (68 psig)	1	668	641	747	756	453	1904	1879	1226
	2	2839	3101	3554	3329	1860	8263	8161	5237
	3	8236	9722	11022	10041	5583	20904	21966	15188

Table 3. Actuator / Valve Body Shaft Combinations

SHAFT DIAMETER, INCHES	ACTUATOR SIZE		
	1	2	3
1 x 3/4	x	x	x
1	---	x	x
1-1/4	---	x	x
1-1/2 x 1-1/4	---	x	x
1-1/2	---	---	x
1-3/4	---	---	x
2-1/8 x 2	---	---	x

x = available construction

Table 1. Actuator Torque, lbf•in

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)		PUSH-DOWN-TO-OPEN (PDTO)	
		T_B	T_D 70°	T_B	T_D 70°
2 barg (29 psig)	1	226	333	226	367
	2	930	1440	930	1533
	3	2479	4448	2890	4179
3 barg (44 psig)	1	320	333	226	798
	2	1551	1440	930	3447
	3	4933	4448	2890	10087
4 barg (58 psig)	1	453	667	453	734
	2	1860	2880	1860	3066
	3	5173	8665	5583	8649
4.7 barg (68 psig)	1	641	667	453	1038
	2	2839	2890	1860	4415
	3	8236	8665	5583	12795

Table 2. Actuator / Valve Body Shaft Combinations

SHAFT DIAMETER, INCHES	ACTUATOR SIZE		
	1	2	3
1/2	x	---	---
5/8	x	x	---
5/8 x 1/2	x	x	---
3/4	x	x	x
1	---	x	x
1-1/4	---	x	x
1-1/2	---	---	x
1-3/4	---	---	x

x = available construction

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Table 1. Actuator Torque, lbf•in - Forward Flow

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)			
		T_B		T_D		T_B		T_D	
		Seating	Unseating	60°	90°	Seating	Unseating	60°	90°
2 barg (29 psig)	1	226	320	378	767	226	767	443	320
	2	930	1551	1665	3342	930	3342	1871	1551
	3	2479	4933	5140	8198	2890	8198	5153	4933
3 barg (44 psig)	1	533	320	378	1293	226	1293	925	320
	2	2319	1551	1665	5586	930	5586	3992	1551
	3	6841	4933	5140	14212	2890	14212	11653	4933
4 barg (58 psig)	1	453	641	756	1533	453	1533	887	641
	2	1860	3101	3329	6684	1860	6684	3743	3101
	3	5173	9722	10041	16688	5583	16688	10626	9722
4.7 barg (68 psig)	1	668	641	756	1904	453	1904	1226	641
	2	2839	3101	3329	8236	1860	8263	5237	3101
	3	8236	9722	10041	20904	5583	20904	15188	9722

Table 2. Actuator Torque, lbf•in - Reverse Flow

AIR TO DIAPHRAGM, PSIG	ACTUATOR SIZE	PUSH-DOWN-TO-CLOSE (PDTC)				PUSH-DOWN-TO-OPEN (PDTO)			
		T_B		T_D		T_B		T_D	
		Seating	Unseating	60°	90°	Seating	Unseating	60°	90°
2 barg (29 psig)	1	226	320	378	226	226	767	443	226
	2	930	1551	1665	930	930	3342	1871	930
	3	2479	4933	5140	2890	2890	8198	5153	2479
3 barg (44 psig)	1	533	320	378	226	226	1293	925	533
	2	2319	1551	1665	930	930	5586	3992	2319
	3	6841	4933	5140	2890	2890	14212	11653	6841
4 barg (58 psig)	1	453	641	756	453	453	1533	887	453
	2	1860	3101	3329	1860	1860	6684	3743	1860
	3	5173	9722	10041	5583	5583	16688	10626	5173
4.7 barg (68 psig)	1	668	641	756	453	453	1904	1226	668
	2	2839	3101	3329	1860	1860	8263	5237	2839
	3	8236	9722	10041	5583	5583	20904	15188	8236

Table 3. Actuator / Valve Body Shaft Combinations

SHAFT DIAMETER, INCHES	ACTUATOR SIZE		
	1	2	3
1/2	x	---	---
5/8	x	x	---
1 x 3/4	x	x	x
1	---	x	x
1-1/4	---	x	x
1-1/2 x 1-1/4	---	x	x
1-1/2	---	---	x

x = available construction

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