

Sinclair Collins® K Series

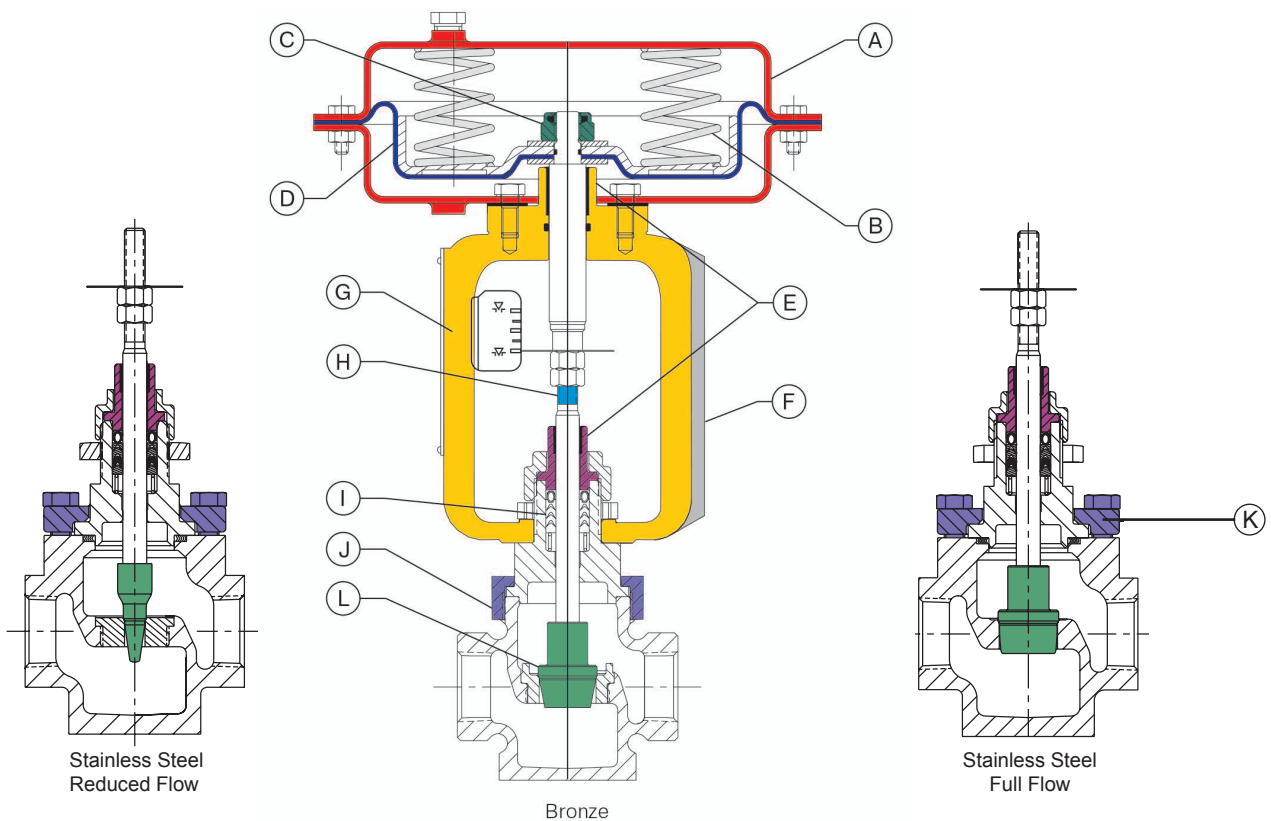
Process control valves for a variety of applications requiring the control of steam, gas, liquids or chemicals.



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) NAMUR 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.

Bronze Body Valves	
Specifications	2
Dimensions	3
Stainless Steel Body Valves	
Specifications	4
Dimensions	5
Options	
Flanges.....	6
Accessories	
Positioner	7
I/P Transducers.....	8
Filter/Regulator	8
Ordering Information	9
Technical Data	
Sizing & Selection	10-13
Flow Tables	14-15
Offer of Sale.....	17



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

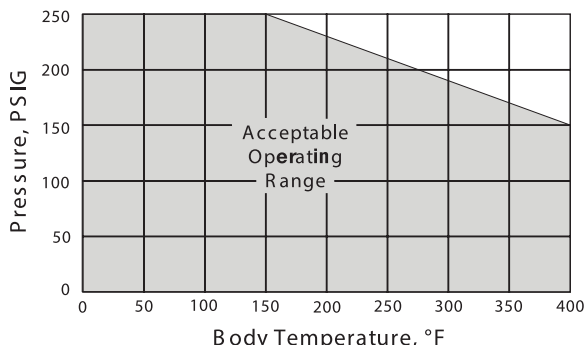
The items described in this document are hereby offered for sale by Parker Hannifin Corporation, its subsidiaries or its authorized distributors. This offer and its acceptance are governed by the provisions stated in the full "Offer of Sale".



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	-	-	-

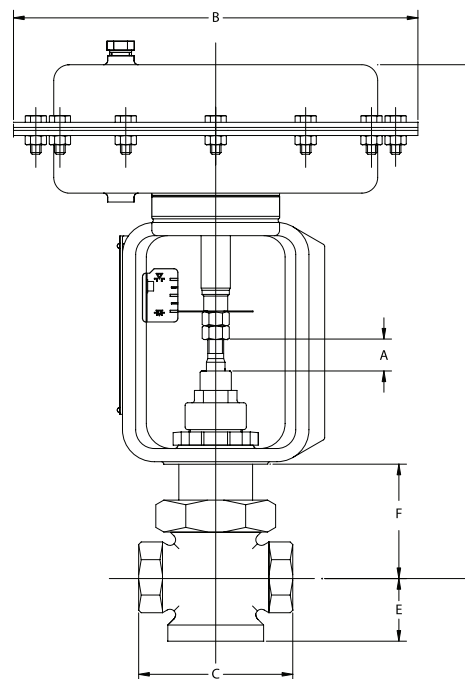
Actuator Selection

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)					
1/2, 3/4	37	0.5, 1.0, 1.5, 2.5	0-250	-	-	-	-	-
1/2	37	4, 6	0-110	111-140	141-170	171-200	201-230	231-250
	64		0-200	201-250	-	-	-	-
3/4	37	4, 8	0-110	111-140	141-170	171-200	201-230	231-250
	64		0-200	201-250	-	-	-	-
1	37	2.5	0-250	-	-	-	-	-
	64		0-110	111-140	141-170	171-200	201-230	231-250
1	37	4, 6, 8	0-200	201-250	-	-	-	-
	64		0-70	71-100	101-120	121-140	141-160	161-190
1	37	13	0-140	141-180	181-220	221-250	-	-
	64		0-70	71-100	101-120	121-140	141-160	161-190
1 1/4	37	8, 13	0-140	141-180	181-220	221-250	-	-
	64		0-250	-	-	-	-	-
1 1/4	37	20	0-50	51-60	61-80	81-100	101-110	111-130
	64		0-90	91-120	121-150	151-180	181-210	211-240
1 1/4	37	13	0-200	201-250	-	-	-	-
	64		0-70	71-100	101-120	121-140	141-160	161-190
1 1/2	37	20, 27	0-140	141-180	181-220	221-250	-	-
	64		0-250	-	-	-	-	-
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
2	37	20, 27, 50	0-160	161-200	201-250	-	-	-
	64		-	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.



Dimensional Data

Millimeter equivalent of inch dimensions given in ().

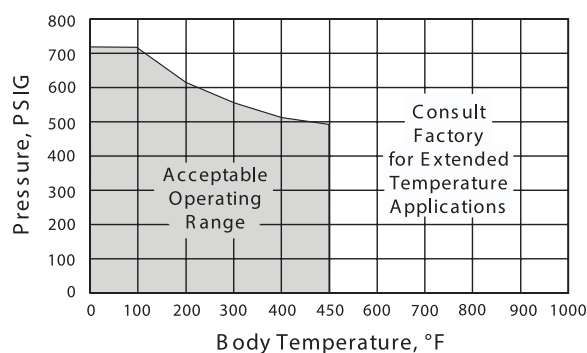
Body Size	A (Set Distance)	B			C	D			E	F
		37	64	135		37	64	135		
1/2"	See chart above	9.5 (241.3)	11.87 (301.5)	n/a	3.62 (91.9)	12.03 (305.6)	13.0 (330.2)	n/a	1.50 (38.1)	2.66 (67.6)
3/4"		9.5 (241.3)	11.87 (301.5)	n/a	3.62 (91.9)	12.03 (305.6)	13.0 (330.2)	n/a	1.50 (38.1)	2.66 (67.6)
1"		9.5 (241.3)	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	-	-	-

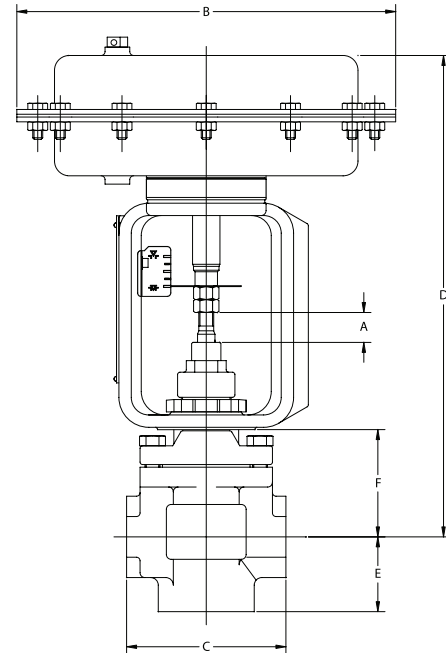
Actuator Selection

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)					
1/2	37	.5	0-660	720	-	-	-	-
	64		0-720	-	-	-	-	-
1/2	37	1.0, 1.5	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
	135		-	0-50	51-60	61-70	71-90	91-100
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
	135		-	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.



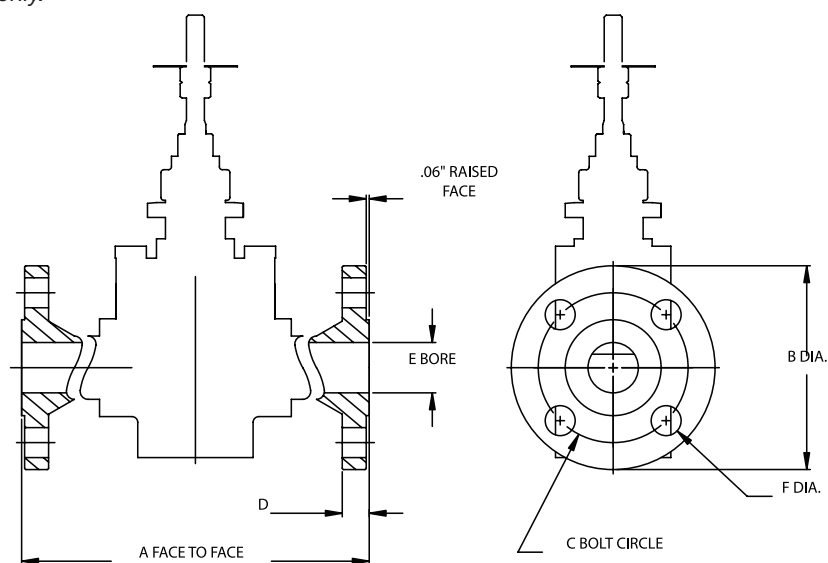
Dimensional Data

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												
	150# Class						300# Class					
SIZE	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".

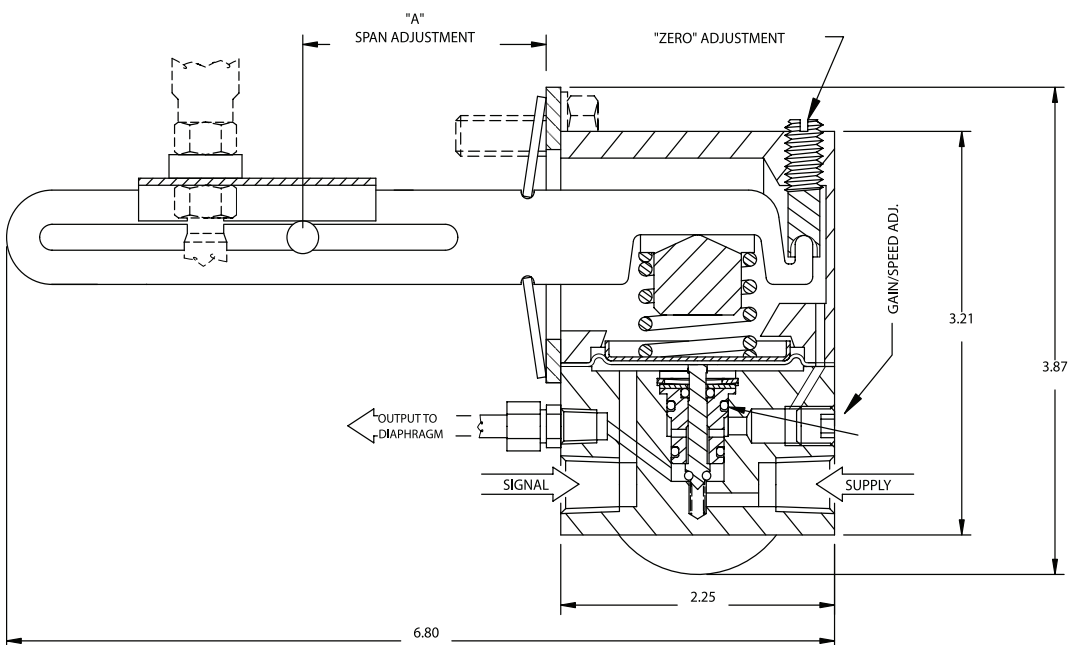
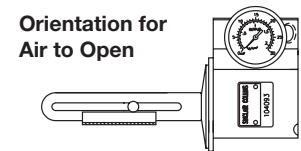
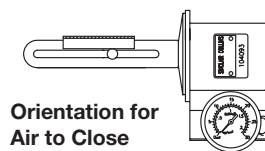
Pneumatic Positioner

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.



Valve Series	Material/Function	Basic Size	Flow Characteristic	Body Configuration	Packing	Trim Size	Accessories
K	01	-	2	1	0	1	2
0	0	0	0	0	0	0	0
Series K K Series	Bronze Valve 01 37 Top, Air to Open 11 37 Top, Air to Close 02 64 Top, Air to Open 12 64 Top, Air to Close 03 135 Top, Air to Open 13 135 Top, Air to Close Stainless Steel Valve (1) 21 37 Top, Air to Open 31 37 Top, Air to Close 22 64 Top, Air to Open 32 64 Top, Air to Close 23 135 Top, Air to Open 33 135 Top, Air to Close	Basic Valve Size 2 1/2" 3 3/4" (2) 4 1" 5 1-1/4" (2) 6 1-1/2" 7 2"	Flow Characteristic 1 Hard Seat Linear 2 Hard Seat Equal %	Body Configuration 0 Bronze w/NPTF Ports 1 Stainless Steel w/NPTF Ports 2 S.S. w/150# ANSI Flanges 3 S.S. w/300# ANSI Flanges	Packing 1 PTFE (Standard) 2 Graphite	Trim Size (4) 0 Cv = 1.0 1 Cv = 2.5 2 Cv = 6.0 3 Cv = 8.0 4 Cv = 13.0 5 Cv = 20.0 6 Cv = 27.0 7 Cv = 50.0 B Cv = .5 C Cv = 1.5 D Cv = 4.0	Filter/Regulator (5) 0 None 3 Filter/Regulator 6 Filter/Regulator with gauge
						Positioner (5) 0 None A Positioner 3-15 D.A. B Positioner 3-15 D.A. with I/P Transducer (3-15) C Positioner 3-15 R.A. D Positioner 3-15 R.A. with I/P Transducer (3-15) E Positioner 3-9 D.A. F Positioner 3-9 D.A. with I/P Transducer (3-15) G Positioner 3-9 R.A. H Positioner 3-9 R.A. with I/P Transducer (3-15) J Positioner 9-15 D.A. K Positioner 9-15 D.A. with I/P Transducer (3-15) L Positioner 9-15 R.A. M Positioner 9-15 R.A. with I/P Transducer (3-15) U I/P Transducer (1-18) Direct Mounting W I/P Transducer (3-15) Direct Mounting	Optional 0 None

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

$$C_v = \frac{q_f}{N_1 F_p F_r} \sqrt{\frac{G_f}{\Delta P}}$$

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

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

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

Flow by Weight

$$C_v = \frac{w}{N_8 F_p P_1 Y} \sqrt{\frac{T_1 Z}{x M}}$$

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

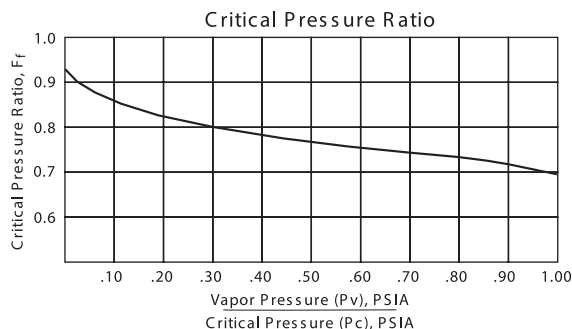
$$Y = 1 - \frac{(F_{kxt})}{3 F_{kxt}} = \frac{2}{3}$$

*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 (V_c).
- 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. $K_c = \Delta P / P_1 - P_v \Delta P_m$
The amount of pressure drop required to produce choked flow $\Delta P_m = F_L^2 (P_1 - F_f P_v)$ 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

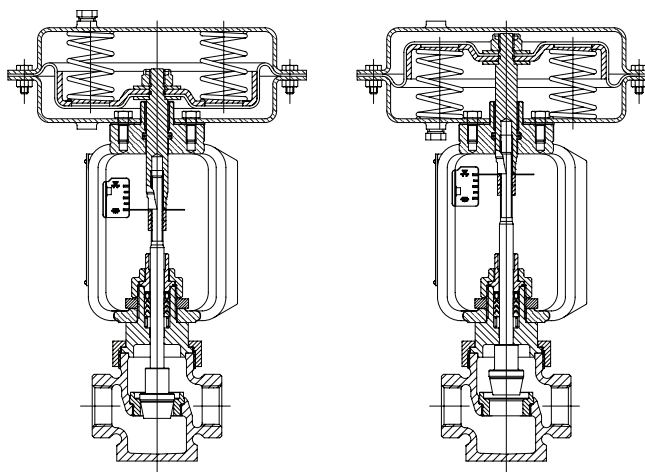
Select valve body size based on Cv and system requirements. Identify the maximum system pressure (P₁) that the valve has to seal against.

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 meet 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)					
1/2	37 64	.5	0-660 0-720	720 -	- -	- -	- -	- -
1/2	37 64	1.0, 1.5	0-470 0-720	471-640 -	641-720 -	- -	- -	- -
1/2	37 64	2.5	0-290 0-510	291-390 511-690	391-480 691-720	481-580 -	581-680 -	681-720 -
1/2	37 64	4, 6	0-110 0-200	111-140 201-250	141-170 251-280	171-200 281-330	201-230 331-390	231-250 391-450
1	37 64	2.5	0-290 0-510	291-390 511-690	391-480 691-720	481-580 -	581-680 -	681-720 -
1	37 64	4, 6, 8	0-110 0-200	111-140 201-250	141-170 251-280	171-200 281-330	201-230 331-390	231-250 391-450
1	37 64	13	0-70 0-140	71-100 141-180	101-120 181-220	121-140 221-250	141-160 251-270	161-190 271-310
1 1/2	37 64 135	13	0-70 0-140 0-250	71-100 141-180 251-330	101-120 181-220 331-420	121-140 221-250 421-500	141-160 251-270 501-590	161-190 271-310 591-670
1 1/2	37 64 135	20, 27	- 0-70 0-160	0-50 71-90 161-200	51-60 91-120 201-250	61-70 121-140 251-270	71-90 141-160 271-310	91-100 161-180 311-360
2	64 135	20, 27, 52	- 0-90	0-50 91-120	51-70 121-150	71-80 151-170	81-90 171-200	91-110 201-230

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.

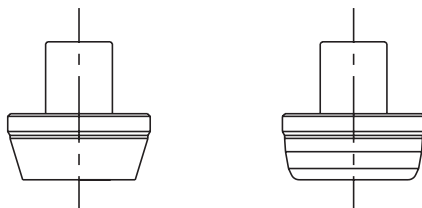
Flow Characteristic

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.

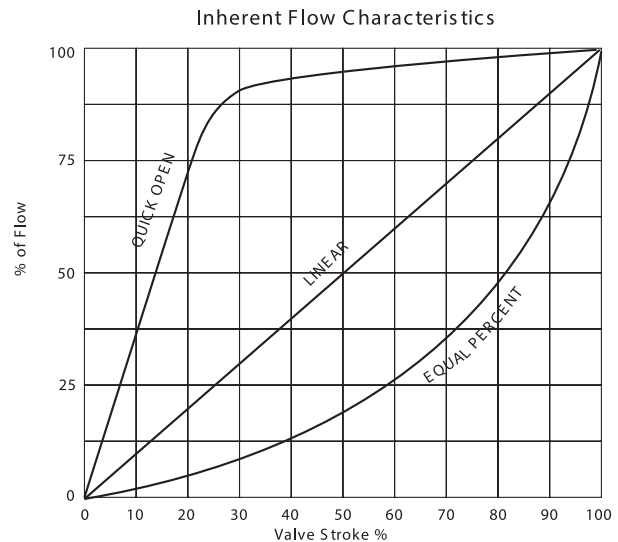
Installed Flow Characteristics

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.

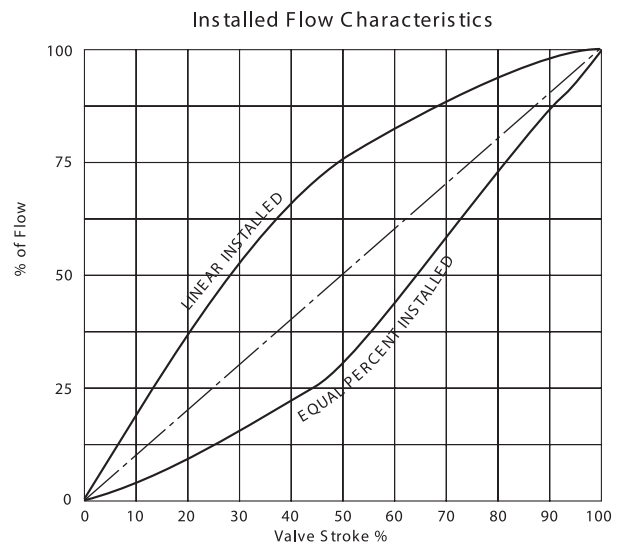
Inherent Flow Characteristic

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

OFFER OF SALE

PARKER-HANNIFIN CORPORATION OFFER OF SALE

1. Definitions. As used herein, the following terms have the meanings indicated.

"Buyer" means any customer receiving a Quote for Products.

"Buyer's Property" means any tools, patterns, plans, drawings, designs, specifications materials, equipment, or information furnished by Buyer, or which are or become Buyer's property.

"Confidential Information" means any technical, commercial, or other proprietary information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered, or made available, whether directly or indirectly, to Buyer.

"Goods" means any tangible part, system or component to be supplied by Seller.

"Intellectual Property Rights" means any patents, trademarks, copyrights, trade dress, trade secrets or similar rights.

"Products" means the Goods, Services and/or Software as described in a Quote.

"Quote" means the offer or proposal made by Seller to Buyer for the supply of Products.

"Seller" means Parker-Hannifin Corporation, including all divisions, subsidiaries and businesses selling Products under these Terms.

"Seller's IP" means patents, trademarks, copyrights, or other intellectual property rights relating to the Products, including without limitation, names, designs, images, drawings, models, software, templates, information, any improvements or creations or other intellectual property developed prior to or during the relationship contemplated herein.

"Services" means any services to be provided by Seller.

"Software" means any software related to the Goods, whether embedded or separately downloaded.

"Special Tooling" means equipment acquired by Seller or otherwise owned by Seller necessary to manufacture Goods, including but not limited to tools, jigs, and fixtures.

"Terms" means the terms and conditions of this Offer of Sale.

2. Terms. All sales of Products by Seller will be governed by, and are expressly conditioned upon Buyer's assent to, these Terms. These Terms are incorporated into any Quote provided by Seller to Buyer. Buyer's order for any Products whether communicated to Seller verbally, in writing, by electronic data interface or other electronic commerce, shall constitute acceptance of these Terms. Seller objects to any contrary or additional terms or conditions of Buyer. Reference in Seller's order acknowledgement to Buyer's purchase order or purchase order number shall in no way constitute an acceptance of any of Buyer's terms or conditions of purchase. Any Quote made by Seller to Buyer shall be considered a firm and definite offer and shall not be deemed to be otherwise despite any language on the face of the Quote. Seller reserves all rights to accept or reject any purported acceptance by Buyer to Seller's Quote if such purported acceptance attempts to vary the terms of the Quote. If Seller ships Products after Buyer issues an acceptance to the Quote, any additional or different terms proposed by Buyer will not become part of the parties' business relationship unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence. If the transaction proceeds without such agreement on the part of Seller, the business relationship will be governed solely by these Terms and the specific terms in Seller's Quote.

3. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices for any reason and at any time by giving ten (10) days prior written notice. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Under any circumstances, Buyer may not withhold or suspend payment of any amounts due and payable as a deduction, set-off or recoupment of any amount, claim or dispute with Seller. Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law. Seller reserves the right to require advance payment or provision of securities for first and subsequent deliveries if there is any doubt, in Seller's sole determination, regarding the Buyer's creditworthiness or for other business reasons. If the requested advance payment or securities are not provided to Seller's satisfaction, Seller reserves the right to suspend performance or reject the purchase order, in whole or in part, without prejudice to Seller's other rights or remedies, including the right to full compensation. Seller may revoke or shorten any payment periods previously granted in Seller's sole determination. The rights and remedies herein reserved to Seller are cumulative and in addition to any other or further rights and remedies available at law or in equity. No waiver by Seller of any breach by Buyer of any provision of these terms will constitute a waiver by Seller of any other breach of such provision.

4. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages or additional costs resulting from any delay. All deliveries are subject to our ability to procure materials from our suppliers. Regardless of the manner of shipment, delivery occurs and title and risk

of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

5. Warranty. The warranty for the Products is as follows:

(i) Goods are warranted against defects in material or workmanship for a period of twelve (12) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT, OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED, UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH-RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".

6. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance 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.

7. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCTS, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, 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 PAID FOR THE PRODUCTS.

8. Confidential Information. Buyer acknowledges and agrees that Confidential Information has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller and shall return all such Confidential Information to Seller within thirty (30) days upon request.

9. Loss to Buyer's Property. Buyer's Property will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Also, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

10. Special Tooling. Seller may impose a tooling charge for any Special Tooling. Special Tooling shall be and remain Seller's property. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer 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 owned by Seller in its sole determination at any time.

11. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms 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 Seller's security interest.

12. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow

applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

13. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, 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, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of Buyer's Property; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms, including any legal or administrative proceedings, collection efforts, or other actions arising from or relating to such failure to comply. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

14. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, 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 and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

15. Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

16. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of any events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, cyber related disruptions, cyber-attacks, ransomware sabotage, delays or failures in delivery from carriers or suppliers, shortages of materials, sudden increases in the price of raw material or components, shutdowns or slowdowns affecting the supply of raw materials or components, or the transportation thereof, oil shortages or oil price increases, energy crisis, energy or fuel interruption, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, embargoes, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by an event of force majeure shall be tolled for the duration of such event of force majeure and rescheduled for mutually agreed dates as soon as practicable after the event of force majeure ceases to exist. The right to allocate capacity is in the Seller's sole discretion. An event of force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub-contractors. An event of force majeure in the meaning of these Terms means any circumstances beyond Seller's control that permanently or temporarily hinders performance, even where that circumstance was already foreseen. Buyer shall not be entitled to cancel any orders following its claim of an event of force majeure.

17. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

18. Duration. Unless otherwise stated in the Quote, any agreement governed by or arising from these Terms shall: (a) be for an initial duration of one (1) year; and (b) shall automatically renew for successive one-year terms unless terminated by Buyer with at least 180-days written notice to Seller or if Seller terminates the agreement pursuant to Section 19 of these Terms.

19. Termination. Seller may, without liability to Buyer, terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms, (b) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property, (d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

20. Ownership of Rights. Buyer agrees that (a) Seller (and/or its affiliates) owns or is the valid licensee of Seller's IP and (b) the furnishing of information, related

documents or other materials by Seller to Buyer does not grant or transfer any ownership interest or license in or to Seller's IP to Buyer, unless expressly agreed in writing. Without limiting the foregoing, Seller retains ownership of all Software supplied to Buyer. In no event shall Buyer obtain any greater right in and to the Software than a right in a license limited to the use thereof and subject to compliance with any other terms provided with the Software. Buyer further agrees that it will not, directly or through intermediaries, reverse engineer, decompile, or disassemble any Software (including firmware) comprising or contained within a Product, except and only to the extent that such activity may be expressly permitted, either by applicable law or, in the case of open source software, the applicable open source license.

21. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any Intellectual Property Rights except as provided in this Section. 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 a third-party claim that one or more of the Products infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer (including Seller's use of Buyer's Property); or (ii) directed to any Products for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

22. Governing Law. These Terms, the terms of any Quote, 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 the sale and delivery of the Products.

23. Entire Agreement. These Terms, along with the terms set forth in the Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the Quote and these Terms, the terms set forth in the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. No modification to these Terms will be binding on Seller unless agreed to in a writing that is signed by an authorized representative of Seller, excluding email correspondence, 'clickwrap' or other purported electronic assent to different or additional terms. Sections 2-25 of these Terms shall survive termination or cancellation of any agreement governed by or arising from these Terms.

24. No 'Wrap' Agreements/No Authority to Bind. Seller's clicking any buttons or any similar action, such as clicking "I Agree" or "Confirm," to utilize Buyer's software or webpage for the placement of orders, is NOT an agreement to Buyer's Terms and Conditions. NO EMPLOYEE, AGENT OR REPRESENTATIVE OF SELLER HAS THE AUTHORITY TO BIND SELLER BY THE ACT OF CLICKING ANY BUTTON OR SIMILAR ACTION ON BUYER'S WEBSITE OR PORTAL.

25. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer represents that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Law.

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