Model 5400 / 5450 Control Valve

The Model 5400 (Figure 1) and Model 5450 (Figure 2) control valves are designed to meet the high pressure and erosive applications common to the oil and gas industry. These valves are ideally suited for pressure, level, temperature, and flow control applications on separators, scrubbers, wellheads, and other oilfield equipment. The ease of maintenance, rugged steel construction, flexibility to meet a wide variety of applications, and safety features make the Model 5400 / 5450 control valve the preferred choice of production operators worldwide.

Features:

- **Simple Maintenance -** Valve trim or the complete actuator assembly can be quickly changed by simply removing the hammer nut and lifting the actuator assembly off the valve body. Disassembly of the actuator or removing the valve from the line is not required. No special tools are required.
- **Simple Installation -** Compact, light-weight design enables quick, easy installation with minimum labor requirements.
- **Hardened Trim -** Control valve trim is available in 17-4 PH stainless steel or Tungsten Carbide, to handle the most difficult applications.
- **Bonnet Safety Pressure Relief -** Special design of hammer nut provides warning indication if an attempt is made to remove the actuator while the valve body is still under pressure (see Figure 4).
- **Bi-directional Flow -** Valve can be installed for either "flow up" or "flow down" operation, whichever best suites the application.
- **Marine and/or Sour Gas Service Option -** For harsh marine environments where corrosion and salt build-up are a problem, select "Marine Service" material option in the valve's model code. Ideal for offshore or coastal production facilities. For sour gas applications, materials are available that comply with NACE MR-01-75 specifications.

Figure 1. Model 5400 open yoke control valve

Figure 2. Model 5450 close-coupled control valve

ISO 9001 Registered Company
QQT Quality - On Time

Specifications

Available Configurations
Open Yoke (Model 5400), fail-open or fail-close
Close-coupled (Model 5450), fail-open or fail-close

Body Styles
Globe: 1" and 2"
Angle: 2" only
Tee: 1" only

End Connections / Pressure Ratings
FNPT:
4000 psig from -20 to 200°F (276 bar from -29 to 93°C)
4000 psig at -40°F (276 bar at -40°C)
3540 at 500°F (1949 bar at 260°C)
Flanged[1]:
- 150# RF 275 psig (19 bar)
- 300# RF 740 psig (51 bar)
- 600# RF 1480 psig (102 bar)
- 600# RTJ 1480 psig (102 bar)
- 900# RF 2220 psig (152 bar)
- 900# RTJ 2220 psig (152 bar)
- 1500# RF 3750 psig (259 bar)
- 1500# RTJ 3750 psig (259 bar)

Available Trim Sizes
1/4", 3/8", 1/2", 3/4", and 1"

Flow Characteristic
Modified Percent (Throttling)
Quick Opening (On/Off)

Flow Coefficients
See Table 3

Shutoff Classification
17-4PH SST or Tungsten Carbide Trim: ANSI Class IV
17-4PH SST Trim with Soft-Seat Insert: ANSI Class VI

Flow Direction
Either direction, to suit the application
Flow up (under the seat) recommended for throttling applications

Actuator Size (Diaphragm Effective Area)
Size 35 (35 in^2)
Size 70 (70 in^2)

Air Pressure to Actuator
3-15 Spring: 0 to 20 psig control signal recommended
6-30 Spring: 0 to 35 psig control signal recommended
Actuator Housing Maximum Pressure:
- Size 35: 50 psig
- Size 70: 35 psig

Maximum Pressure Drops
See Tables 1 and 2
Note: For trim with soft-seat insert, maximum pressure drops are equal to values in Tables 1 and 2 or 1000 psi (69 bar), whichever is less.

Assembled Valve Temperature Limits
5450 (close-coupled)
WCC body with Buna-N seals:-20 to 180°F (-29 to 82°C)
WCC body with Viton seals: -20 to 200°F (-29 to 93°C)
SST body with Buna-N seals: -40 to 180°F (-40 to 82°C)
5400 (open yoke)
WCC body with Buna-N seals:-20 to 180°F (-29 to 82°C)
WCC body with Viton seals: -20 to 450°F (-29 to 232°C)
WCC body with Kalrez seals: -20 to 500°F (-29 to 260°C)
SST body with Buna-N seals: -40 to 180°F (-40 to 82°C)

Materials of Construction / Temperature Limits
See Table 4

Approximate Weights
Model 5400: See Table 5
Model 5450: See Table 6

1. Pressure ratings at 100°F (38°C).

Manual Override Handwheel

For applications requiring an adjustable travel stop, or a ready means of positioning the valve in an emergency, the Model 5400 can be equipped with a top-mounted handwheel. The handwheel, shown in Figure 3, is available only on size 70, reverse-acting (fail-close), open yoke style (Model 5400) actuators.

Figure 3. Model 5400 with Manual Override Handwheel

Table 1. Maximum Allowable Shutoff Pressure Drops[1], Reverse-Acting (Fail-Close) Actuator

Actuator Size	Flow Direction	Trim Size	Signal to Actuator							
			3 to 15 psig		0 to 20 psig		6 to 30 psig		0 to 35 psig	
			(3 to 15 spring)				(6-30 spring)			
		Inches	psi	bar	psi	bar	psi	bar	psi	bar
35	Up	1/4	3800	262	4000	276	4000	276	4000	276
		3/8	2050	141	3280	226	3410	235	4000	276
		1/2	1100	76	1680	116	1830	126	2300	159
		3/4	320	22	560	39	690	48	950	66
		1	110	8	220	15	320	22	490	34
	Down	1/4	4000	276	4000	276	4000	276	4000	276
		3/8	4000	276	4000	276	4000	276	4000	276
		1/2	3350	231	4000	276	4000	276	4000	276
		3/4	1580	109	2300	159	2530	174	3270	226
		1	770	53	1100	76	1240	86	1680	116
70	Up	1/4	4000	276	4000	276	4000	276	4000	276
		3/8	3210	221	4000	276	4000	276	4000	276
		1/2	1650	114	3190	220	4000	276	4000	276
		3/4	530	37	940	65	2020	139	2800	193
		1	230	16	420	29	960	66	1460	101
	Down	1/4	4000	276	4000	276	4000	276	4000	276
		3/8	4000	276	4000	276	4000	276	4000	276
		1/2	4000	276	4000	276	4000	276	4000	276
		3/4	2080	143	2800	193	3780	259	4000	276
		1	970	67	1460	101	2510	173	2950	203

1. For valves with soft-seat inserts, maximum allowable pressure drop is 1000 psi (69 bar) or the values in the table, whichever is less.

Table 2. Maximum Allowable Shutoff Pressure Drops[1], Direct-Acting (Fail-Open) Actuator

Actuator Size	Flow Direction	Trim Size	Signal to Actuator[2]			
			3 to 15 psig		6 to 30 psig	
			(3 to 15 spring)		(6-30 spring)	
		Inches	psi	bar	psi	bar
35	Up	1/4	4000	276	4000	276
		3/8	2700	186	4000	276
		1/2	1370	94	2880	199
		3/4	410	28	1080	74
		1	140	10	520	36
	Down	1/4	4000	276	4000	276
		3/8	4000	276	4000	276
		1/2	3800	262	4000	276
		3/4	1750	121	1940	134
		1	860	59	940	65
70	Up	1/4	4000	276	4000	276
		3/8	4000	276	4000	276
		1/2	2540	175	4000	276
		3/4	730	50	2020	139
		1	230	16	960	66
	Down	1/4	4000	276	4000	276
		3/8	4000	276	4000	276
		1/2	4000	276	4000	276
		3/4	4000	276	4000	276
		1	1840	127	2790	192

1. For valves with soft-seat inserts, maximum allowable pressure drop is 1000 psi (69 bar) or the values in the table, whichever is less.
2. Actual signal pressure to actuator includes an additional 5 psig (0.3 bar) of supply pressure to the controller.

Table 3. Flow Coefficients (C_V)

Body Size	Orifice Size	Modified Percent											Quick Open	
		Globe Body										Angle Body	Globe Body	Angle Body
		Valve Opening (% Travel)												
		10	20	30	40	50	60	70	80	90	100	100	100	100
1”	0.25	.284	.506	.657	.767	.875	.989	1.10	1.20	1.32	1.40	1.64	1.68	1.92
	0.38	.311	.621	.942	1.28	1.64	2.07	2.51	2.93	3.35	3.70	4.23	3.82	4.34
	0.50	.502	1.05	1.59	2.09	2.61	3.14	3.72	4.27	4.96	5.62	6.61	5.70	6.72
	0.75	.882	1.76	2.76	3.82	4.93	6.17	7.49	8.85	10.0	11.0	15.1	11.6	15.2
	1.00	1.01	2.02	3.44	5.07	6.78	8.42	10.3	12.4	14.3	15.4	20.8	15.5	20.9
2”	0.25	.284	.506	.657	.767	.875	.989	1.10	1.20	1.32	1.40	1.66	1.68	1.98
	0.38	.311	.621	.942	1.28	1.64	2.07	2.51	2.93	3.35	3.70	4.35	3.82	4.47
	0.50	.592	1.17	1.76	2.34	2.95	3.70	4.57	5.50	5.95	6.08	6.90	6.19	7.00
	0.75	.882	1.81	2.98	4.11	5.74	7.03	8.49	10.1	11.5	12.9	15.2	13.0	15.8
	1.00	1.08	2.12	3.58	5.43	7.46	9.27	11.4	13.7	15.8	17.1	21.1	18.0	22.0

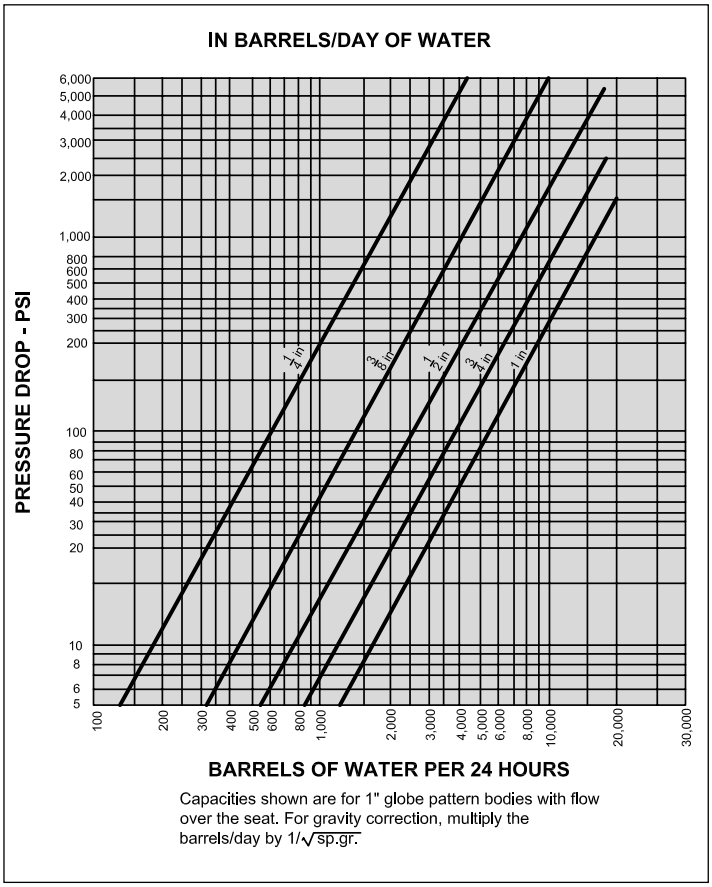
Liquid Sizing Equation:

$$Cv = Q\sqrt{\frac{S\,G}{\Delta P}}$$

where:
Cv = flow coefficient
Q = liquid flow rate, (gpm)
SG = specific gravity
ΔP = pressure drop, (psi)

Useful Conversions for Liquid Flow:

To Convert	Multiply By	To Obtain
Barrels	42	U.S. Gallons
Barrels/Hr	0.7	U.S. gpm
Barrels/Day	0.02917	U.S. gpm
Ft^3/Sec	448.83	U.S. gpm
M^3/Hr	4.403	U.S. gpm
Lb/Hr	0.0020	U.S. gpm
Kg/Hr	0.0044	U.S. gpm



Gas Sizing Equation:

$$Cv = (Q / 963)\sqrt{\frac{(SG)(T)}{(\Delta P)(P1 + P2)}}$$

where:
Cv = flow coefficient
Q = gas flow rate, (scfh)
SG = specific gravity
P1 = inlet pressure (psia)
P2 = outlet pressure (psia)
ΔP = pressure drop, (psi)
T = °Rankin (°F +460)

Useful Conversions for Gas Flow:

To Convert	Multiply By	To Obtain
scfd	0.04167	scfh
scfs	3600	scfh
scfm	60	scfh
M^3/Hr	35.34	scfh
Lb/Hr	19.52	scfh
Kg/Hr	43.04	scfh

Bonnet Safety Pressure Relief

The left picture in Figure 4 shows the hammer nut in the "locked" position during normal operation.

The right picture in Figure 4 illustrates the "Bonnet Safety Pressure Relief". The O-Ring clears the packing plug while the hammer nut is still engaged (threaded) onto the valve body. At this point, if the valve assembly is under pressure, process fluid will escape through the weep hole to indicate a warning to the service person that the valve is still under pressure, thereby prompting him to remove line pressure before proceeding, thus preventing the actuator assembly from "blowing out".

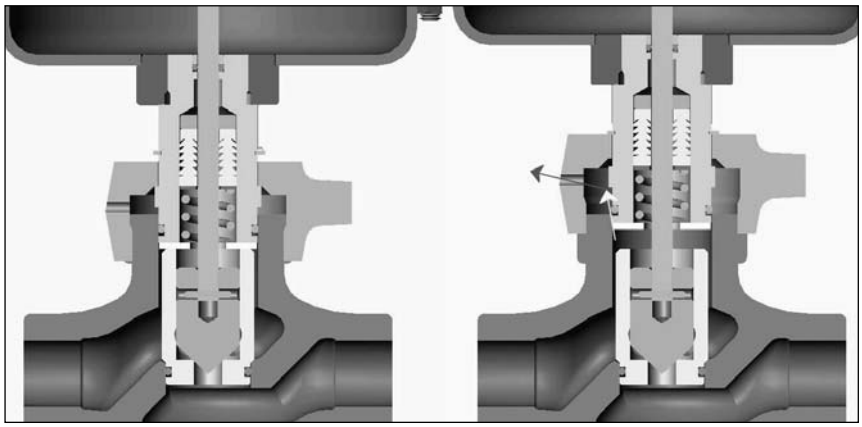


Figure 4. Bonnet Safety Pressure Relief

Table 4. Materials of Construction

Part	Material	Temperature Limits	
		°F	°C
Body	A216 WCC Steel	-20 to 1000	-29 to 538
	316 Stainless Steel	-50 to 1000	-45 to 538
Bonnet (Packing Plug)	1018 Carbon Steel	-20 to 1000	-29 to 538
	316 Stainless Steel	-50 to 1000	-45 to 538
Hammer Nut	A216 WCC Steel	-20 to 1000	-29 to 538
	316 Stainless Steel	-50 to 1000	-45 to 538
Trim	17-4PH Stainless Steel	-50 to 1000	-45 to 538
	Tungsten Carbide	-50 to 1000	-45 to 538
	17-4PH Stainless Steel with TFE or UHMW soft-seat insert	-50 to 400	-45 to 204
Valve Stem	303 Stainless Steel	-50 to 1000	-45 to 538
	316 Stainless Steel	-50 to 1000	-45 to 538
Packing	PTFE V-Ring	-50 to 450	-45 to 232
	Heavy-Reinforced PTFE V-Ring	-50 to 500	-45 to 260
Actuator Housing	Steel	-20 to 1000	-29 to 538
Actuator Spring	Steel	-20 to 1000	-29 to 538
Seal O-Rings	Buna-N	-40 to 180	-40 to 82
	Viton	-20 to 450	-29 to 232
	Aflas	-20 to 450	-29 to 232
	Kalrez	-20 to 500	-29 to 260
Diaphragm[1]	Nylon-Reinforced Neoprene	-20 to 200	-29 to 93

1. Actual diaphragm upper temperature limit is 180°F. Additional 20°F for heat dissipation is allowed on close-coupled (Model 5450) valves. For open yoke (Model 5400) valves, diaphragm is not a temperature-limiting factor.

Table 5. Approximate Weights for Model 5400 Valves, Pounds (Kg)

End Connections	Actuator Size, Body Size, Body Style							
	Size 35				Size 70			
	1”		2”		1”		2”	
	Globe	Tee	Globe	Angle	Globe	Tee	Globe	Angle
NPT	29 (13.2)	32 (14.5)	36 (16.3)	36 (16.3)	44 (20.0)	47 (21.3)	51 (23.1)	51 (23.1)
ANSI 150	34 (15.4)	38 (17.2)	46 (20.9)	46 (20.9)	49 (22.2)	53 (24.0)	61 (27.7)	61 (27.7)
ANSI 300	37 (16.8)	41 (18.6)	50 (22.7)	50 (22.7)	52 (23.6)	56 (25.4)	65 (29.5)	65 (29.5)
ANSI 600	39 (17.7)	43 (19.5)	52 (23.6)	52 (23.6)	54 (24.5)	58 (26.3)	67 (30.4)	67 (30.4)
ANSI 900	46 (20.9)	51 (23.1)	80 (36.3)	80 (36.3)	61 (27.7)	66 (29.9)	95 (43.1)	95 (43.1)
ANSI 1500	46 (20.9)	51 (23.1)	80 (36.3)	80 (36.3)	61 (27.7)	66 (29.9)	95 (43.1)	95 (43.1)

Valve Assembly Dimensions (Inches)

End Connection Style	1” Globe Body			2” Globe Body			1” Tee Body		2” Angle Body	
	A	B	C	A	B	C	G	H	G	H
NPT	6.25	1.56	3.69	7.50	1.69	3.69	4.69	3.13	5.44	3.75
150# RF	7.25	1.56	3.69	10.00	1.69	3.69	5.19	3.63	6.69	5.00
300# RF	7.75	1.56	3.69	10.50	1.69	3.69	5.44	3.88	6.94	5.25
600# RF	8.25	1.56	3.69	11.25	1.69	3.69	5.69	4.13	7.31	5.63
600# RTJ	8.25	1.56	3.69	11.38	1.69	3.69	5.69	4.13	7.38	5.69
900# RF	9.38	1.56	3.69	12.88	1.69	3.69	6.25	4.69	8.13	6.44
900# RTJ	9.38	1.56	3.69	13.00	1.69	3.69	6.25	4.69	8.19	6.50
1500# RF	9.38	1.56	3.69	12.88	1.69	3.69	6.25	4.69	8.13	6.44
1500# RTJ	9.38	1.56	3.69	13.00	1.69	3.69	6.25	4.69	8.19	6.50

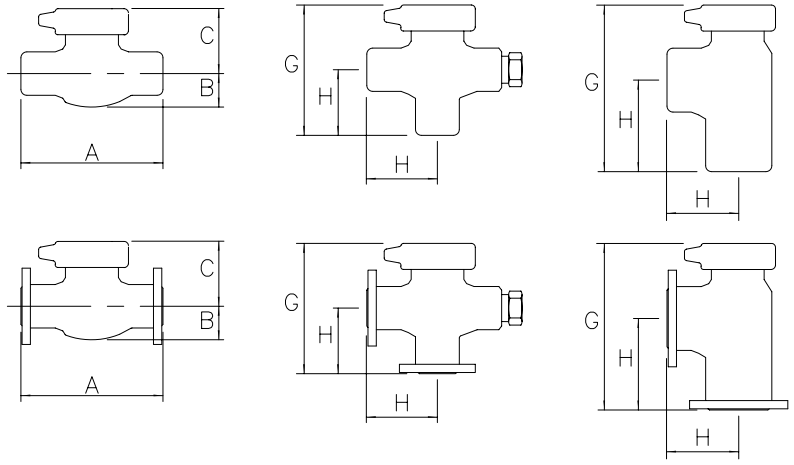
Actuator Assembly Dimensions (Inches)

Actuator Size	5400						5450					
	Direct			Reverse			Direct			Reverse		
	D	E	J[1]	D	E	F	D	E	J[1]	D	E	F
Size 35	17.06	9.50	5.50	14.31	9.50	16.31	11.44	9.50	5.50	8.69	9.50	10.69
Size 70	18.56	12.50	7.00	15.44	12.50	17.44	12.94	12.50	7.00	9.81	12.50	11.81

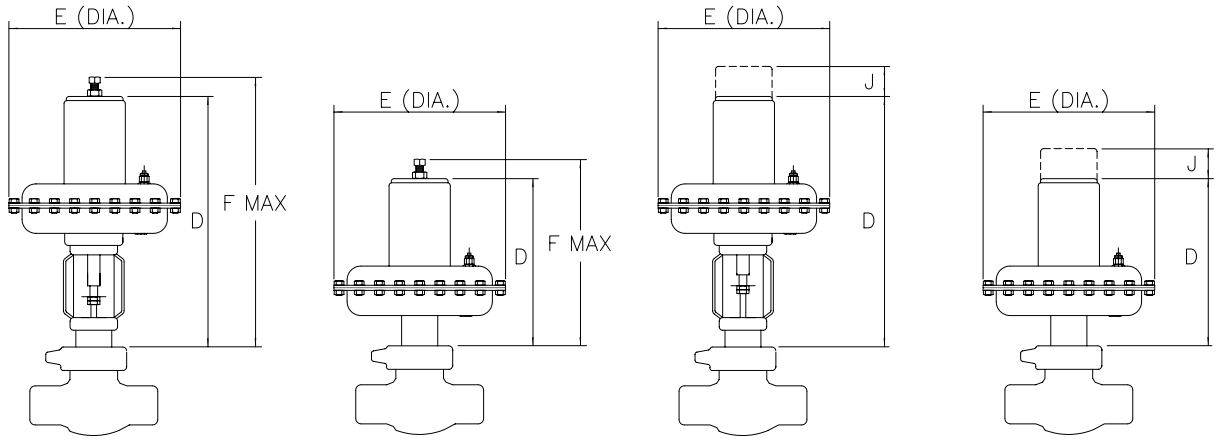
1. Clearance required for spring cover removal.

Table 6. Approximate Weights for Model 5450 Valves, Pounds (Kg)

End Connections	Actuator Size, Body Size, Body Style							
	Size 35				Size 70			
	1”		2”		1”		2”	
	Globe	Tee	Globe	Angle	Globe	Tee	Globe	Angle
NPT	25 (11.3)	28 (12.7)	32 (14.5)	32 (14.5)	40 (18.1)	43 (19.6)	47 (21.3)	47 (21.3)
ANSI 150	30 (13.6)	34 (15.4)	42 (19.1)	42 (19.1)	45 (20.4)	49 (22.2)	57 (25.9)	57 (25.9)
ANSI 300	33 (15.0)	37 (16.8)	46 (20.9)	46 (20.9)	48 (21.8)	52 (23.6)	61 (27.7)	61 (27.7)
ANSI 600	35 (15.9)	39 (17.7)	48 (21.8)	48 (21.8)	50 (22.7)	54 (24.5)	63 (28.6)	63 (28.6)
ANSI 900	42 (19.1)	47 (21.3)	76 (34.5)	76 (34.5)	57 (25.9)	62 (28.1)	91 (41.3)	91 (41.3)
ANSI 1500	42 (19.1)	47 (21.3)	76 (34.5)	76 (34.5)	57 (25.9)	62 (28.1)	91 (41.3)	91 (41.3)



1” and 2” Globe Body **1” Tee Body** **2” Angle Body**



Reverse Acting 5400 **Reverse Acting 5450** **Direct Acting 5400** **Direct Acting 5450**

Model Number Information

Sample Model Number: 5450 - 2 S 5 - G 73 R B - 1 4 Q

STYLE	CODE
Open Yoke	00
Close-Coupled	50

BODY SIZE	CODE
1”	1
2”	2

END CONNECTIONS	CODE
Female NPT	S
Raised Face (RF) Flange	F
Ring Type Joint (RTJ) Flange	J
Other	(special)

ANSI CLASS (PRESSURE RATING)	CODE
150 (275 psig @ 100°F)	1
300 (740 psig @ 100°F)	3
600 (1480 psig @ 100°F)	6
900 (2220 psig @ 100°F)	9
1500 (3750 psig @ 100°F)	5
FNPT, Socket Weld, Butt Weld Ends (4000 psig@200°F)	

MATERIALS OF CONSTRUCTION	CODE
WCC Steel - Standard Service	-
WCC Steel - Marine Service	M
WCC Steel - NACE MR-01-75	N
WCC Steel - Marine Service and NACE MR-01-75	P
Other	(special)

BODY STYLE	CODE
Globe	G
Tee (1”) or Angle (2”)	T
Globe with Tapped Pressure Ports	P

ACTUATOR SELECTION	CODE
No. 35 Actuator with 3-15 Spring	33
No. 35 Actuator with 6-30 Spring	36
No. 70 Actuator with 3-15 Spring	73
No. 70 Actuator with 6-30 Spring	76

ACTUATOR TYPE	CODE
Reverse Acting (spring closes/air opens)	R
Direct Acting (spring opens/air closes)	D
Reverse Acting (fail-close) with Manual Override Handwheel (only available with open yoke style, size 70 actuator with 3-15 spring)	H

SEAL MATERIAL	CODE
Buna-N	B
Viton	V
Other	(special)

TRIM MATERIAL	CODE
17-4PH SST	1
Tungsten Carbide	2
Other	(special)

TRIM SIZE	CODE
1/4”	2
3/8”	3
1/2”	4
3/4”	6
1”	8

TRIM CHARACTERISTICS	CODE
Quick Opening (on/off)	Q
Modified Percent (Throttling)	M

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