



Sinclair Collins® K Series

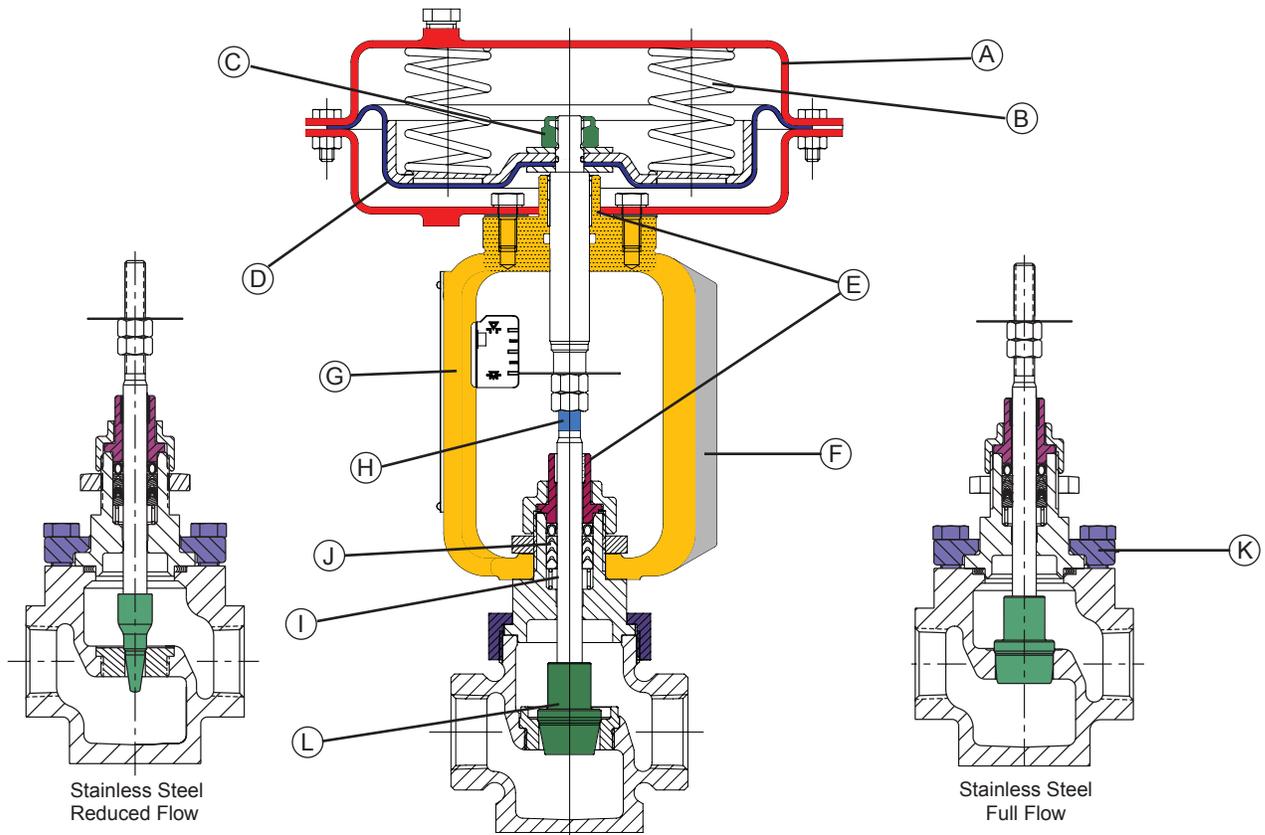
Process control valves for a variety of applications requiring the control of steam, gas, liquids or chemicals.



ENGINEERING **YOUR** SUCCESS.

Sinclair Collins Valves: Designed for High Performance

For over 50 years, Sinclair Collins has been designing and manufacturing process control valves for a variety of industries. The rugged design and reliability of the K Series valves make them ideally suited for a variety of applications requiring the control of steam, gas, liquids or chemicals. All components must meet our high performance specifications and quality control standards. Prior to shipment, every valve is fully tested to assure the quality that is expected from Sinclair Collins.



Features

- (A) Actuators in sizes 37, 64 and 135 provide for a wide range of operating requirements.
- (B) Multiple-spring design reduces valve height.
- (C) Field reversible from "air-to-open" to "air-to-close" without disassembling the valve body.
- (D) Nylon-reinforced, molded EPDM rolling style diaphragm provides ease of maintenance and uniform thrust throughout the valve stroke.
- (E) Dual stem guides with integral bearings for maximum alignment and longer life.
- (F) Nemur mounting rail for accessory mounting.
- (G) Yoke is made of cast bronze for rugged construction and long service life. Stainless steel valves use the same quality yoke with particle/silicone resin coating for superior wash down service and is FDA approved for incidental food contact.
- (H) Extended threads on stem allow for easy adjustment to accommodate a wide range of operating pressures.
- (I) Engineered and manufactured by Parker Hannifin, the combination of stainless steel filled PTFE seals and carbon filled PTFE seals provide optimum sealing, low friction and long life for a wide variety of temperatures and services. Other options are available.
- (J) Bronze valve with union nut retention of the bonnet allows for servicing without removal from the installation.
- (K) Stainless steel valve with bolted flange construction allows for easy servicing without removal from the installation.
- (L) Plugs are hardened stainless steel for maximum protection against erosive and corrosive services with Class IV shutoff.

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 **WARNING**

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS AND/OR SYSTEMS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provide product and/or system options for further investigation by users having technical expertise. It is important that you analyze all aspects of your application, including consequences of any failure, and review the information concerning the product or system in the current product catalog. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by Parker Hannifin Corporation and its subsidiaries at any time without notice.

Offer of Sale

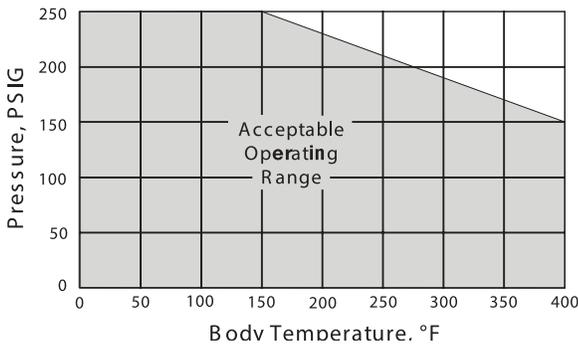
The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the full "Offer of Sale".



Technical Specifications

- Maximum media pressure = 250 PSI (2" valve maximum = 230 PSI)
- Body sizes 1/2", 3/4", 1", 1¼", 1½", 2"
- -40°F to 400°F (-40°C to 204°C) maximum temperature
- Actuator is field reversible, air to open, air to close
- Rolling style diaphragm provides uniform thrust
- Three actuator sizes: 37, 64, 135. Maximum 35 PSI on 37 and 64 sizes; maximum 25 PSI on 135 size.
- Stem diameter 7/16"
- Stem travel (stroke) 0.75" all sizes
- Multi-spring, low-profile actuators offer a 12 PSI control band. Other options available.
- 100% nitrogen gas tested
- Hard seat meets Class IV leakage standards

Body Pressure/Temperature Ratings



Materials of Construction

Part Name	Standard Material
Valve Body	Cast bronze ASTM B62
Plug, Hard Seat	17-4 stainless steel (linear & equal %)
Seat	17-4 stainless steel, replaceable
Packing Nut	Cast bronze ASTM B62
Stem Packing	Combination of stainless steel filled PTFE and carbon filled PTFE seals; other options available
Bonnet	Brass ASTM B16
Packing Follower	Brass ASTM B16 with integral bearing
Stem Bearings	Engineered proprietary polymer
Yoke	Cast bronze, ASTM B62
Actuator	Cast bronze, ASTM B62 with stainless steel coating FDA approved for incidental food contact
Diaphragm	Molded EPDM reinforced with nylon fabric
Springs	Zinc-plated music wire

Flow Capacity & Pressure Drop

Body Size	Actuator Size	Flow Capacity Cv					
		Standard Trim Sizes					
		Full	Reduced				
1/2"	37,64	6	4	2.5	1.5	1	0.5
3/4"	37,64	8	4	2.5	1.5	1	0.5
1"	37,64	13	8	6	4	2.5	-
1-1/4"	37,64,135	20	13	8	-	-	-
1-1/2"	37,64,135	27	20	13	-	-	-
2"	64,135	50	27	20	-	-	-

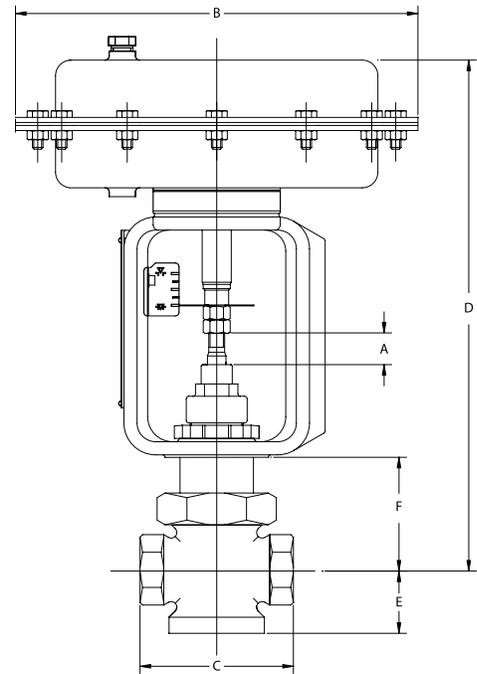
Actuator Selection

Air to Open Valves						
Set Distance, Dimension "A"	0.75	0.81	0.88	0.94	1.00	1.06
Dimension "A" for Graphite Packing	0.65	0.71	0.78	0.84	0.90	0.96
Pilot Pressure in Actuator at Which Valve Begins to Open	3	4	5	6	7	8

Air to Close Valves						
Set Distance, Dimension "A"	1.87	1.87	1.87	1.87	1.87	1.87
Dimension "A" for Graphite Packing	1.77	1.77	1.77	1.77	1.77	1.77
Pilot Pressure Required in Actuator for Valve to Shut Off	18	19	20	21	22	23

Port Size	Actuator Size	Cv, FLOW Capacity	Maximum System Shut Off Pressure (psi)					
			0.5	1.0	1.5	2.5		
1/2, 3/4	37		0-250	-	-	-	-	-
	64	4, 6	0-110 0-200	111-140 201-250	141-170 -	171-200 -	201-230 -	231-250 -
3/4	37	4, 8	0-110 0-200	111-140 201-250	141-170 -	171-200 -	201-230 -	231-250 -
	64	4, 8	0-250	-	-	-	-	-
1	37	2.5	0-110 0-200	111-140 201-250	141-170 -	171-200 -	201-230 -	231-250 -
	64	4, 6, 8	0-70 0-140	71-100 141-180	101-120 181-220	121-140 221-250	141-160 -	161-190 -
1	37	13	0-70 0-140	71-100 141-180	101-120 181-220	121-140 221-250	141-160 -	161-190 -
	64	4, 6, 8	0-250	-	-	-	-	-
1 1/4	37	8, 13	0-70 0-140	71-100 141-180	101-120 181-220	121-140 221-250	141-160 -	161-190 -
	64	8, 13	0-250	-	-	-	-	-
1 1/4	37	20	0-50 0-90	51-60 91-120	61-80 121-150	81-100 151-180	101-110 181-210	111-130 211-240
	64	20	0-200	201-250	-	-	-	-
1 1/2	37	13	0-70 0-140	71-100 141-180	101-120 181-220	121-140 221-250	141-160 -	161-190 -
	64	13	0-250	-	-	-	-	-
1 1/2	37	20, 27	- 0-70	0-50 71-90	51-60 91-120	61-70 121-140	71-90 141-160	91-100 161-180
	64	20, 27	0-160	161-200	201-250	-	-	-
2	64	20, 27, 50	- 0-90	0-50 91-120	51-70 121-150	71-80 151-170	81-90 171-200	91-110 201-230
	135	20, 27, 50	-	-	-	-	-	-

Note: All values are based on flow under seat.



Dimensional Data

Millimeter equivalent of inch dimensions given in ().

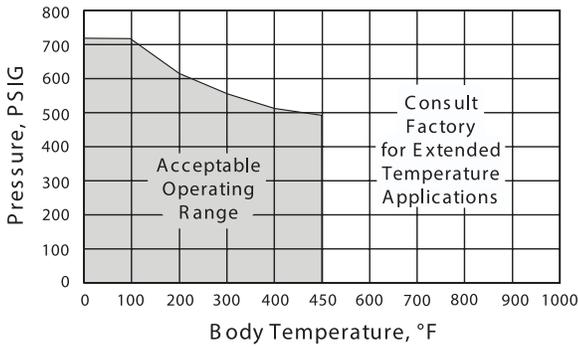
Body Size	A (Set Distance)	B			C	D			E	F
		37	64	135		37	64	135		
1/2"	See chart above	9.5 (241.3)	11.87 (301.5)	n/a	3.62 (91.9)	12.03 (305.6)	13.0 (330.2)	n/a	1.50 (38.1)	2.66 (67.6)
3/4"		9.5 (241.3)	11.87 (301.5)	n/a	3.62 (91.9)	12.03 (305.6)	13.0 (330.2)	n/a	1.50 (38.1)	2.66 (67.6)
1"		9.5 (241.3)	11.87 (301.5)	n/a	4.12 (104.6)	12.03 (305.6)	13.0 (330.2)	n/a	1.75 (44.5)	2.66 (67.6)
1-1/4"		9.5 (241.3)	11.87 (301.5)	16.09 (408.7)	5.38 (136.7)	12.1 (307.3)	13.06 (331.7)	13.56 (344.4)	2.25 (57.2)	2.73 (69.3)
1-1/2"		9.5 (241.3)	11.87 (301.5)	16.09 (408.7)	5.38 (136.7)	12.1 (307.3)	13.06 (331.7)	13.56 (344.4)	2.25 (57.2)	2.73 (69.3)
2"		n/a	11.87 (301.5)	16.09 (408.7)	7.5 (190.5)	n/a	13.99 (355.3)	14.49 (368.0)	3.06 (77.7)	3.65 (92.7)



Technical Specifications

- 300# Class stainless steel body per ANSI B16.34
- Body sizes 1/2", 1", 1½", 2"
- -40°F to 450°F (-40°C to 232°C) temperature range. For extended ranges, consult factory.
- Actuator is field reversible, air to open, air to close
- Rolling style diaphragm provides uniform thrust
- Three actuator sizes: 37, 64, 135. Maximum 35 PSI on 37 and 64 sizes; maximum 25 PSI on 135 size.
- Stem diameter 7/16"
- Stem travel (stroke) 0.75" all sizes
- Multi-spring, low-profile actuators offer a 12 PSI control band. Other options available.
- 100% nitrogen gas tested
- Hard seat meets Class IV leakage standards

Body Pressure/Temperature Ratings



Materials of Construction

Part Name	Standard Material
Valve Body	Investment cast 316 stainless steel with integrally machined seat
Plug, Hard Seat	17-4 stainless steel (linear & equal %)
Seat	Full flow – integral to body Reduced orifice – 17-4 stainless steel
Packing Nut	Investment cast 316 stainless steel
Stem Packing	Combination of stainless steel filled PTFE and carbon filled PTFE seals; other options available.
Bonnet	Stainless steel type 316
Bonnet Flange	Investment cast 316 stainless steel secured with 18-8 stainless steel bolts
Bonnet Gasket	18-8 spiral wound gasket with graphite filler
Packing Follower	Stainless steel type 316 with integral bearing
Stem Bearings	Engineered proprietary polymer
Yoke	Cast bronze, ASTM B62 with stainless steel coating FDA approved for incidental food contact
Actuator Cover	Stamped steel with epoxy powder coated finish, stainless steel fasteners
Diaphragm	Molded EPDM reinforced with nylon fabric
Springs	Zinc-plated music wire

Flow Capacity & Pressure Drop

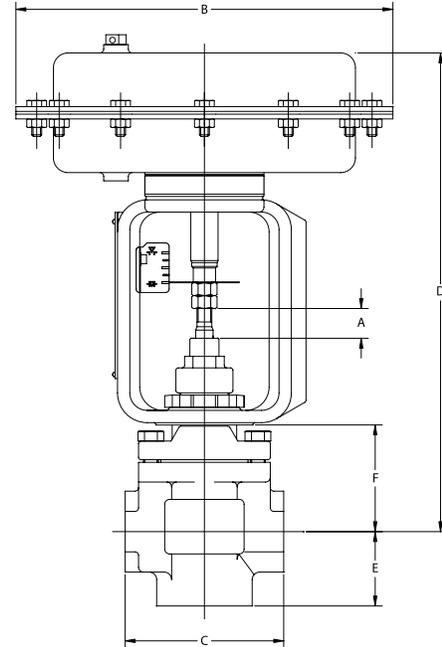
Body Size	Actuator Size	Flow Capacity Cv					
		Standard Trim Sizes					
		Full	Reduced				
1/2"	37,64	6	4	2.5	1.5	1	0.5
1"	37,64	13	8	6	4	2.5	-
1-1/2"	37,64,135	27	20	13	-	-	-
2"	64,135	50	27	20	-	-	-

Actuator Selection

Air to Open Valves						
Set Distance, Dimension "A"	0.75	0.81	0.88	0.94	1.00	1.06
Dimension "A" for graphite packing	0.65	0.71	0.78	0.84	0.90	0.96
Pilot Pressure in Actuator at Which Valve Begins to Open	3	4	5	6	7	8

Air to Close Valves						
Set Distance, Dimension "A"	1.87	1.87	1.87	1.87	1.87	1.87
Dimension "A" for graphite packing	1.77	1.77	1.77	1.77	1.77	1.77
Pilot Pressure Required in Actuator for Valve to Shut Off	18	19	20	21	22	23

Port Size	Actuator Size	Cv. Flow Capacity	Maximum System Shut Off Pressure (psi)					
			0-660 0-720	720 -	- -	- -	- -	- -
1/2	37	.5	0-470	471-640	641-720	-	-	-
	64		-	-	-	-	-	
1/2	37	1.0, 1.5	0-290	291-390	391-480	481-580	581-680	681-720
	64		0-510	511-690	691-720	-	-	-
1/2	37	2.5	0-110	111-140	141-170	171-200	201-230	231-250
	64		0-200	201-250	251-280	281-330	331-390	391-450
1	37	4, 6	0-290	291-390	391-480	481-580	581-680	681-720
	64		0-510	511-690	691-720	-	-	-
1	37	2.5	0-110	111-140	141-170	171-200	201-230	231-250
	64		0-200	201-250	251-280	281-330	331-390	391-450
1	37	4, 6, 8	0-70	71-100	101-120	121-140	141-160	161-190
	64		0-140	141-180	181-220	221-250	251-270	271-310
1	37	13	0-70	71-100	101-120	121-140	141-160	161-190
	64		0-140	141-180	181-220	221-250	251-270	271-310
1 1/2	37	13	0-250	251-330	331-420	421-500	501-590	591-670
	64		-	-	-	-	-	-
1 1/2	37	20, 27	0-70	71-90	91-120	121-140	141-160	161-180
	64		0-160	161-200	201-250	251-270	271-310	311-360
2	37	20, 27, 52	0-90	91-120	121-150	151-170	171-200	201-230
	64		-	-	-	-	-	-
2	64	20, 27, 52	0-90	91-120	121-150	151-170	171-200	201-230
	135		-	-	-	-	-	-



Note: All values are based on flow under seat.

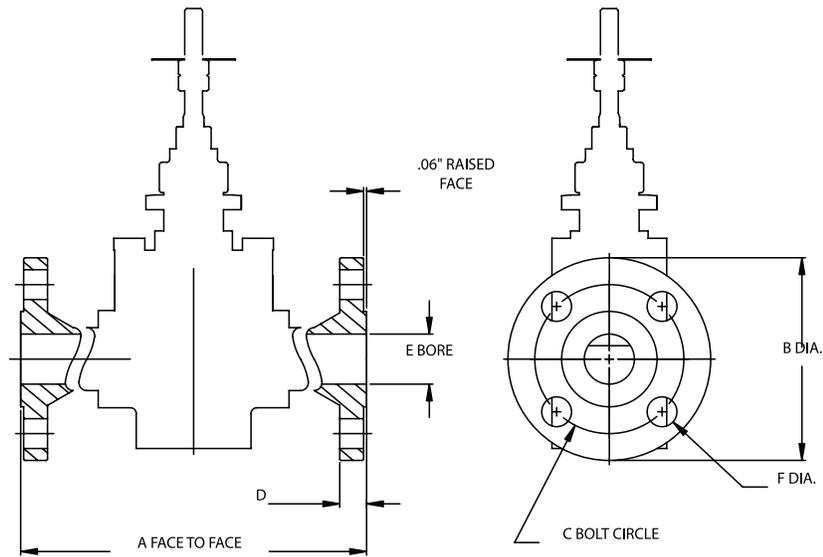
Dimensional Data

Millimeter equivalent of inch dimensions given in ().

Body Size	A (Set Distance)	B			C	D			E	F
		37	64	135		37	64	135		
1/2"	See chart above	9.5 (241.3)	11.87 (301.5)	n/a	3.13 (79.5)	12.00 (304.8)	12.94 (328.7)	n/a	1.50 (38.1)	2.62 (66.5)
1"		9.5 (241.3)	11.87 (301.5)	n/a	4.00 (101.6)	12.07 (306.6)	13.01 (330.5)	n/a	1.88 (47.8)	2.69 (68.3)
1-1/2"		9.5 (241.3)	11.87 (301.5)	16.09 (408.7)	5.00 (127.0)	13.11 (333.0)	14.05 (356.9)	14.55 (369.6)	2.44 (62.0)	3.73 (94.7)
2"		n/a	11.87 (301.5)	16.09 (408.7)	7.50 (190.5)	n/a	14.96 (380.0)	15.46 (392.7)	3.50 (88.9)	4.62 (117.3)

Flange Mounting

Flanges are available on stainless steel valves only.



DIMENSIONAL DATA												
SIZE	150# Class						300# Class					
	A *	B	C	D	E	F	A *	B	C	D	E	F
1/2"	7.25 (184.2)	3.50 (88.9)	2.38 (60.5)	.44 (11.2)	.62 (15.7)	.62 (15.7)	7.50 (190.5)	3.75 (95.3)	2.62 (66.5)	.56 (14.2)	.62 (15.7)	.62 (15.7)
1"	7.25 (184.2)	4.25 (108.0)	3.12 (79.5)	.56 (14.2)	1.05 (26.7)	.62 (15.7)	7.75 (196.9)	4.88 (124.0)	3.50 (88.9)	.69 (17.5)	1.05 (26.7)	.62 (15.7)
1-1/2"	8.75 (222.3)	5.00 (127.0)	3.88 (98.6)	.69 (17.5)	1.61 (40.9)	.62 (15.7)	9.25 (235.0)	6.13 (155.7)	4.50 (114.3)	.81 (20.6)	1.61 (40.9)	.62 (15.7)
2"	11.25 (285.8)	6.00 (152.4)	4.75 (120.7)	.75 (19.1)	2.07 (52.6)	.75 (19.1)	11.75 (298.5)	6.50 (165.1)	5.00 (127.0)	.88 (22.4)	2.07 (52.6)	.75 (19.1)

* FACE TO FACE DIMENSION PER ISA-S75.03-1992 EXCEPT 2".

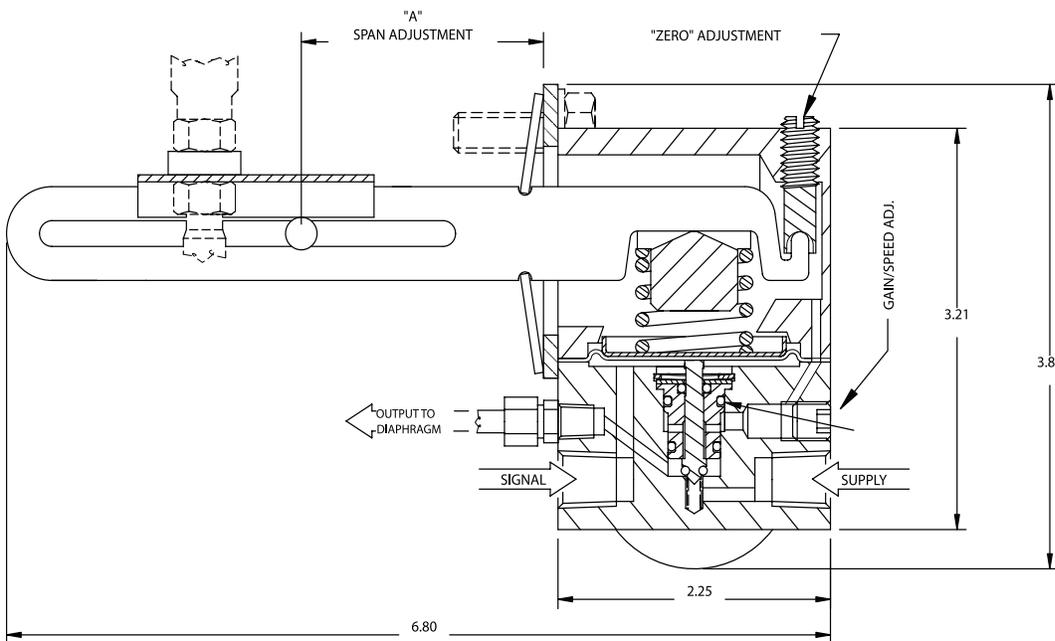
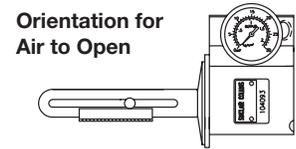
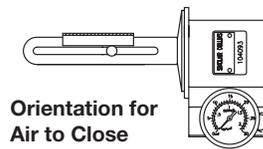
Pneumatic Positioner

K10-1

Single acting positioner assures an exact relationship between controlled input signal and actuator valve stem position.

Specifications

Travel	3/4"
Signal Input	3-15 PSIG
Maximum Open Loop Gain	150:01:00
Minimum Open Loop Gain	50:01:00
Steady State Air Consumption @9 PSIG Signal & 30 PSIG Supply	.15 SCFM
Linearity	<±1.3% of Span
Hysteresis	<0.4% of Span
Dead Band	<0.2% of Span
Travel Time, 37 Actuator	1.2 Seconds, Air In
3/4" Stroke @ 30 PSIG Supply*	3.0 Seconds Air Out
Supply Pressure Effect	0.12% of Span
Ambient Temperature Effect	0.1% per 2°F
Ambient Temperature Range	-10° to +250°F
Connections	1/4" NPT Signal & Supply 1/8" NPT Output & Gauge
Manifold Body Material	Anodized Aluminum
Cover Material	Anodized Aluminum, Epoxy Coated
External Feedback Parts	Stainless Steel
Dimensions	2 1/2" x 3 1/4" x 3 3/4"
Weight	1.75 lbs.



I/P Transducer

K10-7

I/P 3-15 PSI output for direct actuator or with pneumatic positioner.

K10-9

I/P 1-18 output for direct actuation only.



Air Preparation Unit

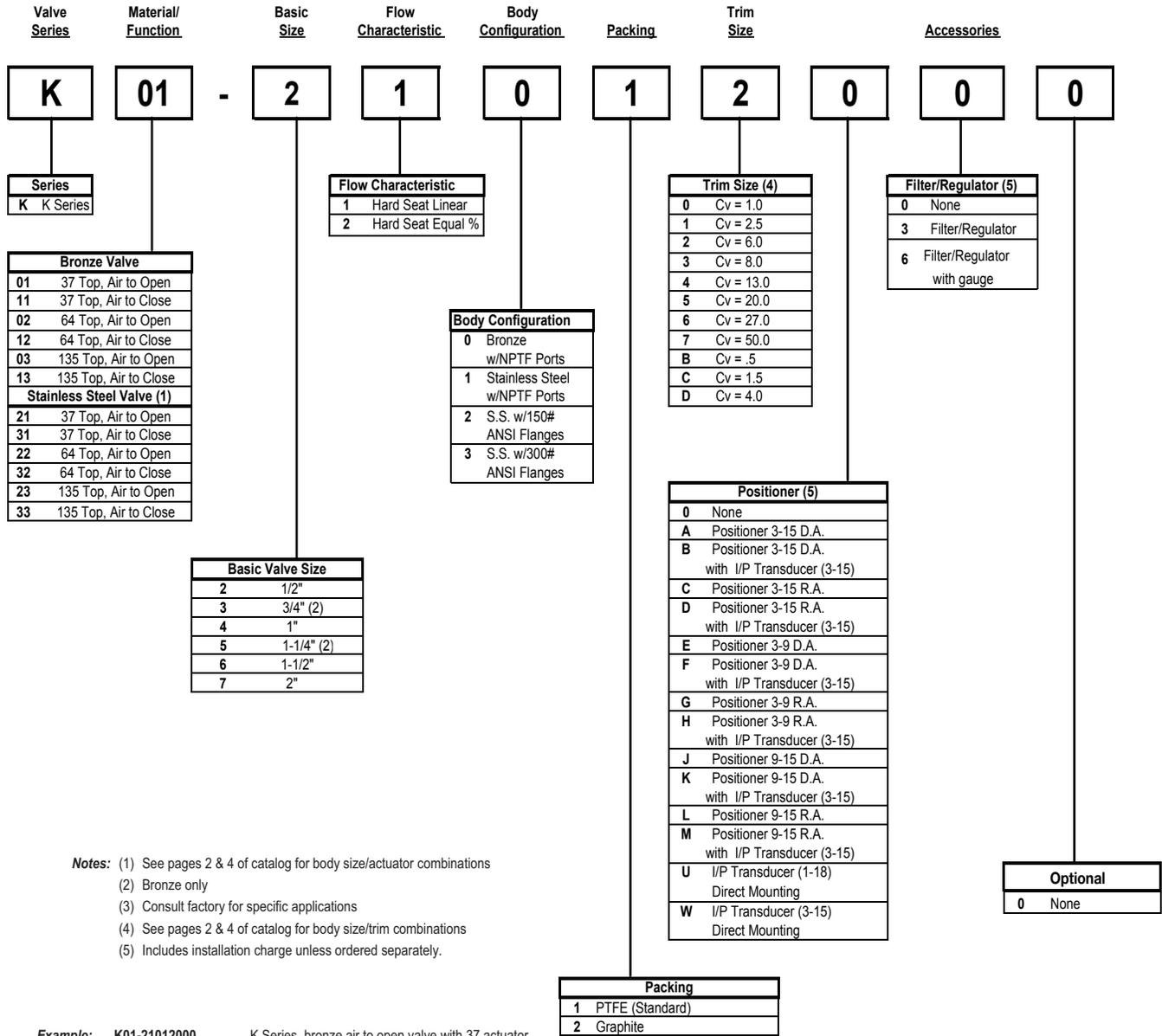
K10-4

Filter/Regulator "piggyback" includes 1/4" NPT, 5 micron filter and 1-60 PSI relieving type regulator.

Gauge must be ordered separately.

Other units are available. Consult factory.





Notes: (1) See pages 2 & 4 of catalog for body size/actuator combinations
 (2) Bronze only
 (3) Consult factory for specific applications
 (4) See pages 2 & 4 of catalog for body size/trim combinations
 (5) Includes installation charge unless ordered separately.

Example: K01-21012000 K Series, bronze air to open valve with 37 actuator, 1/2" linear hard seat body with NPTF ports, PTFE packing, Cv of 6, no accessories.

To size and select a process control valve, a number of factors must be considered. For more in-depth information, see following pages.

Valve Selection

- 1) **Service**
 - a) Modulating
 - b) On/Off
- 2) **Media**
 - a) Gas
 - b) Liquid
- 3) **System Pressure (P1)**
 - a) Maximum and minimum
- 4) **Pressure Drop (ΔP)**
 - a) Maximum and minimum
- 5) **Flow Required**
 - a) Maximum and minimum
- 6) **Actuation**
 - a) Air to Open (Fail to Close)
 - b) Air to Close (Fail to Open)
- 7) **Actuator Signal (Source)***
- 8) **Valve Characteristic**
 - a) Equal percentage
 - b) Linear
- 9) **Shutoff required**
 - a) Class IV
 - b) Class VI
- 10) **Body material**
 - a) Bronze
 - b) Stainless steel
- 11) **End connections**
 - a) Threaded ports
 - b) Flanges
 - c) Socket weld
- 12) **Packing (Seals)**
- 13) **Accessories**
 - a) Positioner
 - b) I-P
 - c) Airset
 - d) Solenoid valve

* The actuator signal can come from an I-P transducer and/or a positioner. If the signal is from an I-P, specify the output span of the unit.

Calculating Flow Capacity (Cv)

Pressure Drop (ΔP)

For sizing a control valve when the pressure drop is unknown, use 5% of the system pressure for systems with pressure greater than 200 PSI (1375.95 kPa). For systems with pressure less than 200 PSI (1375.95 kPa), use 10 PSI (68.95 kPa).

Liquid

$$Cv = \frac{q_f}{N_1 F_p Fr} \sqrt{\frac{G_f}{\Delta P}}$$

Choked flow*: $\Delta P \geq FL^2 (P_1 - F_i P_v)$.

If actual ΔP is greater than the value for choked flow, use the lower of the two values for sizing.

Gas/Steam

Flow by Volume

$$Cv = \frac{q_g}{N_7 F_p P_1 Y} \sqrt{\frac{G_g T_1 Z}{x}}$$

Flow by Weight

$$Cv = \frac{w}{N_8 F_p P_1 Y} \sqrt{\frac{T_1 Z}{xM}}$$

Choked flow*: $\Delta P \geq P_1 F_{kxt}$

If actual ΔP is greater than the value for choked flow, substitute (F_{kxt}) for x.

Non-choked

$$Y = 1 - \frac{(x)}{3 F_{kxt}}$$

Choked

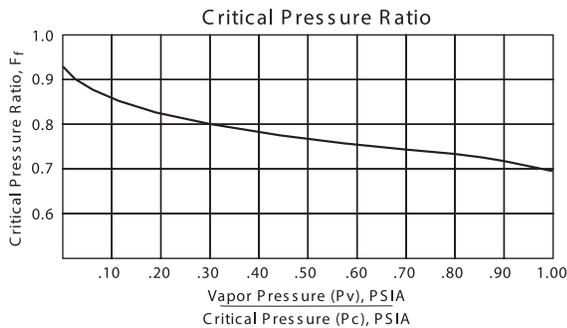
$$Y = 1 - \frac{(F_{kxt})}{3 F_{kxt}} = \frac{2}{3}$$

***Choked Flow**

This is the point where additional pressure drop will not result in an increase in flow.

Where:

- Cv** Universal valve sizing coefficient
- Ff** Liquid critical pressure ratio (see chart below). Use when the fluid has a high temperature and the vapor pressure is approaching that of the inlet pressure.



- Fk** Ratio of specific heat factor to air = $k/1.4$
- FL** Factor for the amount of pressure that a liquid recovers as it flows through the geometry of a valve and the effect it has on the maximum capacity. Representative value = 0.9
- Fp** Piping geometry factor. This value is an adjustment to the Cv of a valve that is to be installed between pipe reducers. Although this factor can be crucial for rotary valves the effect on globe style valves is minimal. If the valve selected has a full size trim, an addition of 5% to the calculated Cv will be sufficient. If the valve has reduced trim, then the effect of the reducers is even less and this adjustment can be ignored.
- Fr** Factor for Reynolds number. Use a factor of (1) unless the fluid has a viscosity greater than 40 centistokes or Cv's less than 0.2. This adjusts the Cv for non turbulent flow conditions.
- Gf** Specific gravity of liquids at flowing temperatures relative to water @ 60°F.
- Gg** Specific gravity of gas relative to air with both at standard pressure and temperature.
- k** Ratio of specific heat. Air = 1.4, Steam = 1.3
- M** Molecular weight (steam has a molecular weight of 18.03)
- P1** Upstream pressure (absolute)
- P2** Downstream pressure (absolute)
- Pc** Thermodynamic critical pressure.
- Pv** Vapor pressure. The pressure and temperature at which a fluid begins to boil
- ΔP** Pressure drop ($P_1 - P_2$)
- qf** Flow rate by volume – liquid
- qg** Flow rate by volume – gas
- T** Absolute temperature.
 $US = R (460 + ^\circ F)$ $SI = K (273 + ^\circ C)$
- Vc** Vena contracta. This is the point downstream of the valve orifice where the flow is at the greatest velocity and lowest pressure.

- w** Flow rate by weight
- x** Ratio of pressure drop to upstream pressure ($\Delta P / P_1$)
- xt** Value of x when Y is at the lowest limit (.667). At this point an additional increase in ΔP will not result in an increase of flow. Representative value = 0.7
- Y** Expansion factor. This factor represents the change of the specific weight of a gas as it passes from the inlet of the valve to the vena contracta (Vc).
- Z** Compressibility Factor. This is a function for determining the relationship of the density of a gas to the actual temperature and pressure conditions. At pressures below 720 PSI, the effects are minimal and a factor of (1) can be used.

Additional Factors:

- Kc** Cavitation index. This describes the point where the flow begins to depart from the proportional relationship of flow versus the square root of pressure drop. $Kc = \Delta P / P_1 - Pv \Delta Pm$
 The amount of pressure drop required to produce choked flow $\Delta Pm = FL^2 (P_1 - FfPv)$ in PSI

Commonly Used Units		
	U.S.	S.I.
Steam and vapors (weight units)	lb/hr	kg/hr
Gases (volumetric units)	scfh	m ³ /h
Liquids (volumetric units)	gpm	m ³ /h
Pressure	psia	kPa

Values for Use in Calculations		
	U.S.	S.I.
N1	1.0	.0865
N7	1,360	4.17
N8	19.3	.948
qf	gpm	m ³ /h
qg	scfh	m ³ /h
P	psia	kPa
w	lb/hr	kg/h
T	R (460 + °F)	K (273 + °C)

Common Subscripts	
1	upstream
2	downstream
f	liquid
g	gas

Trim Size

In the discussion of sizing and flow characteristics for Sinclair Collins valves, the components referred to as trim (full or reduced) will be the plug/stem assembly and the valve seat.

Actuator Selection

Air to Open and Air to Close

Actuators can be ordered air to open (fail to close) or air to close (fail to open).

Actuator Sizing

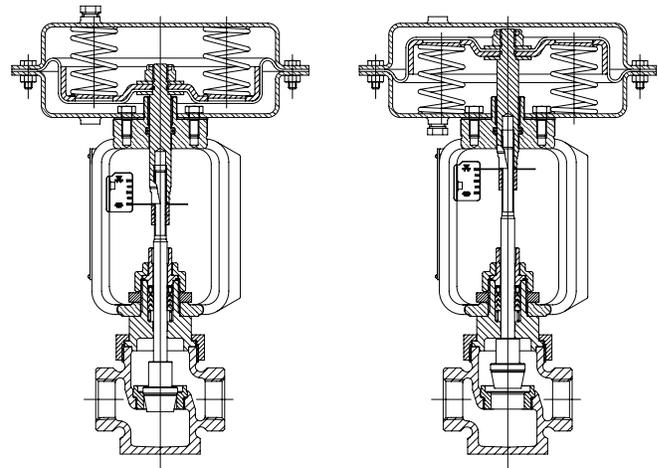
Select valve body size based on Cv and system requirements. Identify the maximum system pressure (P₁) that the valve has to seal against.

The tables to the right show pressure required to actuate an air to open or air to close actuator for various system pressure ranges. For example, a 1" valve with a 37 actuator air to open, will begin to actuate with a 3 PSI signal against a system pressure up to 70 PSI (full open at 15). If the same valve is used in a system that has a pressure of 150 PSI, then 7 PSI would be required to the actuator to start opening and 19 PSI would be required to fully open the valve.

Actuation Pressure

If an I-P is supplying the air pressure (PSI) to the actuator, then identify the output span of the unit for proper selection. A common output range is 3-15 PSI. However, additional pressures and spans are available. The charts on the right identify the minimum pressure required to actuate the valve. Once the minimum pressure is identified, an additional 12 PSI will fully extend the actuator. Please note that an air to close valve requires a pressure greater than 15 PSI for shutoff. Therefore, an I-P will have to be selected with an output sufficient to met this requirement or consider the use of a positioner.

If a positioner is used, select an actuator based on the valve size and the system pressure. This is possible because the positioner is regulated by the valve's stem position and therefore can supply a higher pressure (PSI) to the actuator.



Air to Open Valve

Air to Close Valve

Air to Open Valves						
Set Distance, Dimension "A"	0.75	0.81	0.88	0.94	1.00	1.06
Dimension "A" for graphite packing	0.65	0.71	0.78	0.84	0.90	0.96
Pilot Pressure in Actuator at Which Valve Begins to Open	3	4	5	6	7	8

Air to Close Valves						
Set Distance, Dimension "A"	1.87	1.87	1.87	1.87	1.87	1.87
Dimension "A" for graphite packing	1.77	1.77	1.77	1.77	1.77	1.77
Pilot Pressure Required in Actuator for Valve to Shut Off	18	19	20	21	22	23

Port Size	Actuator Size	Cv, Flow Capacity	Maximum System Shut Off Pressure (psi)					
			0-660 0-720	720	-	-	-	-
1/2	37	.5	0-470	471-640	641-720	-	-	-
	64		0-720	-	-	-	-	-
1/2	37	2.5	0-290	291-390	391-480	481-580	581-680	681-720
	64		0-510	511-690	691-720	-	-	-
1/2	37	4, 6	0-110	111-140	141-170	171-200	201-230	231-250
	64		0-200	201-250	251-280	281-330	331-390	391-450
1	37	2.5	0-290	291-390	391-480	481-580	581-680	681-720
	64		0-510	511-690	691-720	-	-	-
1	37	4, 6, 8	0-110	111-140	141-170	171-200	201-230	231-250
	64		0-200	201-250	251-280	281-330	331-390	391-450
1	37	13	0-70	71-100	101-120	121-140	141-160	161-190
	64		0-140	141-180	181-220	221-250	251-270	271-310
1 1/2	37	13	0-70	71-100	101-120	121-140	141-160	161-190
	64		0-140	141-180	181-220	221-250	251-270	271-310
	135		0-250	251-330	331-420	421-500	501-590	591-670
1 1/2	37	20, 27	-	0-50	51-60	61-70	71-90	91-100
	64		0-70	71-90	91-120	121-140	141-160	161-180
	135		0-160	161-200	201-250	251-270	271-310	311-360
2	64	20, 27, 52	-	0-50	51-70	71-80	81-90	91-110
	135		0-90	91-120	121-150	151-170	171-200	201-230

Note: All values are based on flow under seat.

Shutoff

K Series valves are available with a hard seat offering Class IV sealing.

Class IV Sealing – Leakage rate of 0.01% of rated valve capacity.

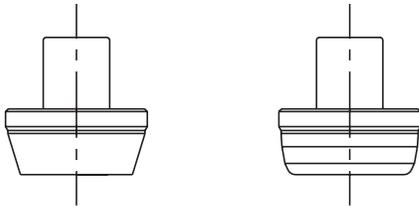
Flow Characteristic

Flow characteristic is the relationship in a valve between a change of signal to the actuator and a corresponding change in flow.

Quick Opening – Normally used for on/off service and not throttling applications. A quick open contour is designed for a rapid increase in flow.

Equal % – Equal increments of stem travel will yield an equal percentage of change to the existing flow. In the installed condition, this design becomes more linear with a decreasing proportion of pressure drop across the valve.

Linear – Equal increments of stem travel will yield equal increments of flow. This is represented by a straight line on a chart depicting flow vs. stem travel. If smaller proportions of the system pressure drop are taken across the valve, this design results in a flow similar to a quick opening plug.



Linear Plug

Equal %

NOTE: Many times a valve is sized at approximately 50% of capacity for various reasons. In this condition, a linear plug will use only 50% of the valve stroke. An equal percentage design will use approximately 80% of its stroke under the same conditions and therefore offer a larger span of control.

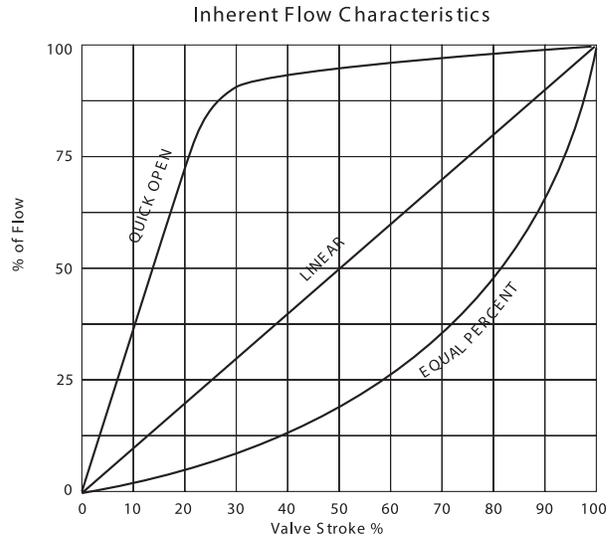
Installed Flow Characteristics

These charts graphically represent how flow through a valve changes in relation to the valve stroke for three common flow characteristics. The "inherent" graph reflects a constant pressure drop that is maintained throughout the stroke of the valve. The "installed" graph reflects a pressure drop that changes according to the valve stroke and the corresponding change in flow.

The graphs do not reflect piping losses that could affect an installed valve. These losses would further exaggerate the installed curve in relation to the inherent curve.

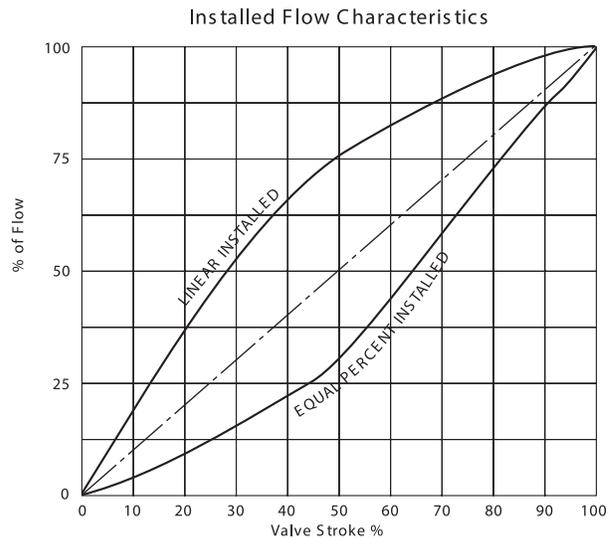
Inherent Flow Characteristic

This is the flow characteristic of the valve as designated by the manufacturer. It does not include system variables.



Installed flow characteristic

The installed flow characteristic of the valve does include certain system variables. This will better reflect the performance of the valve installed in a system.



% Stroke vs. Cv

Bronze Valves, Linear Plug

Valve Size	Trim Size	% Stroke									
		10	20	30	40	50	60	70	80	90	100
1/2"	6.0	0.50	1.80	2.70	3.50	4.20	4.70	5.20	5.80	6.20	6.3
	2.5	0.13	0.51	0.88	1.24	1.53	1.77	2.01	2.25	2.44	2.76
	1.0	0.12	0.23	0.34	0.45	0.55	0.64	0.73	0.82	0.90	1.0
3/4"	8.0	0.60	1.80	3.00	3.90	4.70	5.30	6.10	6.80	7.60	8.0
	2.5	0.13	0.51	0.88	1.24	1.53	1.77	2.01	2.25	2.44	2.76
	1.0	0.12	0.23	0.34	0.45	0.55	0.64	0.73	0.82	0.90	1.00
1"	13.0	1.30	2.80	4.20	5.40	6.50	7.20	8.10	9.70	11.00	13.0
	8.0	0.96	1.90	2.80	3.67	4.64	5.49	6.24	6.83	7.43	8.0
	6.0	0.98	1.85	2.49	2.98	3.47	3.98	4.50	4.85	5.35	6.0
	2.5	0.13	0.54	0.93	1.28	1.60	1.86	2.11	2.32	2.45	2.70
1 1/4"	20.0	1.3	3.9	6.2	8.2	10.3	12.3	14.4	16.5	19.1	21.5
	13.0	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7	13.0
	8.0	0.60	1.80	3.00	3.90	4.70	5.30	6.10	6.80	7.60	8.0
1 1/2"	27.0	2.8	6.2	9.2	12.2	15.0	17.6	20.4	22.5	25.9	27.0
	20.0	1.3	3.9	6.2	8.2	10.3	12.3	14.4	16.5	19.1	21.5
	13.0	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7	13.0
2"	50.0	5.3	10.3	15.3	20.7	25.7	31.6	36.4	40.5	46.1	50.0
	27.0	2.8	6.2	9.2	12.2	15.0	17.6	20.4	22.5	25.9	27.0
	20.0	1.3	3.9	6.2	8.2	10.3	12.3	14.4	16.5	19.1	21.5

Bronze Valves, Equal % Plug

Valve Size	Trim Size	% Stroke									
		10	20	30	40	50	60	70	80	90	100
1/2"	6.0	0.30	0.50	0.60	0.70	1.00	1.50	2.20	2.90	4.20	6.3
	2.5	0.05	0.07	0.09	0.21	0.32	0.61	0.91	1.33	1.80	2.58
	1.0	0.04	0.05	0.06	0.08	0.15	0.23	0.39	0.56	0.81	1.00
3/4"	8.0	0.40	0.50	0.70	1.10	1.70	2.30	4.10	5.90	7.30	8.0
	2.5	0.05	0.07	0.09	0.21	0.32	0.61	0.91	1.33	1.80	2.58
	1.0	0.04	0.05	0.06	0.08	0.15	0.23	0.39	0.56	0.81	1.00
1"	13.0	0.50	0.41	0.72	1.02	1.70	3.60	6.50	9.00	11.10	13.0
	8.0	0.30	0.30	0.41	0.72	1.02	2.45	3.72	5.38	6.68	8.0
	6.0	0.33	0.43	0.61	0.82	1.13	1.46	2.04	2.72	4.00	6.0
	2.5	0.05	0.07	0.09	0.21	0.32	0.61	0.91	1.33	1.80	2.58
1 1/4"	20.0	0.8	1.7	2.4	3.8	5.1	6.3	9.3	14.1	16.4	20.0
	13.0	0.3	0.5	0.7	1.1	1.6	2.5	3.8	5.7	8.6	13.0
	8.0	0.40	0.50	0.70	1.10	1.70	2.30	4.10	5.90	7.30	8.0
1 1/2"	27.0	0.9	1.7	2.8	4.8	7.1	12.1	17.5	21.8	24.4	27.0
	20.0	0.8	1.5	2.4	3.5	4.7	6.2	9.2	13.2	16.1	19.6
	13.0	0.3	0.5	0.7	1.1	1.6	2.5	3.8	5.7	8.6	13.0
2"	50.0	1.6	3.1	5.2	9.7	20.5	28.4	35.5	43.5	49.5	52.7
	27.0	0.9	1.7	2.8	4.8	7.1	12.1	17.5	21.8	24.4	27.0
	20.0	0.8	1.5	2.4	3.5	4.7	6.2	9.2	13.2	16.1	19.6

% Stroke vs. Cv

Stainless Steel Valves, Linear Plug

Valve Size	Trim Size	% Stroke									
		10	20	30	40	50	60	70	80	90	100
1/2"	6.0	1.00	2.10	3.10	4.00	4.10	4.30	4.80	5.10	5.50	6.0
	2.5	0.13	0.51	0.88	1.24	1.53	1.77	2.01	2.25	2.44	2.76
	1.0	0.12	0.23	0.34	0.45	0.55	0.64	0.73	0.82	0.90	1.00
1"	13.0	1.30	2.80	4.20	5.40	6.50	7.20	8.10	9.70	11.00	12.0
	8.0	0.96	1.90	2.80	3.67	4.64	5.49	6.24	6.83	7.43	8.0
	6.0	0.98	1.85	2.49	2.98	3.47	3.98	4.50	4.85	5.35	6.0
	2.5	0.13	0.54	0.93	1.28	1.60	1.86	2.11	2.32	2.45	2.70
1½"	27.0	2.3	5.7	9.3	12.0	14.6	16.8	19.0	20.9	25.1	27.7
	20.0	1.3	3.9	6.2	8.2	10.3	12.3	14.4	16.5	19.1	21.5
	13.0	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4	11.7	13.0
2"	50.0	4.7	10.8	15.9	20.5	25.1	30.1	34.7	39.5	46.6	52.1
	27.0	2.3	5.7	9.3	12.0	14.6	16.8	19.0	20.9	25.1	27.7
	20.0	1.3	3.9	6.2	8.2	10.3	12.3	14.4	16.5	19.1	21.5

Stainless Steel Valves, Equal % Plug

Valve Size	Trim Size	% Stroke									
		10	20	30	40	50	60	70	80	90	100
1/2"	6.0	0.40	0.50	0.70	1.00	1.60	2.10	3.30	4.60	5.70	6.0
	2.5	0.05	0.07	0.09	0.21	0.32	0.61	0.91	1.33	1.80	2.58
	1.0	0.04	0.05	0.06	0.08	0.15	0.23	0.39	0.56	0.81	1.00
1"	12.0	0.49	0.80	1.10	1.80	2.50	3.30	6.10	7.40	10.60	12.0
	8.0	0.30	0.41	0.72	1.02	1.70	2.45	3.72	5.38	6.68	8.0
	6.0	0.33	0.43	0.61	0.82	1.13	1.46	2.04	2.72	4.00	6.0
	2.5	0.05	0.07	0.09	0.21	0.32	0.61	0.91	1.33	1.80	2.58
1½"	27.0	1.2	2.0	3.3	5.4	7.6	12.3	18.9	24.1	26.3	27.0
	20.0	0.8	1.5	2.4	3.5	4.7	6.2	9.2	13.2	16.1	19.6
	13.0	0.3	0.5	0.7	1.1	1.6	2.5	3.8	5.7	8.6	13.0
2"	50.0	1.9	3.6	6.1	11.9	20.5	28.0	35.8	44.4	50.8	53.4
	27.0	0.9	1.7	2.8	4.8	7.1	12.1	17.5	21.8	24.4	27.0
	20.0	0.8	1.5	2.4	3.5	4.7	6.2	9.2	13.2	16.1	19.6

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- 4. Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twenty four (24) months from the date of manufacture or 2,000 hours of normal use, whichever occurs first. Exception to this warranty is taken for the Angle Body Valve line which has a (12) month warranty. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**
- 5. Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to the Seller within ten (10) days of delivery. No other claims against Seller will be allowed unless asserted in writing within thirty (30) days after delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the defect is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.
- 6. LIMITATION OF LIABILITY.** IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE WITHIN A REASONABLE PERIOD OF TIME. **IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**
- 7. User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.
- 8. Loss to Buyer's Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.
- 9. Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.
- 10. Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller retains a security interest in all Products delivered to Buyer and this agreement is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.
- 11. Improper Use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, application, design, specification or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Products; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.
- 12. Cancellations and Changes.** Buyer may not cancel or modify or cancel any order for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change Product features, specifications, designs and availability.
- 13. Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.
- 14. Force Majeure.** Seller does not assume the risk and is not liable for delay or failure to perform any of Seller's obligations by reason of events or circumstances beyond its reasonable control (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.
- 15. Waiver and Severability.** Failure to enforce any provision of this agreement will not invalidate that provision; nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.
- 16. Termination.** Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate this agreement, in writing, if Buyer: (a) breaches any provision of this agreement (b) appoints a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or one if filed by a third party (d) makes an assignment for the benefit of creditors; or (e) dissolves its business or liquidates all or a majority of its assets.
- 17. Governing Law.** This agreement and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.
- 18. Indemnity for Infringement of Intellectual Property Rights.** Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and refund the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller is not liable for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.
- 19. Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged. The terms contained herein may not be modified unless in writing and signed by an authorized representative of Seller.
- 20. Compliance with Laws.** Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards of care, including those of the United Kingdom, the United States of America, and the country or countries in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act") and the U.S. Food Drug and Cosmetic Act ("FDCA"), each as currently amended, and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that it is familiar with the provisions of the U. K. Bribery Act, the FCPA, the FDA, and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller.

Worldwide Division Headquarters

North America

Fluid Control Division

95 Edgewood Avenue
New Britain, CT 06051

Europe

Fluid Control Division-Europe

16 Ch. Faubourg-de-Cruseilles
CH- 1227 Caourage, Geneva

Additional product information
can be found on our website:

www.parker.com/fcd

Questions on our product line,
please call: 800.825.8305



Parker Hannifin Corporation

Fluid Control Division

95 Edgewood Avenue
New Britain, CT 06051
phone 800 cparker
fax 860 827 2384
www.parker.com/fcd