MODEL 521

TOTAL TFE, GLOBE-PATTERN CONTROL VALVE

1" – Model "521" Control Valve with Air-to-Open, Fail Close Model 30R Actuator.

The Cashco Model 521 is a sliding stem, globe style, bellows sealed, pneumatically actuated control valve designed to provide superior long-term performance and maximum corrosion resistance in pure chemical service.

The design allows for all wetted internal parts to be machined from a solid block of isostatically compacted, virgin TFE, thus ensuring maximum density and the lowest possible permeability. An additional design benefit is that the wall thickness integrity is ensured as a result of the TFE body being internally machined after it is secured in a cast 304 SST body shell, thus preventing distortion problems related to the plastic stability of TFE. There is simply no better design or materials available when consideration is given to corrosion resistance and thermal stability.

DESIGN FEATURES

The Model 521 combines the TFE corrosion resistance with superior design and construction for the Chemical Process Industry:

- Unibody TFE construction minimizes potential leak paths.
- Dual stem seal design: 100,000 full-cycle bellows primary seal plus V-ring secondary stem seal.
- Anti-stem rotation device to prevent bellows damage.
- 304 SST body jacket resists external corrosion.
- Quick change trim with easily replaceable plug-tip.
- Four body sizes - 1/2", 1", 1-1/2" and 2"; (DN 15, 25, 40 and 50).
- Wide selection of trim sizes and forms.
- 150# RF, flanged body with "gasketless" pipe-to-valve joint.
- Optional capability to mate with 300# RF.
- Optional capability to mate with PN16, PN25 or PN40 DIN flanges.
- Class VI shutoff.
- Spring-loaded bonnet seal.
- All wetted parts are machined from isostatically compacted TFE.
- May be applied in full vacuum service.

APPLICATIONS

Designed specifically for corrosive chemical use, including most hazardous or toxic fluids. Ultimate performance when handling chlorine (wet or dry); bromine; hydrochloric, sulphuric, nitric, and hydrofluoric acids; and most industrial reagents. Also performs well in alkaline or strong basic fluids and most organics.

Refer to Section "Chemical Resistance" on pages 8 and 9 for additional application information.

ISO 9001 Registered

GENERAL SPECIFICATIONS

Body Sub-Assembly

Body Form: Globe style; straight body pattern.

Body Sizes: 1/2", 1", 1-1/2" and 2"; (DN 15, 25, 40 and 50).

Maximum Pressure & Working Temperature: Pressure Vs. Temperature application zone indicated in Graph No. 1:
Pressure – Up to 275 psig (19.0 Barg).
Full Vacuum: Down to 0 psia (-14. 7 psig, -29.92 "Hg); 0 BarA (-1.01 Barg, -760 mm Hg).
Temperature Range – 0° to +310°F (-17.4° to + 155°C).

End Connections: Standard – 150# RF flanged; gasketless design. Flange bolt circle per ANSI B16.5. Bolt holes drilled and tapped to receive flange bolting.
Optional ANSI – 300# RF per above.
Optional DIN – Standard ANSI raised face dimensions on body. Mating bolt circle dimensions in accordance with DIN standard 2501 and ISO 2084, classes PN16, PN25 and PN40. Bolt holes drilled and tapped to receive metric bolting. Provided with compression molded TFE annular adapter gaskets to ensure proper loading of integral body gasket. (See Figure 2). Recommended to use flange gasket.

Stem Seal: Dual design —
Primary Seal: TFE bellows with 100,000 full stroke cycle design life.
Secondary Seal: TFE "V-ring" packing.

Seat Leakage: ANSI/FCI 70-2 (Rev. 1982), Class VI.

Flow Direction: Standard is Flow-to-Open (FTO).

Inherent Flow Characteristic: Standard – Equal Percentage (Equal %).
Optional – Linear or Quick Opening (Q.O.) (Characteristic only maintained in FTO direction.)

Maximum Pressure Drop: Up to 275 psid (19.0 Bard). Dependent on actuator size and bench set selection. See Table 4.

Seat Design: Integral TFE seat. Replaceable TFE plug-tip.

Flow Capacity Range:

Body Size in. (DN)	Capacity (Cv) Range Smallest Trim Size — Largest Trim Size
1/2" (15)	.10 — 2.5
1" (25)	.10 — 10.0
1-1/2" (40)	6.30 — 21.0
2" (50)	10.00 — 40.0

See Tables 1 and 2 for theoretical Cv @ % travel.
Equal % and Linear Characteristics - available in all trim sizes.
See Table 3.
Q.O. Characteristic - available only in largest orifice available per line size.

Rangeability: Standard – 50:1, except 1/4" (6 mm) orifice.
Minimum – 25:1 for 1/4" (6mm) orifice.
See Tables 1and 2.

Actuator Sub-Assembly

Design: Spring-diaphragm type.

Action	Basic Model No.	Body Sizes Utilized On in. (DN)
Direct; ATC-FO. Reverse; ATO-FC Field reversible.	30	All
Direct; ATC-FO Non-field reversible.	55D	1", 1-1/2", 2" (25,40,50)
	75D	1-1/2", 2" (40, 50)
	115D	2" (50)
Reverse; ATO-FC Non-field reversible.	55R	1", 1-1/2", 2" (25,40,50)
	75R	1-1/2", 2" (40,50)
	115R	2" (50)

Direct: Increase in air "LOAD" extends actuator stem.
Reverse: Increase in air "LOAD" retracts actuator stem.
ATC-FO: Air-to-Close, Fail Open; Direct-acting.
ATO-FC: Air-to-Open, Fail Closed; Reverse-acting.

See Table 4 for proper selection of required bench setting range spring and full actuator model number.

Ambient Temp. Range: Actuator or Actuator with positioner: -20 to +175°F (-29 to +80°C).

Bench Set: See Table 4.

Supply Pressure: See Table 4.

Stroke: See Tables 4 and 5.

Supply Connection: 1/4" female NPT.

Mounting Position: Model 30 – Horizontal-to-vertically up, and all angles in between.
Models 55, 75 or 115 – Vertical ONLY.

Exterior Corrosion Resistance: Standard – all non-SST portions painted with corrosion resistant epoxy paint per Cashco Specification #S-1606 except tubing and fittings.
Optional – 2-coat epoxy coating per Cashco Specification #S-1547.

Sizes, Strokes & Volumes: See Table 5.

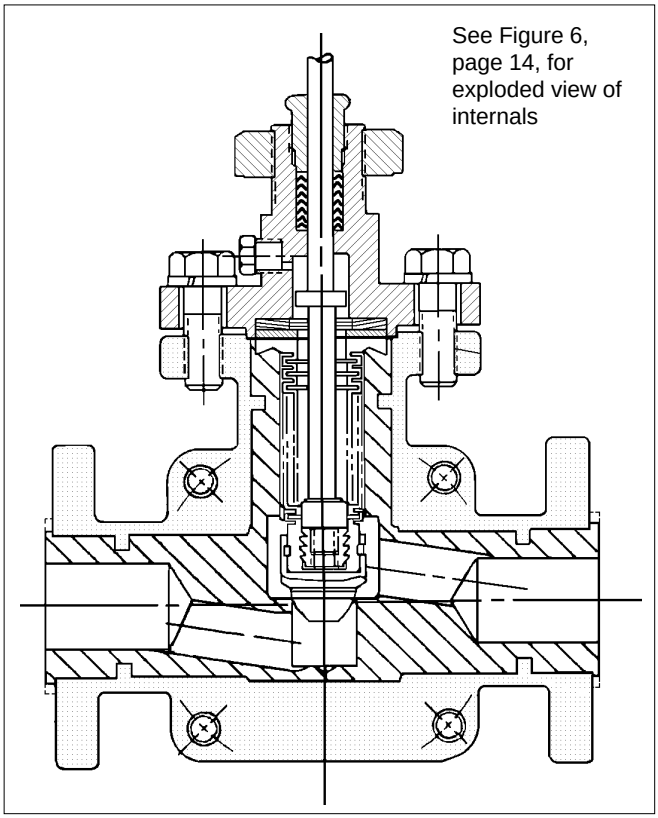
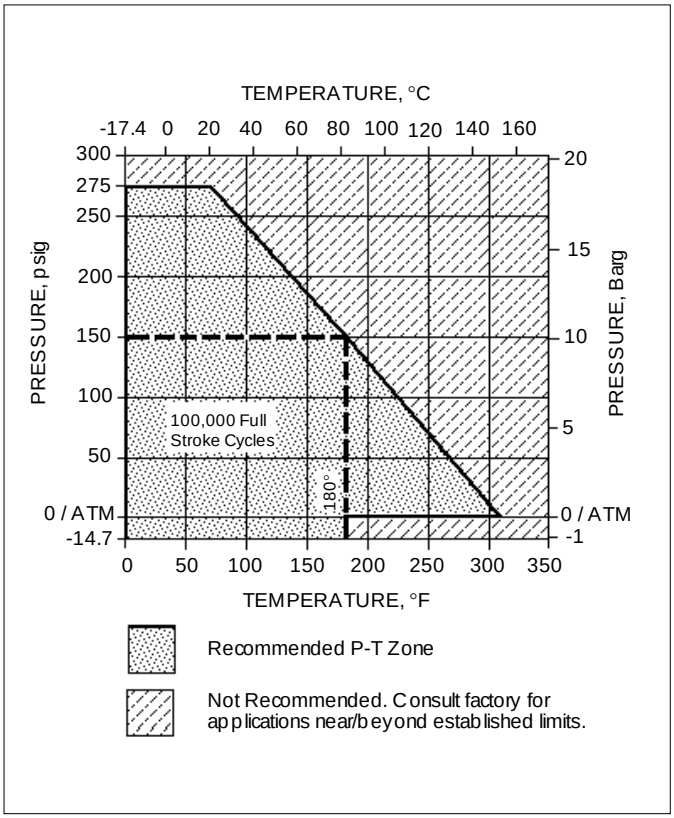


Figure 1
Model "521" Control Valve
Cross-Section



GRAPH NO. 1

MATERIALS SPECIFICATIONS

Body Sub-Assembly

Body, Plug Head & Bellows: Isostatically compacted, high density TFE - tetrafluoroethylene; i.e. PTFE – polytetrafluoroethylene. Precision machined. (Note: TFE or PTFE are used as abbreviations; they are the same material.)

Body Shell and Bonnet: Investment castings. Cast 304 SST per ASTM A351-CF8.

Body & Bonnet Bolting: 18-8 SST.

Bonnet Gasket: TFE.

Secondary Packing: TFE "V-ring".

Belleville Spring Washers: 18-8 SST.

Stem Assembly: *Standard:* 316 SST stem and anti-rotational stop; 420 SST pin (body sizes 1/2" (DN15) and 1" (DN25)), silver soldered (body sizes 1-1/2" (DN40) and 2" (DN50)). Embedded stem-to-bellows connection nut of 316 SST.

Optional: Two optional stem constructions available:

Option "D" – Hastelloy C-22 stem, anti-rotational stop and pin, and embeded stem-to-bellows connector nut.

Option "F" – Hastelloy C-22 stem only. Stop and pin of standard materials.

***NOTE**: Alternate stem materials should be considered when the fluid is known to permeate TFE and is corrosive to 316 SST in the presence of moisture. See Section "Chemical Resistance" and Options "D" and "F" above.*

Packing Follower: 18-8 SST.

Actuator Sub-Assembly

Parts	Model 30	Models 55R & 115R Models 55D & 115D	Models 75D & 75R
Diaphragm Casings:	Cast aluminum, including cap	Pressed carbon steel	Pressed carbon steel
Spring Housing:	Integral with diaphragm casing; cast aluminum	Integral with yoke; cast iron	Integral with yoke; cast iron
Yoke:	Cast aluminum	Cast iron	Cast iron
Yoke Nut:	SST	SST	SST
Diaphragm:	Reinforced Neoprene	Reinforced Neoprene	Reinforced Neoprene
Diaphragm Plate:	Cast aluminum	Cast iron	Cast iron
Spring:	Epoxy coated steel	Epoxy coated steel	Epoxy coated steel
Spring Button:	Aluminum	Cast iron	Cast iron
Bolting – Diaphragm Casing, Yoke-to-Diaphragm Casing:	SST	Plated steel	Plated steel
Travel Indicator, Indicator Plate, & Screws:	SST	SST	SST
Spring Adjustor & Jam Nuts:	SST	SST	SST
Stem:	316 SST	416 SST	416 SST

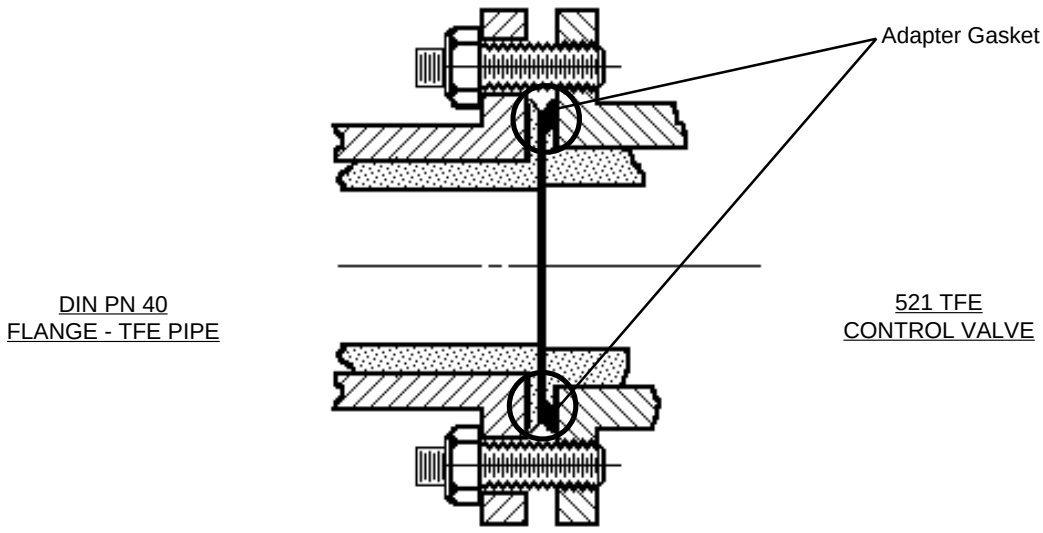


FIGURE 2
ANSI / DIN ADAPTER GASKET

TECHNICAL SPECIFICATIONS

TABLE 1
MODEL 521
THEORETICAL CAPACITY

EQUAL % CHARACTERISTIC

F_L Factor = 0.90

Valve Size inch (DN)	Orifice Size inch (mm)	Range-ability	Minimum Controllable Cv	Cv @ 10% Travel Increments									
				10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1/2" (15)	0.250" (6.35)	25:1	0.004	.006	.008	.011	.014	.020	.028	.038	.053	.072	**0.10**
			0.006	.009	.012	.017	.023	.032	.044	.061	.084	.12	**0.16**
			0.010	.014	.019	.026	.036	.050	.069	.095	.13	.18	**0.25**
			0.016	.022	.030	.042	.058	.080	.11	.15	.21	.29	**0.40**
			0.025	.035	.048	.066	.091	.13	.17	.24	.33	.46	**0.63**
	0.438" (11.12)	40:1	0.020	.030	.044	.065	.096	.14	.21	.31	.46	.68	**1.00**
			0.032	.047	.070	.10	.15	.23	.33	.49	.73	1.08	**1.60**
			0.050	.074	.11	.16	.24	.35	.52	.77	1.14	1.69	**2.50**
1" (25)	0.250" (6.35)	25:1	0.004	.006	.008	.011	.014	.020	.028	.038	.053	.072	**0.10**
			0.006	.009	.012	.017	.023	.032	.044	.061	.084	.12	**0.16**
			0.010	.014	.019	.026	.036	.050	.069	.095	.13	.18	**0.25**
			0.016	.022	.030	.042	.058	.080	.11	.15	.21	.29	**0.40**
			0.025	.035	.048	.066	.091	.13	.17	.24	.33	.46	**0.63**
	0.562" (14.27)	40:1	0.020	.030	.044	.065	.096	.14	.21	.31	.46	.68	**1.00**
			0.032	.047	.070	.10	.15	.23	.33	.49	.73	1.08	**1.60**
			0.050	.07	.11	.16	.24	.35	.52	.77	1.14	1.69	**2.50**
			0.080	.12	.17	.26	.38	.57	.84	1.24	1.83	2.70	**4.00**
			0.100	.15	.22	.32	.48	.71	1.05	1.55	2.29	3.38	**5.00**
	0.875" (22.22)	50:1	0.126	.19	.28	.41	.60	.89	1.32	1.95	2.88	4.26	**6.30**
			0.150	.22	.33	.49	.72	1.06	1.57	2.32	3.43	5.07	**7.50**
			0.200	.30	.44	.65	.96	1.41	2.09	3.09	4.57	6.76	**10.0**
1-1/2" (40)	0.875" (22.22)	50:1	0.126	.19	.28	.41	.60	.89	1.32	1.95	2.88	4.26	**6.30**
			0.150	.22	.33	.49	.72	1.06	1.57	2.32	3.43	5.07	**7.50**
	1.500" (38.10)	50:1	0.200	.30	.44	.65	.96	1.41	2.09	3.09	4.57	6.76	**10.0**
			0.300	.44	.66	.97	1.43	2.12	3.14	4.64	6.86	10.1	**15.0**
			0.500	.62	.92	1.36	2.01	2.97	4.39	6.49	9.60	14.2	**21.0**
2" (50)	1.500" (38.10)	50:1	0.200	.30	.44	.65	.96	1.41	2.09	3.09	4.57	6.76	**10.0**
			0.300	.44	.66	.97	1.43	2.12	3.14	4.64	6.86	10.1	**15.0**
			0.500	.74	1.09	1.62	2.39	3.54	5.23	7.73	11.4	16.9	**25.0**
	1.750" (44.45)	50:1	0.700	1.04	1.53	2.26	3.35	4.95	7.32	10.8	16.0	23.7	**35.0**
			0.800	1.18	1.75	2.59	3.83	5.66	8.37	12.4	18.3	27.0	**40.0**

TABLE 2
MODEL 521
THEORETICAL CAPACITY

LINEAR CHARACTERISTIC

F_L Factor = 0.90

Valve Size in/(DN)	Orifice Size in/(mm)	Range-ability	Minimum Controllable Cv	Cv @ 10% Travel Increments									
				10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
1/2" (15)	0.250" (6.35)	25:1	0.004	.010	.020	.030	.040	.050	.060	.070	.080	.090	**0.10**
			0.006	.016	.032	.048	.064	.080	.10	.11	.13	.14	**0.16**
			0.010	.025	.050	.075	.10	.13	.15	.18	.20	.23	**0.25**
			0.016	.040	.080	.12	.16	.20	.24	.28	.32	.36	**0.40**
			0.025	.063	.13	.19	.25	.32	.38	.44	.50	.57	**0.63**
	0.438" (11.12)	40:1	0.020	.10	.20	.30	.40	.50	.60	.70	.80	.90	**1.00**
			0.032	.16	.32	.48	.64	.80	.96	1.12	1.28	1.44	**1.60**
			0.050	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	**2.50**
1" (25)	0.250" (6.35)	25:1	0.004	.010	.020	.030	.040	.050	.060	.070	.080	.090	**0.10**
			0.006	.016	.032	.048	.064	.080	.10	.11	.13	.14	**0.16**
			0.010	.025	.050	.075	.10	.13	.15	.18	.20	.23	**0.25**
			0.016	.040	.080	.12	.16	.20	.24	.28	.32	.36	**0.40**
			0.025	.063	.13	.19	.25	.32	.38	.44	.50	.57	**0.63**
	0.562" (14.27)	40:1	0.020	.10	.20	.30	.40	.50	.60	.70	.80	.90	**1.00**
			0.032	.16	.32	.48	.64	.80	.96	1.12	1.28	1.44	**1.60**
			0.050	.25	.50	.75	1.00	1.25	1.50	1.75	2.00	2.25	**2.50**
			0.080	.40	.80	1.20	1.60	2.00	2.40	2.80	3.20	3.60	**4.00**
			0.100	.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	**5.00**
	0.875" (22.22)	50:1	0.126	.63	1.26	1.89	2.52	3.15	3.78	4.41	5.04	5.67	**6.30**
			0.150	.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	**7.50**
			0.200	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	**10.0**
1-1/2" (40)	0.875" (22.22)	50:1	0.126	.63	1.26	1.89	2.52	3.15	3.78	4.41	5.04	5.67	**6.30**
			0.150	.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	**7.50**
	1.500" (38.10)	50:1	0.200	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	**10.0**
			0.300	1.50	3.00	4.50	6.00	7.50	9.00	10.5	12.0	13.5	**15.0**
			0.420	2.10	4.20	6.30	8.40	10.5	12.6	14.7	16.8	18.9	**21.0**
2" (50)	1.500" (38.10)	50:1	0.200	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	**10.0**
			0.300	1.50	3.00	4.50	6.00	7.50	9.00	10.5	12.0	13.5	**15.0**
			0.500	2.50	5.00	7.50	10.0	12.5	15.0	17.5	20.0	22.5	**25.0**
	1.750" (44.45)	50:1	0.700	3.50	7.00	10.5	14.0	17.5	21.0	24.5	28.0	31.5	**35.0**
			0.800	4.00	8.00	12.0	16.0	20.0	24.0	28.0	32.0	36.0	**40.0**

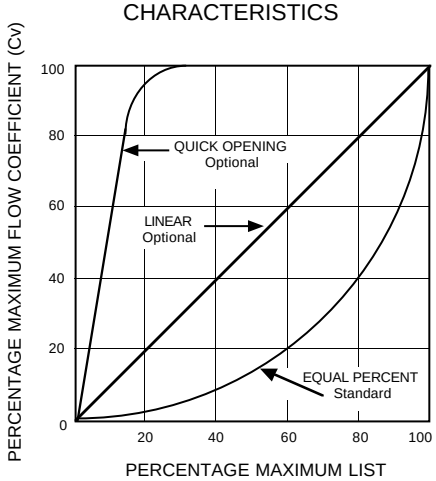
TABLE 3
CAPACITY – Cv

QUICK OPENING

F_L Factor = 0.90

Valve Size inch (DN)	Orifice Size inch (mm)	Cv @ 100% Travel
1/2" (15)	.438" (11.12)	2.50
1" (25)	.875" (22.22)	10.0
1-1/2" (40)	1.500" (38.10)	21.0
2" (50)	1.750" (44.45)	40.0

TYPES OF FLOW CHARACTERISTICS



GRAPH NO. 2

TABLE 4
MAXIMUM PRESSURE DROP – psid (Bard)
ATO-FC; REVERSE ACTION
ATC-FO; DIRECT ACTION
FTO DIRECTION

Body Size Inch (DN)	Port-Orifice Description	Port-Orifice Size Inch (mm)	Maximum Operating Pressure Drop psid (Bard)	Actuator Bench Settings psig (Barg)	Actuator Model No. Reverse Action	Actuator Model No. Direct Action	Air Supply Pressure psig (Barg)
1/2" (15)	Full	.438" (11.12)	275 (19.0)	3-15 (.21-1.03)	**30R-00**	**30D-00**	20 (1.4)
	1-Step Reduced	.250" (6.35)					
1" (25)	Full	.875" (22.22)	65 (4.5)	4-15 (.28-1.03)	**30R-01**	**30D-01**	20 (1.4)
			135 (9.3)	7-28 (.48-1.93)	**30R-02**	**30D-02**	35 (2.4)
			225 (15.5)	5-15 (.34-1.03)	55R-01	55D-01	20 (1.4)
	1-Step Reduced	.562" (14.27)	240 (16.5)	4-15 (.28-1.03)	**30R-01**	**30D-01**	
			275 (19.0)	3-15 (.21-1.03)	55R-00	55D-00	
	2-Step Reduced	.250" (6.35)	275 (19.0)	3-15 (.21-1.03)	**30R-03**	**30D-03**	
1-1/2" (40)	Full	1.500" (38.10)	40 (2.7)	4-15 (.28-1.03)	55R-03	55D-03	20 (1.4)
			90 (6.2)	4-15 (.28-1.03)	75R-00	75D-00	
			125 (8.6)	4-15 (.28-1.03)	115R-00	115D-00	
			35 (2.4)	7-28 (.48-1.93)	**30R-04**	**30D-04**	35 (2.4)
			90 (6.2)	6-30 (.41-2.07)	55R-04	55D-04	
	1-Step Reduced	.875" (22.22)	65 (4.5)	4-15 (.28-1.03)	**30R-05**	**30D-05**	20 (1.4)
			200 (13.8)	4-15 (.28-1.03)	55R-03	55D-03	
			135 (9.3)	6-30 (.41-2.07)	**30R-06**	**30D-06**	35 (2.4)
2" (50)	Full	1.750" (44.45)	20 (1.4)	4-15 (.28-1.03)	55R-03	55D-03	20 (1.4)
			60 (4.1)	4-15 (.28-1.03)	75R-00	75D-00	
			90 (6.2)	4-15 (.28-1.03)	115R-00	115D-00	
			25 (1.7)	7-28 (.48-1.93)	**30R-04**	**30D-04**	35 (2.4)
			40 (2.7)	6-30 (.41-2.07))	55R-04	55D-04	
	1-Step Reduced	1.500" (38.10)	40 (2.7)	4-15 (.28-1.03)	55R-03	55D-03	20 (1.4)
			90 (6.2)	4-15 (.28-1.03)	75R-00	75D-00	
			125 (8.6)	4-15 (.28-1.03)	115R-00	115D-00	
			35 (2.4)	7-28 (.48-1.93)	**30R-04**	**30D-04**	35 (2.4)
			90 (6.2)	6-30 (.41-2.07)	55R-04	55D-04	

= Field Reversible.

TABLE 5
Actuator Size, Stroke & Volumes

Body Size in (DN)	Actuator Model No.	Nominal Diaphragm Area in² (cm²)	Stroke in (mm)	Volumes Clearance in³ (cm³)	Volumes Displacement in³ (cm³)
1/2" (15)	30	30 (200)	.438 (11.13)	20 (325)	15 (250)
1" (25)	30	30 (200)	.625" (15.88)	15 (250)	20 (325)
	55	50 (325)		35 (575)	30 (500)
1-1/2" (40) and 2" (50)	30	30 (200)	.875" (22.22)	15 (250)	30 (500)
	55	50 (325)		20 (325)	45 (725)
	75	75 (500)		75 (1225)	65 (1075)
2" (50)	115	110 (700)	.875" (22.22)	80 (1300)	100 (1650)

OPTION AND ACCESSORIES SPECIFICATIONS

Alternate Stem Construction: See Page 3, "Stem Assembly".

Option -3: MANUAL HANDWHEEL: Overrides the actuator spring force to allow manual stroking of the valve. Single acting design, top-mounted, enclosed handwheel. For ATO-FC action, handwheel operator "opens" the valve against spring force; may be utilized as a travel stop to prevent full closure. For ATC-FO action, handwheel operator "closes" the valve against spring force; may be utilized as a travel stop to prevent full opening.

Option -57: SPECIAL CLEANING: Per Cashco Specification #S-1589 for Chlorine Service.

Option-95: EPOXY PAINT: Special epoxy painting for exterior surfaces. Utilized in harsh atmospheric conditions. Procedures and specs per Cashco Specification #S–1547.

Positioners: *General:* Yoke mounted to unit. All feedback linkage exposed to elements of SST materials. Aluminum housing with corrosion resistant polyurethane paint. Standard with 2-gauge cluster. Pneumatic output load as required by actuator bench range. Adjustable zero, stroke, gain and damping settings. Field reversible action.

P/P Pneumatic: Model 9540L. Accepts 3-15 psig (0.2-1.0 Barg); 2-way split ranges 3-9 or 9-15 psig (0.2-0.6 or 0.6-1.0 Barg); or 3-way split ranges 3-7, 7-11 and 11-15 psig (0.2-0.5, 0.5-0.8 and 0.8-1.0 Barg) input signals. Plastic cover with see-thru panel to view internal gauges.

I/P Electro-Pneumatic: Model 9520L. Accepts 4-20 mA; 2-way split ranges 4-12 or 12-20 mA; 3-way split ranges 4-9.3, 9.3-14.7 or 14.7-20 mA input signals. NEMA 3 enclosure, intrinsically safe. FM approved. Gauges mounted on external gauge block.

Instrument Air Tubing: Standard tubing and fittings are Imperial-Eastman "Impolene" thermoplastic tubing and brass fittings, rated to 250 psig (17 Barg) and -20 to +200°F (-29 to +93°C).

Optional copper tubing wtih brass fittings, or SST fittings and tubing are available.

Airset: Model 5100P is bracket mounted to the actuator diaphragm case. 1-1/2" (40 mm) output pressure gauge included when unit supplied with 9520L I/P positioner. 1/4" NPT female connections. Use with positioners or solenoids.

3-Way Solenoid Valve: Standard Brass: Available in standard NEMA 3, 4 and 6 weatherproof model, or NEMA 4 & 7 explosion-proof model. Brass body, 1/4" female NPT connections. Nipple mounted to actuator casing. 120 VAC, 60 Hz power supply. Class F coil, continuous duty. 0.125" (3 mm) orifice.

Gen. Purpose: ASCO #8320G176.
X-Proof: ASCO #EF8320G176.

Alternate SST: Similar to standard unit, except with .094" (2.38 mm) orifice, and 303 SST body.

Gen. Purpose: ASCO #8320G201.
X-Proof: ASCO #EF8320G201.

Standard installation vents actuator and drives valve to failsafe position upon loss of electrical power.

Position Indicating Switches: *Standard:* Yoke mounted, rotary trip switch; contains 1-SPDT switch. Switch rating is 15A @ 125 or 250 VAC. UL/CSA rating L96. Up to two switch units may be mounted per valve.

Gen. Purpose: Microswitch #OP-AR. NEMA 4 enclosure.
X-Proof: Microswitch #EX-AR. For "hazardous locations" NEMA 7, Class 1, Groups C & D; NEMA 9, Class II, Groups E,F & G.

Alternate: Proximity Controls Model #12ALO, 2-SPDT switches. Switch rating is 15A @ 125 or 250 VAC; proximity-type. UL and CSA listed for Class I, Groups A, B, C, D; Class II, Groups E, F, G; Div. 1 and 2. Enclosure per NEMA 1, 2, 3, 3R, 3S, 4, 4X, 6, 7, 9, 12 and 13.

Alternate: Proximity Controls Model #12GLOB, 2-SPDT switches. Switch rating is 1A @ 24 VDC, 1A @ 125 VAC. BASEFA certified EX dIIC T6 per BS4683 Part 2, IP68. CENELEC certified EEX dIIC T6 per BS5501: Parts 1 & 5.

CHEMICAL RESISTANCE

General Statement: Statements located within this technical bulletin concerning suitability of fluids with TFE materials are general statements, and should not be construed as recommendations. Any statements of suitability are the result of a compilation of various sources of information based on experience, tests, and published technical literature. No guarantee or warranty is in anyway implied for a given particular service or application.

Additional Reference: For an inclusive listing covering a broader range of service application fluids, reference *"Handbook of Corrosion Resistant Piping"*, P.A. Schweitzer, Industrial Press, 1969; or *"Compass Corrosion Guide"*, 2nd Edition, K.M. Pruett, Compass Publications, 1983. This publication will include information based on the following fluid variables:

1. Solution concentration
2. Pressure
3. Temperature

Chemical Resistance of TFE. TFE is, in general, inert to chemical corrosion of nearly all known industrial or commercial chemicals. When applied within the P vs. T zone of Graph No. 1, the following partial listing represents general classifications of fluids that normally do not corrode TFE:

- Strong inorganic acids – HCl, H_2SO_4, aqua regia
- Strong caustics or bases - NaOH, KOH
- Bleaches
- Oxidizers (except F_2 related chemicals)
- Organic acids
- Aliphatic and aromatic hydrocarbon solvents
- Chlorides
- Sulfates
- Peroxides
- Phenols
- Alcohols
- Esters
- Ketones
- Ethers

A partial listing of fluids that are known to chemically react with TFE and should not be applied are:

- Molten alkali metals – Na, K, Li
- Molten anhydrous bases – NaOH
- Fluorine gas (dry) above 250°F (121°C)
- Strong fluorinating agents – ClF_3, OF_2
- Hydrogen fluoride (dry) above 220°F(104°C)

Absorption. Depending on concentration, pressure and temperature conditions, some fluids absorb trace (minute) quantities into the wetted surfaces of TFE. When pressure is suddenly reduced or temperature increased, the absorbed fluids can "expand" and cause physical damage to the polymerized molecules. Blisters may be formed. Controls to eliminate/minimize sudden temperature and/or pressure changes are recommended. Chemical resistance is not compromised when absorption occurs.

Permeation. Depending on concentration, pressure and temperature conditions, certain fluids permeate (pass-thru) TFE molecular structure in trace quantities. Effects of pressure/temperature changes are similar to absorption effects. As with absorption, chemical resistance of the TFE is not reduced. Added considerations are:

a. purging of non-wetted (backside) of bellows
b. alternate stem materials.

See Table 6 for a partial listing of fluids known to permeate TFE.

TABLE 6
Chemicals Known To Permeate TFE

* Ammonium beryllium fluoride	Ethylene chloride	Naphthalene
Benzene	Ethylene dibromide	Nitric acid
* Bromine	Ethylene dichloride	Nitrobenzene
* Bromine (water - 3% saturated)	* FREON Fluorocarbons	Nitromethane
* Bromine chloride	Hexane	Oxygen
Butane	* Hydrobromic acid	Perchloroethylene
Butyl bromide	* Hydrochloric acid	Phenol
Butyl chloride	* Hydrofluoric acid	* Phosgene
Butyl phenol	Hydrogen	Potassium cyanide
Butylene (Butadiene)	* Hydrogen chloride	Propane
Carbon bisulfide	* Hydrogen cyanide	Propylene oxide
* Carbon tetrachloride	* Hydrogen fluoride gas	Styrene monomer
Chlorinated phenol	Hydrogen sulfide	Sulfur trioxide
* Chlorine (5% in CCl_4)	* Iodine (gas)	Sulfuric acid
* Chlorine dioxide	* Iodine (Tincture of)	Tetrahydrofuran
* Chlorine	Methane	Toluene
* Chlorobenzene	Methyl chloride	Toluene (25%) + kerosene (75%)
* Chlorobenzyl chloride	** Methyl chloroform	1,1,2-Trichloroethane
Chloroform (Trichloromethane)	** Methyl chloromethyl ether	Trichloroethylene
* o-Dichlorobenzene	Methyl ethyl ketone	** Trimethyl propane
Dichloroethane	Methyl isobutyl ketone	Vinyl chloride monomer (liquid)
Diethyl ether	** Methylene bromide	** Vinylidene chloride (monomer)
* Ethyl benzene (acidic)	Methylene chloride	Xylene
Ethyl ether	Naphtha	

* Fluids where alternate stem materials are recommended.
** Corrosion effects on metallic parts unknown.

CONSIDERATIONS FOR ALTERNATE STEM MATERIALS

When a fluid permeates TFE, the rate of permeation is very low, and the molecules will diffuse uniformly into the "gaseous void" or "non-wetted" zone in the center portion of the bellows of a Model 521. These molecules can come in contact with metallic, non-TFE parts, including the stem. With each stroke of the valve stem downwards, molecules of water vapor in the atmosphere are entrapped in the peaks and valleys of the stem's microstructure, and are drawn down into the secondary packing rings. As the stem retracts, a molecule of the permeated fluid may be pulled up into the packing rings. If the molecules of moisture and permeated fluid come into contact, a "solution" may be formed. This "solution" will be highly "concentrated" and can be highly corrosive. If the stem material is vulnerable to the concentrated solution, chemical attack of the valve stem in the mid-range of the packing zone may begin. Once this mechanism begins, the result may lead to premature stem failure.

Examples of gases which permeate TFE in microscopic quantities are hydrogen sulfide (H_2S) and chlorine gas (Cl_2). When dissolved in moisture (H_2O) —

$$H_2S + H_2O \longrightarrow H_3O^+ + HS^-$$

hydrogen sulfide + water ⟶ Hydrosulfuric acid; a weak acid even when concentrated.

$$2Cl_2 + 6H_2O \longrightarrow 4H_3O^+ + 4Cl^- + O_2\uparrow$$

chlorine gas + water ⟶ hydrochloric acid; + oxygen gas
a very strong acid
even when not
concentrated

— acids are formed in both cases. The hydrosulphuric acid is a weaker acid that 316 SST is sufficiently corrosion resistant against. However, the hydrochloric acid is a strong acid that corrosively attacks 316 SST. Both increased pressure and temperature accelerate the corrosive mechanism. However, the overall rate of corrosion is very low as the permeation rate is very low. Chlorine gas is an example of a fluid where alternate stem construction of Hastelloy C-276 will maximize unit life and proper functioning of the secondary stem seal design. Use of alternate stem material is subjective and dependent on many various factors, and is like most CPI decisions, based on value judgement.

Note that the corrosive effects are primarily limited to the stem/secondary packing rings zone where moisture and acid molecules interface.

APPLICATION AND SELECTION

The following procedure will help determine a suitable selection for an application. Consult Cashco area representative for assistance in proper sizing.

STEP 1. CORROSION RESISTANCE. Consulting information in Section "Chemical Resistance" herein or other corrosion data, determine the corrosion suitability of TFE. Determine if permeation effects dictate use of alternate stem materials.

STEP 2. P vs. T BODY RATINGS. Reference Graph No. 1 to determine if the maximum/minimum pressure-temperature conditions are located in the recommended P-T zone.

STEP 3. FIVE KNOWNS. The following minimal parameters/information must be available before a selection procedure can begin:

a. Service Fluid – What is it? Liquid or gas? SG (std. cond.).
b. Inlet Pressure – P_1 (upstream pressure).
c. Outlet Pressure – P_2 (downstream pressure).
d. Desired capacity – Cv, GPM, SCFH; minimum, maximum and normal.
e. Fluid temperature – T_1, SG (actual).

STEP 4. CHARACTER and RESERVE. Decide whether the inherent characteristic of the valve should be =%, linear or quick opening. Also, decide the amount of overcapacity in the selection; i.e. =% character with 20% reserve capacity. (NOTE: An =% character gives a "low gain" up to about 50% of full travel, a "medium gain" up to about 75% of full travel, and "high gain" the last 25% of travel. A linear character gives "constant gain" throughout the full stroke. A quick opening character gives "high gain" the first 25% of travel, and is used primarily for ON-OFF service, where thermal shock is negligible.

STEP 5. CAPACITY. Using the knowns from Step 3, calculate the maximum and minimum Cv required.

Example: Max Cv Req'd = 7.5 Cv
Min Cv Req'd = 0.8 Cv
=% Character
20% reserve capacity

Max Cv Available
7.5 ÷ (1.00-.20) = 9.4 Cv.

STEP 5 (Cont).

Select the body/orifice sizes that are near the 9.4 Cv Available level. Table 7 should be used as the character is =%.

Preliminary selections –

a. 1" @ 10.0 Cv Max, full port.
b. 1-1/2" @ 10.0 Cv Max, reduced port.
c. 2" @ 10.0 Cv Max, reduced port.

STEP 6.

RANGEABILITY. Check the Min Cv Available from Table 1 for the selections of Step 5:

a. 0.200 Cv @ Min Cv
b. 0.200 Cv @ Min Cv
c. 0.200 Cv @ Min Cv

As the Min Cv Req'd is greater than any of the above Min Cv Available, all of the selections are acceptable at minimum flow rate.

STEP 7.

BODY SIZE. Lined or plastic piping systems are normally utilized with TFE-bodied control valves, and are frequently designed for low velocities; i.e. "oversized". Piping reducers may not be desired; if so, then a line-sized body should be selected which will likely require a reduced port selection. If piping reducers are acceptable, then use the smallest body size for which the reducers are available.

STEP 8.

FAILURE ACTION. Consider the process related safety conditions to determine if the valve should "fail open" or "fail close" upon:

a. loss of air supply pressure
b. loss of electric power *
c. loss of both supply air and electric power. *

* Requires 3-way solenoid valve.

STEP 9.

PRESSURE DROP & ACTUATOR. Maximum pressure drop (ΔP) is normally experienced at shutoff flow. Knowing the maximum ΔP required, go to Table 4 to ensure the actuator's capability.

Example: ΔP shutoff – 60 psid (4.14 Bard).
Valve selected – 1-1/2" (40 mm) @ 10.0 Cv Max, reduced port with 0.875" (22.22 mm) orifice. Action – ATO-FC (reverse).

Selection: Any of the following actuator Model/size/action are acceptable:

a. 30R-05 @ 4-15 psig bench set, up to 65 psid (4.5 Bard) ΔP, field reversible.
b. 55R-03 @ 4-15 psig bench set, up to 200 psid (13.8 Bard) ΔP, non-field reversible.
c. 30R-06 @ 6-30 psig (.41-2.07 Barg) bench set, up to 135 psid (9.3 Bard) ΔP, field reversible.

Note: Selections a. and b. above may have a 3-15 psig (.2-1.0 Barg) SIG drive the valve unit without a positioner. Selection c. above would require a positioner.

STEP 10.

ACCESSORIES. Consider use of various valve installed accessories:

a. P/P positioner
b. I/P positioner
c. Position limit switches
d. Manual handwheel
e. Solenoid valve
f. Airset

TABLE 7
Flange Stud Bolting Size/Thread Guide

Body Size		End Connection Flange			Recommended
in.	(DN)	150# – Dim. "F"	300# – Dim. "F"	DIN 16/25/40 – Dim. "F"	Stud Length
1/2"	(15)	1/2"-13 UNC-2B	1/2"-13 UNC-2B	14mm - M12 x 1.75-6H	2.00" (50 mm)
1"	(25)	1/2"-13 UNC-2B	5/8"-11 UNC-2B	14mm - M12 x 1.75-6H	2.25" (56 mm)
1-1/2"	(40)	1/2"-13 UNC-2B	3/4"-10 UNC-2B	18mm - M16 x 2.0-6H	2.75" (70 mm)
2"	(50)	5/8"-11 UNC-2B	5/8"-11 UNC-2B	18mm - M16 x 2.0-6H	3.00" (75 mm)
"L" - # Bolt Holes		4	4/8*	4	– –

* 2" – 300# flg. requires 8; all others 4.

NOTE: All flange bolt holes straddle centerlines.

TABLE 8
Dimensions and Weights
English Units – Inch and Lbs.

End Conn.	Dimension	BODY SIZE																	
		1/2"	1"			1-1/2"							2"						
		ACTUATOR MODEL #																	
		30D/R	30D/R	55D	55R	30D/R	55D	55R	75D	75R	115D	115R	30D/R	55D	55R	75D	75R	115D	115R
ALL	A	5.19	7.44	7.44		8.75	8.75		8.75		8.75		10.40	10.40		10.40		10.40	
	B	4.13	5.38	5.38		7.06	7.06		7.06		7.06		7.00	7.00		7.00		7.00	
	C	3.53	4.88	4.88		6.50	6.50		6.50		6.50		6.38	6.38		6.38		6.38	
	D	20.00	21.25	18.93	21.06	22.94	20.63	22.75	24.30	28.03	26.25	28.94	22.88	20.56	22.69	24.24	27.97	26.18	28.88
	E	9.00	9.00	10.50		9.00	10.50		13.81		15.50		9.00	10.50		13.81		15.50	
	H	27.18	28.44	26.06	30.38	30.12	27.81	32.06	32.24	37.65	33.38	39.25	30.06	27.75	32.00	32.18	37.59	33.31	39.18
150# FLGD.	G	2.38	3.12	3.12		3.88	3.88		3.88		3.88		4.75	4.75		4.75		4.75	
	K	1.75	2.13	2.13		2.50	2.50		2.50		2.50		3.00	3.00		3.00		3.00	
300# FLGD.	G	2.62	3.50	3.50		4.50	4.50		4.50		4.50		5.00	5.00		5.00		5.00	
	K	1.88	2.44	2.44		3.06	3.06		3.06		3.06		3.25	3.25		3.25		3.25	
DIN FLGD.	G	2.56	3.35	3.35		4.33	4.33		4.33		4.33		4.92	4.92		4.92		4.92	
	K	1.88	2.44	2.44		3.06	3.06		3.06		3.06		3.25	3.25		3.25		3.25	
WT. #	—	26	30	44	50	49	63	69	83	93	112	146	53	67	73	87	97	116	150

TABLE 9
Dimensions and Weights
Metric Units – mm and kg

End Conn.	Dimension	BODY SIZE																	
		DN15	DN25			DN40							DN50						
		ACTUATOR MODEL #																	
		30D/R	30D/R	55D	55R	30D/R	55D	55R	75D	75R	115D	115R	30D/R	55D	55R	75D	75R	115D	115R
ALL	A	132	189	189		222	222		222		222		264	264		264		264	
	B	105	137	137		179	179		179		179		178	178		178		178	
	C	90	124	124		165	165		165		165		162	162		162		162	
	D	508	540	481	535	583	524	578	617	712	667	735	581	522	576	616	710	665	734
	E	229	229	267		229	267		351		394		229	267		351		394	
	H	691	722	662	772	765	706	814	819	956	848	997	764	705	813	817	955	846	995
150# FLGD.	G	60	79	79		98	98		98		98		121	121		121		121	
	K	44	54	54		64	64		64		64		76	76		76		76	
300# FLGD.	G	66	89	89		114	114		114		114		127	127		127		127	
	K	48	62	62		78	78		78		78		83	83		83		83	
DIN FLGD.	G	65	85	85		110	110		110		110		125	125		125		125	
	K	48	62	62		78	78		78		78		83	83		83		83	
WT. kg	—	12	14	20	23	23	29	32	38	42	51	67	24	31	34	40	44	52	68

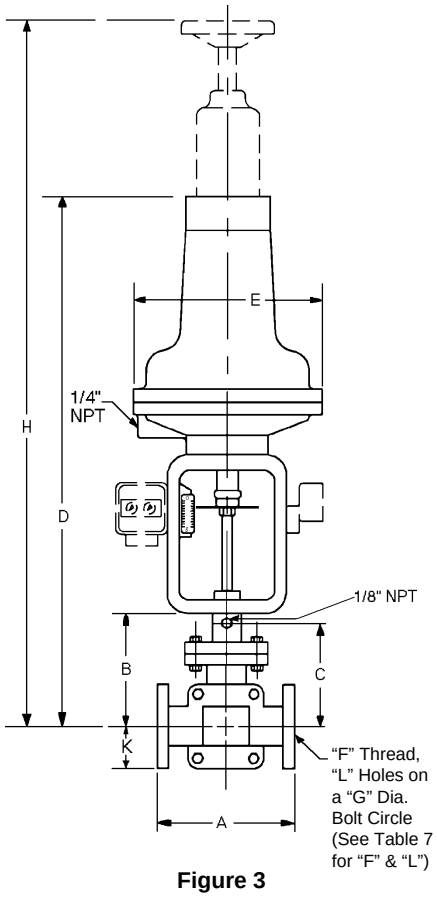


Figure 3
Model 521 with 30R Actuator

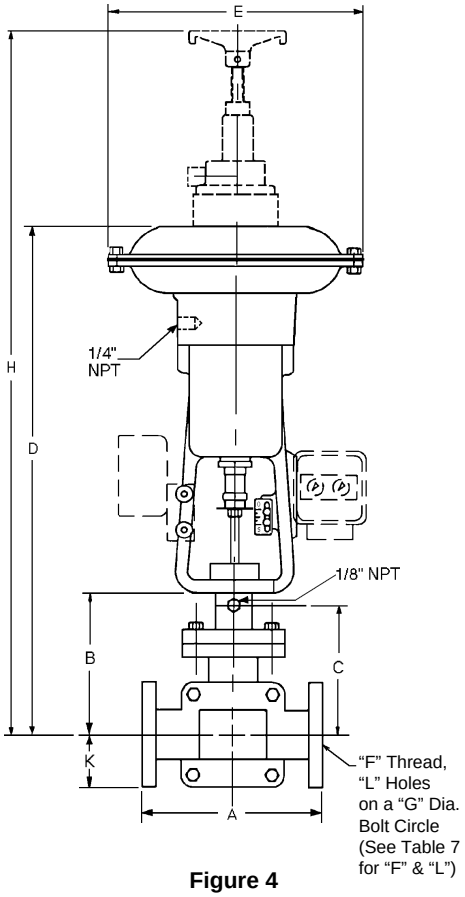


Figure 4
Model 521 with 55R, 75R & 115R Actuators

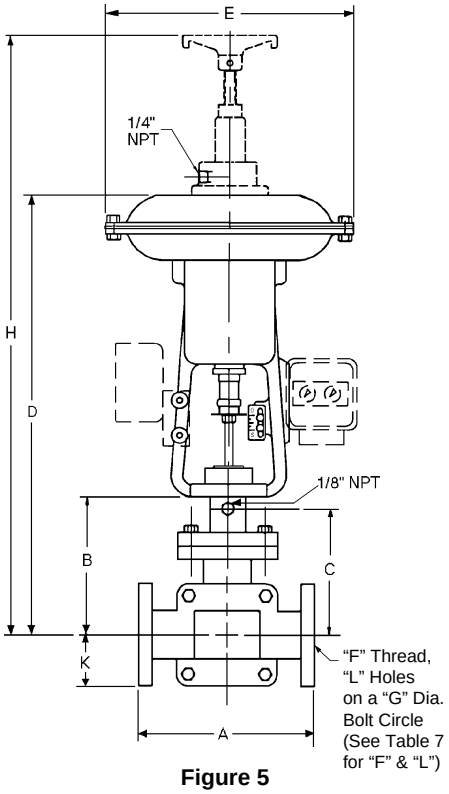


Figure 5
Model 521 with 55D, 75D & 115D Actuators

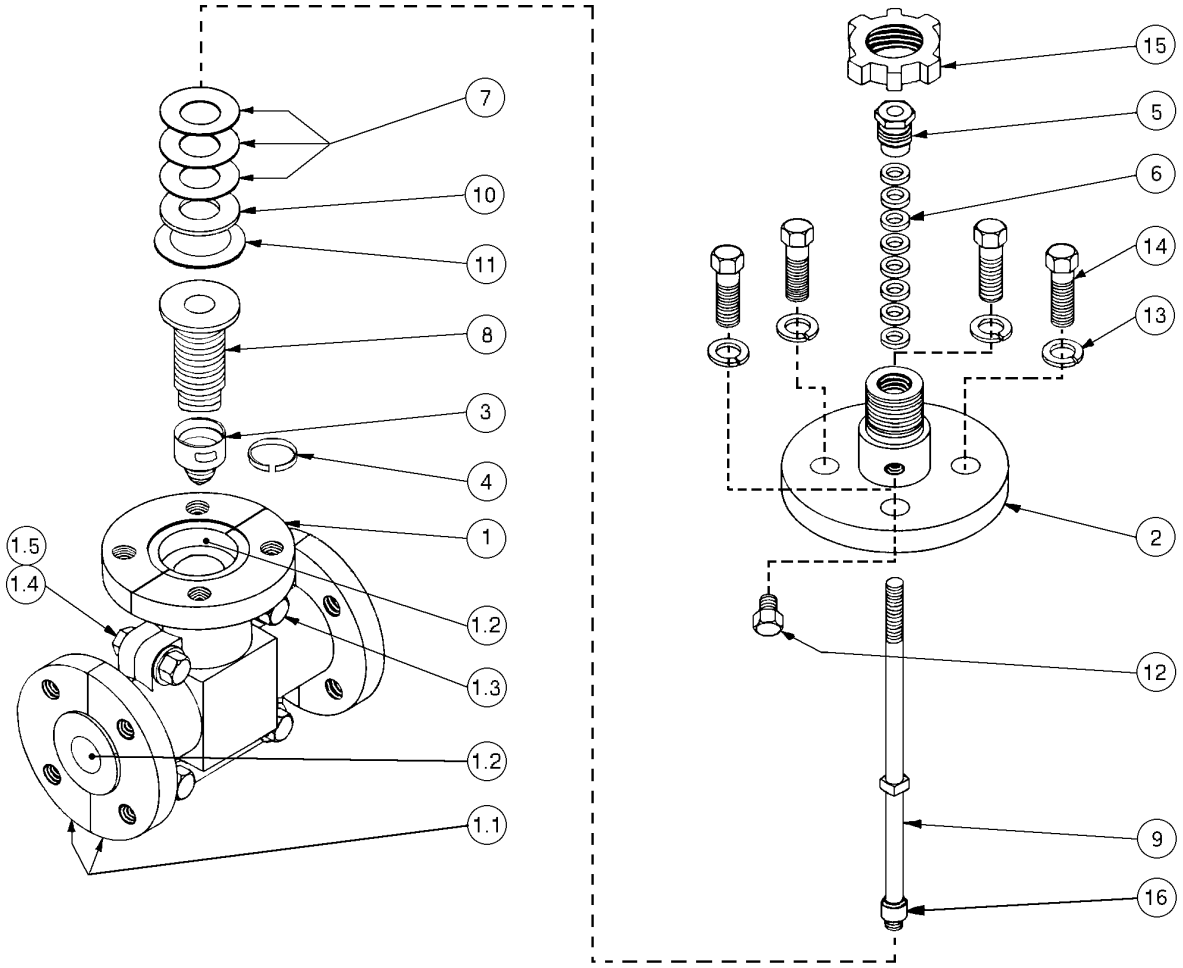


Figure 6
Model "521" Control Valve
Internals

ITEM NO.	DESCRIPTION
1	Body Sub-Assembly
1.1	* Half Shell
1.2	* TFE Core
2	Bonnet
3	Plug Head
4	Plug Retainer Strip
5	Packing Gland
6	Packing Set
7	Belleville Spring Washer
8	Bellows Sub-Assembly
9	Stem Sub-Assembly
10	Spacer Washer
11	Bonnet Gasket
12	Vented Pipe Plug
13	Lockwasher
14	Hex Hd. Cap Screw
15	Yoke Nut
16	Adapter (1-1/2" & 2" sizes only)
17	ANSI/DIN Adapter Gasket (not shown)

* Sub-level parts that make up the body sub-assembly;
these parts are not field replaceable individually

NOTES

PRODUCT CODE 06/05/96

TABLE 3

TRIM FORM, FTO DIRECTION	CODE
Equal % - (Standard)	1
Linear - (Optional)	2
Quick Opening - (Optional-Available only in largest full orifice.)	3

TABLE 2

MATERIALS			
BODY & BONNET	SHELL	STEM	CODE
TFE	304 SST	Standard	B
		Option "D": Hast C Stem, Anti-Rotation Stop & Pin	D
		Option "F": Hast C Stem, SST Pin & Anti-Rotation Stop	F

TABLE 1

BODY & ACTUATOR SIZE					
Body Size Inches	Body Size (DN)	Actuator Basic Model Nos.	Orifice Size (Inches)	Max. C_v Range	CODE
1/2"	(15)	30R/30D	.250" .438"	0.10 - 0.63 1.00 - 2.50	1
1"	(25)	30R/30D	.250" .562" .875"	0.10 - 0.63 1.00 - 5.00 6.30 - 10.0	2
		55R-55D	.562" .875"	1.00 - 5.00 6.30 - 10.0	3
1-1/2"	(40)	30R/30D	.875" 1.500"	6.30 - 7.50 10.0 - 21.0	A
		55R/55D	.875" 1.500"	6.30 - 7.50 10.0 - 21.0	B
		75R/75D	1.500"	10.0 - 21.0	C
		115R/115D	1.500"	10.0 - 21.0	D
2"	(50)	30R/30D	1.500" 1.750"	10.0 - 25.0 10.0 - 40.0	4
		55R/55D	1.500" 1.750	10.0 - 25.0 10.0 - 40.0	5
		75R/75D	1.500" 1.750"	10.0 - 25.0 10.0 - 40.0	E
		115R/115D	1.500" 1.750"	10.0 - 25.0 10.0 - 40.0	6

NOTE: Consult Tech Bulletin to confirm ΔP capability of selected actuator.

TABLE 4

TRIM Cv SIZE			
ORIFICE SIZE	APPLICABLE VALVE BODY SIZES	TRIM C_v SIZE	CODE
.250"	1/2" & 1"	.10 Reduced	E
		.16 Reduced	F
		.25 Reduced	G
		.40 Reduced	H
		.63 Full	J
.438"	1/2" Only	1.00 Reduced	K
		1.60 Reduced	L
		2.50 Full*	M
.562"	1" Only	1.00 Reduced	P
		1.60 Reduced	R
		2.50 Reduced	S
		4.00 Reduced	T
		5.00 Full	U
.875"	1" & 1-1/2"	6.30 Reduced	V
		7.50 Reduced	W
	1" Only	10.0 Full*	1
1.500"	1-1/2" & 2"	10.0 Reduced	Y
		15.0 Reduced	2
	1-1/2" Only	21.0 Full *	6
	2" Only	25.0 Full	3
1.750"	2" Only	35.0 Reduced	4
		40.0 Full *	5

*Only sizes available with Q.O. trim form.

TABLE 5

END CONNECTION	CODE
Standard-150# RF Flanged	3
300# RF Flanged	4
DIN PN 16/25/40	5

TABLE 6

BENCH SETTING psig	ACTUATOR ACTION/MODEL NO.							
	REVERSE -ATO-FC				DIRECT-ATC-FO			
	30R	55R	75R	115R	30D	55D	75D	115D
3-15	1/2"	1"	—	—	1/2"	1"	—	—
	-00	-00	—	—	-00	-00	—	—
	1	2	—	—	D	E	—	—
	1"	—	—	—	1"	—	—	—
	-03	—	—	—	-03	—	—	—
	3	—	—	—	F	—	—	—
4-15	1"	1-1/2", 2"	1-1/2", 2"	1-1/2", 2"	1"	1-1/2", 2"	1-1/2", 2"	1-1/2", 2"
	-01	-03	-00	-00	-01	-03	-00	-00
	4	5	6	7	G	H	J	K
	1-1/2"	—	—	—	1-1/2"	—	—	—
	-05	—	—	—	-05	—	—	—
	8	—	—	—	L	—	—	—
5-15	—	1"	—	—	—	1"	—	—
	—	-01	—	—	—	-01	—	—
	—	9	—	—	—	M	—	—
7-28	1"	—	—	—	1"	—	—	—
	-02	—	—	—	-02	—	—	—
	A	—	—	—	N	—	—	—
	1-1/2", 2"	—	—	—	1-1/2", 2"	—	—	—
	-04	—	—	—	-04	—	—	—
	B	—	—	—	P	—	—	—
6-30	1-1/2"	1-1/2, 2"	—	—	1-1/2"	1-1/2", 2"	—	—
	-06	-04	—	—	-06	-04	—	—
	C	U	—	—	R	T	—	—

NOTE: Codes are in shaded boxes.

Trim C_v Size

Trim Form

End Connection

Actuator Action

Body & Actuator Size

Materials

S	T		–			7	–								C

MODEL "521" GLOBE-STYLE, TOTAL TFE CONTROL VALVE

Positioner

Accessories

Painting/Special Cleaning

Position Limit Switches

Airset

Tubing & Fittings

TABLE 7

POSITIONER	CODE
Special Construction	X
No Positioner	0

I/P-Electro-Pneu. Model #9520L	CODE w/Airset	CODE wo/Airset	P/P-Pneumatic Model #9540L	CODE w/Airset	CODE wo/Airset
Direct 4-20 ma	A	G	Direct 3-15 psig	1	R
Reverse 20-4ma	B	H	Reverse 15-3 psig	2	S
Direct Split Range 4-12 ma	C	J	Direct Split Range 3-9 psig	5	V
Direct split Range 11-20 ma	D	K	Direct Split Range 9-15 psig	6	W
Reverse Split Range 12-4 ma	E	L	Reverse Split Range 15-9 psig	7	Y
Reverse Split Range 20-12 ma	F	M	Reverse Split Range 9-3 psig	8	Z

When ordering a valve per one of Cashco's special drawings, the code "X" and the 5-digit number following over-ride all other options. Otherwise, proceed with the following tables.

TABLE 8

TUBING & FITTINGS	
NONE(NO Positioner, airset, solenoid, etc.)	
STD-Impolene Plastic Tubing, Brass Fittings	
Copper tubing, Brass fittings	
SST tubing and fittings	

TABLE 9

POSITION LIMIT SWITCHES				
MFGR/ MODEL	TYPE	NO.OF SWITCH UNITS *	TRIP POSITIONS	CODE
NONE				0
*Microswitch #OP-Ar	Rotary Trip NEMA 4	1	Plug Closed	1
		1	Plug Full Open	2
		2	Plug Closed & Full Open	3
*Microswitch #EX-AR X-Proof	Rotary Trip NEMA 7	1	Plug Closed	A
		1	Plug Full Open	B
		2	Plug Closed & Full Open	C
Proximity Controls #12ALO	Proximity Rotary Trip X-Proof	2	Plug Closed & Full Open	K
Proximity Controls #12GLOB	Proximity Rotary Trip BASEFA CENELAC Instrinsically Safe	2	Plug Closed & Full Open	L

*Each "switch unit" contains 1-SPDT switch.

TABLE 11

ACCESSORIES	CODE
NONE(other than indicated on this Coder Sheet)	0
Manual Handwheel	A
VALVE MTD ACCESSORIES Any of the following: 3-Way Solenoid Valve 764P Press Controller Extra Airset(s) I/P Transducer Lockup Valve	9 *
Manual Handwheel plus Code 9 above	Z *

Note: Use of a "9" code requires that a "99 Coder" sheet be completed.

TABLE 10

AIRSET RANGE	CODE
NONE- no Airset	0
3-15, 4-15, 5-15 psig Bench Settings (0-30 psig)	A
7-28, 6-30 psig Bench Settings (0-60 psig)	B

TABLE 12

PAINTING and CLEANING	Standard Cleaning	Cleaned to Spec. #S-1589 (O_2 Cleaned) for Chlorine Service
	CODE	CODE
Standard	0	A
Epoxy-Actuator	1	B
Epoxy-Actuator & Acces.	2	C
Epoxy-Actuator & Valve	3	D
Epoxy-Actuator, Valve & Acces.	4	E

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